**FAST CRITICAL EXPERIMENTS IN**

**PLATE AND PIN GEOMETRY FORM.**

**THE ZEBRA CADENZA CORES,**

**ASSEMBLIES 22, 23, 24 AND 25.**

**Evaluator**

**John ROWLANDS**

**81 South Court Avenue, Dorchester DT1 2DA, UK**

**Internal Reviewer**

**Peter SMITH**

**Serco Assurance, Winfrith, UK**

**Independent Reviewers**

**Makoto ISHIKAWA**

**Japan Nuclear Cycle Development Institute, Japan**

**Masayuki NAKAGAWA**

**Consultant to the OECD/NEA**

**Udo K WEHMANN**

**Consultant to the OECD/NEA**

***Acknowledgements***

*The Evaluator wishes to thank the members of the ZEBRA Group who carried out the Cadenza experiments, and the authors of the ZTN22 series of Technical Notes describing them, which are the basis of the present document. Especial thanks to Gerry Ingram and Mike Stevenson who designed and analysed the ZEBRA Cadenza experiments in such a way as to provide these benchmarks. Thanks also to Brian Burbidge who provided the information on the IRMA spectral index intercomparison studies carried out in the MASURCA facility (CEA Cadarache, France). And thanks to Les Munn for describing the double element and drawing a sketch of it. Chris Dean, Bernard Franklin and Dave Sweet also provided valuable information on components of ZEBRA missing from the documentation. Also thanks to Bernard Franklin and Atsushi Zukeran for the illustrations of ZEBRA and thanks to Chris White of INL who has redrawn some of the illustrations in colour and added a number of useful figures.*

*Thanks also to those who have kindly reviewed the document, Peter Smith, Makoto Ishikawa, Masayuki Nakagawa and Udo Wehmann. Blair Briggs and Virginia Dean have also provided helpful comments. In particular, Peter Smith’s review was most detailed, comprehensive and vital to the completion of this work.*

*I am also most grateful to Mikhail Semenov and Anatoly Tsiboulia for setting up models of the cores in KENO5a, on the basis of the specifications in this document, and for carrying out k-effective calculations using the ABBN-93 nuclear data library. These confirm that the model specifications are complete. The calculations reproduce a similar pattern of results to those obtained using the nuclear data libraries JEF-2.2, ENDF/B-VI and JENDL-3.2 in the MONK Monte Carlo code and using JEFF-3.1 and JENDL-3.3 in the MCNP Monte Carlo code.*

*This document is based on the information given in the NEACRP documents specifying the Pin-Plate Benchmark and the series of Zebra Technical Notes for Assemblies in the ZEBRA 22 series of experiments (denoted by ZTN22-1, etc). Reference is also made to a number of publications on other ZEBRA experimental programmes. Most of these documents are available on cd from the OECD-NEA.*

*I also wish to thank the Government of Japan for their budget to the OECD which has provided me with contracts during the course of this work of compilation and evaluation of this reactor physics benchmark.*

**Revision of 1 February 2010.**

The main difference is the explicit representation of the superlattice grid plates in the detailed models. Also the adjustments made to the k-effective values to be used with the simplified models have been reevaluated. The opportunity has also been taken of including k-effective values calculated using the more recent nuclear data libraries JEFF-3.1 and JENDL-3.3, calculated using MCNP5. MCNP models are included in Appendices. Reactivity perturbation measurements have been calculated to verify the consistency of different measurements.

**TABLE OF CONTENTS**

[Summary 1](#_Toc254005853)

[1 DETAILED DESCRIPTION 2](#_Toc254005854)

[1.0 Overview 2](#_Toc254005855)

[1.1 Description of the Critical Configurations. 12](#_Toc254005856)

[1.1.1 Overview of Experiment 12](#_Toc254005857)

[1.1.2A Description of Experimental Configurations. 12](#_Toc254005858)

[1.1.2B The Measured k-effective Values for the Assemblies, 22, 23, 24 and 25. 45](#_Toc254005859)

[1.1.3 Description of Material Data 54](#_Toc254005860)

[1.1.4 Temperature Information. 87](#_Toc254005861)

[1.1.5 Additional Information Relevant to Criticality Measurements. 87](#_Toc254005862)

[1.2 Description of Bucklings and Extrapolation Length Measurements 88](#_Toc254005863)

[1.3 Description of Spectral Characteristics Measurements 88](#_Toc254005864)

[1.3.1 Overview of the Experiment 88](#_Toc254005865)

[1.3.2A Description of the Experimental Configuration 88](#_Toc254005866)

[1.3.2B Methods 92](#_Toc254005867)

[1.3.2C Results of the Measurements 97](#_Toc254005868)

[1.3.3 Description of the Material Data 98](#_Toc254005869)

[1.3.4 Description of Temperature Data 98](#_Toc254005870)

[1.3.5 Additional Relevant Information 98](#_Toc254005871)

[1.4 Description of Reactivity Effects Measurements 99](#_Toc254005872)

[1.4.1 Overview of the Experiment 99](#_Toc254005873)

[1.4.2A Description of the Experimental Configuration 99](#_Toc254005874)

[1.4.2B Methods 101](#_Toc254005875)

[1.4.2C Results of the Measurements 106](#_Toc254005876)

[1.4.3 Description of the Material Data 131](#_Toc254005877)

[1.4.4 Description of Temperature Data 137](#_Toc254005878)

[1.4.5 Additional Relevant Information. 137](#_Toc254005879)

[1.5 Description of Reactivity Coefficient Measurements 138](#_Toc254005880)

[1.6 Description of Kinetics Measurements 139](#_Toc254005881)

[1.7 Description of Reaction-Rate Distribution Measurements 139](#_Toc254005882)

[1.7.1 Overview. 139](#_Toc254005883)

[1.7.2A Description of the Experimental Configuration 139](#_Toc254005884)

[1.7.2B Methods 140](#_Toc254005885)

[1.7.2C Results 140](#_Toc254005886)

[1.7.3 Description of the Material Data 141](#_Toc254005887)

[1.7.4 Description of Temperature Data 141](#_Toc254005888)

[1.7.5 Additional Relevant Information. 141](#_Toc254005889)

[1.8 Description of Power Distribution Measurements 141](#_Toc254005890)

[1.9 Description of Isotopic Measurements 141](#_Toc254005891)

[1.10 Other Miscellaneous Types of Measurements 141](#_Toc254005892)

[2. EVALUATION OF EXPERIMENTAL DATA 153](#_Toc254005893)

[2.1 Evaluation of Critical or Subcritical Configuration Data 153](#_Toc254005894)

[2.1.1 keff Values of the Four Assemblies, 22, 23, 24 and 25. 153](#_Toc254005895)

[2.1.2 Reactivity Differences between Assemblies. 156](#_Toc254005896)

[2.1.3 The Two Intermediate Assemblies having Plate Zones at the Centres of the Pin Geometry Cores. 157](#_Toc254005897)

[2.2 Evaluation of Buckling and Extrapolation Length Data 157](#_Toc254005898)

[2.3 Evaluation of Spectral Characteristics Data 158](#_Toc254005899)

[2.3.1 Spectral Index Measurements in the Plate Geometry Assembly 22 158](#_Toc254005900)

[2.3.2A Comparisons with Measurements made in other ZEBRA assemblies. 158](#_Toc254005901)

[2.3.2B Intercomparisons with the Measurements made by Other Groups. 160](#_Toc254005902)

[2.3.3 Effects of Uncertainties in Composition and Dimensions. 162](#_Toc254005903)

[2.3.4 Recommended Spectral Index Values 163](#_Toc254005904)

[2.4 Evaluation of Reactivity Effects Data 165](#_Toc254005905)

[2.4.1 Delayed Neutron Data and the Reactivity Scale. 166](#_Toc254005906)

[2.4.2 Reactivity Differences between Assemblies. 167](#_Toc254005907)

[2.4.3 Measurements Replacing Elements either Singly or in Groups of 9. 168](#_Toc254005908)

[2.4.4 Enrichment Measurements. 168](#_Toc254005909)

[2.4.5 The Reactivity Effects of Changes in Cell Heterogeneity in Assembly 22 168](#_Toc254005910)

[2.4.6 Small Sample Reactivity Worth Measurements. 168](#_Toc254005911)

[2.4.7 Sodium Voiding Reactivity Measurements. 169](#_Toc254005912)

[2.4.8 Reactivity Equivalence of Arrays of Plate Elements at the Centres of the Pin Geometry Assemblies 23 and 25. 170](#_Toc254005913)

[2.5 Evaluation of Reactivity Coefficients Data 170](#_Toc254005914)

[2.6 Evaluation of Kinetics Data 170](#_Toc254005915)

[2.7 Evaluation of Reaction-Rate Distributions 171](#_Toc254005916)

[2.7.1 Reaction Rate Scan Measurements in Standard Plate Geometry Cells and in Modified Cells. 171](#_Toc254005917)

[2.7.2 Multi-chamber Scanning System Measurements. 171](#_Toc254005918)

[2.7.3 Axial and Radial Reaction Rate Scan Measurements. 171](#_Toc254005919)

[2.8 Evaluation of Power Distribution Data 172](#_Toc254005920)

[2.9 Evaluation of Isotopic Measurements 172](#_Toc254005921)

[2.10 Evaluation of other Miscellaneous Types of Measurements 172](#_Toc254005922)

[3. BENCHMARK SPECIFICATIONS 173](#_Toc254005923)

[Overview of the Calculational Methodology and the Models. 173](#_Toc254005924)

[3.1 Critical or Subcritical Configuration Benchmark Specifications 176](#_Toc254005925)

[3.1.1 Description of the Calculational Methodology and the Models 176](#_Toc254005926)

[3.1.2 Dimensions 185](#_Toc254005927)

[3.1.3 Material Data 212](#_Toc254005928)

[3.1.4 Temperature data. 259](#_Toc254005929)

[3.1.5 Experimental and Benchmark Model keff Parameters 259](#_Toc254005930)

[3.2 Benchmark-Model Specifications for Buckling and Extrapolation-Length Measurements 262](#_Toc254005931)

[3.3 Benchmark-Model Specifications for Spectral Characteristics Measurements 263](#_Toc254005932)

[3.3.1 Description of the Calculational Methodology and Model 263](#_Toc254005933)

[3.3.2 Dimensions 263](#_Toc254005934)

[3.3.3 Material Data 263](#_Toc254005935)

[3.3.4 Temperature Data 263](#_Toc254005936)

[3.3.5 Experimental and Benchmark Reaction Rate Ratios 263](#_Toc254005937)

[3.4 Benchmark-Model Specifications for Reactivity Effects Measurements 265](#_Toc254005938)

[3.4.1 Description of the Calculational Methodology and Model 265](#_Toc254005939)

[3.4.2 Dimensions 265](#_Toc254005940)

[3.4.3 Material Data 265](#_Toc254005941)

[3.4.4 Temperature data. 275](#_Toc254005942)

[3.4.5 Experimental and Benchmark Model Reactivity Worth Measurements 275](#_Toc254005943)

[3.5 Benchmark-Model Specifications for Reactivity Coefficient Measurements 275](#_Toc254005944)

[3.6 Benchmark-Model Specifications for Kinetics Measurements 275](#_Toc254005945)

[3.7 Benchmark-Model Specifications for Reaction Rate Distribution Measurements 276](#_Toc254005946)

[3.7.1 Description of the Calculational Methodology and Model 276](#_Toc254005947)

[3.7.2 Dimensions of the Zebra Control Rods 276](#_Toc254005948)

[3.7.3 Compositions of the Zebra Control Rods 279](#_Toc254005949)

[3.7.4 Temperature Data. 286](#_Toc254005950)

[3.7.5 Experimental and Benchmark Reaction Rate Distribution Measurements 286](#_Toc254005951)

[3.8 Benchmark-Model Specifications for Power Distribution Measurements 286](#_Toc254005952)

[3.9 Benchmark-Model Specifications for Isotopic Measurements 286](#_Toc254005953)

[3.10 Miscellaneous 286](#_Toc254005954)

[4. RESULTS OF SAMPLE CALCULATIONS 287](#_Toc254005955)

[4.1 Results of Calculations of the Critical or Subcritical Configurations. 287](#_Toc254005956)

[4.1.1 Keff Values for the CADENZA Cores Calculated for the Reference Model (Model A) 287](#_Toc254005957)

[4.1.2 Differences Between the Values of (C-E) for k-effective for the Different Assemblies; the Pin-Plate Discrepancy and the Reactivity Change resulting from Sodium Voiding. 290](#_Toc254005958)

[4.1.3 Comments on the Results of the Monte Carlo k-effective Calculations. 293](#_Toc254005959)

[4.2 Results of Bucklings and Extrapolation Lengths Calculations 293](#_Toc254005960)

[4.3 Results of Spectral Characteristics Calculations 294](#_Toc254005961)

[4.4 Results of Reactivity Effects Calculations 297](#_Toc254005962)

[4.5 Results of Reactivity Coefficient Calculations 306](#_Toc254005963)

[4.6 Results of Kinetics Parameter Calculations 306](#_Toc254005964)

[4.7 Results of Reaction-Rate Distribution Calculations 306](#_Toc254005965)

[4.8 Results of Power Distribution Calculations 306](#_Toc254005966)

[4.9 Results of Isotopic Calculations 306](#_Toc254005967)

[5. REFERENCES 307](#_Toc254005968)

[APPENDIX A. INPUT DATA USED IN THE CALCULATIONS 310](#_Toc254005969)

[A.1 MONK MONTE CARLO MODELS OF THE ASSEMBLIES. 310](#_Toc254005970)

[A1.1. Assembly 22B. The sodium filled plate geometry core. Model A. 310](#_Toc254005971)

[\* MONK9A Input Listing for Assembly 22B Model A, 310](#_Toc254005972)

[A1.2. Assembly 24. The voided plate geometry core. Model A 319](#_Toc254005973)

[A1.3. Assembly 23. The sodium filled pin geometry core. Model A. 329](#_Toc254005974)

[\* MONK9A Input Listing for Assembly 23, Model A. 329](#_Toc254005975)

[A1.4. Assembly 25. The sodium voided pin geometry core, Model A. 343](#_Toc254005976)

[\* MONK9A Input Listing for Assembly 25, Model A 343](#_Toc254005977)

[A1.5. Assembly 23 with the central region of plate elements. Model A 358](#_Toc254005978)

[\* MONK9A Input Listing for Assembly 23 with the central plate region. 358](#_Toc254005979)

[A1.6. Assembly 25 with the central region of 69 plate elements. Model A representation but without the grid plates. 372](#_Toc254005980)

[\* MONK9A Input Listing for Assembly 23 with the central plate region. 372](#_Toc254005981)

[A1.7.Simplified MONK Models 386](#_Toc254005982)

[\* MONK8B Input Listing for Assembly 22B, Model B 386](#_Toc254005983)

[\* MONK9A Input Listing for Assembly 22B Model C, 388](#_Toc254005984)

[A.2 Input data for the KENO5a+CONSYST+ABBN-93 System Calculations 410](#_Toc254005985)

[A.3 The ERANOS RZ model used for sensitivity calculations. 476](#_Toc254005986)

[A4. MCNP – JEFF-3.1 Input Decks 480](#_Toc254005987)

[A4.1 MCNP-JEFF-3.1 Zebra22 Model A 480](#_Toc254005988)

[A4.2 MCNP-JEFF-3.1 Zebra 23 Model A. 526](#_Toc254005989)

[A4.3 MCNP-JEFF-3.1 Zebra24 Model A 578](#_Toc254005990)

[A4.4 MCNP-JEFF-3.1 Zebra25 Model A 639](#_Toc254005991)

[A4.5 MCNP-JEFF-3.1 Zebra23 Model with Central Plate Zone 691](#_Toc254005992)

[A4.6 MCNP-JEFF-3.1 Zebra25 Model with Central Plate Zone 742](#_Toc254005993)

[LIST OF TABLES 799](#_Toc254005994)

**FAST CRITICAL EXPERIMENTS IN PLATE AND PIN GEOMETRY FORM.**

**THE ZEBRA CADENZA CORES: ASSEMBLIES 22, 23, 24 AND 25.**

**IDENTIFICATION NUMBER:**

ZEBRA-LMFR-EXP-001

CRIT-SPEC-REAC-RRATE

**KEY WORDS:**

fast critical experiments, LMFR, GCFR, ZEBRA, CADENZA Programme, pin and plate geometry lattices, mixed uranium-plutonium dioxide, uranium dioxide plus plutonium metal, sodium cooled, steel structure, sodium voiding, spectral indices, reactivity perturbations, MONK models, MCNP models.

# Summary

The ZEBRA CADENZA Experiments consisted of a series of four simple geometry cores, two of which, Zebra 22 and 24, used plate geometry components and two, Zebra 23 and 25, pin geometry components. One plate geometry core, Zebra 22, and one pin geometry core, Zebra 23, contained sodium and the other two were the corresponding cores voided of sodium. Measurements were made to enable the relationships between the four cores to be analysed in more detail.

The cores were surrounded by natural uranium blankets and steel reflectors.

The plate geometry cores contained plutonium metal plates and natural uranium oxide plates whereas the pin geometry cores used mixed uranium-plutonium oxide pins. The uranium in core and blanket regions was natural. The average plutonium enrichment in the core, [Pu/(U+Pu)], was ~24%. The fissile content of the plutonium, [(Pu239+Pu241)/Total Pu] was ~80%

**Revision of 1 February 2010.**

The main difference is the explicit representation of the superlattice grid plates in the detailed models. Also the adjustments made to the k-effective values to be used with the simplified models have been reevaluated. The opportunity has also been taken of including k-effective values calculated using the more recent nuclear data libraries JEFF-3.1 and JENDL-3.3, calculated using MCNP5. MCNP models are included in Appendices. Reactivity perturbation measurements have been calculated to verify the consistency of different measurements.

# 1 DETAILED DESCRIPTION

## 1.0 Overview

ZEBRA (the Zero Energy Breeder Reactor Assembly) was located at the Winfrith Atomic Energy Establishment, AEEW, of the United Kingdom Atomic Energy Authority, UKAEA, and operated from 1962 to 1982. It was used to validate fast reactor neutronics methods and nuclear data. The CADENZA programme (1980-1982) was the final one carried out in ZEBRA and involved studies on assemblies built using components in both plate geometry and pin geometry form.

The team who carried out the measurements and analyses in the Cadenza programme included the following:

B L H Burbidge, B Franklin, M Grimstone, G Ingram, S E Johnson, A D Knipe, J Marshall, Miss A M Osmond, Miss P A Smart, Miss M P Smith, P M J Stone, and J M Stevenson. The information on the measurements, and the associated analyses carried out by the Zebra team, contained in the present document, have been taken from the series of Zebra Technical Notes, and in particular those in the series ZTN22. Grateful thanks are expressed to these authors. In several cases parts of the text in these documents have been reproduced here unaltered. The experiments were also formulated in the 1980s as an NEACRP benchmark, the Pin-Plate Benchmark, and the associated documents have also been used as sources. Especial thanks are expressed to Gerry Ingram and Mike Stevenson whose work was key to these experiments being carried out and successfully analysed, and subsequently to them being adopted as benchmarks by the NEACRP.

#### The ZEBRA Zero Power Critical Facility

The ZEBRA facility was housed in a cylindrical steel containment building, as shown in Figure1.1. The reactor could accommodate cores, blankets and shielding assemblies with a wide range of compositions and sizes up to a 3 m cube. A top view is shown in Figure 1.2 and a vertical drawing in Figure 1.3. The component materials were stacked in thin-walled steel sheaths to form the elements, nominally 5x5 cm square and 3 m long, as shown in Figure 1.4. In the Cadenza cores most elements were in the form of double elements. These were of two types, the "standard" double elements, as shown in Figure 1.6, and the "instrumented" double elements. These latter were designed to hold instruments to measure temperature and Pu239 fission rates. The elements were located in a steel bed-plate. Lateral support for groups of 5x5 elements was provided at their tops and at two intermediate positions by thin steel lattice plates (the super-lattice grid plates). The materials in the elements were in either plate form or consisted of mini-calandria containing a 4x4 array of pins.

Assemblies consisted of core regions surrounded by blanket regions outside which were regions of steel shielding material. The blanket and shield regions were chosen to be of sufficient thickness to ensure that the core neutronics was not influenced by the materials beyond the shield regions.

Figure 1.3 shows the dimensions of the reactor regions (in feet and inches). The top of the upper super-lattice grid plate is 3 m (~9ft 10in) above the top of the bedplate and the elements, which are 3 m long and slot into the bedplate, reach up to near the top of the upper super-lattice grid plate (being below this by the height of the location spigot at the bottom of the element). The tops of the elements and the upper super-lattice grid plates (surrounding the groups of 5x5 elements) can be seen in Figure 1.2.

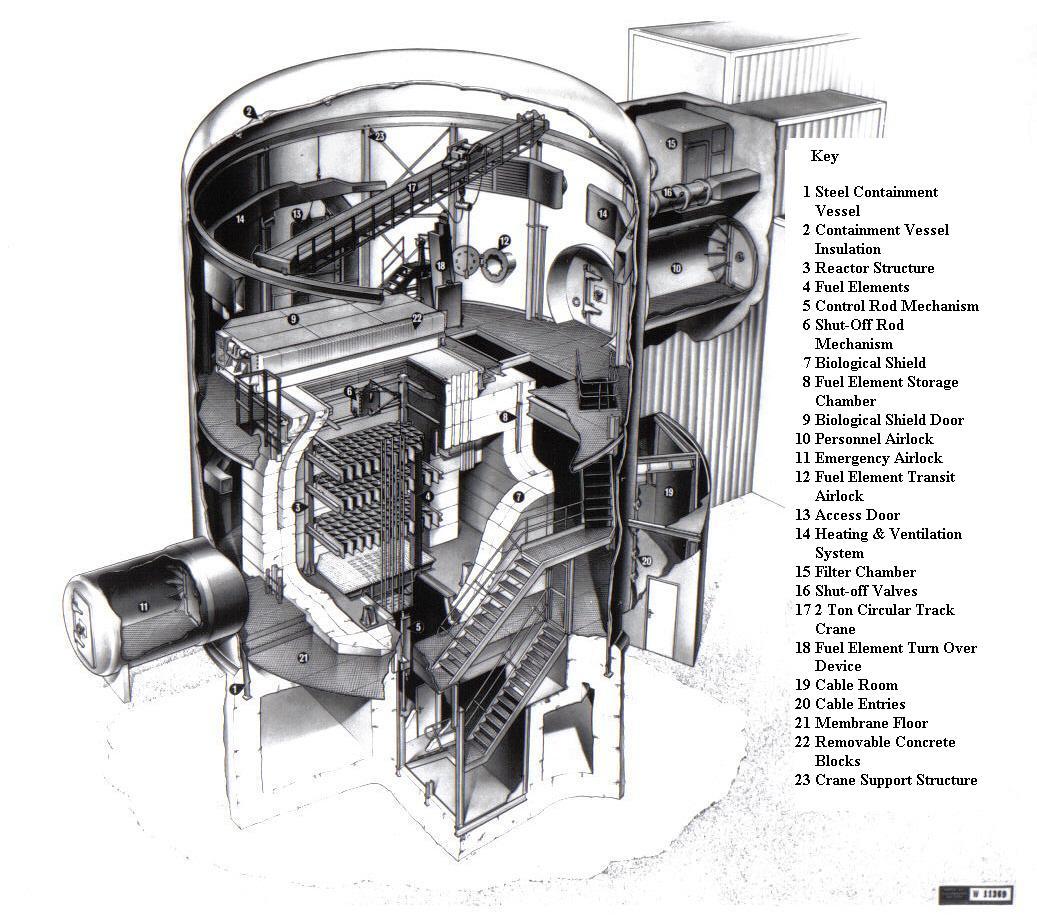
The core sections of the elements are located between the lower two super-lattice grids, these being 100.4 cm apart and having a height of 30.4 cm and thickness of 0.25 cm.

When the reactor is in operation the shield doors above the assembly are closed. The underside of the doors is over 1.5 m above the top of the elements, the space between being occupied by the control rod mechanisms. Concrete radial shielding surrounds the assembly structure, providing a square space about 3.5 m x 3.5 m within. The vertical steel structure which supports the bedplate and superlattice grid plates is in the four corners of this square space. The concrete radial biological shield includes places for the temporary storage of elements and there is a corridor within it with access to the assembly from the side, as can be seen in Figure 1.1.

The reactor was controlled by means of nine control rods, using two different types of control rod mechanism. Four rods, the shut-off rods, were actuated by cable-type mechanisms located above the reactor (see Figure 1.2). The remaining five rods were actuated by screw-type mechanisms located in the pit below the reactor bed-plate. These five rods comprised two safety-rods, two coarse regulating rods and a fine regulating rod. When the reactor was at power, the safety rods and shut-off rods were fully raised, while the regulating rods were used to balance the power level. The location of the control rods on the bed-plate, and their "fully raised" positions were variable. All the rods operated in guide tubes with the same external dimensions as normal elements. Control rods normally contained a similar plate arrangement to ordinary core elements and when in the raised position the core sections of the rods were aligned with the core sections of neighbouring elements and had similar neutronics characteristics to the core elements.

Reactivity changes were measured in terms of the balancing changes in the insertion of regulating control rods and are expressed in terms of "standard centimetres" of movement of the reference regulating rod. A "standard cm." is the worth per cm. of insertion at the point of maximum change in reactivity with insertion. The "std. cm." is then calibrated by inverse kinetics measurements, analysed using the reference set of delayed neutron data, to give reactivities on an absolute scale.

The multi-chamber scanning system measured the Pu239 fission rate at points throughout the core, the fission chambers occupying the places of plate components within core cells.

Figure 1.1 A Perspective View of the ZEBRA Critical Assembly Facility.

*The cut-away reveals the central axial section of the facility.*

*(With thanks to Bernard Franklin and Atsushi Zukeran, for providing these illustrations of ZEBRA)*

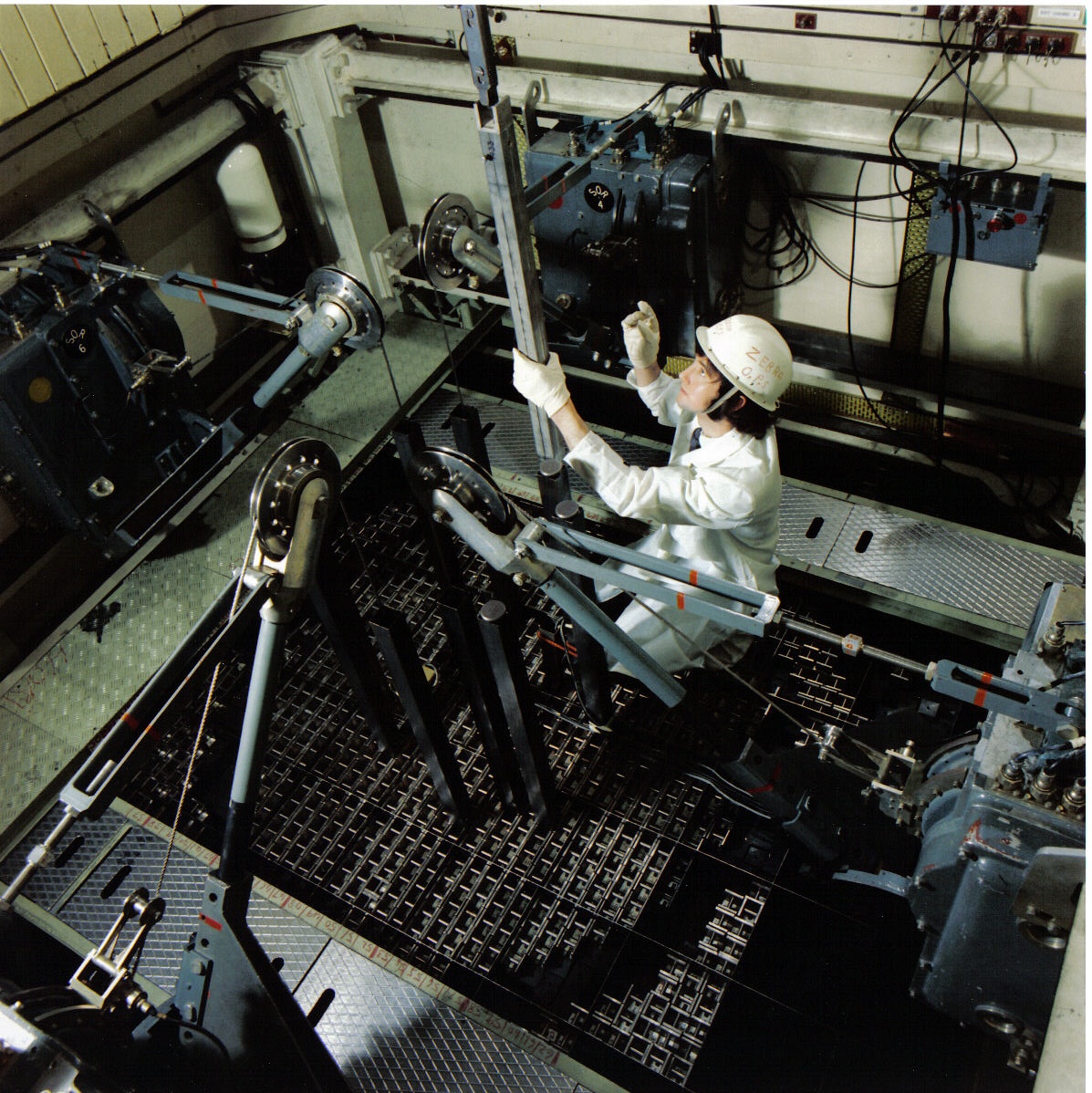


Figure 1.2 View of an Element being Loaded into a ZEBRA Assembly.

*The figure shows the tops of the elements and the upper super-lattice grid (within which are the groups of 5x5 elements), with one element being loaded into the assembly. The cable mechanisms of the 4 control rods which are operated from above the assembly can also be seen.*

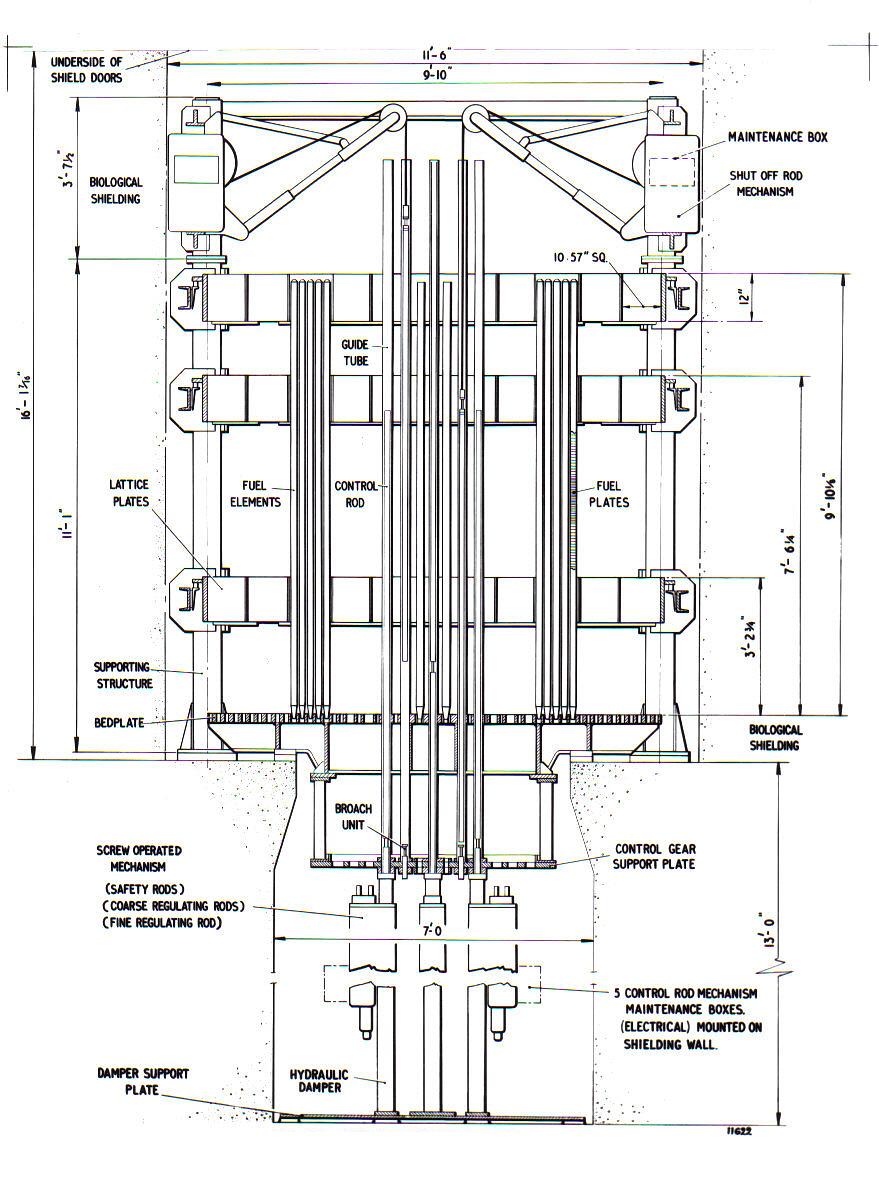


Figure 1.3 Vertical Sectional View of the ZEBRA Facility

*(dimensions in feet,', and inches,'').*

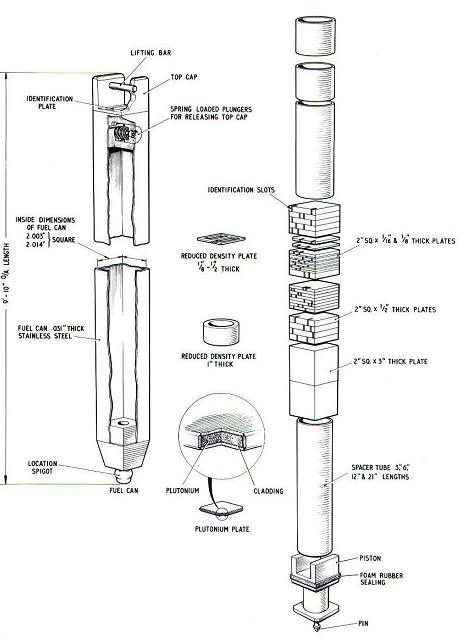


Figure 1.4 Diagram of a Fuel Element Containing Materials in Plate Form

*(dimensions in feet and inches).*

*(There were some differences from this in the bottom and top regions of the double element. Aluminium components were included at the top and bottom in addition to the mild steel spacer tubes.)*

#### The CADENZA Programme

Most of the assemblies studied in ZEBRA were built using materials in plate geometry form, and this is also the case for most other fast critical assembly facilities. Measurements made in the ZEBRA BIZET programme, with some regions containing fuel in pin geometry form, had shown an inconsistency between the reactivity worths calculated for the two types of geometry using the then current UK fast reactor neutronics methods (see BTN-106). The CADENZA series of simple geometry assemblies was built to explore this difference and to provide a basis for validating the methods used to calculate the two types of cell geometry, plate and pin. The series also provides data suitable for validating the methods and nuclear data used to calculate plutonium/uranium fuelled, sodium cooled and gas cooled fast reactors.

Four assemblies were built, numbered 22 to 25. All cores were surrounded by natural uranium axial and radial blankets, and steel reflectors, thus providing a simple environment for the cores. Assembly 22 had fuel in plate geometry form and included sodium. In Assembly 23 most of the core contained materials in pin geometry form and included sodium. Assembly 24 differed from Assembly 22 in that the sodium plates were replaced by “dummy plates” having the same size and containing the same amount of steel but no sodium. Similarly, Assembly 25 differed from Assembly 23 in that sodium was absent, the sodium regions of the Assembly 23 elements being voided.

The core regions of Assemblies 22 and 24 were essentially uniform. However, Assemblies 23 and 25 had outer rings of plate geometry elements and used mini-calandria containing groups of 4x4 pins having different plutonium enrichments in different regions of the core. Each mini-calandria contained either mixed oxide pins having an enrichment of Pu/(U+Pu) = 24% or two types of mixed oxide pin having an average plutonium enrichment, for the array of 4x4 pins, of 24%.

The effective multiplication values, keff, of the four related cores provide a test of the consistency of the methods used to treat cells in plate and pin geometry form although account must be taken of the different oxygen content. This is a consequence of the plutonium in the plate geometry cores being in metal form and that in the pin geometry cores in oxide form (the uranium being in oxide form in both geometries). Thus the oxygen content is about 24% lower in the plate geometry core. There is also a difference in composition due to the gallium stabiliser and the copper cladding used for the plutonium metal plate, and there are other differences in the constituents.

In addition to the four cores the pin and plate elements were replaced in stages and intermediate keff values determined. Two of these intermediate cores have also been specified here as critical assemblies, the keff values in these cases having been determined by measuring the changes in reactivity relative to the pin geometry assemblies, 23 and 25. Extrapolated all pin cores were also specified in the original studies.

The assemblies were used to define Benchmarks for an International Comparison of Calculations, sponsored by the OECD/NEA Committee on Reactor Physics, the NEACRP, in 1982 (see NEACRP-A-445). The results of the intercomparison are described in NEACRP-L-300, written in August 1987. The reactivity effects of heterogeneity were separated into two components, the effect excluding streaming and the streaming effect. The effect excluding streaming was calculated to be about +1.8% dk for the plate cell and about +0.4% dk for the pin cells, although the calculated values varied depending on the method and data set used, with a range of about 0.4% dk and 0.2% dk respectively. The streaming effects of the heterogeneity calculated for the two geometries were similar, being about –0.2% dk for the whole core. However, again the values calculated by the different participants covered a wide range. At the time of this analysis the UK methods were overestimating the reactivity of the pin geometry Assembly 23 relative to the plate geometry Assembly 22. The measured value of the reactivity change resulting from replacing the plate geometry elements by pin geometry elements was a reduction of about 0.9% dk. This was compensated by the addition of extra core elements at the edge of the core to restore criticality. However, using a one dimensional plate cell model the calculated reactivity difference between the two critical assemblies was about 0.9% dk, implying that the effect of replacing the plate elements by pin elements was being calculated as close to zero instead of a reduction of 0.9% dk. When a three dimensional model was used the discrepancy was reduced to about 0.5% dk (the uncertainty on the difference between the measured keff values being ± 0.13% dk 1 s.d.). Using current nuclear data libraries and Monte Carlo codes to calculate detailed models of the assemblies the relative discrepancies between the plate and pin geometry cores are in the range 0.25% dk to 0.4% dk, depending on the nuclear data set used.

At ANL the ZPPR-12 assemblies were built to study the problem of treating heterogeneity in plate versus pin geometry (NEACRP-A-688 and NEACRP-A-723) and are highly relevant to investigations of this effect. The ANL Monte Carlo calculations made for these ZPPR plate and pin geometry cores were consistent for the two geometries (within the uncertainty of ± 0.18% dk). However, the ANL Monte Carlo calculations made for the CADENZA cores were discrepant, with a difference of 0.52 ± 0.19% dk. There is consistency between the results for the ZEBRA and ZPPR pin cell assemblies, suggesting that there was a problem in the analysis made for the ZEBRA plate geometry assembly, or arising from the differences of composition.

The reactivity effects of these differences in composition were calculated. The difference in oxygen content gives a calculated difference of 0.3% dk and the copper cladding on the plutonium plate gives a difference of about 0.15% dk and so the errors in these calculated effects would need to be substantial to explain the discrepancy. There is also the effect of the gallium in the plate geometry cores to be taken into account.

These Zebra measurements also provide a test of the accuracy of predicting the reactivity effect of voiding sodium. Sodium voiding reactivity worth measurements were also made in regions of the cores.

Plutonium enrichment experiments were performed to provide a check of the reactivity scale based on kinetics measurements (interpreted using delayed neutron data). The cell geometry of groups of elements was altered to provide further checks on the methods used to calculate cell heterogeneity and the reactivity changes and reaction rate distributions through the cells were measured. Various material worth measurements were also performed. Central reaction rate ratios and Pu-239 fission rate distributions across the core were also measured.

The CADENZA Programme was the final one carried out in the ZEBRA facility.

#### Suitability of the measurements as benchmarks

The measurements are summarised in Table 1.1. Not all of these are currently being recommended as benchmarks although descriptions are included and the necessary supplementary references listed so that they can be analysed. The reactivity coefficients were only measured to provide corrections for temperature and Pu241 decay and are not benchmarks.

Concerning the suitability as benchmarks there are two questions to be considered:

(i) are the data complete and have the uncertainties been assessed

(ii) do the measurements provide useful information

The data are considered to be complete, and are recommended as benchmarks, for:

the criticality measurements of the four cores and the differences between the criticality of the different cores (including the pin cores with central plate zones), six cores in all;

the spectral index measurements;  
the reactivity perturbation measurements (for element interchange, sodium voiding and flooding, and the substitution of different materials);   
the Pu239 fission chamber scans in Core 22 and 24.

However, there is a question over the usefulness of the fission ratio measurements made using fission chambers (except for the fission ratios Pu240/Pu239 and Pu241/Pu239 for which the accuracy requirements are not so high). The measurements made using foils within plates can be accurately modelled but there could be a problem modelling the chambers in the measurement position. Also, some of the small sample reactivity worth measurements might not have sufficient accuracy to be useful (such as the measurements made for Al and Al2O3 designed to give information on the reactivity worth of oxygen). Some of the reaction rate scan measurements through cells might not have enough accuracy to give useful information, because the variations through a cell are so small for some reactions, and these measurements have not been evaluated in the present document.

Table 1.1 Summary of Assemblies and Measurements

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Basic Assemblies** | | | | **Variants** | |
|  | **Core 22** | **Core 23** | **Core 24** | **Core 25** | **Core 23 + inner plate zone** | **Core 25 + inner plate zones** |
| **Geometry** | Plate | Pin (outer ring plate ) | Plate | Pin (outer ring plate) | Pin/plate | Pin/plate |
| **Materials** | Pu/UO2, Na, SS. | U-PuO2, Na, SS. | Pu/UO2, Void, SS. | U-PuO2, Void, SS. | Includes Na | Voided of Na |
| **Measurements** |  |  |  |  |  |  |
| **Criticality** | keff | keff | keff | keff |  |  |
| **keff difference** |  | k difference | k difference | k difference | k difference | k difference |
| **Spectral index** | F25/F49, F28/F25, C28/F49, F40/F49, F41/F49 |  |  |  |  |  |
| **Element interchange reactivity perturbations** | Pin versus plate | Plate versus pin | Pin versus plate | Plate versus pin |  |  |
| **Sodium voiding and flooding** | 2/3 axial regions.  9 elements | 2/3 axial regions.  9 elements | 2/3 axial regions.  9 elements | 2/3 axial regions.  9 elements |  |  |
| **Small sample perturbations** | Plate interchange PuO2, Al, Al2O3, C, SS, Cu | Pin interchange PuO2, Al, Al2O3, C, SS, Cu | Plate interchange PuO2, Al, Al2O3, C, SS, Cu, Na | Pin interchange PuO2, Al, Al2O3, C, SS, Cu |  |  |
| **Cell heterogeneity** | Change of thickness of Pu plates |  |  |  |  |  |
| **Reactivity coefficients** | Temperature Pu241 decay |  |  |  |  |  |
| **Pu239 multichamber and foil scans** | F49 and  Foil activation | F49 chamber | F49 chamber | F49 chamber | F49 chamber | F49 chamber |
| **Detailed reaction rate scans in cells** | F49, F28, C28, F40, Rh103(n,n’) In115(n,n’) |  |  |  |  |  |

## 1.1 Description of the Critical Configurations.

### 1.1.1 Overview of Experiment

Four critical assemblies were built in the Cadenza programme, two in plate geometry (Assemblies 22 and 24) and two in pin geometry (Assemblies 23 and 25). There were also intermediate cores, with plate zones at the centres of pin geometry cores. The measurements of primary interest are the reactivities of the reference cores and the differences in reactivity between the different reference cores.

The critical configurations have been evaluated and are considered acceptable for use as benchmarks.

### 1.1.2A Description of Experimental Configurations.

The plate geometry Assemblies 22 and 24 are described first, followed by the pin geometry Assemblies 23 and 25.

All the assemblies consist of arrays of square section elements held vertically and located on a bedplate. The contents of the elements are built up from components grouped to form the basic cells. There is a central region of core elements surrounded radially by a region of radial blanket elements, containing natural uranium, around which are steel shield (or reflector) elements. The core elements have a central region of core cells above and below which are the axial blanket regions and shield regions. The same control rods were used in all cores. These use plate geometry components and include sodium.

The plan view of the Assembly 22 is shown in Figure 1.7A. Element positions are indicated by their X and Y coordinates, the central position being (X,Y) = (50,45). The outer radial boundary of the blanket is the same in all the CADENZA Assemblies, although the core radial boundary varies. The thickness of the axial blanket is the same in all the assemblies although there are small variations in the core height. The axial and radial steel reflector regions are the same in all of the CADENZA Assemblies.

Elements are grouped in arrays of 5x5 separated by a small gap of 0.2665 cm by the three mild steel superlattice grids. The top superlattice grid plate is above the region of the assembly modelled. The two intermediate superlattice grids are above and below the core section, in the axial blanket/shielding areas. Nominally these two grids extend between 50.2 cm and 80.6 cm above and below the mid plane, each being 30.4 cm high and are 0.25 cm thick. (The horizontally smeared density of the grids is quoted as being 0.154 g/cm3.) The distance between the centres of elements within a group of 5x5 is 5.3721 cm and the overall average spacing is 5.4254 cm (the distance between the centres of two superlattices divided by 5). (Please note that this latter spacing has usually been assumed in the ZEBRA calculational models to be found in the ZEBRA documentation.) The dimensions of the element sheath, are inside width 5.102 cm, outside width 5.2544 cm. The nominal width assumed for all the square plate components situated within an element sheath is 5.067 cm.

Dimensions and compositions of components were given in documents presented to the OECD/NEA Committee on Reactor Physics in the 1980s (describing the Pin-Plate Benchmark) and these formed the basis for the data adopted in the present document. Additional data have been obtained from the Zebra PLATEDATA Database. Sometimes slightly different values are given in different sources.

#### Description of the Plate Geometry Cores, Assemblies 22 and 24.

There are 24 core cells in the core region of a Core 22 element, arranged one above the other. They are composed of plutonium metal plates, natural uranium oxide plates, sodium plates and (in the central 22 cells) a steel plate. Core 22 was built in two versions, 22A and 22B which differed only in the axial orientation of the core region cells. The cells do not have axial symmetry and in the first version of the core, 22A, all of the core cells had the same axial orientation. It was found that the fission rate scans showed an axial asymmetry and so alternate cells were inverted to give axial symmetry. This is version 22B (Figure 1.5). The difference in reactivity between the two versions was found to be negligibly small compared with the uncertainties, (-1 ± 4) x 10-5 dk.

The plate cells of Assembly 24, the “sodium voided” core, differ from those of Assembly 22 in that the sodium plates have been replaced by “sodium dummy” plates. These steel plates are of three different designs (denoted by X, Y and Z), X and Y being rings of steel and Z having a honeycomb form.

The core elements were not all identical. There were small differences between the plutonium metal plates used in the central region and in the outer region of the cores and in the special elements. The element loading of the core of Assembly 22 is shown in Figure 1.8A.

To summarise the naming convention, in Core 22 the types of core element were:

C22+01C which used the Mark VIII plutonium plate, PUVIII8.

C22+01D which used the Mark IX plutonium plate, PUIX8.

The Mark X plutonium plate, PUX8, was used in the instrumented elements containing resistance-bulbs (denoted by RE), thermocouples (denoted by TE) and chambers of the multi-chamber scanning system (denoted by ME, which contain 5 chambers, NE (the central element) containing 9 chambers and these are paired in these multi-chamber double elements with the HE element arrays). Elements A, B and Z were used in special experiments and these contained the plutonium plates PuIV4, PuVII8 and PuII8 respectively. The reactivity effects of the differences between the plutonium plates are very small and were measured so that corrections could be made for the differences.

The elements in the core of Assembly 24 (Figure 1.8B) have names of the form C24+20CX, where X denotes the sodium dummy plate (X, Y or Z). In addition there were the elements containing the plutonium metal plates of the types used in the corresponding Core 22 elements, C24+20BX, and DX and the instrumented elements RX , TX , MX, NX, and HX (containing the cores of type E).

An automatic loading machine was used to load the plates into an element. This required the edge of the plates which have the identification slots to be on the same side. Thus all of the plates in an element have the same orientation (see Figure 1.4). Figure 1.4 shows a piston at the lower end of the column of materials. This is not present in a double element this being replaced by aluminium components.

(Note the final number, N, in the name of a plate component corresponds to the nominal thickness, or height, in inches, or alternatively to the thickness in the form 1/N inches).

##### The core region cells

The standard plate cells of Assembly 22 are illustrated in Table 1.2 and Figure 1.5. They contain one plutonium metal plate, two UO2 plates, three sodium plates and one 40% stainless steel plate (a plate with sections cut out of it). There are a total of 24 cells in the core, 22 standard cells and two cells with the 40% stainless steel plate removed. These two cells are at the top and bottom of the core. This steel plate was omitted to make the height of the core match the pin cell core height more closely. The standard cell is Cell 1. Cell 11 is the inverse of Cell 1 and was combined with it in version 22B of the Assembly to make the core axially symmetrical.

Table 1.2 Standard Plate Geometry Cells

|  |  |  |
| --- | --- | --- |
|  | **Cell 1** | **Cell 11** |
|  |  |  |
| (Top) | Na | Na |
|  | UO2 | UO2 |
|  | Na | 40% Steel |
|  | Pu | Pu |
|  | 40% Steel | Na |
|  | UO2 | UO2 |
| (Bottom) | Na | Na |

Notes: Na is a NASTDL4 plate

UO2 is a U023R4 plate

Pu is a PUVIII8 plate

40% Steel is a STSTF8 plate.

Thus the central 22 cells in Core 22B can be considered as 11 double cells symmetric about the mid plane of the double cell, formed by inverting Cell 1 to form Cell 11 and placing Cell 11 above Cell 1 (the combined cell being called Cell 13). The end cells, Cell 2 and Cell 12 are formed by omitting the 40% Steel plate from Cell 1 and Cell 11 respectively. The pattern of cells in the core of Assembly 22B, going from the top downwards, is

(2, 11, 1, 11, 1, 11, 1, 11, 1, 11, 1, 11, 1, 11, 1, 11, 1, 11, 1, 11, 1, 11, 1, 12)

or

(2, 13, 13, 13, 13, 13, 13, 13, 13, 13, 13, 13, 12).

The arrangement of Cell 1 and Cell 11 forming 11 symmetric double-length cells in Core 22B is shown in Figure 1.5. The end cells, Cell 2 and Cell 12, are also shown.

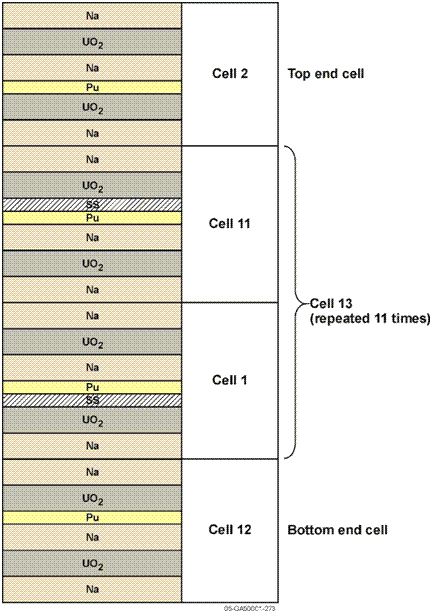


Figure 1.5 Core Cells of Assembly 22B.

The plutonium metal plates have welded copper and steel cans (see Figures 1.9, 1.10, and 1.11), the UO2 plates have brazed steel cans (Figures 1.12 and 1.13) and the sodium plates have welded steel cans (Figure 1.14).

The objective of the programme of measurements was to provide data for validating calculational methods and nuclear data, with an emphasis on the treatment of cell heterogeneity in whole core criticality calculations. Measurements were made to enable simplifications to be adopted in calculation, in particular measurements of the differences between elements containing the different plutonium plates.

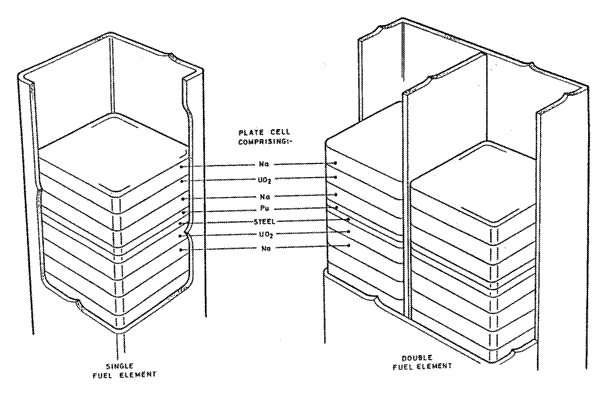


Figure 1.6 Plate Arrangement in the Single and Double Elements.

Most elements were in the form of double elements, some of these being instrumented double elements.

The wall between the two columns of plates in the double element, as it is shown here, applies to the "standard" double element. In the instrumented double elements there is a V-shaped spacer which serves to keep the two columns apart and allow space for the cabling.

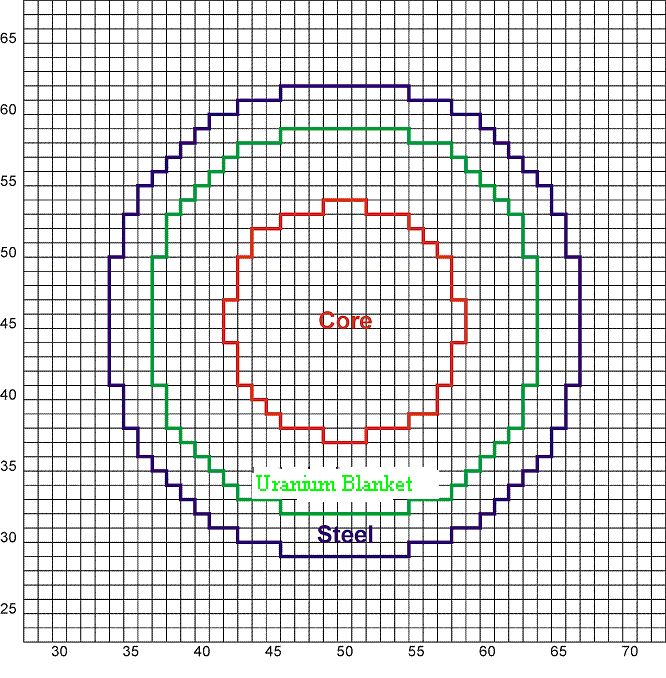


Figure 1.7A Plan of Assembly 22.

In Assembly 22 there are 215 core elements, 386 uranium blanket elements and 276 steel shielding elements.

(The equivalent radii corresponding to these areas are 8.273 p, 13.831 p and 16.708 p where p is the lattice pitch. For the average overall lattice pitch of 5.4254 cm these radii are 44.884 cm, 75.039 cm and 90.648 cm.)

In Assembly 23 there are 226 core elements, equivalent radius, 46.018 cm (375 blanket elements).

In Assembly 24 there are 231 core elements, equivalent radius, 46.523 cm (370 blanket elements).

In Assembly 25 there are 243 core elements, equivalent radius, 47.716 cm (358 blanket elements).

Outside the radial shield the lattice positions are empty in the remainder of the 3m x 3m area, apart from the super-lattice grid plates (see Figure 1.3).

##### Instrumented elements

Included in the core are a number of instrumented elements. These are the double elements containing resistance bulbs for measuring temperature (elements of the type E containing these are denoted by RE) those containing thermocouples (denoted by TE) and those containing the Pu239 fission chambers of the multichamber scanning system (denoted by HE, ME and NE) with the elements ME and NE containing the fission chambers and HE being the associated element in the double element.

Corrections for the reactivity differences are made to replace these elements by standard elements in the calculational models. These corrections are based on measurements made in the cores.

C22+01RE has 3 resistance bulbs centred onPu plates and located at 30.48 cm and 1.78 cm above the core centre plane and 27.94 cm below the core centre plane. The bulbs are between the plate stacks and against one stack.

C22+01TE has a thermocouple inserted between the stacks and brazed to a special dividing strip, near the core centre plane.

In the pin geometry assemblies:

C22+03RA and C22+03RC are resistance bulb elements, similar to C22+01RE but are in pin cell elements. The 3 bulbs are located vertically at the side of the calandria and approximately 30.48 cm above and below the core centre plane and on the centre plane.

All special elements contain the v-shaped dividing strip between the two component stacks to protect the connecting leads.

The Pu239 fission chambers in the plate geometry elements (denoted as plate component MFC38, thickness 0.95 cm) each replace either a sodium plate plus a 40% steel plate (nominal thickness 0.616 cm + 0.317 cm = 0.933 cm) or two sodium plates (2 x 0.616 cm nominal thickness), in which case a stainless steel plate, STST8V, (0.3175 cm thick, weight 16.96 g, essentially the same weight as the steel of a sodium plate) is placed next to the chamber (2 x 0.616 - 0.3175 = 0.9145 cm).

For Assembly 22B the pattern of the standard and multi-chamber cells is shown in Figure 1.7B:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cell 13 (standard core cell) | Cell 14 | Cell 15 |
|  |  |  |  |
| (Top) | Na | Na | Na |
|  | UO2 | UO2 | UO2 |
|  | ***40% Steel*** | ***40% Steel*** | Pu |
|  | Pu | Pu | Na |
|  | Na | Na | UO2 |
|  | UO2 | UO2 | Na |
|  | ***Na*** | ***STST8V*** | ***MFC38*** |
|  | ***Na*** | ***MFC38*** | UO2 |
|  | UO2 | UO2 | Na |
|  | Na | Na | Pu |
|  | Pu | Pu | 40% Steel |
|  | 40% Steel | 40% Steel | UO2 |
|  | UO2 | UO2 | Na |
| (Bottom) | Na | Na |  |

Figure 1.7B Positions of the Pu239 Fission Chambers in Core Cells of Assembly 22B which Replace Cell 13.

Element ME replaces the normal core element cell pattern (see ZTN22-11):

(2, 13, 13, 13, 13, 13, 13, 13, 13, 13, 13, 13, 12).

by

(2, **14**, 13, 11, **15**, 1, 13, **14**, 13, 11, **15**, 1, 13, **14**, 12).

That is, it contains 5 Pu239 chambers and has 8 fewer sodium plates, and 2 fewer 40% steel plates, but an additional 3 steel plates STST8V.

At the centre of the core is one element NE which has the cell pattern:

(2, **14**, 11, **15, 15**, 1, **14, 14, 14**, 11, **15, 15**, 1, **14**, 12)

This contains 9 Pu239 fission chambers and has 14 fewer sodium plates 4 fewer 40% steel plates but an additional 5 STST8V plates.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  |  |  | 1D | 1D | 1D |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  | 1D | 1D | 1D | 1D | 1D | 1ME | 1HE | 1D | 1D |  |  |  |  |  |
| 51 |  |  |  | 1C | 1RE | 1D | 1D | 1D | 1HE | 1C | 1RE | 1D | 1D | 1D | 1RE |  |  |  |  |
| 50 |  |  |  | 1D | 1RE | 4 | 1C | 1D | 1ME | 1C | 1RE | 1D | 1C | 2 | 1RE | 1D |  |  |  |
| 49 |  |  | 1D | 1D | 1ME | 1C | 1C | 1C | 1C | 1C | 1HE | 1C | 1C | 1C | 1ME | 1D | 1D |  |  |
| 48 |  |  | 1D | 9 | 1HE | 1C | 1CD | 1C | 1C | 1C | 1ME | 1C | 1CD | 1C | 1HE | 1D | 1D |  |  |
| 47 |  |  | 1D | 1CD | 1RE | 1TE | 1C | 1RE | 1C | 1C | 1C | 1C | 1C | 1TE | 1RE | 1CD | 1D |  |  |
| 46 |  | 1D | 1D | 6 | 1RE | 1TE | 1C | 1RE | 1ME | 1HE | 1C | 1C | 1C | 1TE | 1RE | 8 | 1D | 1D |  |
| 45 |  | 1D | 1D | 1ME | 1HE | 1ME | 1C | 1ME | 1CD | 1NE | 1HE | 1ME | 1C | 1ME | 1HE | 1ME | 1D | 1D |  |
| 44 |  | 1D | 1D | 7 | 1C | 1HE | 1C | 1HE | 1CD | 1HE | 1ME | 1HE | 1C | 1HE | 1C | 5 | 1D | 1D |  |
| 43 |  |  | 1D | 1CD | 1C | 1TE | 1TE | 1C | 1C | 1CD | 1RE | 1RE | 1TE | 1TE | 1C | 1CD | 1D |  |  |
| 42 |  |  | 1D | 1D | 1HE | 1C | 1CD | 1C | 1ME | 1C | 1C | 1C | 1CD | 1C | 1HE | 1D | 1D |  |  |
| 41 |  |  | 1D | 1D | 1ME | 1C | 1C | 1C | 1HE | 1C | 1C | 1C | 1C | 1C | 1ME | 1D | 1D |  |  |
| 40 |  |  |  | 1D | 1RE | 1 | 1C | 1D | 1RE | 1C | 1ME | 1D | 1C | 3 | 1RE | 1D |  |  |  |
| 39 |  |  |  |  | 1RE | 1D | 1D | 1D | 1RE | 1C | 1HE | 1D | 1D | 1ME | 1RE | 1C |  |  |  |
| 38 |  |  |  |  |  | 1D | 1D | 1HE | 1ME | 1D | 1D | 1D | 1D | 1HE |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  | 1D | 1D | 1D |  |  |  |  |  |  |  |  |

Figure 1.8A Assembly 22 Reference Core Loading (Fissile Elements)

The plutonium metal plates used in different types of element are as follows. In the 1C elements type PuVIII8 plutonium plates are used and in 1D elements type PuIX8. Most elements are in the form of double elements.

Mark PuX8 plates are used in the paired instrumented elements (of type E) containing resistance-bulbs which measure temperature (RE, 10 double elements), thermocouples (TE, 4 double elements) and chambers of the multichamber scanning system (HE, ME and NE; 20 double elements, with HE being the element partnering the multichamber element. Elements ME hold 5 fission chambers and the element NE holds 9). (See ZTN22-11 for more details of core loadings and element compositions.)

Elements A, B and Z are used in special experiments and these contain plates PuIV4, PuVII8 and PuII8 respectively. CD denotes a C element with a demountable sheath which permits the positions of the plates in the column of plates to be measured.

The numbers 1 to 9 denote the control rods. These contain approximately the same quantities of plutonium and uranium as the normal core elements and measurements were made of the reactivity equivalence between these and standard core elements.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  | 0BZ | 0CZ | 0DZ | 0DZ | 0DZ | 0CZ | 0CZ |  |  |  |  |  |  |
| 52 |  |  |  |  | 0DZ | 0DZ | 0DY | 0DY | 0DY | 0MY | 0HY | 0DZ | 0DZ |  |  |  |  |  |
| 51 |  |  | 0CZ | 0RZ | 0DY | 0DY | 0DY | 0HY | 0CX | 0RY | 0DY | 0DY | 0DY | 0RZ | 0CZ |  |  |  |
| 50 |  |  | 0DZ | 0RY | 4 | 0CY | 0DY | 0MY | 0CX | 0RY | 0DY | 0CY | 2 | 0RY | 0DZ |  |  |  |
| 49 |  | 0DZ | 0DY | 0MY | 0CY | 0CY | 0CX | 0CX | 0CY | 0HX | 0CX | 0CY | 0CY | 0MY | 0DY | 0DZ |  |  |
| 48 | 0CZ | 0DZ | 9 | 0HY | 0CY | 0CX | 0CX | 0CX | 0CY | 0MX | 0CX | 0CX | 0CY | 0HY | 0DY | 0DZ |  |  |
| 47 | 0CZ | 0DY | 0CY | 0RY | 0SX | 0CX | 0RX | 0CX | 0CX | 0CX | 0CX | 0CX | 0TX | 0RY | 0CY | 0DY | 0CZ |  |
| 46 | 0DZ | 0DY | 6 | 0RY | 0SX | 0CX | 0RX | 0MX | 0HX | 0CX | 0CX | 0CX | 0TX | 0RY | 8 | 0DY | 0DZ |  |
| 45 | 0DZ | 0DY | 0MY | 0HY | 0MX | 0CX | 0MX | 0CX | 0NX | 0HX | 0MX | 0CX | 0MX | 0HY | 0MY | 0DY | 0DZ |  |
| 44 | 0DZ | 0DY | 7 | 0CY | 0HX | 0CX | 0HX | 0CX | 0HX | 0MX | 0HX | 0CX | 0HX | 0CY | 5 | 0DY | 0DZ |  |
| 43 | 0CZ | 0DY | 0CY | 0CY | 0TX | 0TX | 0CX | 0CX | 0CX | 0RX | 0RX | 0TX | 0TX | 0CY | 0CY | 0DY | 0CZ |  |
| 42 |  | 0DZ | 0DY | 0HY | 0CY | 0CX | 0CX | 0MX | 0CX | 0CX | 0CX | 0CX | 0CY | 0HY | 0DY | 0DZ | 0CZ |  |
| 41 |  | 0DZ | 0DY | 0MY | 0CY | 0CY | 0CX | 0HX | 0CX | 0CX | 0CX | 0CY | 0CY | 0MY | 0DY | 0DZ |  |  |
| 40 |  |  | 0DZ | 0RY | 1 | 0CY | 0RY | 0CY | 0CY | 0MY | 0DY | 0CY | 3 | 0RY | 0DZ |  |  |  |
| 39 |  |  | 0CZ | 0RZ | 0DY | 0DY | 0RY | 0CY | 0CY | 0HY | 0DY | 0DY | 0MY | 0RZ | 0CZ |  |  |  |
| 38 |  |  |  |  | 0DZ | 0DZ | 0HY | 0MY | 0DY | 0DY | 0DY | 0DZ | 0HZ |  |  |  |  |  |
| 37 |  |  |  |  |  | 0CZ | 0CZ | 0DZ | 0DZ | 0DZ | 0CZ | 0BZ |  |  |  |  |  |  |

Figure 1.8B Assembly 24 Reference Core Loading (Fissile Elements)

The final letter in the identifier, X, Y and Z denotes the type of "dummy" (or voided) sodium plate used. The elements which do not form part of an instrumented double element have identifiers beginning with 0C and 0D. Consistently with the Assembly 22 notation the 0C elements contain the PuVIII8 plates and 0D the PuIX8 plates. Again most elements are in the form of double elements.

The instrumented elements are denoted by 0R (resistance bulbs), 0S and 0T (thermocouples), and 0M, 0N, 0H for the elements of the multi-chamber scanning system, all these instrumented elements having the plutonium plates of the type E elements. 0S differs from 0T in having a special connecting box in the lower plenum, the region below the lower reflector region (so-called because it simulated the plenum region of a fast reactor fuel element in reactor mock-up studies).

##### Dimensions of plate geometry components

The plates are illustrated in Figures 1.9 to 1.15.

The nominal width of all plates, other than the control rod plates is 5.067 cm (unless otherwise stated).

***Note concerning the numbering of Tables. Tables giving Dimensions have the form 1.Dx those giving Material data the form 1.Mx, etc.***

Table 1.D1 Dimensions of the Core Region Plates. (cm)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Plate thickness | Core thickness | Core width |
| Pu metal \* | 0.3274 | 0.236 | 4.671 |
| UO2 | 0.6313 | 0.558 | 4.851 |
| Sodium \*\* | 0.613694 | 0.541 | 4.963 |
| STNAVR4 (X) | 0.616 | ring |  |
| STNAVS4 (Y) | 0.616 | ring |  |
| STNAV4 (Z) | 0.616 | honeycomb |  |
| 40%steel, STSTF8 | 0.317 | void regions |  |
|  |  |  |  |
| Multiscan chamber | 0.95 |  |  |

*\* Note 1: These are the dimensions of the PuVIII8 plutonium plate used in the 1C element (the reference element) which occupies the central region and the majority of the core. The other plutonium plates, PuIX8 and PuX8, have a slightly different thickness, 0.3265 ± 0.0005 cm and 0.3264 ± 0.0005 cm respectively (a difference of ~0.001 cm or ~0.3%, see Table 1M.18). The dimensions of the PuVIII8 plate are used in the subsequent general descriptions of the dimensions of core regions. The differences in thickness of the alternative plutonium plates, compared with the PuVIII8 plate, result in a difference in the core height of ~ 0.02 cm, a difference which is small compared with the assumed uncertainty in the core height of ± 0.05 cm. Measurements are made to correct the keff values of the cores for the differences from the reactivity of the 1C element.*

*\*\* Note 2: the nominal height of the sodium plate is 0.616 cm. The value of 0.613694 cm corresponds to the measured core height. It has been assumed by the measurers that the difference in height from the value calculated using the nominal plate dimensions is because the sodium plates have been compressed by the weight of plates above.*

The sodium "dummy" plates, STNAV, (or sodium voided plates) have nominally the same thickness and weight as the cans of the sodium plates. STNAVR4 and S4 are ring shaped (*outer diameter 5.067 cm, inner diameter 4.6 cm)* and STNAV4 is "honeycomb" shaped.

The 40% steel plate has cut-out sections (see Figure 1.15).

The 22 standard core cells of Assembly 22 have a height of 3.748082 cm and the two upper and lower cells a height of 3.431082 cm making a total core height of 89.32 cm.

In Assembly 24 each cell is 0.006918 cm higher (3.755 cm and 3.438 cm, respectively for the two cell types) and the core height is 0.166 cm higher, a total measured core height of 89.486 cm.

The heights were measured in special demountable subassemblies.

Table 1.D2 Dimensions of the Axial Blanket Region Natural Uranium Plates and Shield Region

|  |  |  |
| --- | --- | --- |
| Plate | Material | Thickness (cm) |
| Axial Blanket | |  |
|  |  |  |
| U8 | Natural Uranium | 0.317 |
| U2 |  | 1.2723 |
| U3 |  | 7.6225 |
|  |  |  |
| Axial Shield (or Plenum) Region | |  |
|  |  |  |
| MST3 | Mild Steel | 7.60628 |
| ALSC3 | Aluminium | 7.62 |
|  |  |  |
| Axial Spacer Regions | |  |
|  |  |  |
| ALSR1 |  | 2.54 |
| MSTST3 | Mild steel | 7.62 |
| MSTST12 |  | 30.48 |

The axial blanket sections consist of 31 U8 plates followed by 10 U2 plates and 1 U3 block, a height of 30.1725 cm.

Above the upper axial blanket and below the lower axial blanket are the mild steel blocks MST3 and the 2 aluminium cylinders, ALSC3.

Above and below these are the mild steel spacer tubes MSTST12 (12 inches long) and MSTST3 (3 inches long) together with aluminium plates such as the 2.54 cm thick ALSR1. The total length of an element is 3 m. There are variations in the aluminium and mild steel Upper Plenum region (the reduced density shielding region simulating a fast reactor plenum region) and Spacer Region components used in different elements and electronic equipment is included in the top region of the instrumented elements (see ZTN22-11, Tables 3 and 5). The components used in the majority of elements are as follows (using the region naming convention of ZTN22-11)

|  |  |  |  |
| --- | --- | --- | --- |
| REGION | Components | Component Height | Region Height |
| Upper Spacers | MSTST12  MSTST3 | 30.48 cm  7.62 cm | 38.1 cm |
| Upper Plenum  (or Shield) | 2xALSC3  MST3 | 15.24 cm  7.60628 cm | 22.84628 cm |
| Upper Unat Blanket | U3  10xU2  31xU8 | 7.6225 cm  12.723 cm  9.827 cm | 30.1725 cm |
| CORE |  |  |  |
| Lower Unat  Blanket | 31xU8  10xU2  U3 | 9.827 cm  12.723 cm  7.6225 cm | 30.1725 cm |
| Lower Plenum  (or Shield) | MST3  2xALSC3 | 7.60628 cm  15.24 cm | 22.84628 cm |
| Lower Spacers | MSTST12  2xALSR1 | 30.48 cm  5.08 cm | 35.56 cm |

##### Radial blanket and reflector regions (or radial shielding).

The cores are surrounded by about 5 rings of radial blanket elements, each element containing 20 U3 blocks, 152.45 cm in height, above and below which are the mild steel blocks. The centre of this region is closely aligned with the centre of the core region so that the upper and lower extremities of the uranium region are close to those of the axial blanket regions. Surrounding the radial blanket elements are about 3 rings of radial reflector (or shielding) elements.

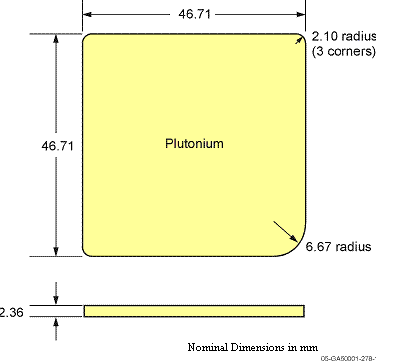
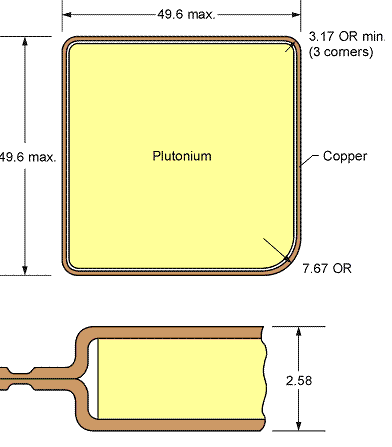
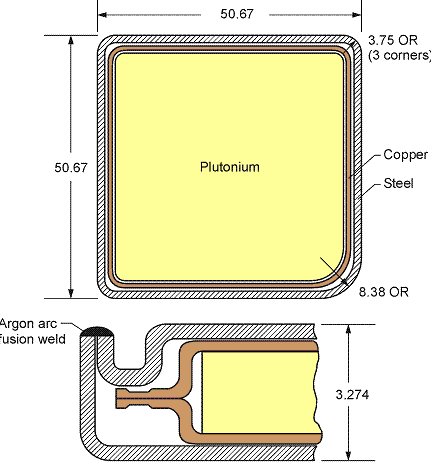


Figure 1.9 Core of the Plutonium Metal Fuel Plate, PuVIII8.



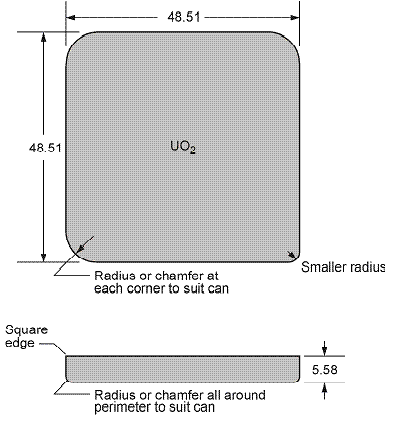
Drawing not to scale. Nominal dimensions in mm.

Figure 1.10 Core and Copper Clad of the Plutonium Metal Fuel Plate.



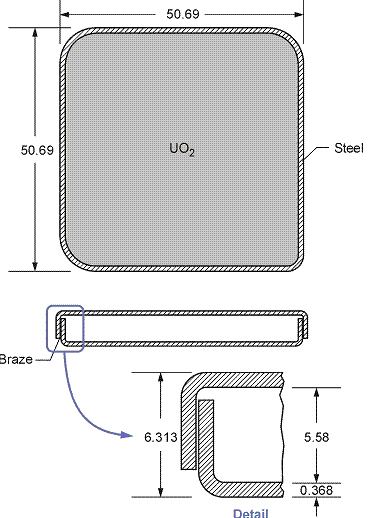
Drawing not to scale. Nominal dimensions in mm.

Figure 1.11 Core, Copper and Steel Clad of the Plutonium Metal Fuel Plate, PuVIII8.



Nominal dimensions in mm

Figure 1.12 Core Region of the Uranium Oxide Plate.



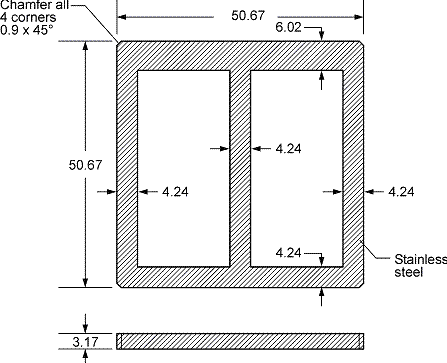
Drawing not to scale. Nominal dimensions in mm.

Figure 1.13 Core and Can Regions of the Uranium Oxide Plate.



Drawing not to scale. Nominal dimensions in mm.

Figure 1.14 Core Plus Can Regions of the Sodium Plate.



Drawing not to scale. Nominal dimensions in mm.

Figure 1.15 The 40% Steel Plate.

Table 1.D3 Dimensions of a Radial Blanket (or Radial Breeder) Element

|  |  |  |
| --- | --- | --- |
|  |  | Height of section (cm) |
| Upper Axial Steel Reflector | 1 MST3 | 7.60628 |
| Radial Blanket section | 20 x U3 | 152.45 |
| Lower Axial Steel Reflector | 1 MST3 | 7.60628 |
|  |  |  |
| Total |  | 167.66256 |

These elements are contained in the mild steel element sheaths.

Table 1.D4 Radial Shield Element, MST9F10

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Width of square section bar (cm) | Height of bar (cm) |
| Steel bar | MST9F10. | 5.08 | 300 |

The bar is not contained in a sheath.

Table 1.D5 The Element Sheaths, Superlattice Grid Plate and the Lattice Spacings

|  |  |
| --- | --- |
|  | (cm) |
| SHEATH WALL THICKNESS | 0.0762 |
| SHEATH INSIDE WIDTH | 5.1020 |
| SHEATH OUTSIDE WIDTH | 5.2544 |
| AVERAGE PITCH WITHIN GROUPS OF 5x5 ELEMENTS | 5.3721 |
| GAP BETWEEN GROUPS OF 5x5 ELEMENTS | 0.2665 |
| SUPERLATTICE PLATE THICKNESS | 0.25 |
| AVERAGE PITCH OVERALL | 5.4254 |

***However, it must be noted that the components forming most elements are contained in the "double element" sheath which has the same outer dimensions but a provision to hold an instrument, and about one third of the double elements in the plate geometry cores contain an instrument (the proportion being fewer in the pin geometry cores). The Zebra Database gives the same dimensions for the double sheath (per element) as for the single sheath but the fractions of steel in each of the walls and in the central vertical channel could differ. In the "standard" double element the central steel partition, separating the two columns of plates or mini-calandria, has the same weight as the two side walls of a single element. In the case of a double element containing an instrument the central partition is V-shaped to accommodate the electrical cables. (The weight of the partition in this case is not given in the documentation.)***

**Superlattice Grid Plate dimensions**

Nominally the two lower grid plates extend between 50.2 cm and 80.6 cm above and below the mid plane, each being 30.4 cm high and 0.25 cm thick. The third grid plate is at the top of the facility, beyond the range of the assembly modelled.

#### Assemblies 23 and 25, the Pin Geometry Cores.

The compositions of the axial and radial blanket and reflector regions are the same as in the plate geometry Assembly 22. It is only the core cells which are different.

The core regions of the pin geometry elements contain three mini-calandria, one above the other, each a little under 30 cm in height, and each containing 16 mixed uranium-plutonium oxide pins on a 4x4 square array. The pins fit into the 4x4 array of tubes which pass through the calandria and are fixed to the top and bottom plates of the calandria. The space around the tubes can be occupied by sodium (the sodium filled calandria used in Assembly 23) or left empty (the voided calandria used in Assembly 25). The average plutonium enrichment of the 4x4 array of pins in each mini-calandria is 24% Pu/(Pu+U). However, the individual pins can differ. All three mini-calandria in an element are the same.

The Core 23 was also built in two versions, 23A and 23B. The pins have a small axial asymmetry because of the end regions and the steel shims which adjust the height of the stack of pellets. In version 23A some of the pins were inverted but in 23B the orientation of all of the pins was the same. Again the difference in reactivity between the two versions was found to be negligibly small compared with the uncertainties (–4 ± 4) x 10-5 dk.

The mixed uranium-plutonium oxide pins are of several different enrichments and are denoted by the names PUPINA to PUPINF. There are also natural uranium oxide pins, UO2PINC. There are 5 different types of mini-calandria, containing sodium, denoted by NACLI to NACLV. These have differing steel compositions. Eight different types of cell have to be distinguished, numbered 3A to 3L. There are also sodium voided mini-calandria which are used for the sodium voiding studies.

Table 1.3 Contents of the 168 Mini-calandria Elements used in Assembly 23.

|  |  |  |  |
| --- | --- | --- | --- |
| Cell Number | Mini-Calandria  Type | Pin Types and Numbers | Numbers of elements |
|  |  |  |  |
| 3A | NACLI | 16 x PUPINC | 16 |
| 3B | NACLI | 11 x PUPINB, 5 x PUPINF | 24 |
| 3C | NACLIII | 8 x PUPINA, 8 *x* PUPINE | 53 |
| 3D | NACLIII | 8 x PUPIND, 8 x PUPINF | 17 |
| 3E | NACLIIS | 8 x PUPIND, 8 x PUPINF | 34 |
| 3H | NACLV | 11 x PUPINB, 5 x PUPINF | 10 |
| 3J | NACLIV | 12 x PUPINE*,* 4 x U02PINC | 4 |
| 3L | NACLIV | 11 x PUPINB, 5 x PUPINF | 10 |

PUPINA and PUPIND have an enrichment Pu/(Pu + U) of 0.16

PUPINB has an enrichment of 0.21

PUPINChas an enrichment of 0.24

PUPINE and PUPINF have an enrichment of 0.33.

Thus all 4x4 pin cells have a very similar average composition.

The instrumented elements 3RA, 3RC and 3TE contain the cells 3A, 3C and 3E respectively.

In addition to the pin-fuelled elements in Core 23 there are the 9 control rods (which are the Assembly 22 control rods) and, around the circumference of the core, there are 49 plate elements, making an array of 226 elements (including the control rods) in the core. Type 3C occupy the central area. The core plan is shown in Figure 1.16 and the mini-calandria are illustrated in Figures 1.17 and 1.18.

The core plan for Assembly 25, the sodium voided core, is shown in Figure 1.19. The element changes on going from Assembly 23 to Assembly 25 are also shown. The number and positions of pin geometry elements is the sam and the pin arrays are the same the difference being that mini-calandria not containing sodium replace the sodium filled mini-calandria. These are not the same mini-calandria but are closely matched in weight of steel. Effectively, the change is the removal of the sodium from the mini-calandria of Assembly 23. Also, the plate geometry elements surrounding the pin geometry elements are now the sodium voided plate elements (denoted by X, Y and Z) and the number of these has increased.

##### The pin cell arrangements in the cells of the mini-calandria.

***Cell 3A*** The pin arrangement is:

|  |  |  |  |
| --- | --- | --- | --- |
| C | C | C | C |
| C | C | C | C |
| C | C | C | C |
| C | C | C | C |

where C = PUPINC and the mini-calandria is NACLI

***Cells 3B, 3H and 3L*** The pin arrangements are the same but the mini-calandria differ.

|  |  |  |  |
| --- | --- | --- | --- |
| B | F | B | B |
| F | B | F | B |
| B | B | B | F |
| B | B | F | B |

where B = PUPINB and F = PUPINF

The mini-calandrias are as follows:

|  |  |
| --- | --- |
| Cell Type | Mini-calandria Type |
| 3B | NACLI |
| 3H | NACLV |
| 3L | NACLIV |

***Cell 3C*** The pin arrangement is:

|  |  |  |  |
| --- | --- | --- | --- |
| E | A | E | A |
| A | E | A | E |
| E | A | E | A |
| A | E | A | E |

where A = PUPINA and E = PUPINE and the mini-calandria is NACLIII

***Cells 3D and 3E*** The pin arrangement has the same pattern as cell 3C being the same in 3D and 3E: (D = PUPIND and F = PUPINF)

|  |  |  |  |
| --- | --- | --- | --- |
| F | D | F | D |
| D | F | D | F |
| F | D | F | D |
| D | F | D | F |

The mini-calandrias differ between 3D and 3E

|  |  |
| --- | --- |
| Cell Type | Mini-calandria Type |
| 3D | NACLIII |
| 3E | NACLIIS |

Arrangements for *Cell 3J* This mini-calandria contains UO2 pins and U/PuO2 pins. The pin arrangement is:

|  |  |  |  |
| --- | --- | --- | --- |
| E | U | E | E |
| E | E | E | U |
| E | U | E | E |
| E | E | E | U |

where U = UO2PINC and E = PUPINE. The mini-calandria is NACLIV

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  |  | *1CD* | *1D* | *1D* | *1D* | *1CD* | *1C* |  |  |  |  |  |  |
| 52 |  |  |  |  |  | *1D* | *1D* | 3L | 3L | 3L | 3L | 3L | *1D* | *1D* |  |  |  |  |  |
| 51 |  |  |  | *1CD* | *1C* | 3H | 3H | 3B | 3B | 3B | 3B | 3B | 3H | 3H | *1CD* | *1CD* |  |  |  |
| 50 |  |  |  | *1D* | 3A | 4 | 3D | 3B | 3B | 3B | 3B | 3B | 3D | 2 | 3A | *1D* |  |  |  |
| 49 |  |  | *1D* | 3B | 3D | 3RC | 3E | 3C | 3C | 3C | 3RC | 3C | 3E | 3RC | 3D | 3B | *1D* |  |  |
| 48 |  |  | *1D* | 9 | 3D | 3RC | 3E | 3C | 3C | 3C | 3RC | 3C | 3E | 3RC | 3D | 3D | *1D* |  |  |
| 47 |  | *1C* | 3A | 3J | 3RA | 3TE | 3E | 3RC | 3C | 3C | 3C | 3C | 3E | 3TE | 3RA | 3J | 3A | *1CD* |  |
| 46 |  | *1D* | 3A | 6 | 3RA | 3TE | 3E | 3RC | 3C | 3C | 3C | 3C | 3E | 3TE | 3RA | 8 | 3A | *1D* |  |
| 45 |  | *1D* | 3B | 3E | 3E | 3E | 3E | 3C | 3C | 3C | 3C | 3C | 3E | 3E | 3E | 3E | 3B | *1D* |  |
| 44 |  | *1D* | 3A | 7 | 3D | 3E | 3E | 3C | 3C | 3C | 3C | 3C | 3E | 3E | 3D | 5 | 3A | *1D* |  |
| 43 |  | *1CD* | 3A | 3J | 3D | 3TE | 3TE | 3C | 3C | 3C | 3RC | 3RC | 3TE | 3TE | 3D | 3J | 3A | *1CD* |  |
| 42 |  |  | *1D* | 3D | 3D | 3RC | 3E | 3C | 3RC | 3C | 3C | 3C | 3E | 3RC | 3D | 3E | *1D* |  |  |
| 41 |  |  | *1D* | 3D | 3D | 3RC | 3E | 3C | 3RC | 3C | 3C | 3C | 3E | 3RC | 3D | 3E | *1D* |  |  |
| 40 |  |  |  | *1D* | 3A | 1 | 3H | 3B | 3B | 3B | 3B | 3B | 3H | 3 | 3A | *1D* |  |  |  |
| 39 |  |  |  | *1CD* | *1C* | 3H | 3H | 3B | 3B | 3B | 3B | 3B | 3H | 3H | *1C* | *1CD* |  |  |  |
| 38 |  |  |  |  |  | *1D* | *1D* | 3L | 3L | 3L | 3L | 3L | *1D* | *1D* |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  | *1CD* | *1D* | *1D* | *1D* | *1C* |  |  |  |  |  |  |  |

Figure 1.16 Assembly 23 Reference Core Loading (Fissile Elements)

See Figure 1.8A for information on the plate geometry elements, 1C, 1D and 1CD (demountable). These are shown in blue.

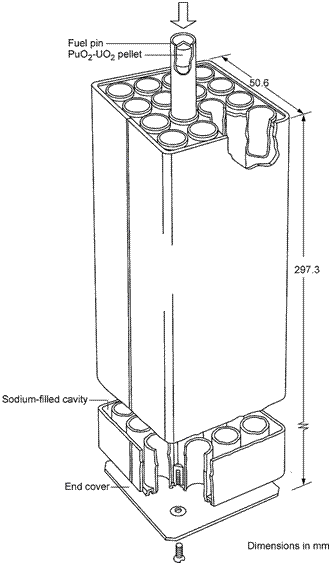


Figure 1.17 Diagram of a Mini-calandria

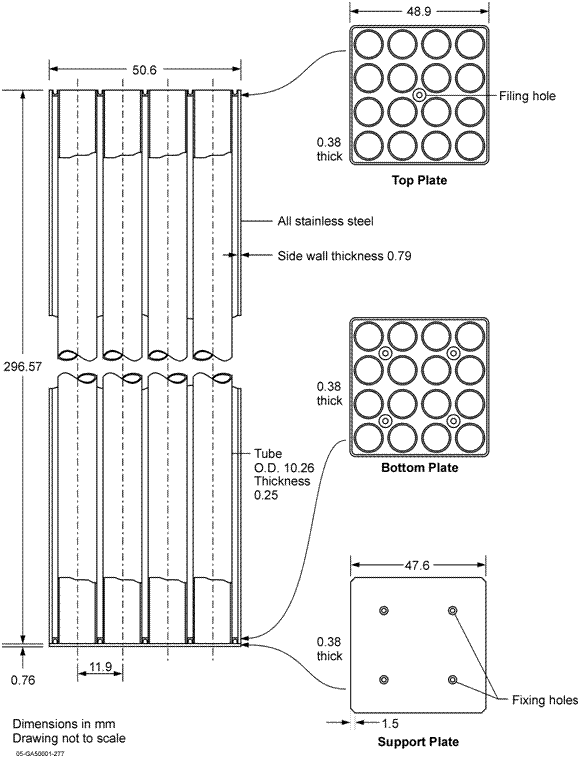


Figure 1.18 Mini-calandria Components

*Note: The thickness of the support plate is given as 0.38 mm but the fitting of the support plate by means of the counter-sunk indentations adds 0.76 mm (NEACRP A445 p8). Note also: the overall length given here is 296.57 + 0.76 mm = 297.33 mm but the generally adopted value is 297.3 mm)*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  | *Z* | *Z* | *Z* | *Z* | *Z* | *Z* | *Z* |  |  |  |  |  |  |
| 52 |  |  |  |  | *Y* | *Z* | *Z* | 387 | 387 | 387 | 387 | 387 | *Z* | *Z* | *Y* |  |  |  |  |
| 51 |  |  |  | *Z* | *Y* | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | *Y* | *Z* |  |  |  |
| 50 |  |  | *Y* | *Y* | 3A1 | 4 | 303 | 387 | 387 | 387 | 387 | 387 | 303 | 2 | 3A1 | *Y* | *Y* |  |  |
| 49 |  | *Z* | *Z* | 387 | 303 | 3C3 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 304 | 3C3 | 303 | 387 | *Z* |  |  |
| 48 |  | *Y* | *Z* | 9 | 303 | 3C3 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 304 | 3C3 | 303 | 303 | *Z* | *Y* |  |
| 47 |  | *Y* | 3A1 | 3J6 | 3A1 | 305 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 301 | 305 | 3A1 | 3J2 | 3A1 | *Y* |  |
| 46 |  | *Z* | 3A1 | 6 | 3A1 | 305 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 305 | 305 | 3A1 | 8 | 3A1 | *Z* |  |
| 45 |  | *Z* | 387 | 304 | 304 | 305 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 301 | 304 | 305 | 301 | 387 | *Z* |  |
| 44 |  | *Z* | 3A1 | 7 | 303 | 305 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 301 | 304 | 303 | 5 | 3A1 | *Z* |  |
| 43 |  | *Y* | 3A1 | 3J6 | 303 | 305 | 305 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 305 | 305 | 303 | 3J2 | 3A1 | *Y* |  |
| 42 |  | *Y* | *Z* | 303 | 303 | 3C3 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 304 | 3C3 | 303 | 304 | *Y* | *Y* |  |
| 41 |  |  | *Z* | 303 | 303 | 3C3 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 304 | 3C3 | 303 | 304 | *Z* | *Z* |  |
| 40 |  |  | *Y* | *Y* | 3A1 | 1 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 3 | 3A1 | *Y* | *Y* |  |  |
| 39 |  |  |  | *Z* | *Y* | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | *Y* | *Z* |  |  |  |
| 38 |  |  |  |  | *Y* | *Z* | *Z* | 387 | 387 | 387 | 387 | 387 | *Z* | *Z* | *Y* |  |  |  |  |
| 37 |  |  |  |  |  |  | *Z* | *Z* | *Z* | *Z* | *Z* | *Z* | *Z* |  |  |  |  |  |  |

Figure 1.19 Assembly 25. Fissile Elements

X, Y and Z denote the plate geometry elements containing the sodium replacement "dummy" plates, X, Y and Z respectively (that is, STNAVR4, STNAVS4 and STNAV4).

The pin geometry element replacement in going from Assembly 23 to 25 is as follows (the pin arrays being the same in the corresponding elements of the two assemblies):

3A and 3RA --🡪 3A1 16 elements using calandria VCLI

3B, 3H and 3L --🡪 387 44 elements using calandria VCLVIIS

3C and 3RC --🡪 3C3 53 elements using calandria VCLIII

3D --🡪 303 17 elements using calandria VCLIII

3E and 3TE --🡪 301, 304 and 305 34 elements using calandria VCLI, VCLIVH and VCLV

3J --🡪 3J2 and 3J6 4 elements using calandria VCLII and VCLVI

The Assembly 25 pin geometry elements contain the same fuel pin arrays as the corresponding Assembly 23 elements, the difference being that the "sodium filled" calandria used in Assembly 23 are replaced by "sodium voided" calandria. The type of calandria used is denoted by the final number in the name of the element type. Thus the 3A1 elements use the "voided" calandria VCLI, the 3C3 elements use the "voided" calandria VCLIII and the elements 303 also use the voided calandria VCLIII. These calandria are very similar, in the composition of the steel components, to the sodium filled calandria, NACLI and NACLIII, used by the 3A, 3C and 3D elements of Assembly 23. The match in the case of the other elements is not so close but it was considered to be sufficiently close for the difference between the Assembly 23 and Assembly 25 calandria to be treated as simply the removal of the sodium (and the associated trace elements in the sodium).

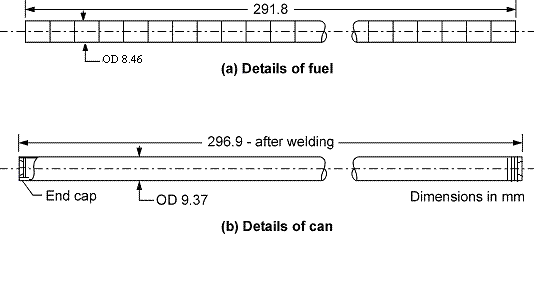


Figure 1.20 Dimensions of an Oxide Fuel Pin

Table 1.D6 Dimensions of the Components used in the Pin-geometry Elements

The pins and mini-calandria all have the same nominal dimensions, as follows (in cm):

|  |  |
| --- | --- |
| Fuel pin dimensions | (cm) |
|  |  |
| Length of fuel column of 30 pellets | 29.18 |
| Uncertainty in fuel column length (Range) | ± 0.25 |
| Fuel column diameter | 0.846 |
|  |  |
| Total inside pin length | 29.464 |
| Total pin length (including welded end caps) | 29.690 |
| Average total thickness of the spacer discs used to make up the length | 0.287 |
| Pin outer diameter | 0.937 |
| Pin can thickness | 0.038 |
| Pin pitch | 1.19 |
|  |  |
| Mini-calandria dimensions |  |
| Total mini-calandria length | 29.730 |
| Mini-calandria length excluding support plate | 29.657 |
| Mini-calandria nominal width | 5.06 |
| Mini-calandria side wall thickness | 0.079 |
| End plate thickness | 0.038 |
| Bottom support plate thickness | 0.038 |
| Height added to the mini-calandria by the attachment of the bottom support plate (by means of countersunk indentations) (see NEACRP A445 page 8) | 0.076 |
|  |  |
| Distance of fuel column from the bottom of the calandria (NEACRP A445) | 0.434 |
| Distance of fuel column from the top of the calandria (NEACRP A445) | 0.111 |
|  |  |
| Calandria tube outer diameter | 1.026 |
| Calandria tube thickness | 0.025 |

*Note, the uncertainty on the height of the three calandria which make up the core region of an element is given as ± 0.15 cm (± 0.05 cm per calandria).*

*The pins rest on the support plate of the mini-calandria. The lower extremity of the oxide pellets is given as 0.038 + 0.109 + 0.287 = 0.434 cm from the bottom of the assembled mini-calandria. Similarly, the upper extremity of the oxide pellets is given as 0.111 cm from the top of the assembled mini-calandria (see NEACRP A445 page 8). The calandria length is 29.73 cm and so this implies a length of the fuel column of 29.185 cm. In BTN/19 there is a note saying that the pellet stack lengths range from 289.3 mm to 294.4 mm. However, the value given in the documentation is rounded from the mean value of 291.85 mm to 291.8 mm (see NEACRP A445 Figure 18) and this is the value adopted here. There is a similar small discrepancy between the thickness of the spacer discs and the inside and total pin lengths, but again within 0.01 cm.*

*In MTN/54 the total height of the mini-calandria is given as 29.73 cm (page 18) but in the drawing on page 30 of MTN/54 (dimensions in inches, converted here to cm) the overall length of the mini-calandria is given as 29.698 cm plus 0.078 cm = 29.776 cm (before welding). Note also that the value given in Figure 1.18 is 29.733 cm. However, in the Zebra Database the value is given as 29.73 cm and this is also the value given in the NEACRP benchmark specification, NEACRP A-445, and the figure adopted here. These differences are within the uncertainty of ± 0.05 cm.*

*In some Zebra assemblies the mini-calandria pellets were contained in steel clad capsules, with 6 pellets per capsule and 5 capsules per pin. The total mass of steel in the end caps is combined with the mass of the steel pin cladding and the steel spacers and the capsule steel (when present) and only the total value is quoted.*

#### Components of the Cells used in Additional Elements and Experiments.

**Additional plutonium and uranium plates**

The plutonium plates used in the cells D (PUIX8) and E (PUX8) are compared here with the plate used in the cells of the reference element cells C (PUVIII8) (the 8 denoting that these have 1/8 inch nominal thickness). The elements containing these are replaced in the reference model for the critical cores by "standard elements".

PUJ16 is the half thickness plutonium plate used in the heterogeneity measurements (the 16 denotes 1/16 inch nominal thickness) and the PUIV4 plate is the double thickness mixed oxide plate used in the enrichment experiments and the element replacement measurements (1/4 inch nominal thickness).

Also used in the element replacement experiments is the uranium oxide plate UO24R4 (which has “4 radiused corners”). This has the same core width as the UO23R4 plate used in standard elements but is slightly thinner, 0.6279 cm compared with 0.6313 cm and the core thickness is 0.55424 cm compared with 0.558 cm for the UO23R4 plate.

Table 1.D7 Dimensions of the Alternative Plutonium and Uranium Plates (in cm)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PUVIII8 | PUIX8 | PUX8 | PUII8 | PUJ16 | PUIV4 | UO23R4 | UO24R4 |
|  | Standard |  |  |  |  |  | Standard |  |
| Plate Thickness | 0.3274 ± 0.0005 | 0.3265 ± 0.0005 | 0.3264 ± 0.0005 | 0.3175 ±0.0005 | 0.155 | 0.6278 ± 0.0005 | 0.6313 | 0.6279 ± 0.0005 |
| Plate width | 5.067 | 5.067 | 5.067 | 5.067 | 5.067 | 5.067 | 5.067 | 5.067 |
| Can thickness | 0.0457 | 0.0457 | 0.0457 | 0.0508 | 0.02 | 0.03734 | 0.03665 | 0.03683 |
| Core thickness | 0.2360 | 0.2351 | 0.2350 | 0.2159 | 0.115 | 0.55312 | 0.558 | 0.55424 |
| Core width | 4.671 | 4.671 | 4.671 | 4.671 | 4.76 | 4.953 | 4.851 | 4.851 |

(The plate width quoted in the database for the PUJ16 plate is 5.07 cm, and for the PUIV4 plate is 5.062 cm, but since the edge region is not precisely defined the value 5.067 cm has been adopted here, this being the nominal value for all the plates.)

**Alternative stainless steel plate.**

The mixed oxide element C22±04A, used in the element replacement measurements, contains the “dull” stainless steel plate STSTDL8 with thickness 0.3236 cm.

#### Components used in the Zebra Control Rods and their Dimensions.

The materials used in the control rods were chosen to match the core and blanket regions of the neighbouring elements but with a boron absorber section above a narrow upper blanket region. The blanket regions consist of natural uranium plates. The 9 control rods occupy the places of single elements. The same rods were used in all four cores, and included sodium.

The control rods were loaded so that when raised the centre line of the core section coincided with the centre line of the core section of the standard core elements. When lowered, the centre line of the boron absorber section took that position.

The control rods comprise a square tube moving within an outer square tube. The inner tube is loaded with plates. All plates are assumed to be 4.318 cm square (an area of 18.6451 cm2). The outer control rod tube has a nominal outer dimension of 5.2544 cm square, the same as the standard elements.

Table 1.D8 Control Rod Plate Identifiers and Dimensions

(All plates are nominally 4.318 cm square)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Identifier | Type of Plate | Thickness (cm) | Core thickness | Core width |
| PUXIVC8 | Pu metal Mk.XIV | 0.3207 | 0.2191 | 3.922 |
| U02C4R4 | U02 (4 radiused corners) | 0.6279 | 0.55424 | 4.100 |
| NASTMC4 | Sodium | 0.616 | 0.54234 | 4.244 |
| STSTCF8 | Stainless steel | 0.3180 |  |  |
| UC8 | Natural uranium | 0.3167 |  |  |
| ALCG8 | 45% aluminium | 0.3167 |  |  |
| B10C2 | B10 | 1.27 | 1.19634 | 4.244 |

**Control rod sheath**

|  |  |
| --- | --- |
| Identifier | Type of sheath |
| CRSHEATH | Single element rod |

**Control Rod Cells**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Core region** |  | **Boron absorber region cell patterns** | | |
| Cell CC22-04A |  | Cell CB22-02A | Cell CB22-03A | Cell CB22-04A |
| NASTMC4 |  | ALCG8 | 3 x ALCG8 | 10 x ALCG8 |
| U02C4R4 |  | B10C2 | B10C2 | B10C2 |
| PUXIVC8 |  | 2 x ALCG8 | 5 x ALCG8 | 19 x ALCG8 |
| U02C4R4 |  | B10C2 | B10C2 | B10C2 |
| STSTCF8 |  | 2 x ALCG8 | 5 x ALCG8 | 10 x ALCG8 |
| NASTMC4 |  | B10C2 | B10C2 |  |
| U02C4R4 |  | ALCG8 | 3 x ALCG8 |  |
| PUXIVC8 |  | B10C2 |  |  |
| U02C4R4 |  | 2 x ALCG8 |  |  |
| NASTMC4 |  | B10C2 |  |  |
|  |  | 2 x ALCG8 |  |  |
|  |  | B10C2 |  |  |
|  |  | ALCG8 |  |  |
|  |  |  |  |  |
| Height |  | Height | Height | Height |
| 5.319 cm |  | 11.104 cm | 8.877 cm | 14.891 cm |

**Control Elements**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Region | Element Type  C22-02B  Rods 1, 2, 3, 4, 5, 6 | Element Type  C22-02C  Rods 7, 8 | Element Type  C22-02D  Rod 9 | Height (cm) |
| Top blanket | 23 x UC8 | 23 x UC8 | 22 x UC8 | See note (a) |
| Absorber | 8 x CB22-02A | 10 x CB22-03A | 6 x CB22-04A | See note (b) |
| Middle blanket | 95 x UC8 | 95 x UC8 | 94 x UC8 | See note (c) |
| Core | 17xCC22-04A | 17xCC22-04A | 17xCC22-04A | 90.42 |
| Lower blanket | 178 x UC8 | 178 x UC8 | 178 x UC8 | 56.37 |

Notes:

(a) 23 UC8 plates have a height of 7.28 cm and 22 a height of 6.97 cm.

(b) Absorber section lengths are:

C22-02B 88.83 cm

C22-02C 88.77 cm

C22-02D 89.35 cm

(c) Upper axial blanket heights:

Control rods 1 to 8 95 UC8 plates - height 30.09 cm

Control rod 9 94 UC8 plates - height 29.77 cm

Note: The heights of the UC8 regions differ from those given in ZTN22-1 and ZTN22-11, the thickness of the plates used here being the PLATEDATA value of 0.3167 cm (and not the value 0.3176 given in ZTN22-1). The height of the core section also differs by 0.03 cm per cell. There are also small differences in the heights of the absorber sections which have here been kept consistent with the PLATEDATA plate thicknesses.

### 1.1.2B The Measured k-effective Values for the Assemblies, 22, 23, 24 and 25.

The standard procedure for determining the critical condition of an assembly was to withdraw all of the control rods excepting for the regulating rod, the fine control rod, FR9, adding core elements at the core radial boundary when necessary to achieve criticality. The subcritical reactor was balanced at a series of power levels and the position of the regulating rod plotted versus inverse power level (as monitored on the in-core array of fission chambers and the ex-core safety circuit flux monitors). Extrapolating to infinite power level gave the rod insertion at critical. The excess reactivity of the core for the regulating rod in the withdrawn position was then calculated from the rod insertion and the calibration of the rod in absolute reactivity units (see Section 1.4.6).

The experimental k-effective values in Table 1.4 are those given in ZTN22/2 and ZTN22/10. The uncertainties in reactor balances, which are ± 1 x 10-6 dk, are negligible compared with the other uncertainties.

The uncertainties in control rod movements were taken to be ± 1% arising from uncertainties in the rod profile and ±1% arising from the absolute calibration by inverse kinetics (these figures, being the ones used in the ZTN22 documentation, are larger than the random uncertainty quoted in BTN-75, and described in Section 1.4.6). In addition there is the systematic uncertainty in the calibration of the control rod movements in terms of reactivity, (which is taken into account in the Tables when all reactivity effects have been combined, because it is systematic). This is dominated by the uncertainties in the delayed neutron data used to interpret the inverse kinetics measurements of rod reactivity worth.

Corrections are made for the decay of Pu241 to Am241 to give values for June 1981, (the reference date for the plutonium compositions given in Section 1.1.3). The measured reductions in reactivity were 2.71 ± 0.12 x 10-6 dk per day for the plate geometry cores and 2.60 ± 0.05 x 10-6 dk per day for the pin geometry cores (ZTN22/10) (to which the additional ± 5% systematic uncertainty in the reactivity scale must be added).

Corrections were also made for differences in the core temperature distribution from the reference temperature of 300K. The procedure, which is based on the temperature measurements made at points in the core and measurements of the changes in reactivity with changes in temperature, is described in Section 1.1.4. The corrections are of the order of 5x 10-4 and have a ± 20% uncertainty.

The additional uncertainties in the experimental k-values given in ZTN22/10 arise from the uncertainties in the core height and the plutonium content of the fuel. For the plate cores these are ± 0.0002 and ± 0.0005 respectively; and for the pin cores ± 0.0006 and ± 0.0010 respectively.

The uncertainties in compositions are based on the measurements made at UKAEA Winfrith. and Harwell. (Data for the pin components are given in BTN-19, -132 and -134, and are summarised in Section 1.1.3.) The problem was how to translate these measurements into estimates of the systematic uncertainties applying to the whole core reactivity. In the ZEBRA documentation a conservative view has been taken and the uncertainties in fissile material content are treated as systematic to the whole core. This is clearly an overestimate because several different sources are used for the fissile materials. Also many different components contain steel (the different types of plate and the element sheaths) and so the various sources of uncertainty in the steel content will tend to average out. The assessments made by the ZEBRA Team were that the conservative estimate of the fissile material content (Pu239 content) uncertainty was the dominant source of uncertainty, the effects of the other uncertainties, uranium, steel, sodium content, being negligible in comparison. This point is considered further in Section 2.1.

Measurements were made of the heights of the core sections of the plate geometry elements using special sheaths in which the plate loadings could be viewed along the length of an element. The estimated uncertainties in the heights of the plate geometry cores are based on these measurements.

For the plate geometry Assemblies 22 and 24 the uncertainties in keff values are based on an uncertainty of ± 0.5 mm in core height (with ± l.0 mm in core height corresponding to ± 0.0004 dk) and ± 0.1% in the plutonium content of the fuel, corresponding to± 0.0005 dk. (The plates tend to flatten slightly with time, reducing the core height by about 0.6mm (ZTN22-10).) The uncertainties for Assemblies 23 and 25 are based on ± 1.5mm in core height, corresponding to ± 0.0006 dk, and ± 0.2% in the plutonium content of the fuel, corresponding to ± 0.0010 dk. These were considered by the measurement team to be the predominant sources of uncertainty in the quoted measured k-values. Uncertainties are discussed in more detail in Section 2.1.

There is no discussion in the ZTN22 documentation about possible uncertainties in the core radial dimensions. An additional uncertainty of ± 0.0005 dk has been added here to allow for the gaps between the components being irregular and not continuous. This estimate is based on the calculated differences between different representations of the void gaps (described in Section 3.1).

Other potential sources of uncertainty are discussed in Section 2.1.

Some uncertainties are systematic to the Cores 22 and 24, and to Cores 23 and 25 (the plutonium content and radial dimensions, for example) and so when differences between the cores are considered the uncertainties can be reduced.

It is considered by the Evaluator that the only satisfactory way to use benchmark data of this sort is to analyse several similar systems, built on different facilities, and examine the consistency of the C/E values obtained. The fact that the Cadenza series used materials in different forms, plate and pin, provides the basis for some intercomparison, but some sources of uncertainty will be common to the two types of assembly.

There is the further ± 5% which is systematic to all measured reactivities and is due to the uncertainties in the delayed neutron data, relative fission rates and delayed neutron importance weighting used in the calibration of the control rods. This is not included with the random errors given in the Table but is added at the end (because it is systematic to all the reactivity corrections).

The corrections made to derive the benchmark models are summarised later, in Section 3. The corrections for replacing control rods and special elements by standard double elements to produce the reference models are based on measurements and are described in this section.

In addition to the direct measurements of the k values of the cores the changes in reactivity on going from one core to another were also measured and are described in Section 1.4.7. The uncertainties quoted for these differences are smaller than for the differences between the k values given in Table 1.4.

The differences between the keff values of versions A and B of both assemblies 22 and 23 were found to be negligibly small, being (–1 ± 4) x 10-5 dk for assembly 22 and (–4 ± 4) x 10-5 dk for assembly 23 (ZTN22/2). These uncertainties are indicative of the core reproducibility uncertainties.

(In ZTN22/13 the measured keff value for Assembly 24 has been increased by 0.0004 to allow for the actual core height being ~l mm greater than that in the flooded core (ZTN22/10) which has been used in the calculational models for both plate assemblies in that document. The actual height of Assembly 24 is used in the present description.)

Table 1.4 The Experimental keff Values Corrected to the Reference Temperature of 300K and the Reference Date, June 1981, with Control Rods Withdrawn.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Assembly | 22A | 23A | 24 | 25 |
| Type | Na-F1ooded Plate | Na-F1ooded Pin | Na-Voided Plate | Na-Voided Pin |
| Number of fissile elements in the core | 215 | 226 | 231 | 243 |
| *Date of reference loading* | *(SU13, 3.12.80)\** | *(SU176, 10.2.81)* | *(SU16, 16.10.81)* | *(SU3, 7.1.82)* |
|  |  |  |  |  |
| k-value of Reference Loading | 1.00000  ± 0.000001 | 1.00000  ± 0.000001 | 1.00000  ± 0.000001 | 1.00000  ± 0.000001 |
| **Corrections** |  |  |  |  |
| Fully raising control rods | + 0.00140  ± 0.00002 | + 0.00118  ± 0.00003 | + 0.00165  ± 0.00002 | + 0.00089  ± 0.00002 |
| Reducing core temperature to 300K | + 0.00048  ± 0.00010 | + 0.00037  ± 0.00007 | + 0.00026  ± 0.00005 | + 0.00035  ± 0.00007 |
| Extrapolation to June 1981 (Pu241 decay) | - 0.00047  ± 0.00004 | - 0.00031  ± 0.00004 | + 0.00031  ± 0.00004 | + 0.00055  ± 0.00004 |
| Uncertainty in fissile material content | ± 0.00050 | ± 0.00100 | ± 0.00050 | ± 0.00100 |
| Uncertainty in axial dimensions | ± 0.00020 | ± 0.00060 | ± 0.00020 | ± 0.00060 |
| Uncertainty in radial dimensions | ± 0.00050 | ± 0.00050 | ± 0.00050 | ± 0.00050 |
|  |  |  |  |  |
| **k-value at 300K, June 1981, control rods withdrawn** | 1.00141  ± 0.00074 | 1.00124  ± 0.00127 | 1.00222  ± 0.00074 | 1.00179  ± 0.00127 |
| Addition of the ± 5% systematic uncertainty in the reactivity scale | 1.00141  ± 0.00074 | 1.00124  ± 0.00127 | 1.00222  ± 0.00075 | 1.00179  ± 0.00127 |

\* The loading is denoted by the Start-up number, SU13 etc. and the date in the form (day.month.year)

#### Measured Corrections to the k-effective Values to Produce Reference Models.

The objective of the ZEBRA measurements was to enable models to be set up to test methods and nuclear data. The aim was to enable simplified models to be set up by measuring the effects of making the required simplifications. Thus simplified criticality models were set up based on measurement. Measurements were made of the reactivity changes resulting from replacing control rods and special elements (the double elements containing fission chambers, thermocouples, etc) by standard core elements. Corrections were then applied to the measured k values to produce simplified reference models containing cores with the control rods and special elements replaced by standard core elements. The corrections and the revised k values are presented in Table 1.5.

In the case of the plate geometry Core 22 the "standard" elements were the C22+01C elements (or denoted more simply as 1C or C) containing the Mark VIII plutonium plate, PUVIII8. The Mark X plutonium plate, PUX8, was used in instrumented elements and the elements A, B and Z, used in special experiments, contained the plates PuIV4, PuVII8 and PuII8 respectively. Corrections to the k value for replacing these elements by the C elements were made based on the measured differences in reactivity between these elements and the C elements and these are shown in Table 1.5. Material data are included in Section 1.1.3 for these alternative Pu plates so that the unmodified cores can also be calculated. Similar corrections were made for the reactivity effects of replacing the special elements in the other cores.

The plate geometry element C22+01D, which used the Mark IX plutonium plate, was also replaced in the reference model of Core 22, and the corresponding reference model of Core 24.

Measurements were made of the reactivity change resulting from replacing nine 1C elements by 1D elements at the centre of Core 22 (9 elements centred on position (X,Y) = (50,45)), the change being a reduction in reactivity of (4.8 ± 4.7)x 10-5 dk/k (ZTN22-2). The 68 elements of type 1D are in the outer regions of the core and so the reactivity addition resulting from their replacement by 1C elements is less than 36 x 10-5 dk/k. Since they are in the outer region of the core the probable weighting is about 0.5, resulting in an estimated increase of (+18 ±18) x 10-5. The same increase is applied to the Core 24 k value.

##### Effect of the Multi-chamber Elements on k-effective

In Assembly 22 there are 20 elements containing fission chambers, 19 with 5 chambers and one at the core centre with 9 chambers, making 104 chambers in all. This compares with the total number of core cells of 215 x 24 = 5160. The number of sodium plates removed in the ME element is 8 per element and in the single NE element 14 plates and so in the whole core the number is 166 out of a total of 3 x 5160 = 15480 sodium plates; that is, about 1% are removed. The effect of the loss of this amount of sodium is a small reduction in reactivity equal to about 1% of the measured change resulting from voiding sodium from the core (which is measured to be a reduction of 1.33 % dk/k, ZTN22-10, page 13); that is the removal of the sodium to make way for the chambers results in a reduction in reactivity of about 1.4 x 10-4 dk/k. In addition there is the effect of the change in steel content. The amount of steel removed in the case of an ME element is equivalent to 8 sodium cans per element and 2 steel plates (40% steel) per element (total weight 8 x 17 g + 2 x 24.7 g = 185.4 g) and for the NE element is equivalent to 14 sodium cans plus 4 steel plates (14x17 g + 4 x 24.7 g = 336.8 g). The steel of the chambers more than compensates for this removal, being an addition per chamber of 108 g or a net addition of 355 g in the 5 chamber elements and 635 g in the case of the 9 chamber element. For 20 elements the net weight of steel added is 7.38 kg. An approximate estimate of the worth per kg of steel, averaged over the core is -0.66 10-4 dk/k per kg. The reactivity effect of adding this quantity of steel is therefore a reduction in reactivity of 4.9 x 10-4 dk/k. As is seen from Table 1.5 the measured effect of replacing these by C22+01C elements is smaller, (2.8 ± 0.4) x10-4 dk/k. However, there is also the change in the steel content of the partition between the two columns of plates in the double element and the effect of the electric cables and their covering as well as the difference between the plutonium plates used in these elements and in the reference elements.

In the versions of Assemblies 23 and 25 on which the keff measurements were made there were no multi-chamber elements.

Table 1.5 Corrections to the Experimental k-effective Values for Replacing Non-standard Elements to Produce Reference Cores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Assembly | 22A | 23A | 24 | 25 |
| Type | Plate (Na) | Pin (Na) | Plate(Na-Void) | Pin (Na-Void) |
| Number of fissile elements | 215 | 226 | 231 | 243 |
| **k-value corrected to 300K and the reference date, with control rods withdrawn** | 1.00141  ± 0.00074 | 1.00124  ± 0.00127 | 1.00222  ± 0.00074 | 1.00179  ± 0.00127 |
| Standard elements (identifiers in parenthesis) replacing the 9 control rods | (9 x C22+01C)  + 0.00040  ± 0.00002 | (9 x C22+03D)  + 0.00032  ± 0.00002 | (9 x C24+20C)  - 0.00012  ± 0.00002 | (9 x C25+03C3)  - 0.00050  ± 0.00002 |
| Replacing 4 pulse counter elements by B22-01A elements | + 0.00003  ± 0.00000 | + 0.00003  ± 0.00000 | + 0.00004  ± 0.00000 | + 0.00006  ± 0.00000 |
| Replacing resistance bulb and thermocouple double elements by standard double elements (numbers and identifiers in parenthesis) | (14 x C22+01C)  - 0.00007  ± 0.00001 | (14 x C22+03A,C)  + 0.00003  ± 0.00001 | (14 x C24+20C)  - 0.00015  ± 0.00001 | (16 x C25+03A1, B7,C3)  + 0.00002  ± 0.00001 |
| Replacing 20 multichamber double elements  by standard double elements (identifiers in parenthesis) | (20 x C22+01C)  + 0.00028  ± 0.00004 | - | (20 x C24+20C)  + 0.00021  ± 0.00004 | - |
| Replacing aspirated elements by standard elements (numbers and element identifiers in parenthesis) | (20 x C22+01C)  - 0.00006  ± 0.00003 | - | (30 x C24+20C)  - 0.00009  ± 0.00006 | (18 x C25+03C)  - 0.00005  ± 0.00003 |
| Removing sealing strip from aspirated elements and multi-chamber elements (the numbers of elements are in parenthesis) | (20 elements)  - 0.00000  ± 0.00001 | - | (39 elements)  - 0.00001  ± 0.00002 | (18 elements)  - 0.00000  ± 0.00001 |
| Replacing D plate elements with C plate elements | + 0.00018  ± 0.00018 |  | + 0.00018  ± 0.00018 |  |
| Total of the corrections to k made to produce reference models | + 0.00076  ± 0.00019 | + 0.00038  ± 0.00002 | + 0.00006  ± 0.00020 | - 0.00047  ± 0.00004 |
| 5% Systematic uncertainty associated with reactivities | ± 0.00008 | ± 0.00005 | ± 0.00008 | ± 0.00004 |
| **k-values of Reference Models** | **1.00217**  **± 0.00077** | **1.00162**  **± 0.00127** | **1.00228**  **± 0.00077** | **1.00132**  **± 0.00127** |

#### Reactivity Differences Between Different CADENZA Assemblies.

An essential component of the benchmark studies is the intercomparison of differences between calculation and experiment for the criticality of the four systems, that is, the consistency between the calculations made for plate geometry and pin geometry cores and between the calculations made for cores containing sodium and voided of sodium. The uncertainties affecting the differences are lower than those for the keff values themselves because some components affect the values in a systematic way. When comparing pin and plate geometry cores this is the case for the superlattice grid correction and the radial dimensions uncertainty. When comparing the sodium filled and voided cores the plutonium content uncertainty affects the results in a systematic way and so can be omitted. However, an estimate of the uncertainty due to the differences in the steel and sodium content is then required. (The relative uncertainty in the axial dimensions of the pin geometry cores might also be reduced.) The uncertainties affecting the differences between plate and pin geometry cores are summarised in Table 1.6 and those affecting the sodium filled and voided cores in Table 1.7.

The transition from one core to another was made in stages, with the changes being balanced using the control rods. The rod worths were recalibrated at points during the transitions. In this way the reactivity change in going from one assembly to another was measured. These reactivity differences are given in Section 1.4. The quoted uncertainties arise from the uncertainty of ± 0.1% of the worth of the elements moved, the uncertainty in the reactivity scale and due to the uncertainties in the composition and axial dimensions of core components.

Measurements were also made of the reactivity changes resulting when zones of plate geometry elements were introduced in the central regions of the pin geometry cores 23 and 25. These measurements are described in Section 1.4.7. Additional critical cores are then defined based on these.

Table 1.6 Uncertainties affecting the Comparison of keff Values for Pin versus Plate Geometry Cores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Assembly | 22A | 23A | 24 | 25 |
| Type | Na-F1ooded Plate | Na-F1ooded Pin | Na-Voided Plate | Na-Voided Pin |
|  |  |  |  |  |
| k of Reference Loading | ± 0.000001 | ± 0.000001 | ± 0.000001 | ± 0.000001 |
| Fully raising control rods | ± 0.00002 | ± 0.00003 | ± 0.00002 | ± 0.00002 |
| Temperature correction | ± 0.00010 | ± 0.00007 | ± 0.00005 | ± 0.00007 |
| Pu241 decay | ± 0.00004 | ± 0.00004 | ± 0.00004 | ± 0.00004 |
| Uncertainty in fissile content | ± 0.00050 | ± 0.00100 | ± 0.00050 | ± 0.00100 |
| Uncertainty in axial dimensions | ± 0.00020 | ± 0.00060 | ± 0.00020 | ± 0.00060 |
|  |  |  |  |  |
| Replacing the 9 control rods | ± 0.00002 | ± 0.00002 | ± 0.00002 | ± 0.00002 |
| Replacing 4 pulse counter | ± 0.00000 | ± 0.00000 | ± 0.00000 | ± 0.00000 |
| Replacing thermocouple elements | ± 0.00001 | ± 0.00001 | ± 0.00001 | ± 0.00001 |
| Replacing multichamber elements | ± 0.00004 | - | ± 0.00004 | - |
| Replacing aspirated elements | ± 0.00003 | - | ± 0.00006 | ± 0.00003 |
| Removing sealing strip | ± 0.00001 | - | ± 0.00002 | ± 0.00001 |
| Replacing D plate elements | ± 0.00018 |  | ± 0.00018 |  |
|  |  |  |  |  |
| 5% Systematic uncertainty | ± 0.00008 | ± 0.00005 | ± 0.00008 | ± 0.00004 |
|  |  |  |  |  |
| Total systematic uncertainty | ± 0.00059 | ± 0.00117 | ± 0.00058 | ± 0.00117 |
|  |  |  |  |  |
| **Total relative uncertainty** | ± 0.00131 | | ± 0.00130 | |

Table 1.7 Uncertainties affecting the Comparison of keff Values for Sodium Filled versus Sodium Voided Cores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Assembly | 22A | 24 | 23A | 25 |
| Type | Na-F1ooded Plate | Na-Voided Plate | Na-F1ooded Pin | Na-Voided Pin |
|  |  |  |  |  |
| k of Reference Loading | ± 0.000001 | ± 0.000001 | ± 0.000001 | ± 0.000001 |
| Fully raising control rods | ± 0.00002 | ± 0.00002 | ± 0.00003 | ± 0.00002 |
| Temperature correction | ± 0.00010 | ± 0.00005 | ± 0.00007 | ± 0.00007 |
| Pu241 decay | ± 0.00004 | ± 0.00004 | ± 0.00004 | ± 0.00004 |
| Uncertainty in steel content | ± 0.00005 | ± 0.00005 | ± 0.00010 | ± 0.00010 |
| Uncertainty in sodium content | ± 0.00007 | ± 0.00000 | ± 0.00007 | ± 0.00007 |
| Uncertainty in axial dimensions | ± 0.00020 | ± 0.00020 | ± 0.00060 | ± 0.00060 |
| Replacing the 9 control rods | ± 0.00002 | ± 0.00002 | ± 0.00002 | ± 0.00002 |
| Replacing 4 pulse counter | ± 0.00000 | ± 0.00000 | ± 0.00000 | ± 0.00000 |
| Replacing thermocouple elements | ± 0.00001 | ± 0.00001 | ± 0.00001 | ± 0.00001 |
| Replacing multichamber elements | ± 0.00004 | ± 0.00004 | - | - |
| Replacing aspirated elements | ± 0.00003 | ± 0.00006 | - | ± 0.00003 |
| Removing sealing strip | ± 0.00001 | ± 0.00002 | - | ± 0.00001 |
| Replacing D plate elements | ± 0.00000 | ± 0.00000 |  |  |
|  |  |  |  |  |
| 5% Systematic uncertainty | ± 0.00008 | ± 0.00008 | ± 0.00005 | ± 0.00004 |
|  |  |  |  |  |
| Total systematic uncertainty | ± 0.00026 | ± 0.00024 | ± 0.00062 | ± 0.00062 |
|  |  |  |  |  |
| **Total relative uncertainty** | ± 0.00036 | | ± 0.00088 | |

### 1.1.3 Description of Material Data

The composition information for all the components of the assemblies is presented in this section. The dimensions and weights of the constituents of ZEBRA components are held in the ZEBRA PLATEDATA Database and this is the source of the data presented here.

*(The number of significant figures has been reduced when it was considered that the extra numbers in the Database were a consequence of computer manipulation.)*

Concerning the percentage weights, these are provided in the Zebra Database for canning materials but not for core materials, in which case they have been calculated here.

Details of the original and repeated measurements of the compositions of the fuel pins, cans and mini-calandria are given in BTN-19, BTN-132 and BTN-134 (for the UO2 pins). These also give information on uncertainties in the compositions.

The detailed compositions for both plate and pin geometry components are also given in the NEACRP benchmark specification documents (issued in the 1980s) although these are limited to the data for the models specified as benchmarks.

The available documentation does not include information on the uncertainties in the compositions of the plate geometry components, however, although the overall uncertainties in the fissile material content and the height of the stacks of fuel plates are given in the ZTN22 documentation describing the assessment of uncertainties in keff values.

The Pu241 and Am241 content of components in the ZEBRA database is a decay-corrected value from the time of chemical analysis up to the reference date of the database. Except when it is stated, in the following tables these components have been adjusted (decay time corrected) to refer to the reference date for the CADENZA assemblies, June 1981.

#### Compositions of the Components in Assemblies 22 and 24.

When given in the ZEBRA PLATEDATA Database the uncertainty in the thickness of a plate is ±0.0005 cm.

Table 1.M1 The Plutonium Metal Plate, PUVIII8.

Figures 1.9, 1.10 and 1.11 illustrate the core region and the two layers of canning, copper and steel, of the plutonium plates.

**Core region**:

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage of weight |
|  |  |  |
| H | 0.0011 | 0.0014 |
| C | 0.0434 | 0.0560 |
| N | 0.0029 | 0.0037 |
| O | 0.0121 | 0.0156 |
| AL | 0.0053 | 0.0068 |
| SI | 0.0034 | 0.0044 |
| CR | 0.0016 | 0.0021 |
| MN | 0.0007 | 0.0009 |
| FE | 0.0078 | 0.0101 |
| NI | 0.0043 | 0.0055 |
| GA | 1.2022 | 1.5513 |
| U238 | 0.0014 | 0.0018 |
| PU238 | 0.0620 | 0.0800 |
| PU239 | 59.1110 | 76.2773 |
| PU240 | 14.1820 | 18.3006 |
| PU241 | 1.5244 | 1.9671 |
| PU242 | 0.3870 | 0.4994 |
| AM241 | 0.9423 | 1.2160 |
|  |  |  |
| Total | 77.4949 | 100.0000 |

**Can region**:

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage of weight |
|  |  |  |
| H | 0.000075 | 0.0004 |
| C | 0.0074 | 0.0357 |
| SI | 0.0556 | 0.2682 |
| P | 0.0023 | 0.0111 |
| CR | 2.6435 | 12.7526 |
| MN | 0.2553 | 1.2316 |
| FE | 10.7342 | 51.7831 |
| NI | 1.3218 | 6.3765 |
| CU | 5.7090 | 27.5409 |
|  |  |  |
| Total | 20.7292 | 100.0000 |

Table 1.M2 The Natural Uranium Oxide Plate, UO23R4.

The core region is illustrated in Figure 1.12 and the plate in Figure 1.13.

Core region

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage of weight |
|  |  |  |
| H | 0.0007 | 0.0005 |
| C | 0.0031 | 0.0023 |
| O | 16.0900 | 11.8488 |
| AL | 0.0020 | 0.0015 |
| SI | 0.0141 | 0.0104 |
| MN | 0.0001 | 0.0001 |
| FE | 0.0016 | 0.0012 |
| NI | 0.0016 | 0.0012 |
| MO | 0.0007 | 0.0005 |
|  |  |  |
| U235 | 0.8500 | 0.6259 |
| U238 | 118.8300 | 87.5076 |
|  |  |  |
| Total | 135.7939 | 100.0000 |

Can region

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage of weight |
|  |  |  |
| H | 0.0001 | 0.0005 |
| C | 0.0078 | 0.0386 |
| SI | 0.0916 | 0.4539 |
| P | 0.0549 | 0.2723 |
| S | 0.0058 | 0.0290 |
| CR | 3.6330 | 18.0110 |
| MN | 0.2377 | 1.1782 |
| FE | 13.6399 | 67.6212 |
| NI | 2.5003 | 12.3953 |
|  |  |  |
| Total | 20.1710 | 100.0000 |

Table 1.M3 The Sodium Plate, NASTDL4.

**Thickness of the sodium plate.**

Figure 1.14 illustrates the plate.

*The thickness of the sodium plate has been reduced from its nominal value of 0.616 cm to 0.613694 cm to give a total core height of 89.32 cm for the 24 plate cells, equal to that actually measured. The sodium plate was chosen for adjustment because these components have a tendency to compress. The plate width has also been changed to be consistent with that of the other plates, the core dimensions remaining unaltered.*

Core region

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage  of weight |
|  |  |  |
| H | 0.0003 | 0.0026 |
| O | 0.0020 | 0.0169 |
| NA | 11.8150 | 99.9517 |
| CA | 0.0032 | 0.0271 |
| FE | 0.0002 | 0.0017 |
|  |  |  |
| Total | 11.8207 | 100.0000 |

Can region

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage  of weight |
|  |  |  |
| H | 0.0001 | 0.0005 |
| C | 0.0142 | 0.0802 |
| SI | 0.0690 | 0.3899 |
| P | 0.0041 | 0.0232 |
| S | 0.0043 | 0.0243 |
| CR | 3.0975 | 17.5016 |
| MN | 0.3009 | 1.7002 |
| FE | 12.4100 | 70.1194 |
| NI | 1.6815 | 9.5009 |
| NB | 0.1168 | 0.6599 |
|  |  |  |
| Total | 17.6984 | 100.0000 |

Table 1.M4 Sodium Dummy Plates.

The plates STNAVR4 and STNAVS4 are rings and STNAV4 is “honeycomb” shaped.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Nuclide | Weight (g) | Percentage  of weight |  | Weight (g) | Percentage  of weight |
|  |  |  |  |  |  |
| PLATENAME | STNAVR4 |  |  | STNAVS4 |  |
|  |  |  |  |  |  |
| H | 0.0001 | 0.0005 |  | 0.000088 | 0.0005 |
| C | 0.0120 | 0.0678 |  | 0.011 | 0.0621 |
| SI | 0.0770 | 0.4348 |  | 0.076 | 0.4291 |
| P | 0.0051 | 0.0288 |  | 0.002 | 0.0113 |
| S | 0.0014 | 0.0079 |  | 0.002 | 0.0113 |
| CR | 3.1294 | 17.6703 |  | 3.064 | 17.3009 |
| MN | 0.2329 | 1.3151 |  | 0.299 | 1.6883 |
| FE | 12.0002 | 67.7595 |  | 12.129 | 68.4864 |
| NI | 2.1146 | 11.9402 |  | 2.001 | 11.2986 |
| NB | 0.1373 | 0.7753 |  | 0.126 | 0.7115 |
|  |  |  |  |  |  |
| TOTAL | 17.7100 | 100.0000 |  | 17.71009 | 100.0000 |

The honeycomb plate, STNAV4, is treated as uniform.

|  |  |  |
| --- | --- | --- |
| ISOTOPE | Weight (g) | Percentage  of weight |
| PLATENAME: | STNAV4 |  |
|  |  |  |
| H | 0.0001 | 0.0005 |
| C | 0.0106 | 0.0600 |
| SI | 0.0898 | 0.5100 |
| P | 0.0041 | 0.0230 |
| S | 0.0021 | 0.0120 |
| CR | 3.3651 | 19.1199 |
| MN | 0.2816 | 1.6000 |
| FE | 11.8386 | 67.2647 |
| NI | 1.8797 | 10.6799 |
| NB | 0.1285 | 0.7300 |
|  |  |  |
| TOTAL | 17.6001 | 100.0000 |

Table 1.M5 The 40% Stainless Steel Plate, STSTF8.

The plate is illustrated in Figure 1.15.

|  |  |  |
| --- | --- | --- |
| ISOTOPE | Weight (g) | Percent weight |
|  |  |  |
| H | 0.0001 | 0.0004 |
| C | 0.0057 | 0.0231 |
| AL | 0.0173 | 0.0700 |
| SI | 0.1210 | 0.4899 |
| P | 0.0067 | 0.0271 |
| S | 0.0025 | 0.0101 |
| TI | 0.0642 | 0.2599 |
| CR | 4.4710 | 18.1012 |
| MN | 0.4446 | 1.8000 |
| FE | 16.7141 | 67.6684 |
| NI | 2.7910 | 11.2996 |
| CU | 0.0173 | 0.0700 |
| NB | 0.0025 | 0.0101 |
| MO | 0.0420 | 0.1700 |
|  |  |  |
| Total | 24.7000 | 100.0000 |

#### The Uranium Blanket and Steel Reflector Regions.

Immediately above and below both the pin and plate geometry core cells there is a region of natural uranium metal pieces, about 30 cm in length. Next to the core there are 31 U8 plates followed by 10 U2 plates and 1 U3 block. Above and below the uranium regions there is a single mild steel block, MST3.

The cores are surrounded by radial blanket elements, each containing 20 U3 blocks, 152.45 cm in height. The centre of this region is closely aligned with the centre of the core region so that the upper and lower extremities of the uranium region are close to those of the axial blanket regions.

The radial blanket elements are surrounded by steel bars, MST9F10, 5.08 cm square and 3 m long, extending axially beyond the region of interest in the core and radial blanket. These bars are not contained in sheaths. (The data for these are given in the Table as weight per 1 cm length).

Table 1.M6 Blanket Region Natural Uranium Components

**Natural Uranium Plate, U8.**

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percent weight |
|  |  |  |
| H | 0.0006 | 0.0004 |
| C | 0.0800 | 0.0536 |
| SI | 0.0800 | 0.0536 |
| FE | 0.0800 | 0.0536 |
|  |  |  |
| U235 | 1.0600 | 0.7097 |
| U238 | 148.0600 | 99.1292 |
|  |  |  |
| Total | 149.3606 | 100.0000 |

**Natural Uranium Plate,** **U2**.

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percent weight |
|  |  |  |
| H | 0.0024 | 0.0004 |
| C | 0.3000 | 0.0492 |
| SI | 0.3000 | 0.0492 |
| FE | 0.3000 | 0.0492 |
|  |  |  |
| U235 | 4.3300 | 0.7106 |
| U238 | 604.1099 | 99.1413 |
|  |  |  |
| Total | 609.3423 | 100.0000 |

**Natural Uranium Block,** **U3.**

|  |  |  |
| --- | --- | --- |
| ISOTOPE | Weight (g) | Percent weight |
|  |  |  |
| H | 0.0146 | 0.0004 |
| C | 1.8400 | 0.0500 |
| SI | 1.8400 | 0.0500 |
| FE | 1.8400 | 0.0500 |
|  |  |  |
| U235 | 26.1300 | 0.7101 |
| U238 | 3648.0000 | 99.1395 |
|  |  |  |
| Total | 3679.6646 | 100.0000 |

Table 1.M7 Axial Reflector Mild Steel Block.

**Mild Steel Block, MST3.**

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage of weight |
|  |  |  |
| H | 0.0084 | 0.0005 |
| C | 1.9890 | 0.1300 |
| AL | 1.2240 | 0.0800 |
| TI | 0.6120 | 0.0400 |
| CR | 0.4590 | 0.0300 |
| MN | 5.8140 | 0.3800 |
| FE | 1517.7600 | 99.1995 |
| NI | 0.9180 | 0.0600 |
| CU | 0.9180 | 0.0600 |
| MO | 0.3060 | 0.0200 |
|  |  |  |
| Total | 1530.0084 | 100.0000 |

Table 1.M8 The Radial Steel Reflector Region.

The width of the square section steel bar is 5.08 cm.

**Steel bar MST9F10.** (Weight per 1 cm length) Total length ~3 m

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage of weight |
|  |  |  |
| H | 0.0020 | 0.0010 |
| C | 0.3550 | 0.1798 |
| SI | 0.3750 | 0.1900 |
| P | 0.0570 | 0.0289 |
| S | 0.0510 | 0.0258 |
| MN | 1.6780 | 0.8500 |
| FE | 194.8830 | 98.7244 |
|  |  |  |
| Total | 197.4010 | 100.0000 |

Table 1.M.9 Mild Steel Sheath and Superlattice Grid Plates.

(The quoted weights are per 1 cm length and corresponding to a single column of plates).

**The double element mild steel sheath, DSHEATH A.**

Note: The weight figures for the double sheath, DSHEATH A, are per single element.

**DSHEATHA**

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Weight percent |
|  |  |  |
| H | 0.0002 | 0.0018 |
| C | 0.0075 | 0.0658 |
| AL | 0.0014 | 0.0123 |
| CR | 0.0005 | 0.0044 |
| MN | 0.0370 | 0.3246 |
| FE | 11.3470 | 99.5395 |
| NI | 0.0022 | 0.0193 |
| CU | 0.0037 | 0.0325 |
|  |  |  |
| Total | 11.3995 | 100.0000 |

**The single element mild steel sheath is MSHTH**

**MSHTH**

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percent weight |
|  |  |  |
| H | 0.0007 | 0.0061 |
| C | 0.0098 | 0.0854 |
| SI | 0.0034 | 0.0296 |
| P | 0.0010 | 0.0087 |
| S | 0.0039 | 0.0340 |
| MN | 0.0396 | 0.3452 |
| FE | 11.4140 | 99.4910 |
|  |  |  |
| Total | 11.4724 | 100.0000 |

The single element mild steel sheath weighs 0.6% more (per element) than the double element sheath.

**The Mild Steel Superlattice Grid Plates.**

These are assumed to have the same composition as the mild steel sheath, MSHTH

Table 1.M10 Mild Steel Cylindrical Spacer Material, MSTST3 and MSTST12 used above and below the Steel Reflector or Shield Region.

Weight per 1 cm length: 33.23 g

Table 1.M11 Multiscan Fission Chambers

The compositions are described in RPD/DWS/100.

The chamber materials consist of:

Stainless steel 106.8 g

Alumina rod (Al2O3) 3.69 g

There is a lead glass seal, 0.14 g,

a PTFE insulated screen cable in a copper tube along the chamber edge, 0.9 g

and a brass cable support, 0.66 g

The weight of the 99.0% Pu239 deposits is about 150 micro-g

#### Details of the Components used in the Pin Geometry Assemblies, 23 and 25.

The weights of the fuel pin materials are given in BTN/132 and the details of the calandria in BTN/19. The dimensions of a fuel pin are illustrated in Figure 1.20. The pins rest on the support plate of the mini-calandria. The lower extremity of the oxide pellets is 0.038 + 0.109 + 0.287 = 0.434 cm from the bottom of the assembled mini-calandria. Similarly, the upper extremity of the oxide pellets is 0.111 cm from the top of the assembled mini-calandria.

The average weight of each endcap is 0.18 g and of each spacer disc is 1.30 g, the total weight of steel in a fuel pin can being about 26 g. The calandria top plate plus filler boss weighs 6.0 g, and the bottom support plate plus 4 screws weighs 7.9 g. Thus the upper plus lower plate regions weigh 23.3 g.

Table 1.M12 Compositions of the Fuel Pins.

Weight in g **(**with the Pu241 and Am241 data adjusted to June 1981, the reference date for the cores)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Nuclide | PUPINA | PUPINB | PUPINC | PUPIND | PUPINE | PUPINF |
| U234 | 0.0088 | 0.0084 | 0.0082 | 0.0090 | 0.0072 | 0.0073 |
| U235 | 0.9036 | 0.8615 | 0.8321 | 0.9133 | 0.7340 | 0.7379 |
| U236 | 0.0051 | 0.0048 | 0.0047 | 0.0051 | 0.0041 | 0.0041 |
| U238 | 125.6506 | 119.7712 | 115.6943 | 126.9800 | 102.0531 | 102.6017 |
| Pu238 | 0.0245 | 0.0382 | 0.0448 | 0.0307 | 0.0615 | 0.0616 |
| Pu239 | 19.3308 | 24.3131 | 29.1105 | 19.6565 | 39.3525 | 39.1400 |
| Pu240 | 4.3973 | 6.2246 | 6.9319 | 4.9327 | 9.8753 | 9.9942 |
| Pu241 | 0.4619 | 0.7353 | 0.7615 | 0.5807 | 1.1626 | 1.2950 |
| Pu242 | 0.1153 | 0.1845 | 0.1981 | 0.1382 | 0.2766 | 0.2926 |
| Am241 | 0.3142 | 0.3663 | 0.3794 | 0.2675 | 0.5355 | 0.4467 |
| O | 20.3101 | 20.4786 | 20.6709 | 20.6188 | 20.6120 | 20.6918 |
|  |  |  |  |  |  |  |
| H | 0.0009 | 0.0009 | 0.0009 | 0.0009 | 0.0009 | 0.0009 |
| Al | 0.0086 | - | 0.0145 | 0.0139 | 0.0070 | 0.0105 |
| Si | - | 0.0069 | 0.0061 | 0.0192 | 0.0350 | - |
| Ca | 0.0086 | - | - | 0.0174 | 0.0350 | 0.0737 |
| Cr |  |  |  |  |  | 0.0070 |
| Fe | 0.0086 | - | 0.0117 | 0.0105 | 0.0157 | 0.0175 |
| Ni | - | 0.0087 | 0.0175 | 0.0226 | - | 0.0035 |
| Total | 171.549 | 173.003 | 174.687 | 174.217 | 174.768 | 175.386 |
| s.d. | ± 1.4 | ± 1.3 | ± 0.8 | ± 0.7 | ± 1.1 | ± 1.2 |

PUPIN denotes a mixed plutonium-uranium oxide fuel pin. There are 6 different types of fuel pin, denoted PUPINA to PUPINF, having the same dimensions but different compositions.

Mean uranium isotopic composition:

U234 (0.007)%, U235 (0.714 ± 0.002)%, U236 (0.004)%, U238 (99.275 ± 0.003)%

The U236 is produced by Pu240 decay and so the U236 content depends on the Pu240 content of the fuel and the decay time.

The standard deviations are for the weight of the pellet stack in a single pin. For an element (which contains 3 calandria each containing 16 pins) the standard deviations of the total weight are correspondingly reduced. Uncertainties are discussed in BTN/132. On the basis of differences between analyses carried out at Winfrith and Harwell it is assumed (probably pessimistically) that the systematic uncertainty in the plutonium content is ± 0.2%. It is considered that the other uncertainties in the compositions are negligible compared with this in the assessment of the uncertainty in keff. In addition to the systematic uncertainty, when small batches of pins are involved there is a batch to batch variation which must be taken into account. For a single element the random uncertainty is given as ± 0.2%, with an additional ± 0.1% random uncertainty when data for the weights of the individual pins are not used in the analysis.

Table 1.M12 continued. Percentage Compositions by Weight of the Fuel

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Nuclide | PUPINA | PUPINB | PUPINC | PUPIND | PUPINE | PUPINF |
| U234 | 0.0051 | 0.0049 | 0.0047 | 0.0052 | 0.0041 | 0.0042 |
| U235 | 0.5267 | 0.4980 | 0.4763 | 0.5242 | 0.4200 | 0.4207 |
| U236 | 0.0030 | 0.0028 | 0.0027 | 0.0029 | 0.0023 | 0.0023 |
| U238 | 73.2448 | 69.2307 | 66.2294 | 72.8861 | 58.3935 | 58.5005 |
| PU238 | 0.0143 | 0.0221 | 0.0256 | 0.0176 | 0.0352 | 0.0351 |
| PU239 | 11.2684 | 14.0536 | 16.6644 | 11.2828 | 22.5170 | 22.3165 |
| PU240 | 2.5633 | 3.5980 | 3.9682 | 2.8314 | 5.6505 | 5.6984 |
| PU241 | 0.2693 | 0.4250 | 0.4359 | 0.3333 | 0.6652 | 0.7384 |
| PU242 | 0.0672 | 0.1066 | 0.1134 | 0.0793 | 0.1583 | 0.1668 |
| AM241 | 0.1832 | 0.2117 | 0.2172 | 0.1535 | 0.3064 | 0.2547 |
| O | 11.8392 | 11.8371 | 11.8331 | 11.8351 | 11.7939 | 11.7979 |
|  |  |  |  |  |  |  |
| H | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 0.0005 |
| Al | 0.0050 |  | 0.0083 | 0.0080 | 0.0040 | 0.0060 |
| Si |  | 0.0040 | 0.0035 | 0.0110 | 0.0200 |  |
| Ca | 0.0050 |  |  | 0.0100 | 0.0200 | 0.0420 |
| Cr |  |  |  |  |  | 0.0040 |
| Fe | 0.0050 |  | 0.0067 | 0.0060 | 0.0090 | 0.0100 |
| Ni |  | 0.0050 | 0.0100 | 0.0130 |  | 0.0020 |
|  |  |  |  |  |  |  |
| Total | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 |

Table 1.M13 Details of the UO2 Pins

Note: The uranium used in U02PIND and U02PINE was obtained from two sources. The U235 content of one batch has been measured as 0.00722, 0.00717, 0.00724 and 0.00721 giving an average of 0.00721. The larger batch has U235 content determinations of 0.00705, 0.00695 and 0.00691, averaging 0.00697. The two batches were randomly mixed in making the pellets and an overall average U235 content of 0.0071 has been taken for these pins.

**Compositions of the UO2 Pellets in the UO2 Pins (weight in g)** (Data from BTN-134)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Nuclide | UO2PINC | Percent by weight | U02PIND | Percent by weight | U02PINE | Percent by weight |
|  |  |  |  |  |  |  |
| U234 | 0.0062 | 0.0035 | 0.0061 | 0.0035 | 0.0061 | 0.0035 |
| U235 | 1.0936 | 0.6256 | 1.0929 | 0.6258 | 1.0945 | 0.6258 |
| U238 | 152.926 | 87.4828 | 152.825 | 87.5069 | 153.050 | 87.5069 |
|  |  |  |  |  |  |  |
| 0 | 20.706 | 11.8451 | 20.6923 | 11.8483 | 20.7227 | 11.8483 |
|  |  |  |  |  |  |  |
| FE | 0.0017 | 0.0010 | 0.0035 | 0.0020 | 0.0035 | 0.0020 |
| AL | 0.0175 | 0.0100 | 0.007 | 0.0040 | 0.007 | 0.0040 |
| SI | 0.0306 | 0.0175 | 0.0105 | 0.0060 | 0.0105 | 0.0060 |
| CA | 0.0140 | 0.0080 | 0.0052 | 0.0030 | 0.0052 | 0.0030 |
| C | 0.0105 | 0.0060 |  |  |  |  |
| H | 0.0009 | 0.0005 | 0.0009 | 0.0005 | 0.0009 | 0.0005 |
|  | 174.807 |  | 174.643 |  | 174.9 |  |
| Total | 174.807 | 100 | 174.643 | 100 | 174.9 | 100 |
| s.d. | ±0.673 |  | ±0.858 |  | ±0.657 |  |

Hydrogen is assumed present at 5 ppm.

The mean isotopic composition of the uranium is U234 (0.004 ±0.001)%, U235 (0.711 ±0.001)%, U238 (99.285 ±0.001)%.

Table 1.M14 Compositions of the Fuel Pin Cans and End Regions

(weights in g) .

Notes: 1 These weights (in g) are obtained from the average total steel weight in a pin, average weights for an end cap and a spacer disc, the estimated average number of spacers in a pin and the bonded compositions of the various steels.

1. Hydrogen has been assumed present at 5 ppm, based on a survey for steel components. This figure has been used for all steels.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Nuclide | PUPINA | PUPINB | PUPINC | PUPIND | PUPINE | PUPINF |
|  |  |  |  |  |  |  |
| H | 0.00014 | 0.00012 | 0.00014 | 0.00013 | 0.00013 | 0.00013 |
| C | 0.0083 | 0.0148 | 0.0085 | 0.0126 | 0.0046 | 0.0045 |
| Al |  |  |  | 0.0009 | 0.0009 | 0.0006 |
| Si | 0.135 | 0.179 | 0.132 | 0.141 | 0.163 | 0.164 |
| P | 0.0061 | 0.0067 | 0.0058 | 0.0055 | 0.0022 | 0.0022 |
| S | 0.0041 | 0.0038 | 0.0041 | 0.0015 | 0.0029 | 0.0030 |
| Ti |  |  |  | 0.0072 | 0.0072 | 0.0054 |
| Cr | 5.296 | 4.421 | 5.198 | 4.672 | 4.724 | 4.773 |
| Mn | 0.477 | 0.480 | 0.468 | 0.361 | 0.310 | 0.311 |
| Fe | 18.731 | 16.842 | 18.393 | 17.592 | 17.894 | 18.057 |
| Co |  | 0.0009 |  | 0.0013 | 0.0013 | 0.0010 |
| Ni | 2.911 | 2.880 | 2.861 | 2.520 | 2.647 | 2.676 |
| Cu |  |  |  | 0.0020 | 0.0020 | 0.0015 |
| Nb |  | 0.142 |  |  |  |  |
| Mo |  |  |  | 0.0011 | 0.0107 | 0.0106 |
|  |  |  |  |  |  |  |
| Total | 27.57 | 24.97 | 27.07 | 25.32 | 25.77 | 26.01 |

Table 1.M15 Compositions of the Cans of the UO2 Pins (g)

|  |  |  |  |
| --- | --- | --- | --- |
| Nuclide | U02PINC | U02PIND | U02PINE |
|  |  |  |  |
| H | 0.00014 | 0.00013 | 0.00013 |
| C | 0.0083 | 0.0128 | 0.0046 |
| AL |  | 0.0008 | 0.0008 |
| SI | 0.135 | 0.144 | 0.164 |
| P | 0.0061 | 0.0056 | 0.0022 |
| S | 0.0041 | 0.0015 | 0.0030 |
| TI |  | 0.0066 | 0.0066 |
| CR | 5.306 | 4.773 | 4.749 |
| MN | 0.478 | 0.369 | 0.311 |
| FE | 18.765 | 17.966 | 17.983 |
| CO |  | 0.0012 | 0.0012 |
| NI | 2.917 | 2.575 | 2.662 |
| MO |  | 0.0010 | 0.0107 |
| AU |  | 0.0018 | 0.0018 |
|  |  |  |  |
| Total | 27.62 | 25.86 | 25.90 |

Table 1.M16 Details of the Mini-calandria - Weights of Steel and Sodium.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mini-calandria identifier | Average Steel wt (g) | ± std deviation (g) | Average Sodium wt (g) | ± std deviation (g) |
| NACLI | 653.9 | 5 | 289.8 | 1.8 |
| NACLIIS | 645.8 | 5 | 292.8 | 1.7 |
| NACLIII | 659.4 | 1.4 | 286.9 | 1.3 |
| NACLIV | 635.5 | 3.3 | 288.7 | 1.7 |
| NACLIVH | 650.1 | 1.8 | 285.4 | 0.6 |
| NACLV | 650.2 | 1.5 | 286.2 | 2.2 |
| VCLI | 661.0 | 1.8 | - |  |
| VCLIIS | 645.8 \* |  | - |  |
| VCLIII | 659.3 | 1.3 | - |  |
| VCLIV | 636.3 | 3.3 | - |  |
| VCLIVH | 647.8 | 2 | - |  |
| VCLV | 651.0 | 2 | - |  |
| VCLVI | 644.0 | 4.2 | - |  |
| VCLVII | 647.0 \* |  |  |  |

\* Zebra PLATEDATA Database value

Note:- Identifiers beginning with NA indicate sodium filled calandria - those beginning with V indicate a voided calandria.

There are 168 mini-calandria elements, the total number of mini-calandria required being 504.

The majority of sodium filled mini-calandria (210) are of type NACLIII. The corresponding voided mini-calandria, type VCLIII, have the same weight and can be taken to differ only in the sodium content. The differences between mini-calandria NACLIV and VCLIV, and between NACLV and VCLV, (0.8 g), are within the uncertainties of the weights and can be neglected. In fact, the PLATEDATA Database gives the same weights for the voided calandria as for the corresponding sodium filled calandria (and are as given above for the sodium filled calandria).

In the models defined in Section 3 the difference between the mini-calandria elements in Assembly 23 and Assembly 25 has been assumed to be the absence of the sodium region material in Assembly 25, although there is not a full correspondence between the sodium filled and the voided calandria used in the cores. The difference between the steel contents of the pin zones of the two assemblies is small (~0.1% overall).

**Element weights of steel in 16 mini-calandria tubes (g)**

Notes: 1. These weights have been obtained from average weights for 16 tubes and the bonded compositions of the steels. For NACLIIS the weights of the steel components of the calandria, other than the calandria tubes for NACLII have been taken to apply, and the weights of the NACLIIS tubes adjusted slightly to give the correct total steel weight.

2. Hydrogen has been assumed present at 5 ppm.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Nuclide | NACLI | NACLIIS | NACLIII | NACLIV | NACLV | VCLVI | VCLVII |
|  |  |  |  |  |  |  |  |
| H | 0.0015 | 0.0014 | 0.0016 | 0.0015 | 0.0015 | 0.0016 | 0.0015 |
| C | 0.088 | 0.416 | 0.0504 | 0.153 | 0.153 | 0.0504 | 0.089 |
| Si | 1.440 | 1.936 | 1.986 | 1.687 | 1.687 | 1.986 | 1.358 |
| P | 0.061 | 0.027 | 0.0252 | 0.0675 | 0.0675 | 0.0252 | 0.068 |
| S | 0.043 | 0.054 | 0.0347 | 0.0153 | 0.0153 | 0.0347 | 0.032 |
| Ti |  | 0.960 |  |  |  |  |  |
| Cr | 56.368 | 52.992 | 58.02 | 56.83 | 56.83 | 58.02 | 55.67 |
| Mn | 5.104 | 4.224 | 3.721 | 4.355 | 4.355 | 3.721 | 5.196 |
| Fe | 198.80 | 183.79 | 218.71 | 212.89 | 212.89 | 218.71 | 201.39 |
| Co |  | 0.054 |  |  |  |  | 0.472 |
| Ni | 31.056 | 31.456 | 32.63 | 30.70 | 30.70 | 32.63 | 30.94 |
| Cu |  | 0.054 |  |  |  |  |  |
| Mo |  | 0.027 | 0.126 |  |  | 0.126 |  |
|  |  |  |  |  |  |  |  |
| Total | 292.9615 | 275.9914 | 315.3049 | 306.6993 | 306.6993 | 315.3049 | 295.2165 |

For the voided calandria, VCLI, VCLII, VCLIII, VCLIV and VCLV the data for the corresponding sodium filled calandria have been used.

**Element weights of mini-calandria excluding the tubes (g)**

Notes: 1 These weights have been obtained from the average weights of the various components (with small adjustments to preserve the total weight of a calandria) and the bonded compositions of the steels.

2 Hydrogen has been assumed present at 5 ppm.

3 The element weights in the filled calandria should also be used in calculations for the equivalent voided calandria.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Nuclide | NACLI | NACLIIS | NACLIII | NACLIV | NACLV | VCLVI | VCLVII |
|  |  |  |  |  |  |  |  |
| H | 0.0018 | 0.0018 | 0.0017 | 0.0016 | 0.0017 | 0.0016 | 0.0018 |
| C | 0.190 | 0.229 | 0.107 | 0.194 | 0.107 | 0.194 | 0.176 |
| SI | 1.95 | 2.317 | 1.802 | 2.210 | 1.799 | 2.209 | 1.357 |
| P | 0.126 | 0.094 | 0.108 | 0.091 | 0.107 | 0.091 | 0.090 |
| S | 0.054 | 0.033 | 0.030 | 0.028 | 0.030 | 0.028 | 0.043 |
| TI |  |  |  |  |  |  |  |
| CR | 66.40 | 67.147 | 61.06 | 59.82 | 60.96 | 59.80 | 61.79 |
| MN | 5.41 | 5.769 | 5.030 | 5.171 | 5.021 | 5.170 | 3.902 |
| FE | 253.66 | 260.438 | 242.25 | 231.49 | 241.83 | 231.42 | 251.92 |
| CO |  |  |  |  |  |  |  |
| NI | 33.18 | 33.786 | 33.64 | 29.73 | 33.58 | 29.72 | 32.450 |
| CU |  |  |  |  |  |  |  |
| MO |  |  | 0.070 | 0.070 | 0.070 | 0.070 | 0.070 |
|  |  |  |  |  |  |  |  |
| Total | 360.9718 | 369.8148 | 344.0987 | 328.8056 | 343.5057 | 328.7036 | 351.80 |

**Total steel content of the minicalandria (g)**.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Nuclide | NACLI | NACLIIS | NACLIII | NACLIV | NACLV | VCLVI | VCLVII |
|  |  |  |  |  |  |  |  |
| H | 0.0033 | 0.0032 | 0.0033 | 0.0031 | 0.0032 | 0.0032 | 0.0033 |
| C | 0.278 | 0.645 | 0.1574 | 0.347 | 0.26 | 0.2444 | 0.265 |
| SI | 3.39 | 4.253 | 3.788 | 3.897 | 3.486 | 4.195 | 2.715 |
| P | 0.187 | 0.121 | 0.1332 | 0.1585 | 0.1745 | 0.1162 | 0.158 |
| S | 0.097 | 0.087 | 0.0647 | 0.0433 | 0.0453 | 0.0627 | 0.075 |
| TI | 0 | 0.96 | 0 | 0 | 0 | 0 |  |
| CR | 122.768 | 120.139 | 119.08 | 116.65 | 117.79 | 117.82 | 117.46 |
| MN | 10.514 | 9.993 | 8.751 | 9.526 | 9.376 | 8.891 | 9.098 |
| FE | 452.46 | 444.228 | 460.96 | 444.38 | 454.72 | 450.13 | 453.31 |
| CO | 0 | 0.054 | 0 | 0 | 0 | 0 | 0.472 |
| NI | 64.236 | 65.242 | 66.27 | 60.43 | 64.28 | 62.35 | 63.39 |
| CU | 0 | 0.054 | 0 | 0 | 0 | 0 |  |
| MO | 0 | 0.027 | 0.196 | 0.07 | 0.07 | 0.196 |  |
|  |  |  |  |  |  |  |  |
| Total | 653.9333 | 645.8062 | 659.4036 | 635.5049 | 650.205 | 644.0085 | 646.946 |

Table 1.M17 Element Contents of the Sodium Regions of the Mini-calandria (g)

The impurity contents were all from measurements except the hydrogen and oxygen contents of NACLIII, NACLIV and NACLV which were assumed to be the same as the average contents of NACLI and NACLIIS.

**Contents by weight (g)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Nuclide | NACLI | NACLIIS | NACLIII | NACLIV | NACLV |
|  |  |  |  |  |  |
| H | 0.0029 | 0.0059 | 0.004 | 0.004 | 0.004 |
| O | 0.054 | 0.009 | 0.03 | 0.03 | 0.03 |
| Na | 289.8 | 292.8 | 286.9 | 288.7 | 286.2 |
| K |  |  | 0.007 | 0.007 | 0.007 |
| Ca | 0.0232 | 0.002 | 0.014 | 0.014 | 0.014 |
| Fe | 0.009 |  |  |  |  |
|  |  |  |  |  |  |
| Total | 289.8891 | 292.8169 | 286.9550 | 288.7550 | 286.2550 |

**Percentages by weight**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Nuclide | NACLI | NACLIIS | NACLIII | NACLIV | NACLV |
|  |  |  |  |  |  |
| H | 0.0010 | 0.0020 | 0.0014 | 0.0014 | 0.0014 |
| O | 0.0186 | 0.0031 | 0.0105 | 0.0104 | 0.0105 |
| Na | 99.9693 | 99.9942 | 99.9808 | 99.9810 | 99.9808 |
| K |  |  | 0.0024 | 0.0024 | 0.0024 |
| Ca | 0.0080 | 0.0007 | 0.0049 | 0.0048 | 0.0049 |
| Fe | 0.0031 |  |  |  |  |
|  |  |  |  |  |  |
| Total | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 |

#### Components of Additional Elements.

The elements containing these components are replaced in the calculational models for the critical cores by "standard elements". These additional data are included here so that a model including a representation of the special elements can be set up. *Both the dimensions and compositions are given in this section (dimensions in cm).*

Table 1.M18 Weights of the Alternative Plutonium Plates

The plutonium plates used in the cells D (PUIX8) and E (PUX8) are compared here with the plate used in the standard element cells C (PUVIII8). Also given is the composition of the mixed oxide plate PUIV4.

CORE REGION DATA

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PUVIII8 (g) | percent weight | PUIX8 (g) | percent weight | PUX8 (g) | percent weight | PUIV4 (g) | percent weight |
| **CORE** |  |  |  |  |  |  |  |  |
| U234 |  |  |  |  |  |  | 0.0040 | 0.003 |
| U235 |  |  |  |  |  |  | 0.6120 | 0.468 |
| U238 | 0.0014 | 0.0018 | 0.0107 | 0.0138 | 0.0029 | 0.0037 | 85.4890 | 65.419 |
| NP237 |  |  |  |  |  |  | 0.0010 | 0.001 |
| PU238 | 0.0620 | 0.0800 | 0.0720 | 0.0929 | 0.0690 | 0.0889 |  |  |
| PU239 | 59.1110 | 76.2773 | 59.0300 | 76.1827 | 59.2570 | 76.3249 | 25.7100 | 19.674 |
| PU240 | 14.1820 | 18.3006 | 14.2030 | 18.3300 | 14.1300 | 18.1999 | 2.8860 | 2.208 |
| PU241 | 2.4750 | 3.1938 | 2.4990 | 3.2251 | 2.4870 | 3.2033 | 0.2920 | 0.223 |
| PU242 | 0.3870 | 0.4994 | 0.3720 | 0.4801 | 0.3820 | 0.4920 | 0.0260 | 0.020 |
| AM241 | -0.0083 | -0.0107 | -0.0343 | -0.0443 | -0.0861 | -0.1109 | 0.1237 | 0.095 |
|  |  |  |  |  |  |  |  |  |
| H | 0.0011 | 0.0014 | 0.0013 | 0.0017 | 0.0009 | 0.0012 |  |  |
| C | 0.0434 | 0.0560 | 0.0288 | 0.0372 | 0.0302 | 0.0389 | 0.0168 | 0.013 |
| N | 0.0029 | 0.0037 | 0.0011 | 0.0014 | 0.0012 | 0.0015 |  |  |
| O | 0.0121 | 0.0156 | 0.0078 | 0.0101 | 0.0062 | 0.0080 | 15.4510 | 11.824 |
| AL | 0.0053 | 0.0068 | 0.0053 | 0.0068 | 0.0050 | 0.0064 | 0.0168 | 0.013 |
| SI | 0.0034 | 0.0044 | 0.0068 | 0.0088 | 0.0038 | 0.0049 | 0.0168 | 0.013 |
| CR | 0.0016 | 0.0021 | 0.0027 | 0.0035 | 0.0019 | 0.0024 |  |  |
| MN | 0.0007 | 0.0009 | 0.0008 | 0.0010 | 0.0005 | 0.0006 |  |  |
| FE | 0.0078 | 0.0101 | 0.0062 | 0.0080 | 0.0071 | 0.0091 | 0.0168 | 0.013 |
| NI | 0.0043 | 0.0055 | 0.0134 | 0.0173 | 0.0081 | 0.0104 | 0.0168 | 0.013 |
| GA | 1.2022 | 1.5513 | 1.2582 | 1.6238 | 1.3311 | 1.7145 |  |  |
|  |  |  |  |  |  |  |  |  |
| Total | 77.4949 |  | 77.4848 |  | 77.6378 |  | 130.6787 |  |
|  |  |  |  |  |  |  |  |  |
| Core width (cm) | 4.671 |  | 4.671 |  | 4.671 |  | 4.953 |  |
| Core thickness | 0.2360 |  | 0.2351 |  | 0.2350 |  | 0.55312 |  |

The data for Pu241 and Am241 relate to the reference date for the ZEBRA databank, *January 1971,* a date which is earlier than the date of manufacture of some of the plates. Hence the negative Am241 content (and a larger Pu241 content than at manufacture) which arises from extrapolation back to a date before the Pu241 in the plate started to decay.

*To obtain values for June 1981, the reference date for the CADENZA programme, reduce the Pu241 content by multiplying by the Factor = 0.605 and add the difference, 0.395 times the original Pu241 content, to the Am241.*

CAN REGION

The can region weights are separated into the steel can and the copper plating region. (The PUIV4 plate does not contain a copper can.

The percentages are based on the combined weight of steel plus copper.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Steel Can** | PUVIII8 (g) | weight percent | PUIX8 (g) | weight percent | PUX8 (g) | weight percent | PUIV4 (g) | weight percent |
| H | 0.000075 | 0.0004 | 0.000075 | 0.0004 | 0.000074 | 0.0004 | 0.00008 | 0.0005 |
| C | 0.007360 | 0.0355 | 0.007342 | 0.0355 | 0.007821 | 0.0378 | 0.00858 | 0.05 |
| SI | 0.055574 | 0.2681 | 0.055437 | 0.2679 | 0.078954 | 0.3816 | 0.07036 | 0.41 |
| P | 0.002253 | 0.0109 | 0.002247 | 0.0109 | 0.004469 | 0.0216 | 0.00342 | 0.02 |
| S |  |  |  |  | 0.002681 | 0.0130 | 0.00343 | 0.02 |
| TI |  |  |  |  | 0.001490 | 0.0072 |  |  |
| CR | 2.643516 | 12.7528 | 2.636999 | 12.7441 | 2.800630 | 13.5368 | 3.07163 | 17.90 |
| MN | 0.255340 | 1.2318 | 0.254711 | 1.2310 | 0.253249 | 1.2241 | 0.25568 | 1.49 |
| FE | 10.73419 | 51.7831 | 10.70775 | 51.7479 | 10.21330 | 49.3655 | 11.92100 | 69.47 |
| NI | 1.321758 | 6.3764 | 1.318502 | 6.3720 | 1.534389 | 7.4165 | 1.71428 | 9.99 |
| NB |  |  |  |  |  |  | 0.11154 | 0.65 |
| Steel Can Wt. | 15.020 |  | 14.983 |  | 14.897 |  | 17.16000 |  |
| **CU region** |  |  |  |  |  |  |  |  |
| CU | 5.709 | 27.5411 | 5.709 | 27.5904 | 5.792 | 27.9956 |  |  |
|  |  |  |  |  |  |  |  |  |
| **Total can region. wt** | 20.729 |  | 20.692 |  | 20.689 |  | 17.16000 |  |
|  |  |  |  |  |  |  |  |  |
| Plate thickness (cm) | 0.3274 ± 0.0005 |  | 0.3265 ± 0.0005 |  | 0.3264 ± 0.0005 |  | 0.6278 ± 0.0005 |  |

Table 1.M18B. The Alternative Natural Uranium Oxide Plate, UO24R4.

This is the uranium oxide plate with “4 radiused corners” used in the core cells of the mixed oxide element, C22±04A. The core section of the element contains 11 cells CC22-06A. This plate includes silver-copper braze material.

Core region

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage of weight |
|  |  |  |
| H | 0.0005 | 0.0004 |
| C | 0.008 | 0.0060 |
| O | 15.847 | 11.8513 |
| SI | 0.008 | 0.0060 |
| FE | 0.008 | 0.0060 |
|  |  |  |
| U234 | 0.006 | 0.0045 |
| U235 | 0.838 | 0.6267 |
| U238 | 117.000 | 87.4991 |
|  |  |  |
| Total | 133.7155 | 100.0000 |
|  |  |  |
| Core width (cm) | 4.851 |  |
| Core thickness | 0.55424 |  |

Can region

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage of weight |
|  |  |  |
| H | 0.000089 | 0.0005 |
| C | 0.008931 | 0.05 |
| SI | 0.087529 | 0.49 |
| P | 0.003573 | 0.02 |
| S | 0.003573 | 0.02 |
| CR | 3.286777 | 18.40 |
| MN | 0.275089 | 1.54 |
| FE | 12.393330 | 69.38 |
| NI | 1.804159 | 10.10 |
|  |  |  |
| CU | 0.265086 | 1.484 |
| AG | 0.682008 | 3.818 |
|  |  |  |
| TOTAL | 18.810100 | 105.3025 |
|  |  |  |
| Plate thickness (cm) | 0.6279 |  |

Table 1.M18C. The Stainless Steel Plate STSTDL8 (dull steel).

This is used in the core cells of the mixed oxide element, C22±04A.

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percent weight |
|  |  |  |
| H | 0.0003 | 0.0005 |
| C | 0.1286 | 0.2000 |
| AL | 0.0643 | 0.1000 |
| SI | 0.5143 | 0.8000 |
| TI | 0.1929 | 0.3000 |
| CR | 11.6380 | 18.1000 |
| MN | 0.7071 | 1.1000 |
| FE | 44.6100 | 69.3995 |
| NI | 6.2350 | 9.7000 |
| CU | 0.0643 | 0.1000 |
| MO | 0.1285 | 0.2000 |
|  |  |  |
| Total | 64.2833 | 100.0000 |
|  |  |  |
| Plate thickness (cm) | 0.3236 |  |

Zebra Control Rods

The benchmark models, specified for the calculation of the core keff values and the central spectral indices, have been corrected for the replacement of the Zebra control rods by core elements. However, for the calculation of the axial reaction rate scans and axial variation of reactivity worths (such as sodium reactivity worths) account should be taken of a possible asymmetry introduced by the asymmetrical loadings of the control rods, with an absorber section being at the top ends of the rods. For this reason the control rod compositions are given here.

The materials used in the control rods were chosen to match the core and blanket regions of the neighbouring elements but with a boron absorber section above a narrow upper blanket region. The blanket regions consist of natural uranium plates. The 9 control rods occupy the places of single elements. The plate geometry control rods were the same in all four cores and contained sodium.

#### The Compositions of the Control Rod Components.

Table 1.M19 Control Rod Plutonium Metal Plate, PUXIVC8

**PLATE CORE COMPOSITION** (Pu241/Am241 content refers to the PLATEDATA Database date)

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight, g | Weight % |
| H | 0.001 | 0.002 |
| C | 0.015 | 0.028 |
| N | 0.001 | 0.002 |
| O | 0.006 | 0.011 |
| AL | 0.004 | 0.007 |
| SI | 0.003 | 0.006 |
| TI | 0.001 | 0.002 |
| CR | 0.002 | 0.004 |
| FE | 0.003 | 0.006 |
| NI | 0.005 | 0.009 |
| CU | 0.001 | 0.002 |
| ZN | 0.001 | 0.002 |
| GA | 0.952 | 1.766 |
| U238 | 0.012 | 0.022 |
| NP237 | 0.001 | 0.002 |
| PU238 | 0.057 | 0.106 |
| PU239 | 41.791 | 77.511 |
| PU240 | 9.290 | 17.231 |
| PU241 | 1.746 | 3.238 |
| PU242 | 0.284 | 0.527 |
| AM241 | -0.260 | -0.482 |
|  |  |  |
| Total | 53.916 |  |

**To obtain values for June 1981 revise the values for Pu-241 and Am-241**

**(Pu-241 Reduction Factor = 0.605, transfer 0.395 times Pu241 to Am241)**

**PU PLATE CAN COMPOSITION**

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight, g | Weight % |
| H | 0.00005 | 0.0005 |
| C | 0.0060 | 0.060 |
| SI | 0.0310 | 0.310 |
| P | 0.0035 | 0.035 |
| S | 0.0017 | 0.017 |
| CR | 1.8245 | 18.250 |
| MN | 0.1560 | 1.560 |
| FE | 6.9639 | 69.660 |
| NI | 1.0107 | 10.110 |
|  |  |  |
| Cu | 4.2 |  |
|  |  |  |
| Total | 14.19735 |  |

Table 1.M20 Control Rod Uranium Oxide Plate , UO2C4R4

**PLATE CORE COMPOSITION**

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight, g | Weight % |
|  |  |  |
| H | 0.00037 | 0.0004 |
| C | 0.0056 | 0.0059 |
| SI | 0.0056 | 0.0059 |
| FE | 0.0056 | 0.0059 |
|  |  |  |
| O | 11.1554 | 11.8513 |
| U234 | 0.0042 | 0.0045 |
| U235 | 0.59 | 0.6268 |
| U238 | 82.3612 | 87.4992 |
|  |  |  |
| Total | 94.12797 |  |

**PLATE CAN COMPOSITION**

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight, g | Weight % |
|  |  |  |
| H | 0.000065 | 0.0005 |
| C | 0.0065 | 0.05 |
| SI | 0.064 | 0.49 |
| P | 0.0026 | 0.02 |
| S | 0.0026 | 0.02 |
| CR | 2.390 | 18.4 |
| MN | 0.200 | 1.54 |
| FE | 9.012 | 69.38 |
| NI | 1.312 | 10.1 |
| CU | 0.230 | 1.77 |
| AG | 0.580 | 4.465 |
|  |  |  |
| Total | 13.80 |  |

Table 1.M21 Control Rod Uranium Metal Plate, UC8

**PLATE COMPOSITION**

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight, g | Weight % |
|  |  |  |
| C | 0.058 | 0.054 |
| SI | 0.058 | 0.054 |
| FE | 0.058 | 0.054 |
| U235 | 0.767 | 0.710 |
| U238 | 107.080 | 99.129 |
|  |  |  |
| Total | 108.021 |  |

Table 1.M22 Control Rod Stainless Steel Plate, STSTCF8

("Reduced density" steel plate, i.e. plate with holes.)

**PLATE COMPOSITION**

|  |  |  |
| --- | --- | --- |
| ISOTOPE | Weight (g) | Percent weight |
|  |  |  |
| Volume |  |  |
|  |  |  |
| H | 0.0001 | 0.0004 |
| C | 0.0040 | 0.0231 |
| AL | 0.0122 | 0.0700 |
| SI | 0.0850 | 0.4899 |
| P | 0.0047 | 0.0271 |
| S | 0.0018 | 0.0101 |
| TI | 0.0451 | 0.2599 |
| CR | 3.1422 | 18.1012 |
| MN | 0.3125 | 1.8000 |
| FE | 11.7467 | 67.6684 |
| NI | 1.9615 | 11.2996 |
| CU | 0.0122 | 0.0700 |
| NB | 0.0018 | 0.0101 |
| MO | 0.0295 | 0.1700 |
|  |  |  |
| Total | 17.3592 | 100.0000 |

COMMENT IN DATABASE: Weights calculated by scaling STSTF8 (Table 1.M.5) by 0.7028, the ratio of sizes.

Table 1.M23 Control Rod Sodium Plate, NASTMC4

**PLATE CORE COMPOSITION**

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight, g | Weight % |
|  |  |  |
| H | 0.0002 | 0.002 |
| O | 0.0014 | 0.017 |
| NA | 8.216 | 99.953 |
| CA | 0.0022 | 0.027 |
| FE | 0.0001 | 0.001 |
|  |  |  |
| Total | 8.22 |  |

**CAN COMPOSITION**

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight, g | Weight % |
|  |  |  |
| H | 0.0001 | 0.0005 |
| C | 0.0078 | 0.06 |
| SI | 0.0665 | 0.51 |
| P | 0.0030 | 0.023 |
| S | 0.0016 | 0.012 |
| CR | 2.4913 | 19.12 |
| MN | 0.2085 | 1.6 |
| FE | 8.7646 | 67.265 |
| NI | 1.3916 | 10.68 |
| NB | 0.0951 | 0.73 |
|  |  |  |
| Total | 13.03 |  |

COMMENTS IN DATABASE: NA + STEEL COMPOSITION AS NASTDM4

##### Control rod absorber regions

The absorber regions are made up from aluminium plates, ALCG8 and the boron plates, B10C2.

Table 1.M24 Control Rod Aluminium Plate, ALCG8

**PLATE COMPOSITION**

|  |  |  |
| --- | --- | --- |
| Material | Weight, g | Weight % |
|  |  |  |
| AL | 7.0644 | 99.500 |
| SI | 0.0133 | 0.187 |
| MN | 0.00225 | 0.032 |
| FE | 0.01773 | 0.250 |
| CU | 0.00225 | 0.032 |
|  |  |  |
| Total | 7.1 |  |

Table 1.M25 Control Rod Boron Absorber Plate, B10C2

**PLATE CORE COMPOSITION**

|  |  |  |
| --- | --- | --- |
| Material | Weight, g | Weight % |
|  |  |  |
| H | 0.0082 | 0.04 |
| B10 | 17.90 | 85.13 |
| B11 | 1.57 | 7.47 |
| C | 0.3154 | 1.50 |
| O | 0.4333 | 2.06 |
| AL | 0.0841 | 0.40 |
| SI | 0.1577 | 0.75 |
| K | 0.0841 | 0.40 |
| CR | 0.0841 | 0.40 |
| FE | 0.1472 | 0.70 |
| NI | 0.1577 | 0.75 |
| CU | 0.0841 | 0.40 |
|  |  |  |
| Total | 21.0259 |  |

**PLATE CAN COMPOSITION**

|  |  |  |
| --- | --- | --- |
| Material | Weight, g | Weight % |
|  |  |  |
| NI | 37.05 | 100 |

(Dimensions are described as being nominal and the can material is assumed to be the same as for the plate NASTBRC4.)

Table 1.M26 The Control Rod Sheath.

**IDENTITY CRSHEATH (weight per unit length of the inner plus outer tube)**

Weight per 1 cm of length

|  |  |  |
| --- | --- | --- |
| Material | Weight, g | Weight % |
|  |  |  |
| H | 0.0015 | 0.00 |
| C | 0.05 | 0.13 |
| SI | 0.04 | 0.11 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| MN | 0.22 | 0.59 |
| FE | 36.82 | 99.11 |
|  |  |  |
| Total | 37.1515 |  |

(All plates are nominally 4.318 cm square and the outer control rod sheath has a nominal outer dimension of 5.2544 cm square, the same as the standard elements. The area occupied by the sheath material (between the plate edges and the outer tube boundary) is then 8.9636 cm2).

### 1.1.4 Temperature Information.

Measurements were made in each of the assemblies to relate changes in the control rod setting to changes in the core temperature in order to correct the measured reactivities to values at **300K, the reference temperature.**

The temperatures at points throughout the core were measured and a core average value obtained by weighting with calculated values of the flux squared for the region of the core in which each of the temperature measurements was made. The basis for this is the assumption that the reactivity effects of the temperature rises (thermal expansion and Doppler effects) are proportional to flux times adjoint flux, (approximated here as flux squared).

The procedure is detailed in BTN-119. Weighting factors equivalent to flux-squared values, averaged over each of the nine super-lattice positions covering the core region and for each axial third of the core height, were obtained from an Assembly 22 RZ-diffusion theory calculation. The adequacy of these data was confirmed by comparison of calculated Pu239 fission rates with multi-chamber scans for each assembly. The weighting factors were directly applicable to all the sodium filled assemblies as a result of the similarity of the fission-rate distributions. Despite the variations produced by sodium removal the nature of the temperature correction procedure allowed the same set of weighting factors to be used for all the CADENZA assemblies, without introducing any significant error.

The influence of temperature variations in the radial blanket on reactivity changes was investigated in Core 25. Although the quantity of U238 in the blanket was considerably greater than in the core, the average flux levels were such that the resulting overall weighting factors for the blanket super-lattice positions were lower than any of the core values. There were, however, approximately 16 super-lattice positions to be considered in the blanket region compared with 9 in the core. Estimates of the influence of the radial blanket were based on the measurements in the four resistance bulbs in the double elements positioned at 59/60-45, 51-35/36, 49-54/55 and 40/41-45. The temperature in the blanket region between lattice coordinates Y-38 and Y-58 was always fairly stable at 300K whereas, due to the flow of cooling air through the core, the lattice positions below Y-38 had a mid-plane temperature of about 3l5K, compared with an average core value of about 330K. The contribution from the blanket region in converting the temperature distribution of a reference balance to an overall uniform temperature of 300K is comparable with the quoted uncertainty of 0.000l dk/k. The maximum contribution to the reactivity change resulting from the comparison of two balances is about 0.00002dk/k. In relation to the overall experimental uncertainties in reactivity measurements, the influence of the radial blanket temperature is generally small and was therefore not included in the analysis.

The balances for the temperature calibrations for each assembly are summarised in ZTN22/10 Table 12 together with the final calibration factors. The reactivity change per weighted temperature difference is lower in the case of the voided cores, consistent with a lower Doppler effect due to a harder spectrum in the absence of sodium.

The validity of the procedure depends on the assumption that the reactivity effects are proportional to the measured temperature increase and to flux squared.

The temperature corrections to keff are at most 5x10-4 dk/k and have a ± 20% uncertainty.

### 1.1.5 Additional Information Relevant to Criticality Measurements.

Refer to Section 1.4 for information on the calibration of control rods and the reactivity scale.

## 1.2 Description of Bucklings and Extrapolation Length Measurements

These were not derived for the CADENZA cores.

## 1.3 Description of Spectral Characteristics Measurements

### 1.3.1 Overview of the Experiment

Reaction rate ratio measurements were made in the plate geometry Assembly 22 using both fission chambers and foils. The measurements are described in detail in ZTN22-9. The fission chamber measurements were made for U235, U238, Pu239, Pu240 and Pu241. A special element was placed at the centre of the core (at position (X,Y)=(50,45)) containing the normal cells in the lower half but space above for a fission chamber. The plate stack contained twelve core cells with a sodium plate at the top. The fission chambers (illustrated in Figure 1.21A) were located 1.0 ± 0.5 mm above the sodium plate (see Figure 1.21B). For the measurements with a half element at the core centre 2 extra edge elements were added to the normal 206 element core at (56,51) and (44,39) (plus 9 control rods, with the standard core being modelled as a 215 element core).

The foil measurements were made for fission in U235, U238 and Pu239 and capture in U238. The foil measurements for U235 and U238 were made across the uranium oxide plates and the Pu239 fission was measured using a foil held adjacent to the plutonium plate in a special steel plate which replaced the standard stainless steel plate. The rate in the plutonium plate was then obtained from a cell calculation to relate the fission rate on the surface of the plate to the average value in the plate. Cell averaged reaction rate ratios were thus derived from the foil measurements.

### 1.3.2A Description of the Experimental Configuration

The experiments were conducted at the centre of Assembly 22. The assembly configuration and the experimental geometry of the environment of the measurements is described fully in Section 1.1.

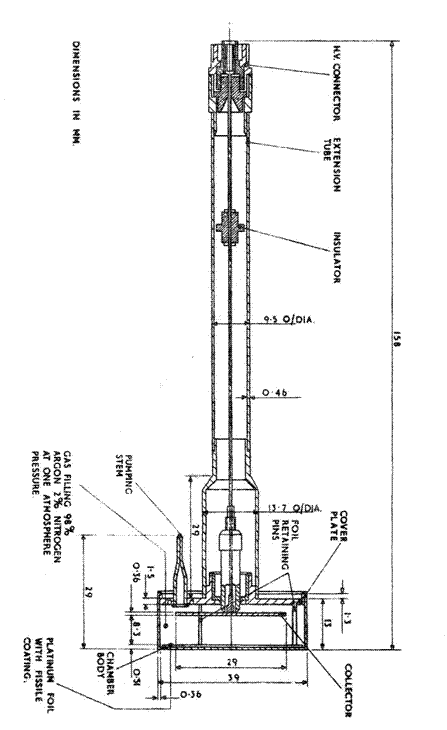
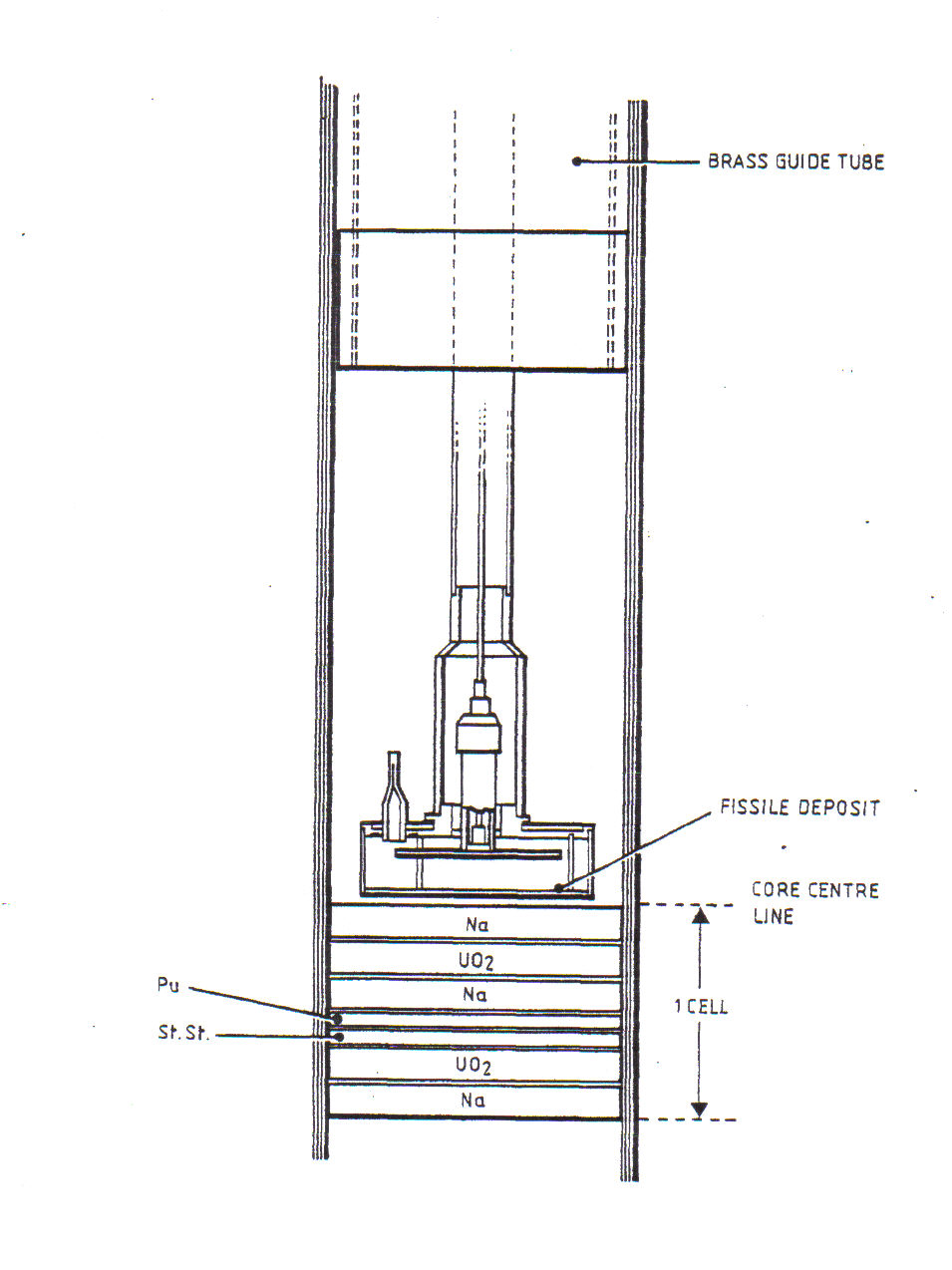
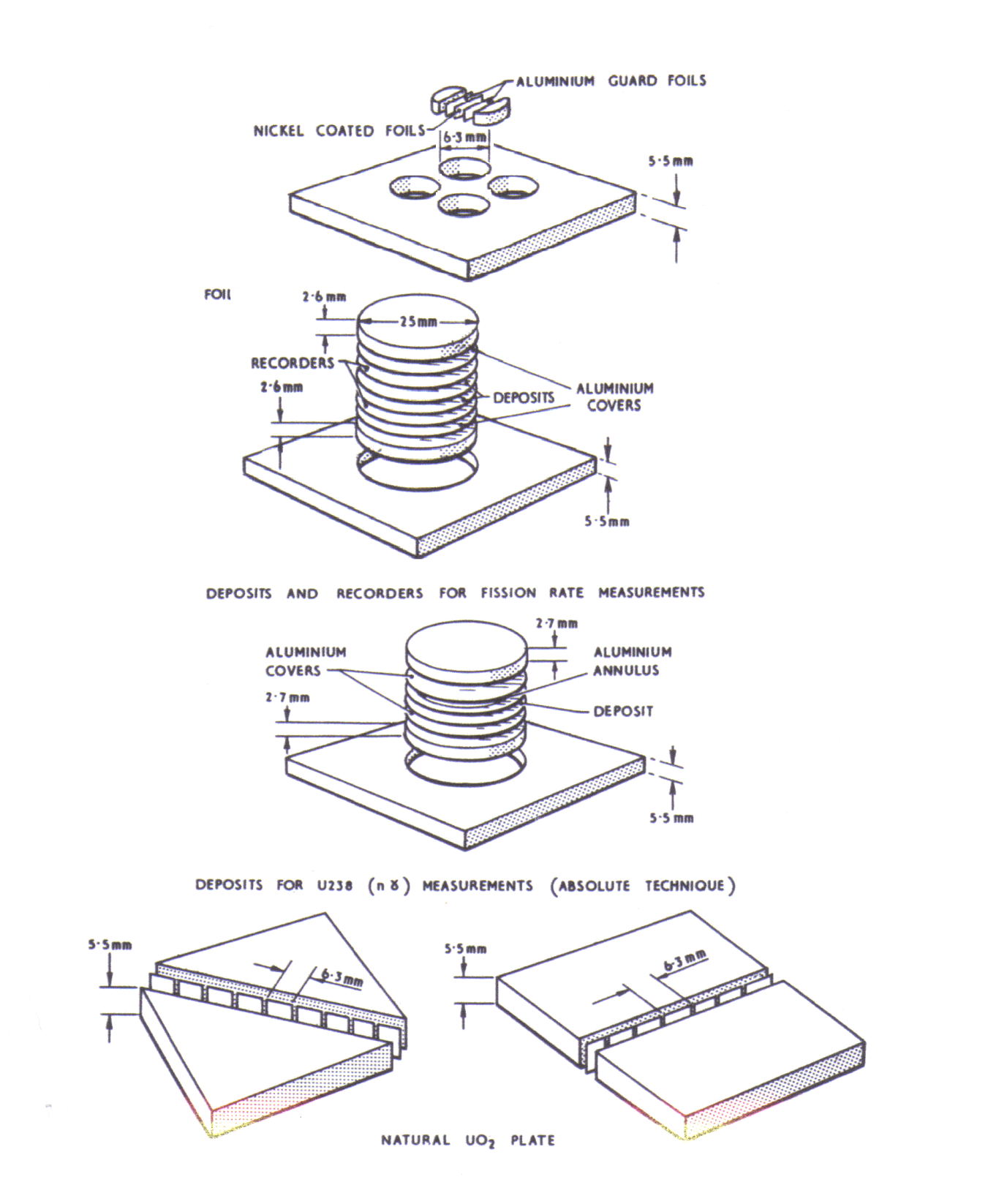
****

Figure 1.21A The Zebra Parallel Plate Fission Chamber.

(dimensions in mm.)

Figure 1.21B Fission Chamber Location on the Mid-plane of a Central Element.

Figure 1.21C Location of Foils in the UO2 plates

### 1.3.2B Methods

The details of the foils and deposits, and the measurements, corrections and sources of uncertainty are given in ZTN22/9 with only the essential information being reproduced in the present document. The ways in which foils were positioned in the UO2 plates are shown in Figure 1.21C. The UO2 plates were standard Zebra plates machined for foil location. The special stainless-steel plate holding the plutonium foils consisted of an integral base and sides (0.38mm and 0.76mm thick respectively) and a separate lid (0.56mm thick). A stainless-steel foil (0.13mm thick) on which the plutonium foils were located was positioned inside, small features on the lid keeping it in contact with the plate base. When assembled, the total plate thickness was 3.l8mm (the thickness of the standard 40% steel plate, STSTF8, being 3.17 mm). The total mass of components was 24.9g, i.e. close to the average mass (24.7g) of the STSTF8 plate that it replaced. This type of special plate was used for two reasons. Firstly, the frame-like geometry of the STSTF8 plate did not lend itself to easy foil location and secondly, the special plate more closely matched the representation in the cell calculations made using the MURAL cell geometry, collision probability routine. At all non-foil bearing locations standard Zebra plates were used.

For the foil measurements of fission rates, the technique involved measuring the induced fission-product gamma-activities above a threshold of 1.28 MeV and applying a factor, P(t), which depends on the fission product yields for the fissioning isotope for the reactor spectrum, and on the time, t, which has elapsed between irradiation and detection. P(t) was derived by comparing the gamma activity ratio of foils irradiated inside a dummy fission chamber with the corresponding fission ratio obtained with chambers. These calibration measurements were made in a half-element which had a chamber above a half core. The fissile deposit was then adjacent to the core centre line.

All the foils were irradiated for the standard period of 2 hours. During the measurements the temperature of the assembly in the region containing the foils was between 330 and 340K. The F28/F25 results were obtained using 93% U235 and 0.04%U235 nickel-coated uranium metal foils. The F25/F49 results were obtained using the nickel-coated 93% U235 uranium metal and 20% Pu02/nickel foils.

The technique used to measure C28/F49 was essentially that developed by Chawla and is described in ZTN22/9. Natural UO2 deposits were irradiated in UO2 plates and the absolute U238 capture rate established by comparison of the induced Np239 activity with that emitted by an Am243 standard source of the same geometry. The deposits were counted on an automatic foil comparator containing a pair of NaI (Tl) detectors, 75mm diameter by 25mm thick, to establish the coincidence rate of the 99, 104 and 117 keV X-rays and the 106 keV gamma-ray. The corresponding value of F49 was measured with an absolute fission chamber located in a half-element (identical to that used in the fission ratio measurements) at lattice position (53,48), where it would not significantly affect the in-cell spectrum at location (50,45). The F49 measurement was related to the C28 measurement with the aid of flux monitors, seven Pu239 chambers from the multi-chamber scanning system being used for this purpose. Subsidiary measurements, using foils, established the small corrections to allow for the orientation of the deposits and the difference in fission rate between the chamber position and the stainless-steel plate in the cell.

Corrections were applied to the foil measurements for the radial and axial variations in the reaction rates to obtain cell average values. The corrections for F25, F28 and C28 were based on measurements made of the radial and axial variations within the uranium oxide plates and on the surfaces, for the different plates in a cell. The correction for F49 was based on calculations made using the MURAL collision probability cell code, which represents the individual regions of the plates in a cell, and the FGL5 fine group cross-section library (a one-dimensional slab model being used in these calculations). The calculated correction was an increase of 0.65% ± 0.3%.

Table 1.8A Location of Foils

|  |  |  |  |
| --- | --- | --- | --- |
| Cell 13 | 13/7 | NASTDL4 |  |
| 13/6 | UO23R4 | F25, F28, C28 |
| 13/5 | NASTDL4 |  |
| 13/4 | PUVIII8 |  |
| 13/3 | STSTF8 | F49 |
| 13/2 | UO23R4 | F25, F28, C28 |
| 13/1 | NASTDL4 |  |
| Cell 12 | 12/7 | NASTDL4 |  |
| 12/6 | UO23R4 | F25, F28, C28 |
| 12/5 | NASTDL4 |  |
| 12/4 | PUVIII8 |  |
| 12/3 | STSTF8 | F49 |
| 12/2 | UO23R4 | F25 |
| 12/1 | NASTDL4 |  |
| Cell 11 | 11/7 | NASTDL4 |  |
| 11/6 | UO23R4 | F25, F28, C28 |
| 11/5 | NASTDL4 |  |
| 11/4 | PUVIII8 |  |
| 11/3 | STSTF8 |  |
| 11/2 | UO23R4 |  |
| 11/1 | NASTDL4 |  |

The axial variation of the U238 fission rate and capture rate are shown in Table 1.8B. (f28 denotes the measured gamma activity.) The rates were measured using 0.04% U235 foils, 25.3mm diameter x 0.08mm thick, located horizontally at the centres of the UO2 plates and have been normalised to unity at the core centre. There are two UO2 plates in each cell, at plate positions 2 and 6, counting the plates from the lower surface of the cells. Cell 12 is below the centre plane of the core and cell 13 above. (Cell/Plate) = (13/2) denotes the plate in position 2 in cell 13. The measurements were made in version A of Core 22 with the axial orientation of all the cells being the same. On the basis of measurements made using foils held horizontally and vertically, as shown in Table 1.9, the cell average value of F28/F25 was obtained.

Sources of uncertainty in the measurements are summarised in Tables 1.10 and 1.11.

Table 1.8B Axial Variations of the U238 Fission and Capture Rates Measured on the Mid-planes of UO2 Plates using 25.3 mm diameter Foils.

(*r denotes a random uncertainty and s a systematic uncertainty, all being in percent*)

Examples of the sources of the systematic errors are the foil and chamber mass calibrations and the corrections made to obtain the cell averaged values. These would be common to the measurements in other cell configurations and in other ZEBRA assemblies.

|  |  |  |  |
| --- | --- | --- | --- |
| Plate Position (Cell/Plate) | Distance Above Core Centre-Plane (mm) | f28  (s.d. in %) | C28  (s.d. in %) |
| U02 (15/6) | 103.4 | 0.958 ±0.2r | 0.965 ±0.2r |
| U02 (15/2) | 84.5 | 0.982 ±0.2r | 0.975 ±0.2r |
| U02 (14/6) | 65.8 | 0.978 ±0.2r | 0.988 ±0.2r |
| U02 (14/2) | 46.9 | 0.998 ±0. 2r | 0.992 ±0.2r |
| U02 (13/6) | 28.2 | 0.992 ±0. 2r | 0.998 ±0.2r |
| U02 (13/2) | 9.3 | 1.008 ±0.2r | 0.999 ±0.2r |
| U02 (12/6) | -9.3 | 0.992 ±0.2r | 1.001 ±0.2r |
| U02 (12/2) | -28.2 | 1.005 ±0.2r | 0.995 ±0.2r |
| U02 (11/6) | -46.9 | 0.984 ±0.2r | 0.993 ±0.2r |
| U02 (11/2) | -65.8 | 0.991 ±0.2r | 0.987 ±0.2r |
| U02 (10/6) | -84.5 | 0.973 ±0.2r | 0.983 ±0.2r |
| U02 (10/2) | -103.4 | 0. 976 ±0.3r | 0.969 ±0.2r |

Table 1.9 U238/U235 Fission Ratios in the Central Region of the Element located at (50,45).

|  |  |  |
| --- | --- | --- |
| Plate Position (Cell/Plate) | Foil orientation | F28/F25 (s.d. in %) |
| U02 (12/6) | Vertical | 0.03635 ± 0.8r 0.6s |
| U02 (13/2) | Vertical | 0.03707 ± 0.9r 0.6s |
| U02 (13/6) | Horizontal | 0.03610 ± 1.0r 0.6s |
| U02 (11/6) | Horizontal | 0.03627 ± 1.0r 0.6s |

Table 1.10 Sources of Uncertainty in the Cell Averaged Fission Ratio Measurements.

|  |  |  |
| --- | --- | --- |
| Sources of uncertainty | F25/F49 | F28/F25 |
|  | (% s.d.) | (% s.d.) |
| P(t) Measurements |  |  |
| Relative masses of fission chambers | 1.0 s | 0.6 s |
| Fission chamber counting rates | 0.4 r | 0.4 r |
| Statistics of foil counting | 0.1 r | 0.1 r |
| Mass uncertainties of foil counting | 0.1 r | 0.07 r |
| Resonance shielding in the foil | 0.1 r | 0.06 r |
| Relating absolute gamma-activities | 0.3 r | 0.6 r |
|  |  |  |
| Plate Measurements |  |  |
| Statistics of foil counting | 0.1 r | 0.2 r |
| Mass uncertainties of foil counting | 0.1 r | 0.05 r |
| Flux corrections (Macroscopic; Global) | 0.2 r | 0.2 r |
| Perturbation produced by the use of 93% U5 foils | 0.2 r | 0.2 r |
| Radial fine structure variations | 0.4 r | 0.5 r |
| Cell average correction | 0.3 r |  |
| Relating absolute U235 and Pu239 gamma-activities | 0.8 r | 0.5 r |
|  |  |  |
| TOTAL | 1.1%r, 1.0%s | 1.1%r, 0.6%s |

Table 1.11 The Sources of Uncertainty for the Cell-averaged value of C28/F49.

|  |  |
| --- | --- |
| Absolute C8 Measurements | (%) |
|  |  |
| Deposit counting | 0.5r, 0.3s |
| Macroscopic flux correction | 0.lr |
| Axial fine structure correction | 0.lr |
| Radial fine structure correction | 0.4r |
| Foil orientation correction | 0.2r |
| Irradiation timing | 0.lr |
|  |  |
| Absolute F9 Measurements | (%) |
|  |  |
| Resonance shielding in foil (chamber) | 0.lr |
| Zebra plate/chamber foil counting | 0.3r |
| Zebra absolute chamber counting | 0.2r, 0.4s |
| Radial fine structure correction | 0.4r |
| Macroscopic flux correction | 0.lr |
| Zebra SS/plutonium plate correction | 0.2r |
| Secondary isotope correction | 0.lr |
|  |  |
| TOTAL | 0.9r, 0.5s |

### 1.3.2C Results of the Measurements

Reaction rate ratio measurements were made both by the AEEW ZEBRA Group and by a team of scientists from ANL. The results are given in Table 1.12 for both the cell averaged values and the chamber measurements.

The effects of uncertainties in the compositions and dimensions of core components have not been included in the above assessments. Also, account has not been taken of the discrepancies found between the measurements made by different teams participating in intercomparison experiments, such as the IRMA intercomparisons. These are discussed in Section 2.3.

Table 1.12 Reaction Rate Ratio Measurements in Assembly 22

|  |  |  |  |
| --- | --- | --- | --- |
| Reaction rate ratio | Measured by AEEW | Measured by ANL | (ANL/AEEW –1)% |
|  |  |  |  |
| F28/F25 (Cell Average) | 0.03634  (± 1.1%r 0.6%s) | 0.03757  (± 0.6%r 1.6%s) | +3.4 ± 2.0 |
|  |  |  |  |
| F25/F49 (Cell Average) | 0.959  (± 1.1%r 1.0%s) | 0.941  (± 0.6%r 1.0%s) | -1.9 ± 1.8 |
|  |  |  |  |
| C28/F49 (Cell Average) | 0.1266  (± 0.9%r 0.5%s) | 0.1226  (± 0.6%r 1.2%s) | -3.2 ± 1.5 |
|  |  |  |  |
| F28/F25 (Chamber) | 0.03483  (± 0.4%r 0.6%s) | 0.03566  (± 0.4%r 1.6%s) | +2.4 ± 1.8 |
|  |  |  |  |
| F25/F49 (Chamber) | 0.960  (± 0.4%r 1.0%s) | 0.948  (± 0.3%r 1.6%s) | -1.3 ± 1.9 |
|  |  |  |  |
| F40/F49 (Chamber) | 0.2594  (± 0.9%r 1.8%s) |  |  |
|  |  |  |  |
| F41/F49 (Chamber) | 1.217  (± 0.5%r 3.8%s) |  |  |
|  |  |  |  |

‘r’ denotes a random uncertainty and ‘s’ a systematic uncertainty.

The F25/F49 and C28/F49 measurements (which involved measurements using the Pu239 fission chamber) have been revised because of a 1% revision in the Pu239 alpha decay half-life relative to the value used when the fission chambers were calibrated by alpha assay. Ratios to Pu239 fission have been reduced by 1%. Both the fission chamber and the foil measurements have been revised. The value used at that time was (24.35 ± 0.02) x 10+3 years and the revised value is (24.11 ± 0.01) x 10+3 . Note, however, that there is no mention of the correction having been applied to the F40/F49 and F41/F49 values.

Uranium deposites were calibrated by measuring the U234 alpha decay and so there was a dependence on isotopic analysis as well as on the accuracy of the U234 half-life. The half-life value used was 0.2442 x 106 ± 0.6% years which compares with the current value of 0.2455 x 106 ± 0.2%, a difference of 0.5%, which is within the assumed uncertainty.

### 1.3.3 Description of the Material Data

The material data for the environment of the measurements is that described in Section 1.1.

### 1.3.4 Description of Temperature Data

Measurements with foils were typically in the range 330 to 340K. Corrections were made for departure from 300 K by the measurers.

### 1.3.5 Additional Relevant Information

The results of international intercomparison studies and other intercomparisons are described in section 2.3.

## 1.4 Description of Reactivity Effects Measurements

### 1.4.1 Overview of the Experiment

The difference in reactivity between two core loadings was measured by the compensating change in the balance position of a calibrated control rod (usually FR9). The control rods were calibrated in terms of the delayed neutron scale by inverse kinetics measurements, as described in Section 1.4.6. The inverse kinetics method is described in BTN-75. (Alternative reactivity scales could be considered, such as that based on the comparison of the measured and calculated effect of changes in the plutonium content of cells, and this scale has been used in the interpretation of some reactivity measurements made in the ZEBRA facility.)

The differences in reactivity between different types of element, such as the plate geometry and pin geometry elements, were measured for single elements and groups of 9 elements. The transition from one core to another core was made in stages, with the change in reactivity in each stage being measured. This required the calibrated control rod to be recalibrated at each stage.

Measurements involving changes to the contents of a single central cell were made using the special Large Sample Changer element, LSC. This was a special element about 4m long, filled with standard core cells. It moved axially between two positions about 1.6m apart. The cells which are aligned with the core centre when the LSC is in the "Down" position are exposed above the top of the surrounding elements when the LSC is in the "Up" position and the contents of these central cells could then be easily modified. The LSC could be moved up and down with little reactivity change with the reactor at power. The reactivity difference between a perturbed cell and a reference cell was measured to give the reactivity of the perturbation. The LSC needed a position in the reactor base plate having a special removable plug. As the central position, (X,Y) =(50,45), was not one of these positions, the LSC was installed in position (50,46).

Measurements of larger region perturbations were made by replacing standard elements with modified elements, either singly or in groups of 9, or in larger groups of elements. In the case of the sodium void measurements the changes were made separately in axial sections, in the central third of the core region of an element and in the two outer thirds sections of the core region. In this way the leakage dependent effects could be separated from the moderation plus absorption effects.

Details of the sodium worth measurements, enrichment changes and the cell heterogeneity and small sample worth measurements made in Assembly 22 are given in ZTN22/4 and ZTN22/8. Measurements made in the voided plate geometry Core 24 are described in ZTN22/5 and in the pin geometry cores in ZTN22/6. The calibration of control rods is described in ZTN22/3. The information needed for specification and evaluation of the benchmarks is reproduced in the present document

### 1.4.2A Description of the Experimental Configuration

The assembly configurations are described in Section 1.1.

The dimensions of the additional components used in the measurements are as follows:

**Plates used in reactivity worth measurements** (all have nominal width 5.067 cm)

**ALF2** 45%Aluminium

PLATE THICKNESS -------- 1.27 cm

These plates replace two sodium (or sodium replacement “dummy”) plates at the interface of each pair of cells (i.e. between the first and second cell, the third and fourth cell, etc). The 40% steel plates, STSTF8, in the central 22 cells, were replaced by the slightly thinner plates, STSTF8T, to correct for the difference in thickness. The ALF2 plates were then replaced, in turn, by 4 full density aluminium plates (AL8), 4 stainless steel plates (STSTBR8), 2 alumina plates (AL2034) and 4 graphite plates (GII8).

**STSTF8T** Stainless steel

PLATE THICKNESS -------- 0.2963 cm

**STSTBR8** Stainless steel

PLATE THICKNESS -------- 0.3172 ± 0.0005 cm

**GII8** Graphite

PLATE THICKNESS -------- 0.31775 ± 0.0005 cm

**AL2O34** Aluminium oxide

PLATE THICKNESS 0.6317 ± 0.0005 cm

**AL8** Aluminium

PLATE THICKNESS -------- 0.3167 cm

**STSTSR4** This is a stainless steel plate corresponding approximately, in weight and dimensions, to the can of a sodium plate, or a "dummy" plate (weight 17.60 g). It replaces a UO2 plate in the reactivity perturbation measurements.

**The steel, aluminium and graphite pins used in the reactivity worth measurements**

For all pins the total length is 29.5 cm.

For all pins the radial dimensions are given in the Zebra Database as:

CAN THICKNESS -------------------- 0.025 cm

TOTAL PIN DIAMETER ----------- 0.938 cm

PIN CORE DIAMETER ------------- 0.937 cm

It is probable that in fact there was no canning on these pins (no compositions are given for a canning region) and the weights correspond to pins of the single material of length 29.5 cm and diameter 0.937 cm when calculated using the densities of the plate geometry components. A pin diameter of 0.937 would be consistent with the size of the other pins used in the mini-calandria and it is proposed that this diameter should be adopted.

**MSTPINA** The mild steel pin

**2ALPINA** The aluminium pin (the 2 in front of the component identifier denotes that it consists of two "6 inch" length pins giving a total length of 29.5 cm)

**2ALOPINA** The aluminium oxide pin

**2CPINA** The graphite pin

### 1.4.2B Methods

#### Reactivity Scale and Delayed Neutron Data used

Movement of the fine control rod (FR9) was calibrated in the reference loading for Core 22 (std cm worth 0.5148 x 10-4 dk/k). A repeat measurement with the Large Sample Changer installed showed negligible difference, and the same rod worth was used throughout for the measurements made in this assembly and in the first analysis for the other assemblies. In ZTN22/13 the reactivity worths were revised, following a recalculation of the kinetics parameters for each core, and applying the correction factors: 0.999 in Core 22, 1.016 in Core 23, 1.012 in Core 24 and 1.025 in Core 25. These factors are not precisely the changes in beta-effective because of the different contributions of Pu239 and U238 to the kinetics and the differences between these components in the normal and voided cores. The beta-effective values (calculated using 37 group RZ diffusion theory and the FGL5 nuclear data set) were 0.003628 in Core 22, 0.003677 in Core 23, 0.003737 in Core 24 and 0.003775 in Core 25.

The reactivity worths of the control rods were obtained by measuring the absolute reactivity change due to rod movements of a few centimetres and using the appropriate rod profile to obtain the value for the full rod movement. The absolute reactivity measurements were made by the inverse kinetics method using counts collected from the four reactor pulse channels. Two measurements were made for each rod, movements being chosen to give reactivity changes of about 3 x 10-4 and 6 x 10-4 dk/k for different rod combinations (see ZTN22/3).

Prior to the ZEBRA BIZET Programme the rods were calibrated by positive period measurements. During the BIZET programme the inverse kinetics method was introduced and comparisons are made with the period method in BTN-39. The inverse kinetics method can be carried out in a shorter time than the period method. The two methods were found to agree on average to 0.9% ± 0.9%. An analysis of the uncertainties is also made, separating the random components and the systematic component of ± 5% due to the choice of delayed neutron data and uncertainties in relative fission rates and importances. For the calibration of a single rod the sum of the random components is given as ± 1.3%. In BTN-75 the random error is reassessed, based on the large number of measurements which had been carried out by then, giving the smaller figures of ± 0.6% and ± 0.4 %. The systematic uncertainty due to the choice of delayed neutron data therefore determines the total uncertainty. This assessment of the uncertainty due to the delayed neutron data is discussed in detail in the paper by J M Stevenson (page 1) in the Proceedings of the 1986 Specialists Meeting on Delayed Neutron Properties held at Birmingham University in the UK.

The delayed neutron data used in evaluating these reactivity worths were Smith's (1974) revision of Tomlinson's (AERE-R6993) delayed neutron evaluation. The total fast spectrum yields in the delayed neutron data set (n/100F) are as follows:

U235, 1.65 ± 0.03; U238, 4.58 ± 0.16; Pu239, 0.633 ± 0.026; Pu240, 0.88 ± 0.09

Pu241, 1.59 ± 0.16; Pu242, 1.5 ± 0.5.

U238 and Pu239 are the dominant components. If we compare these values with a recent evaluation (d’Angelo and Rowlands, Prog. Nucl. Energy 41 p391 (2002)) we see that the more recently recommended value for U238 is 4.65, or 1.5% higher, and for Pu239 fast fission is 0.651, or 2.8% higher (the Smith-Tomlinson values for Pu240, 241 and 242 being similar to values currently in use). This could imply that the reactivity worths calculated using these more recent data would be about 2% higher, this difference being within the uncertainty of ± 5% associated with the reactivity measurements.

The recommended relative abundances in the Smith-Tomlinson evaluation are Keepin’s 1957 fission spectrum averaged data for U235, U238 and Pu239. The data are summarised in the following Tables 1.13 to 1.15.

Delayed neutron spectra were specified for each of the 6 time groups, being the same for all fissioning isotopes in these time groups. The values are based on Keepin’s six group spectra modified for the 37 group data set used in the analyses.

Table 1.13 Delayed Neutron Fractions and Total Yields used in the Inverse Kinetics Analyses

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | U235 | U238 | Pu239 | Pu240 | Pu241 | Pu242 |
| Time group |  |  |  |  |  |  |
| 1 | 0.038 | 0.013 | 0.038 | 0.025 | 0.010 | 0.004 |
| 2 | 0.213 | 0.137 | 0.280 | 0.270 | 0.229 | 0.195 |
| 3 | 0.188 | 0.162 | 0.216 | 0.184 | 0.173 | 0.162 |
| 4 | 0.407 | 0.388 | 0.329 | 0.358 | 0.390 | 0.411 |
| 5 | 0.128 | 0.225 | 0.103 | 0.135 | 0.182 | 0.218 |
| 6 | 0.026 | 0.075 | 0.035 | 0.027 | 0.016 | 0.010 |
|  |  |  |  |  |  |  |
| n/F | 0.0165 | 0.0458 | 0.00633 | 0.0088 | 0.0159 | 0.015 |

The 6 group fractions for U235, U238 and Pu239 are the fission spectrum averaged values of Keepin et al.

Table 1.14 Delayed Neutron 6 Time Group Decay Constants (sec-1) used in the Analyses

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | U-235 | U-238 | Pu-239 | Pu-240 | Pu-241 | Pu-242 |
| Time group |  |  |  |  |  |  |
| 1 | 0.0127 | 0.0132 | 0.0129 | 0.0129 | 0.0128 | 0.0129 |
| 2 | 0.0317 | 0.0321 | 0.0311 | 0.0313 | 0.0299 | 0.0295 |
| 3 | 0.115 | 0.139 | 0.134 | 0.135 | 0.124 | 0.131 |
| 4 | 0.311 | 0.358 | 0.331 | 0.333 | 0.352 | 0.338 |
| 5 | 1.40 | 1.41 | 1.26 | 1.36 | 1.61 | 1.39 |
| 6 | 3.87 | 4.02 | 3.21 | 4.04 | 3.47 | 3.65 |

Table 1.15 Delayed Neutron Energy Spectra used in the Inverse Kinetics Analyses

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Lower E | Upper E | Group1 | Group2 | Group3 | Group4 | Group5 | Group6 |
| (MeV) | (MeV) |  |  |  |  |  |  |
| 2.2313 | 3.6788 | 0 | 0.01 | 0 | 0.02 | 0.01 | 0.01 |
| 1.3534 | 2.2313 | 0.03 | 0.04 | 0.03 | 0.04 | 0.04 | 0.04 |
| 0.82085 | 1.3534 | 0.06 | 0.12 | 0.08 | 0.12 | 0.14 | 0.14 |
| 0.49787 | 0.82085 | 0.13 | 0.27 | 0.22 | 0.24 | 0.23 | 0.23 |
| 0.30197 | 0.49787 | 0.20 | 0.26 | 0.30 | 0.24 | 0.23 | 0.23 |
| 0.18316 | 0.30197 | 0.23 | 0.15 | 0.19 | 0.19 | 0.17 | 0.17 |
| 0.11109 | 0.18316 | 0.16 | 0.08 | 0.09 | 0.09 | 0.11 | 0.11 |
| 0.06738 | 0.11109 | 0.19 | 0.07 | 0.09 | 0.06 | 0.07 | 0.07 |

There was found to be no significant variation in worth/std-cm with size of rod movement or detector channel. The spread of the results indicated that the random uncertainty on the worth/std-cm. was about 0.2%. The assessment of errors followed the principles laid down in BTN-75, the inclusion of errors due to drift, the dead-time etc. increasing this to 0.4%.

To recalculate the reactivity scales an estimate of the change in reactivity made when calibrating the rods is required, because this affects the variation of flux with time, which is measured and interpreted using the "effective" delayed neutron data. Details are given in ZTN22-3, the changes in reactivity being in the range 2.5 to 6.5 x 10-4 dk/k.

The delayed neutron fractions calculated using the Smith-Tomlinson delayed neutron data and the FGL5 cross-section set are given in Table 1.15A, broken down by nuclide and time-group. To recalculate the reactivity scales using different delayed neutron data and cross-sections the period for a reactivity change of 4 x 10-4 dk/k should be calculated using the data in the Table and then the reactivity corresponding to this period calculated using the new data. The ratio of this reactivity to the value of 4 x 10-4 dk/k is the correction factor to be applied to the control rod reactivity scales.

Table 1.15B Total Beta-effective Values Calculated for the CADENZA Cores (ZTN22/13)

(delayed neutron data of Smith-Tomlinson and FGL5 cross-sections)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Core 22B | Core 23A | Core 24 | Core 25 |
| Total = βeff | 0.003628 | 0.003677 | 0.003737 | 0.003775 |

Table 1.15A Delayed Neutron Parameters Calculated for the CADENZA Cores (ZTN22/13)

(calculated using the delayed neutron data of Smith-Tomlinson and FGL5 cross-sections)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Isotope | Delayed  Neutron  Group | ai (x 10-8) | | | | λi (sec-1) |
|
| Core 22B | Core 23A | Core 24 | Core 25 |
| U235 | 1 | 709 | 704 | 717 | 711 | 0.0127 |
|  | 2 | 4153 | 4106 | 4214 | 4169 | 0.0317 |
|  | 3 | 3598 | 3563 | 3647 | 3612 | 0.115 |
|  | 4 | 7967 | 7876 | 8084 | 7997 | 0.311 |
|  | 5 | 2485 | 2458 | 2520 | 2494 | 1.40 |
|  | 6 | 507 | 501 | 514 | 508 | 3.87 |
|  | Total | 19419 | 19208 | 19696 | 19491 |  |
| Pu239 | 1 | 5006 | 5123 | 4848 | 4944 | 0.0129 |
|  | 2 | 37866 | 38617 | 36655 | 37295 | 0.0311 |
|  | 3 | 28966 | 29589 | 28037 | 28563 | 0.134 |
|  | 4 | 44573 | 45452 | 43163 | 43912 | 0.331 |
|  | 5 | 13885 | 14164 | 13445 | 13680 | 1.26 |
|  | 6 | 4700 | 4794 | 4551 | 4630 | 3.21 |
|  | Total | 134996 | 137739 | 130699 | 133024 |  |
| U238 | 1 | 2333 | 2345 | 2522 | 2527 | 0.0132 |
|  | 2 | 25355 | 25393 | 27455 | 27427 | 0.0321 |
|  | 3 | 29497 | 29588 | 31921 | 31927 | 0.139 |
|  | 4 | 71931 | 72026 | 77898 | 77808 | 0.358 |
|  | 5 | 41506 | 41575 | 44936 | 44896 | 1.41 |
|  | 6 | 13849 | 13873 | 14995 | 14981 | 4.02 |
|  | Total | 184471 | 184800 | 199727 | 199566 |  |
| Pu240 | 1 | 291 | 289 | 307 | 306 | 0.0129 |
|  | 2 | 3237 | 3190 | 3403 | 3380 | 0.0313 |
|  | 3 | 2177 | 2149 | 2289 | 2277 | 0.135 |
|  | 4 | 4291 | 4229 | 4513 | 4483 | 0.333 |
|  | 5 | 1616 | 1593 | 1700 | 1688 | 1.36 |
|  | 6 | 326 | 321 | 343 | 341 | 4.04 |
|  | Total | 11938 | 11771 | 12555 | 12475 |  |
| Pu241 | 1 | 109 | 130 | 100 | 118 | 0.0128 |
|  | 2 | 2650 | 3160 | 2434 | 2866 | 0.0299 |
|  | 3 | 1974 | 2357 | 1812 | 2137 | 0.124 |
|  | 4 | 4510 | 5376 | 4143 | 4878 | 0.352 |
|  | 5 | 2103 | 2508 | 1931 | 2275 | 1.61 |
|  | 6 | 189 | 225 | 173 | 204 | 3.47 |
|  | Total | 11535 | 13756 | 10593 | 12478 |  |
| Pu242 | 1 | 2 | 2 | 2 | 2 | 0.0129 |
|  | 2 | 89 | 89 | 93 | 95 | 0.0295 |
|  | 3 | 73 | 73 | 77 | 78 | 0.131 |
|  | 4 | 187 | 188 | 197 | 200 | 0.338 |
|  | 5 | 99 | 100 | 104 | 106 | 1.39 |
|  | 6 | 5 | 5 | 5 | 5 | 3.65 |
|  | Total | 455 | 457 | 478 | 486 |  |

#### Uncertainties in Reactivity Worth Measurements

In addition to the uncertainty in the conversion of the measured control rod movement into absolute reactivity units (via the inverse kinetics measurements) there are the uncertainties arising from reproducibility and drift. For the measurements involving changes to single elements or groups of nine elements the uncertainties are given in the following Table 1.16.

Table 1.16 Uncertainties arising from Reproducibility and Drift

(in units of std cm of FR9 1 std cm ~ -0.5 x 10-4 dk/k and units of dk/k)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | In units of std. cm. of FR9 | | In units of 10-4 dk/k. | |
| Core | Single Element Measurements | Nine Element Sodium Voiding Measurements | Single Element Measurements | Nine Element Sodium Voiding Measurements |
| 22 | 0.045 | 0.16 | 0.023 | 0.08 |
| 23 | 0.036 | 0.10 | 0.018 | 0.05 |
| 24 | 0.025 |  | 0.013 |  |
| 25 | 0.025 |  | 0.013 |  |

For the plate cores, the uncertainties for the single element measurements are for a comparison of two different elements, without reloadings between balances, (a second comparison with a similar uncertainty was necessary to allow for any differences in the element contents). They do not include the uncertainty associated with core height variations, (0.03 std cm for Core 22 and 0.02 std cm for Core 24). For the pin cores, the errors are for a comparison of the two loadings of the same element with reloadings between balances.

For both core 22 and 23 nine element measurements, the comparisons are between two loadings of the same nine elements with reloadings between balances. Only one "nine element" measurement was made in Core 24, and three in Core 25. The uncertainties were assumed to be the same as for Cores 22 and 23.

Measurements were made with different thickness steel plates to determine the correction for changes in core height resulting from the interchange of plates. Changes in the associated steel content also accompanied the sodium voiding and flooding measurements. The components were weighed and the effects of the changes in the steel contents of elements were assessed.

There is also the possibility of an interaction between the perturbation and the control rod worth. Corrections of up to 1.6% were required for this effect in the case of the enrichment perturbation measurements.

Relative reactivity worth measurements are only affected by these uncertainties. The uncertainties arising from the delayed neutron reactivity scale conversion will not apply to the relative values.

### 1.4.2C Results of the Measurements

These are presented sequentially for each type of measurement in turn.

#### 1.4.2C.1 Reactivity Differences between Assemblies Containing Sodium and Voided of Sodium.

The transition from one core to another was made in stages, with the changes being balanced using the control rods. Changes to the numbers of edge elements were also made progressively. The rod worths were recalibrated at points during the transition. In this way the reactivity change in going from one assembly to another was measured. Corrections were made for temperature differences from 300K and Pu241 decay (maximum corrections of 0.3 x 10-4 dk/k and 0.7 x 10-4 dk/k respectively). The measurements are described in ZTN22-10, which gives the results for each stage of the transition. The total reactivity change is a combination of the effects of changes to the elements and the addition or removal of edge elements, with compensating movements of the control rods. *To calculate the measured effects it would be preferable to calculate each step, or correct for the effects of the changes in the numbers of edge elements. These measurements are not being proposed as benchmarks.*

The reactivity worth of sodium in the plate geometry Core 22 was measured by changing from Core 22B to Core 24 in several stages, at each stage sodium-filled plates being replaced by stainless-steel components selected to closely match the thickness and steel weights of the sodium plates. The net effect was to remove sodium but to retain approximately the same mass of stainless steel. The measurements are complicated by the addition of edge elements which are also either voided or flooded. Details of the component changes are given in ZTN22-10 Appendix 1. The weight of sodium removed was 173.4 kg and there was an associated reduction in weight of steel in the 206 standard core elements, by about 1 kg. Three types of "dummy" plate replaced the sodium filled plate, two being ring shaped and the third "honeycomb" (or "egg-box") shaped.

*The core with 231 fissile elements (the voided Core 24) has a reactivity (125.9 ± 3.6) x 10-4 dk/k lower than a hypothetical 231 element flooded core. However, it is not clear whether corrections are needed for the special elements and the uncertainties associated with these and so this result has not been recommended as a benchmark measurement.*

Because of compression of the sodium filled plates, and to a lesser degree of the "honeycomb" shaped "dummy" plates, the height of the core section of an element containing the ring shaped "dummy" plates was 1.2 mm greater than the height of the standard sodium containing elements. Elements containing the "honeycomb" shaped "dummy" plates were on average 0.3 mm higher. (Note: the difference in average core height between Core 22 and Core 24 has been represented in the core models described in Sections 1.1.2 and 3.1.2.)

The sodium voiding procedure was reversed when the 66 plate elements and 168 voided mini-calandria elements in Core 25 were progressively replaced by sodium filled elements. The weight of sodium added to the mini-calandria elements was 145.4 kg and the associated change in weight of steel was about 0.01 kg. The overall reactivity gain due to flooding with sodium was +131.6x10-4 dk/k. This included the "flooding" of the plate elements at the radial boundary of the core. Combining this with the correction of +9xl0-4 dk/k, to allow for the differences in corrections for control rods, instrumented elements and aspirated elements, brings the total reactivity gain to (+141 ±13) xl0-4dk/k on changing from the sodium-voided 168 pin, 66 plate element loading of Core 25 to a sodium-flooded core.

Because of the complication of treating the edge element "flooding" it might be more appropriate to consider the core with the plate elements already "flooded". This is a core of 237 elements, 168 flooded pin elements and the remainder flooded plate elements.

*The reactivity change resulting from voiding just the 168 pin elements (in the core with 237 elements) is (-71.9± 5)xl0-4dk/k which when combined with the experimentally based correction for the special elements and account taken of the uncertainties becomes (-81± 13)xl0-4dk/k.*

#### 1.4.2C.2 Element Replacement Measurements for Single Elements and Groups of 9 Elements.

Various measurements were made of the reactivity effect of replacing one type of element by another. This included groups of sodium voided elements in Cores 22 and 23 and sodium flooded elements in Cores 24 and 25. The effect of replacing plate elements by pin elements at various positions and interchanging the different types of pin element were also measured.

Measurements were made for both single elements and groups of 9 elements and at both the central position and off-central positions.

In Core 22 the standard plate elements were replaced by pin geometry elements, 3A or 3C. The results are summarised in Tables 1.17 to 1.20.

Table 1.17 Measured values of the Reactivity Effects of Replacing Standard Plate Elements C22±01C (PUVIII8 plates) by Alternative Plate and by Pin Elements in Core 22 (x10-4 dk/k)

|  |  |  |  |
| --- | --- | --- | --- |
| Element | Central position of group of 9, or position of single element | 9 elements | 1 element |
| C22±03A (pins) | (50,45) | -18.16 ± 0.27 | -2.10 ± 0.05 |
| C22±03A | (50,42) | -14.43 ± 0.21 | -1.52 ± 0.04 |
| C22±03A | (50,39) | -5.36 ± 0.10 | -0.575 ± 0.03 |
|  |  |  |  |
| C22±03C (pins) | (50,42) | -9.48 ± 0.21 |  |
|  |  |  |  |
| C22±04A (PUIV4 mixed oxide plates) | (50,45) | -35.02 ± 0.51 | -4.10 ± 0.06 |
| C22±04A | (50,42) | -27.55 ± 0.40 | -3.09 ± 0.05 |
| C22±04A | (50,39) | -13.31 ± 0.20 | -1.51 ± 0.03 |
|  |  |  |  |
| C22-01A (PUII8 plates) | (50,45) |  | -3.166 ± 0.06 |
| C22-01A | (50,42) |  | -2.64 ± 0.05 |
| C22-01A | (50,39) |  | -1.465 ± 0.02 |
|  |  |  |  |
| C22±01D (PUIX8 plates) | (50,45) | -0.482 ± 0.11 |  |

**The C22±04A elements**

The core regions of the C22±04A elements contain 11 C22-06A cells comprising 5xPUIV4 mixed oxide plates, one UO24R4 plate, 6xNASTDL4 plates, an STSTF8 plate and an STSTDL8 plate. The order of the plates in a cell, from the bottom upwards, is:

NA, PU IV4, STSTDL8, NA, PU IV4, NA, UO2, PU IV4, NA, PU IV4, NA, STSTF8, PU IV4, NA

Table 1.18 Measured values of the Reactivity Effects of Replacing 9 Standard Plate Elements, or a Single Element (C24±20CY), by Pin or Alternative Plate Elements in Core 24

(centred about or in the position specified in column 2) (x10-4 dk/k)

|  |  |  |  |
| --- | --- | --- | --- |
| Element | Central position | 9 elements | 1 element |
| C22±30A (pins) | (50,45) | -17.24 ± 0.27 | -2.105 ± 0.05 |
| C22±30A (pins) | (50,42) | -13.74 ± 0.21 | -1.662 ± 0.04 |
| C22±30A (pins) | (50,39) | -6.059 ± 0.10 | -0.707 ± 0.03 |
|  |  |  |  |
| C24±40A(MOX plates) | (50,45) | -31.52 ± 0.45 | -3.663 ± 0.06 |
| C24±40A(MOX plates) | (50,42) | -25.98 ± 0.38 | -3.000 ± 0.05 |
| C24±40A(MOX plates) | (50,39) | -13.81 ± 0.20 | -1.548 ± 0.03 |
|  |  |  |  |
| C24-20ZX(PUII8 pl) | (50,45) |  | 2.715 ± 0.05 |
| C24-20ZX(PUII8 pl) | (50,42) |  | 2.377 ± 0.05 |
| C24-20ZX(PUII8 pl) | (50,39) |  | 1.537 ± 0.03 |

Table 1.19 Measured values of the Reactivity Effects of Replacing Standard Pin Elements (C25+03A1) by Plate Elements (C24+20CY) in Core 25

(centred about, or in the position specified in column 2) (x10-4 dk/k)

|  |  |  |  |
| --- | --- | --- | --- |
| Element | Central position | 9 elements | 1 element |
| C24+20CY (plates) | (50,45) | 17.79 ± 0.27r ± 0.69s | 2.11 ± 0.05r ± 0.08s |
| C24+20CY (plates) | (50,42) | 14.57 ± 0.23r ± 0.63s | 1.735 ± 0.04r ± 0.07s |
| C24+20CY (plates) | (50,39) | 6.32 ± 0.11r ± 0.39s | 0.737 ± 0.02r ± 0.04s |

Table 1.20 Reactivity change resulting from Replacing 9 (C22-03C) Elements at the Centre of Core 23 by the Element Named in Column 1

(x10-4 dk/k)

|  |  |
| --- | --- |
| Element | Reactivity change |
| C22-03A | -6.5 ± 0.8 |
| C22-03B | -3.9 ± 0.8 |
| C22-03D | +3.1 ± 0.8 |
| C22-03E | +2.5 ± 0.8 |

*The experimental uncertainties in these tables are the random contributions from the rod profile and reproducibility and drifts during the measurements. The systematic uncertainties due to the plutonium contents of the fuel ((0.08 to 0.04) x 10-4 dk/k per element for the pin element replacements and (0.10 to 0.06) x 10-4 dk/k per element for the oxide plate element replacements) and the ± 5% systematic uncertainty in reactivity measurements is to be applied to all of these measured values.*

#### 1.4.2C.3 Plutonium Enrichment Measurements.

To measure the reactivity effects of changing the plutonium content of cells in Core 22A, twenty-four PUIV4 mixed oxide plates displaced a UO2 plate in each of the 24 core cells of the chosen element. In Assemblies 22B and 24 they replaced the lower UO2 plate in the cells 1,3,5, ..,23 (cells numbered from the bottom of the core) and the upper UO2 plate in cells 2,4, ..,24 (see ZTN22-10).

In Core 23A, 12 x PUPINF pins replaced 12 x UO2PINC pins in a C22-03J element. The mini-calandria of the C22-03J element contained 12 PUPINE pins and 4 UO2PINC pins. These latter 4 pins were replaced by the PUPINF pins in the three mini-calandria of the element.

The recalibration of the control rods used for these measurements in the maximum perturbed cases (i.e. enrichment at the centre) showed that these were the same as in the unperturbed cores, within the accuracy of the measurements. A correction (by up to 1.6%) was made for the interaction between the reactivity increase effect and the control rod.

The systematic uncertainties arise from a ±0.3% uncertainty in the plutonium content of a mixed-oxide plate and a ±0.2% uncertainty for a mixed-oxide pin. Other sources of error are associated with the control rod profile, the inverse kinetics measurements and the rod interaction corrections, giving a total uncertainty of ~1.5%. The measured plutonium worth could be used as an alternative reactivity scale, based on the calculated reactivity worth of the measured change.

*Additionally, the 5% systematic uncertainty in the reactivity scale is to be combined with the above uncertainties.*

Table 1.21 Reactivity Changes resulting from the Enrichment Changes

(±1.5%) (The data in this table are from ZTN22-13; slightly different data are given in ZTN22-10)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Lattice Position | Reactivity Change (10-4 dk/k) | | | |
| Assembly 22B | Assembly 23B | Assembly 24 | Assembly 25 |
| (50,45) | 19.45 | 16.09 | 17.25 | 14.13 |
| (50,42) | 16.40 | 13.32 | 14.79 | 12.09 |
| (50,51) + (50,39) | 17.49 | 14.58 | 9.13 \* | 14.66 |

\* Only the one position, (50,39), was used in Core 24.

#### 1.4.2C.4 The Reactivity Effects of Changes in Cell Heterogeneity in Assembly 22

The changes made were to combine pairs of standard plutonium plates and to replace the standard plates by pairs of half-thickness plates (PUJ16) and then to separate them. The changes were made in cells bordering the mid-plane in either 1 element or groups of 9 elements.

In the case of the combined pairs of standard plates, four standard cells were involved, two on either side of the mid-plane. These were replaced by two symmetrical cells, one on either side of the mid-plane. The sequence of plates in each cell was:

Na, UO2, Na, Na, UO2, SS, Pu, Pu, SS, UO2, Na, Na, UO2, Na

Two different patterns were used in the case of the half-thickness plates. These were first introduced paired in the positions of the standard plutonium plates in three cells, two above and one below the mid-plane (C22+22K). They were then separated into the following two patterns:

Na, UO2, Pu, SS, Na, Pu, UO2, Na, repeated three times (C22+21K) (PNC1)

and

Na, Pu, UO2, SS, Na, Pu, UO2, Na, repeated three times (C22+23K) (PNC2).

Table 1.22 Reactivity Effects of Changes in Heterogeneity

(x10-4 dk/k)

|  |  |  |  |
| --- | --- | --- | --- |
| Cell change | Cells per element | 9 elements | 1 element |
| Standard to pairs of standard Pu plates | 4 | 2.945 ± 0.09 | 0.304 ± 0.005 |
| Standard to pairs of thin Pu plates | 3 |  | 0.257 ± 0.023 |
| Pairs of thin Pu plates separated I | 3 | 0.43 ± 0.08 | 0.042 ± 0.004 |
| Pairs of thin Pu plates separated II | 3 | 0.56 ± 0.08 |  |

*(There is a further systematic uncertainty of ± 5% from the delayed neutron reactivity scale.)*

#### 1.4.2C.5 Small Sample Reactivity Worth Measurements.

The materials used in the reactivity perturbation measurements included UO2, sodium, carbon, oxygen, aluminium, steel, and copper (see ZTN22-13 for an analysis of the measurements).

Measurements were made using aluminium and alumina in order to derive the reactivity worth of oxygen and hence the contribution of the different oxygen contents of the plate and pin geometry cores to the difference between the keff values calculated for the two types of core. However, the measurement uncertainties, when the C/E values were scaled up to give the estimated error in the difference between the calculated keff values for the two cores due to the oxygen data, resulted in an uncertainty of ±0.002 dk/k, too large to be helpful in resolving discrepancies. Approximations in the analysis methods would increase this uncertainty further.

The measurements made in Core 22B (the symmetrical cell version) are described in ZTN22-4 and are summarised in Tables 1.23 to 1.25. Corrections were made for element differences and changes in core height. The uncertainties arise from the uncertainties in control rod profile, reproducibility and the changes in core height.

The corresponding programme of measurements made in Core 24 are described in ZTN22-5 and are summarised in Tables 1.26 and 1.27.

The measurements involved the replacement of either a UO2 plate in each of a set of cells or were made relative to 45% density aluminium plates, ALF2. These replace two sodium (or “dummy”) plates at the interface of each pair of cells (i.e. between the first and second, the third and fourth, etc). The 40% steel plates, STSTF8, in the central 22 cells, were replaced by the slightly thinner plates, STSTF8T, to correct for the difference in thickness between the ALF2 plates and two sodium plates. The ALF2 plates were then replaced, in turn, by 4 full density aluminium plates (AL8), 4 stainless steel plates (STSTBR8), 2 alumina plates (AL2034) and 4 graphite plates (GII8).

The measurements made in the pin cell cores are described in ZTN22-6 and are summarised in Tables 1.28 and 1.29. All the measurements with pin samples were made in element type C22=03J in the flooded pin core and element type C25=03J6 in the voided core. The four positions in the minicalandria normally occupied by the U02 pins were used. The U02PINC, ALPINA, CPINA and MSTPINA were compared in turn with empty positions. Alumina ALOPINA pins were compared with ALPINA in Core 23 (the alumina pins were not available when the Core 25 measurements were made). For the enrichment measurements, the U02PINC pins were replaced by PUPINF pins.

The method of making these measurements in single element positions was similar to that in Cores 22B and 24. In this case, however, changes were made to the chosen element between each start-up and balance. This was preferred to the method of comparing two different elements (one perturbed, the other unperturbed) with a subsequent comparison of the elements in the same (unperturbed) state. Four balances gave two estimates of the perturbation, after interpolation to allow for drifts with time. Because the changes only involved the pins inside the mini-calandria, there were no core height changes and no associated reactivity corrections.

The uncertainties in the single element measurements made in the pin geometry cores have the following components:

(a) Rod Profile:

This was taken to be ±1% in all of the cores.

(b) Reproducibility and Drifts:

The rms differences (in terms of the control rod movements) between repeat measurements of perturbations were as follows:

In Core 23, 0.032 std cm for measurements in (50,45) or in {(50,39) + (50,51)};

In Core 25, 0.022 std cm in (50,45) and 0.010 std cm for the 4 measurements in {(50,39) + (50,51)}.

The associated uncertainties on the mean were taken to be 1.12 x 0.032 = 0.04 std cm in Core 23 and 1.12 x 0.022 = 0.025 std cm in Core 25.

These are very similar to the errors on the mean std cm movements found using the four balance technique for central single-element exchanges in the corresponding plate cores. For the plate cores, pairs of elements were used which were not reloaded between balances so the core height remained unchanged. In the pin cores, because of the robust construction of the mini-calandria, core height changes are small when pins are exchanged. Thus these uncertainties of about 0.04 std cm in the flooded cores and 0.025 std cm in the voided cores arise mainly from variations in the flow of the core-cooling air and in the cooling of elements when out of the core.

For the enrichment experiments, the control rod profile uncertainty (1% of the signal) dominated. For the other materials, the reproducibility and drift uncertainties were more dominant and gave typical uncertainties of ±0.020x10-4 dk/k in Core 23 and ±0.014 x 10-4 dk/k in Core 25.

For the plate cores, the uncertainties due to reproducibility and drifts were larger by a factor of *√2* because a second comparison was necessary for pairs of elements in the same loading to allow for differences in fuel plates, etc. There were also uncertainties in the core height for different loadings of the plate elements. Thus typical final uncertainties for the single-element perturbations were ±0.04 x 10-4 dk/k for Core 22 and ±0.02 x 10-4 dk/k for Core 24, both being somewhat higher than for the pin cores.

The average compensating movements of the fine control rod FR9 for each perturbation have been converted to reactivity units using std cm worths of 0.5315 x 10-4 dk/k in Core 23 and 0.5218 x 10-4 dk/k in Core 25.

*In addition to the above uncertainties there is the systematic uncertainty of ±5% associated with the absolute calibration of the control rods in terms of the delayed neutron scale.*

Table 1.23 Changes in Reactivity for Plate Replacements in Position (50,45) in Core 22B

*Reactivity perturbations in units of 10-4 dk/k (1 std cm = -0.5094x10-4 dk/k)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Change to Perturbed Element (S013) | | | | Reactivity Perturbation |
| Plates Introduced | Plates Removed | Cells Perturbed | No. of Plates Introduced |  |
| PUIV4 | U023R4 | All 24 | 24 | +19.61 ±0.20 |
|  |  | Top 8 | 8 | +5.31 ±0.06 |
|  |  | Bottom 8 | 8 | +5.36 ±0.06 |
| STSTSR4 | U023R4 | Middle 8 | 16 | +3.21 ±0.05 |
|  |  | Top 8 + Bottom 8 | 32 | +1.87 ±0.04 |
| GII8 | ALF2 | Middle 8 | 16 | -0.34 ±0.04 |
|  |  | Top 8 + Bottom 8 | 32 | +0.02 ±0.04 |
| AL8 | ALF2 | Middle 8 | 16 | -0.35 ±0.04 |
|  |  | Top 8 + Bottom 8 | 32 | -0.10 ±0.04 |
| AL2O34 | ALF2 | Middle 8 | 8 | -0.67 ±0.04 |
|  |  | Top 8 + Bottom 8 | 16 | -0.18 ±0.04 |
| STSTBR8 | ALF2 | Middle 8 | 16 | -1.09 ±0.04 |
|  |  | Top 8 + Bottom 8 | 32 | -0.10 ±0.04 |
| STSTF8 (Height change) | STSTF8T | Middle 22 | 22 | (see ZTN22-4) |

Table 1.24 Changes in Reactivity for Plate Replacements in Position (50,42) in Core 22B

*Reactivity perturbations in units of 10-4 dk/k (1 std cm = -0.5094x10-4 dk/k)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Change to Perturbed Element (S019) | | | | Reactivity Perturbation |
| Plates Introduced | Plates Removed | Cells Perturbed | No. of Plates Introduced | Position (50,42) |
| PUIV4 | U023R4 | All 24 | 24 | +16.52 ±0.17 |
| STSTSR4 | U023R4 | Middle 8 | 16 | +3.32 ±0.05 |
| GII8 | ALF2 | Middle 8 | 16 | -0.14 ±0.04 |
|  |  | Top 8 + Bottom 8 | 32 | +0.15 ±0.04 |
| AL8 | ALF2 | Middle 8 | 16 | -0.19 ±0.04 |
|  |  | Top 8 + Bottom 8 | 32 | +0.02 ±0.04 |
| AL2O34 | ALF2 | Middle 8 | 8 | -0.41 ±0.04 |
|  |  | Top 8 + Bottom 8 | 16 | +0.07 ±0.04 |
| STSTBR8 | ALF2 | All 24 | 24 | -1.19 ±0.04 |

Table 1.25 Changes in Reactivity for Plate Replacements in Position (50,39) and (50,51) in Core 22B

*Reactivity perturbations in units of 10-4 dk/k (1 std cm = -0.5094x10-4 dk/k)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Change to Perturbed Element  (SO13 and S019) | | | | Reactivity Perturbation |
| Plates Introduced | Plates Removed | Cells Perturbed | No. of Plates Introduced | Positions (50,39)+(50,51) |
| PUIV4 | U023R4 | All 24 | 24 | +17.72 ±0.18 |
| STSTSR4 | U023R4 | All 24 | 24 | -0.58 ±0.05 |
| GII8 | ALF2 | All 24 | 24 | -0.14 ±0.04 |
| AL8 | ALF2 | All 24 | 24 | -0.19 ±0.04 |
| AL2O34 | ALF2 | All 24 | 24 | -0.41 ±0.04 |
| STSTBR8 | ALF2 | All 24 | 24 | -1.19 ±0.04 |

(Elements SO13 and SO12 were used in (50,39), SO19 and SO10 in (50,51))

Table 1.26 Changes in Reactivity for Plate Replacements in Position (50,45) in Core 24

*Reactivity perturbation in units of 10-4 dk/k (1 std cm = -0.5022x10-4 dk/k)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Change to Perturbed Element (S008) | | | | Reactivity Perturbation  (10-4 dk/k) |
| Plates Introduced | Plates Removed | Cells Perturbed | No of Plates Introduced |
| STSTSR4 | U023R4 | Middle 8 | 16 | +2.311 ± 0.03 |
|  |  | Top 8 + Bottom 8 | 32 | +1.122 ± 0.02 |
| GII8 | ALF2 | Middle 8 | 16 | -0.509 ± 0.02 |
|  |  | Top 8 + Bottom 8 | 32 | -0.329 ± 0.02 |
| AL8 | ALF2 | Middle 8 | 16 | -0.386 ± 0.02 |
|  |  | Top 8 + Bottom 8 | 32 | -0.210 ± 0.02 |
| AL2034 | ALF2 | Middle 8 | 8 | -0.788 ± 0.02 |
|  |  | Top 8 + Bottom 8 | 16 | -0.415 ± 0.02 |
| STSTBR8 | ALF2 | Middle 8 | 16 | -1.058 ± 0.02 |
|  |  | Top 8 + Bottom 8 | 32 | -0.844 ± 0.02 |

The height change correction is based on measurements made by replacing the STSTF8T plate by the STSTF8 plate.

Table 1.27 Reactivities of Material Perturbations in Elements in Off-central Positions in Core 24

*Reactivity perturbation in units of 10-4 dk/k (1 std cm = -0.5094x10-4 dk/k)*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Plates Introduced | Plates Removed | Cells Perturbed | No of Plates Introduced | **Element position**  (50,42)  (S014) | **Element position**  (50,39)+  (50,51)  (S008, S014) |
| STSTSR4 | U023R4 | All | 48 | +2.192 ± 0.03 | -0.884 ± 0.02 |
| GII8 | ALF2 | All | 48 | -0.460 ± 0.02 | +0.242 ± 0.02 |
| AL8 | ALF2 | All | 48 | -0.351 ± 0.02 | +0.255 ± 0.02 |
| AL2034 | ALF2 | All | 24 | -0.692 ± 0.02 | +0.495 ± 0.02 |
| STSTBR8 | ALF2 | All | 48 | -1.388 ± 0.02 | -0.482 ± 0.02 |

Table 1.28 Material Worth Measurements in Position (50,45) in Cores 23 and 25.

*Reactivity changes in units of (10-4 dk/k)*

|  |  |  |  |
| --- | --- | --- | --- |
| Material introduced | Minicalandria used | Core 23 | Core 25 |
| U02PINC | Middle | -1.164 ±0.020 | -0.928 ±0.016 |
|  | Top + Bottom | -0.716 ±0.020 | -0.527 ±0.014 |
| ALOPINA Replacing ALPINA | Middle | -0.174 ±0.020 | - |
|  | Top + Bottom | +0.082 ±0.020 | - |
| ALPINA | Middle | -0.342 ±0.020 | -0.329 ±0.013 |
|  | Top + Bottom | +0.035 ±0.020 | +0.013 ±0.013 |
| CPINA | Middle | -0.213 ±0.020 | -0.338 ±0.013 |
|  | Top + Bottom | +0.249 ±0.020 | +0.055 ±0.013 |
| MSTPINA | Middle | -0.767 ±0.020 | -0.747 ±0.015 |
|  | Top + Bottom | -0.271 ±0.020 | -0.385 ±0.014 |

The materials were introduced in the four positions of each minicalandria normally occupied by U02PINC pins in the C22-05J and 25C-05J6 cells. The Al203 pins replaced aluminium pins, the others were measured relative to empty positions.

Table 1.29 Material Worth Measurements in Positions (50,39) plus (50,51) in Cores 23 and 25

*Reactivity worth in units of (10-4 dk/k)*

|  |  |  |  |
| --- | --- | --- | --- |
| Material introduced | Minicalandria used | Core23 | Core 25 |
| U02PINC | All 3 | -0.223 ±0.020 | 0.037 ±0.013 |
| ALOPINA replacing ALPINA | All 3 | +0.317 ±0.020 | - |
| ALPINA | All 3 | +0.364 ±0.020 | 0.362 ±0.014 |
| CPINA | All 3 | +1.322 ±0.022 | 0.942 ±0.016 |
| MSTPINA | All 3 | +0.373 ±0.020 | 0.178 ±0.013 |

The measurements with the alumina and aluminium pins were made in (50,39) only.

#### 1.4.2C.6 Sodium Voiding Reactivity Measurements.

In Core 22 the sodium plates were replaced by the voided plates, the so-called "dummy" plates, which have nominally the same thickness and steel content as the sodium plates. All the plates being interchanged were weighed and the differences in thickness measured. The changes were made either over the whole core section or in the central 8 cells and the upper and lower 8 cells (in some cases separately and in other cases combined).

Only one set of elements was used at each position, with the special elements removed from the area. The measurements were made as a sequence of four conversions of the elements (voiding, flooding, voiding and flooding) each followed by a reactor balance using the fine control rod, FR9. The four balances were achieved in a cycle of about 2 hours. The assumption that drift rates are linear with time was tested by comparing the two values for the rod movement.

*Reproducibility and Drifts*

The drifts between repeat balances varied from -0.4 to +0.6 std. cms. of FR9, arising from perturbations to the core cooling flow and temperature changes resulting from elements being modified. The differences between pairs of measured results for the compensating movement, derived from the four balances, were up to 0.35 std cm. The average (rms) value of the difference was 0.14 std cm. Consideration of the partially systematic nature of the derivation of the two values shows that the uncertainty on the mean is ~ 1.12 times this expected average value of this difference, therefore taken to be ±0.16 std cm. It is interesting to compare these values with the uncertainty of ±0.1% of an element worth which has been found appropriate for element reloadings in uranium-fuelled Zebra cores where there were no temperature rises from alpha-activity. With a central element worth of 36 x 10-4dk/k, and nine elements in the measurement, this uncertainty becomes √9x 36 x 10-4 x 1 x 10-3 = 0.1 x 10-4 dk/k = 0.2 std cm FR9.

*Plate thickness and Core Height*

The effect of voiding on the core height was studied during the complete core voiding to produce Core 24. For those elements which were voided using the STNAVR4 rings, the core height increased by ~ 1.9 mm. (The measurements during the conversion to Core 24 showed a much smaller change in core height when the STNAV4 dummies were used, as described above.)

To determine the effect of core height changes on reactivity, the 22 STSTF8T plates in the "perturbed-reference" element were replaced by the thicker STSTF8 plates, at the core-centre position. The correction for the height change in the case of middle group of 8 cells, for the group of 9 elements centred on (50,45), was (-0.16 ± 0.05) 10-4 dk/k. The corrections were similar for the other changes.

*Weight of steel*

The differences between the weights of steel in the sodium filled plates and in the "dummy" plates which replaced them were measured and the differences are given in Table 1.30. The correction for this difference is small compared with the uncertainties.

The reactivity changes resulting from the voiding of cells in Core 22 elements are summarised in Table 1.31.

*A single "nine element" measurement was made in Core 24. This involved "flooding" just the central group of 8 cells in each of the nine elements, centred on position (50,45). The reactivity change was measured to be about 15% smaller than the corresponding value in Core 22, and this could be partly due to the larger size of Core 24.*

As in Cores 22 and 24, the measurements in Cores 23 and 25 were carried out as a sequence of four conversions of the elements (voiding, flooding, voiding and flooding in Core 23 and vice-versa in Core 25). Each conversion was followed by a reactor balance using the fine control rod, FR9. Six voiding measurements were made in Core 23, the middle, the top plus bottom mini-calandria in the 9 elements centred on (50,45), (50,42) and (50,39). Only three flooding measurements were made in Core 25, the middle and then the top plus bottom mini-calandria in the elements centred on (50,45) and the middle mini-calandria in the elements centred on (50,39). In Core 23, element types C22+03C were used; and in Core 25, type C25+03C3. In both cases, some exchange of core elements was required for the measurements around (50,39).

The uncertainties were as follows:

(a) Rod Profile:

This was ±1% in all cores.

(b) Reproducibility and Drifts:

The rms difference between the six pairs of repeat results for voiding in Core 23 was 0.09 std cm. For flooding in Core 25, there were only two pairs of results and although there was some evidence of a smaller average difference, the value from Core 23 was adopted. Applying the factor of 1.12 to obtain the standard deviation gives an uncertainty on the mean of ±0.10 std cm, i.e. ±0.05 x 10-4 dk/k. For the single result for the top plus bottom mini-calandria in (50,45) in Core 25, the uncertainty was taken to be ±0.06 x 10-4 dk/k.

The uncertainty of ±0.05 x 10-4 dk/k for this flooded pin core compares with the value of ±0.08 x 10-4 dk/k for the flooded plate core. The greater error for the plate core is probably a consequence of the poorer reproducibility of the core height onreloading the plate cells, which include the compressible sodium plates in the flooded case, compared with the rigid mini-calandria.

(c) Core height:

The height of a mini-calandria before welding (and excluding the support plate) has a tolerance of ±0.08mm. The 0.38mm thick support plate, because of the way it fits-to the base of the mini-calandria, adds 0.76mm to the total length with an associated uncertainty, which is assumed to be ±0.13mm. Thus the tolerance in the total length of the assembled mini-calandria is ~ ±0.15mm. A *random* difference of ±0.15mm between the lengths of two mini-calandria which replace each other compares with a *systematic* difference of 0.6mm when a third of the core height is voided in a plate cell element. Hence the reactivity uncertainty associated with the core height changes in 9 elements in the sodium measurements in the pin cores is ~ 10% of the corrections applied during the measurements in the plate cores, i.e. up to 0.015 x 10-4 dk. This is barely significant compared with the uncertainties arising from reproducibility and drifts.

(d) Weight of steel:

The weights of steel in the sodium filled mini-calandria NACLIII and the corresponding voided mini-calandria, VCLIII used in these experiments show only small variations. The largest difference in total steel weights between the voided and flooded versions in any of these experiments is 7g. Based on the measured specific worths of steel these differences give rise to reactivity effects of less than ~ 0.01 x 10-4 dk/k, and can be ignored.

The uncertainties from the rod profile, reproducibility and drifts, and height uncertainties have been combined to give the uncertainties in the sodium measurements in the pin cell elements given in Table 1.32. The typical value of the uncertainty, ±0.06 x 10-4 dk/k is somewhat smaller than the uncertainties of ±0.10 x 10-4 dk/k given for the plate geometry elements.

*In addition to the above uncertainties there is the systematic uncertainty of ±5% associated with the absolute calibration of the control rods in terms of the delayed neutron scale.*

Table 1.30 Comparison of Steel Weights in Sodium Plates and Dummy Rings

This table is included for completeness but is not required for the benchmark calculations because the effect of the differences in the weight of steel is estimated to be negligible compared with the uncertainties.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Lattice position of centre of 9 | Cells Voided | Total Number of Plates | Mass of Na Plates (g) | Mass of Steel in Na Plates (g) | Mass of Steel in Dummies (g) | Dummy Steel - Can Steel (g) |
| (50,45) | Top 8 | 216 | 6395 | 3842 | 3822 | -20 |
|  | Middle 8 | 216 | 6377 | 3824 | 3822 | -2 |
|  | Bottom 8 | 216 | 6393 | 3840 | 3822 | -18 |
| (50,42) | Top 8 | 216 | 6394 | 3841 | 3822 | -19 |
|  | Middle 8 | 216 | 6395 | 3842 | 3822 | -20 |
|  | Bottom 8 | 216 | 6396 | 3843 | 3822 | -19 |
| (50,39) | Top 8 | 216 | 6389 | 3836 | 3822 | -14 |
|  | Middle 8 | 216 | 6382 | 3829 | 3822 | -7 |
|  | Bottom 8 | 216 | 6382 | 3829 | 3822 | -7 |

1. The average weight of sodium in a NASTDM4 sodium plate is 11.82g, giving a total of 2553g in 216 plates.

2. The expected difference between the steel weights using the average component data from the ZEBRA Database is +2.2g. (The expected weight of 216 dummies is 3825g; the expected weight of 216 sodium cans is 3823g).

Table 1.31 Comparison of Axially Symmetric Void Worths in Cores 22A and 22B (10-4 dk/k)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Lattice Position (Centre of 9 elements.) | Cells Voided | Core Loading | | |
| Core 22A | Core 22A with central 25 elements symmetrised axially | Core 22B |
| (50,45) | Middle 8  Top 8 + Bottom 8 All 24  \* (measured) | +3.79 ± 0.08  -0.85 ± 0.11  +2.94 ± 0.14 (+2.81 ± 0.08)\* | +3.86 ± 0.08  -1.12 ± 0.11  +2.74 ± 0.14 | +3.86 ± 0.08  -0.98 ± 0.11  +2.88 ± 0.14 |
| (50,42) | Middle 8  Top 8 + Bottom 8 All 24 | +1.73 ±0.08  -2.39 ± 0.11  -0.67 ± 0.14 |  | +1.66 ± 0.08  -2.48 ± 0.11  -0.82 ± 0.14 |
| (50,35) | Middle 8  Top 8 + Bottom 8  All 24 | -2.36 ± 0.08  -5.15 ± 0.11  -7.51 ± 0.14 |  | -2.46 ± 0.08  -5.15 ± 0.11  -7.61 ± 0.14 |

\* The value in brackets is for a direct measurement of all 24 cells voided together. The other figures for "All 24" are a sum of the values for "Middle 8" and "Top 8 + Bottom 8".

Table 1.32 Reactivity Changes resulting from Sodium Voiding in Core 23 and Sodium Flooding in Core 25

*Reactivity worth in units of (10-4 dk/k)*

|  |  |  |  |
| --- | --- | --- | --- |
| Lattice Position | Minicalandria used | Voiding in Core 23 | Flooding in Core 25 |
| (50,45) | Middle  Top + Bottom | +3.47 ±0.06  -2.11 ±0.05 | -3.23 ±0.06  +0.80 ±0.06 |
| (50,42) | Middle  Top + Bottom | +1.63 ±0.05  -3.21 ±0.06 | - |
| (50,39) | Middle  Top + Bottom | -1.97 ±0.05  -4.98 ±0.07 | +1.08 ±0.05 |

#### 1.4.2C.7 Reactivity Equivalence of Arrays of Plate Elements at the Centres of the Pin Geometry Assemblies 23 and 25.

Arrays of pin geometry elements were replaced with plate elements in central zones of the cores. The changes were made in stages, with reactivity being balanced in each stage using the control rods. Firstly 25 plate elements were introduced into the central 5x5 area of the reference cores. Then the number was increased in a symmetrical pattern. Then plate elements at the core boundary were replaced with pin elements and, in the final stage, a number of edge elements were removed. The overall reactivity change of the replacement of pin elements by plate elements was thus measured.

The control rods were recalibrated at stages throughout. The regulating rod worth did not change significantly when the number of edge elements remained the same and it was only in the final step, when edge elements were removed, that there was a significant change in rod worth.

The reactivity effect of the interchange of the pin and plate elements is compensated by the removal of edge elements. In addition there is the change in the positions of the combined pair of control rods, CR7+CR8. A final correction is made for the difference between the worth of the rod insertion at the beginning of the sequence and at the end.

#### Arrays of Plate Elements at the Centre of Assembly 23

The changes were made in three stages, with criticality being balanced using the control rods. The reactivity changes are given in Table 1.33. Firstly 25 plate elements were introduced into the central 5x5 area of the reference core, Figure 1.22, replacing the pin elements. Then the number was increased to 45, in a symmetrical pattern. Then 44 plate elements at the core boundary were replaced with pin elements and, in the final stage, 5 core elements were removed at the core boundary and replaced by radial blanket elements. This resulted in a symmetrical core pattern.

Table 1.33 Reactivity Changes, Replacing Pin Elements by Plate Elements in Core 23

(ZTN22-2, Table 11).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Date | Start-up  S.U. No | State | | CR7+8  (std cm) | Temp.  Correction  (std cm) | Pu241  Decay  Correction  (std cm) | Corrected  CR7+8  (std cm) |
|  |  | Plate elements at centre | Changes of elements at core edge |  |  |  |  |
| 13.5.81 | 351 | Reference |  | 85.607 |  |  | 85.607 |
|  | 352 | 25 |  | 70.663 | 0.117 | -0.001 | 70.779 |
| 14.5.81 | 353 | 45 |  | 62.630 | 0.060 | -0.002 | 62.628 |
|  | 354 | 45 |  | 62.479 | -0.320 | -0.009 | 62.470 |
|  | 355 |  | 44 pin elements | 63.145 | -0.333 | -0.010 | 62.802 |
|  | 356 |  | 5 elements removed | 80.174 | -0.315 | -0.011 | 79.848 |
| 15.5.81 | 357 | Reference |  | 85.286 | +0.039 | -0.018 | 85.307 |
| 18.5.81 | 358 | Reference |  | 85.439 | -0.019 | -0.047 | 85.373 |

The criticality of each configuration was expressed in terms of the positions of the two control rods CR7 and CR8, these positions being expressed in standard cm (denoted by std cm). Corrections were then applied for differences in temperature from the reference temperature and for Pu241 decay from the reference date.

The plate elements added were the standard C22+0lC elements. The edge elements were removed from positions 53-53, 56-51, 56-39, 44-39 and 44-51. The locations of the pin elements at the edge of the core are shown in Figure 1.22, which shows startup number S.U.356.

Calibration of control rods CR7+8 with 45 plate elements at the centre gave for the std cm 2.151 x 10-4 dk/k, which is not significantly different from the reference Core 23 value of 2.141 x 10-4 dk/k and this latter value is the one used in converting std cm to reactivity units for the changes which do not affect the core size. With edge elements removed the calibration gave 2.205 x 10-4 dk/k for the reactivity worth of 1 std cm.

Taking a mean value of the reactivity held down by the control rods in the reference cores at the beginning and end of the sequence of changes CR7+CR8 balance of (85.607+85.373)/2 = 85.490 std cm, yields the following:

**For the element replacements:**

*Plate replacing pin geometry elements in the central region*

a) Worth of 25 plate elements at centre = (85.490-70.779) x 2.l4l x l0-4 = 31.48 x l0-4 dk/k

b) Worth of 45 plate elements at centre = (85.490-62.470) x 2.l4l x l0-4 = 49.28 x l0-4 dk/k

*Pin replacing plate geometry elements at the core boundary*

c) Worth of 44 pin elements at edge = (62.470-62.802) x 2.14l x l0-4 = -0.7l x l0-4 dk/k

*Radial blanket elements replacing core elements at the core boundary*

d) Worth of 5 edge elements = (90.339-79.848) x 2.205 x l0-4 - (90.339-62.802) x 2.l41 x l0-4 = 35.82 x l0-4 dk/k

where 90.339 std. cm is the position of the fully withdrawn rod pair

*Resulting total reactivity change*

The reactivity change resulting from replacing the 45 pin elements by plate elements at the core centre, the 44 plate elements by pin elements at the core boundary and removing the 5 edge elements is (49.28 -0.7l -35.82) x l0-4 = + 12.75 x l0-4 dk/k.

This change can also be written in terms of the difference between the worth of the rod insertion at the beginning and at the end of the sequence:

(90.339-79.848) x 2.205 x l0-4 - (90.339-85.490) x 2.l41 x l0-4 = 12.75 x l0-4 dk/k

(To within the accuracy of the measurements, this is the difference in rod positions at the beginning and end of the sequence multiplied by the average of the rod worths in the core before and after the removal of the edge elements,

~ (85.490 - 79.848) x 2.173 x l0-4 dk/k = ~ 12.26 x l0-4 dk/k )

*Uncertainty in the reactivity change*

The random uncertainties in the pin/plate values, arising primarily from reproducibility errors, are about ± 0.5 x 10-4 dk/k. The systematic uncertainties arising from uncertainties in the compositions of the pin and plate elements are about ± 3 x 10-4 dk/k. The systematic uncertainty arising from the uncertainty in the control rod calibration (± 5%) is ± 0.6 x 10-4dk/k.

*Combining these uncertainties quadratically gives a total uncertainty in the reactivity change of ± 3.1 x 10-4 dk/k.*

***On the above basis a critical core configuration can be defined. This is the core shown in Figure 1.22. It is the difference in keff relative to the value for Assembly 23 which is to be calculated, the measured value of this difference being + 12.75* *± 3.1 x l0-4 dk/k.* *It is included with the criticality benchmarks in Section 3.1.1.***

#### Arrays of Plate Elements at the Centre of Assembly 25

A similar series of measurements was made in Assembly 25, as shown in Figure 1.23. The changes were made in several stages, with reactivity again being balanced using the control rods. Firstly 25 plate geometry elements were introduced into the central 5x5 area of the reference core followed by the replacement of 24 plate elements by pin elements at the core edge. Then the number in the central array was increased to 45, in a symmetrical pattern, followed by the replacement of a further 20 plate elements by pin elements at the core edge. Then the number of plate elements at the core centre was increased to 69 and more of the core boundary plate elements replaced. Finally 8 elements were removed from the core boundary, being replaced by radial blanket elements.

The final loading of core start-ups numbered S.U. 92 and 93 is shown in Figure 1.23. The order of the element changes is shown in Figure 1.24. The changes in control rod positions, and the corrections for temperature and Pu-241 decay are shown in the following Table 1.34.

Table 1.34 Reactivity Changes, Replacing Pin Elements by Plate Elements in Core 25

(ZTN22/10 Table 17)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Date | Start-up. (SU) No. | State | | CR7+8  (std cm) | Temp.  Correction  (std cm) | Pu-241  Decay  Correction  (std cm) | Corrected  CR7+8  (std cm) |
|  |  | Plate elements at centre | Pin elements at core edge |  |  |  |  |
| 18.2.82 | 85 | 0 | 0 | 87.380 | 0 | 0 | 87.380 |
|  | 86 | 25 | 0 | 71.700 | +0.211 | -0.002 | 71.909 |
|  | 87 | 25 | 24 | 73.055 | +0.058 | -0.003 | 73.110 |
| 19.2.82 | 88 | 45 | 24 | 63.602 | +0.122 | -0.013 | 63.711 |
|  | 89 | 45 | 44 | 64.492 | -0.031 | -0.015 | 64.446 |
| 22.2.82 | 90 | 69 | 44 | 56.012 | -0.033 | -0.053 | 55.926 |
|  | 91 | 69 | 66 | 55.214 | -0.082 | -0.054 | 55.078 |
|  | 92 | 69 | 66 - 8 | 87.122 | -0.105 | -0.055 | 86.962 |
| 23.2.82 | 93 | 69 | 66 - 8 | 87.131 | -0.077 | -0.065 | 86.989 |
| 24.2.82 | 95 | 0 | 0 | 87.523 | +0.076 | -0.078 | 87.521 |

Taking a mean value of the control rod positions in the reference cores at the beginning and end of the measurement sequence, startup numbers SU 85 and SU 95, gives the critical position of the control rods in the reference core as (87.380 + 87.521)/2 = 87.450 std cm.

The mean balance position for the core with 69 plate elements in the core centre and 8 elements removed at the core edge, startup numbers SU 92 and SU 93 is (86.962+86.989 )/2 = 86.975 std cm.

Using these values the following changes in reactivity are obtained:

a) Worth of 25 central plate elements (denoted 1 in Figure 1.24.)

= (87.450 - 71.909) x l.990 x 10-4 = 30.93 x 10-4 dk/k

b) Worth of 24 edge pin elements (denoted A in Figure 1.24.)

= (71.909 - 73.110) x l.990 x 10-4 = -2.39 x 10-4dk/k

c) Worth of next 20 central plate elements (denoted 2 in Figure 1.24.)

= (73.110 - 63.711) x 1.990 x l0-4 = 18.70 x 10-4 dk/k

d) Worth of next 20 edge pin elements (denoted B in Figure 1.24.)

= (63.711 - 64.446) x l.990 x 10-4 = -1.46 x 10-4 dk/k

e) Worth of next 24 central plate elements (denoted 3 in Figure 1.24.)

= (64.446 - 55.926) x l.990 x l0-4 = 16.95 x 10-4dk/k

f) Worth of next 22 edge pin elements (denoted C in Figure 1.24.)

= (55.926 - 55.078) x l.990 x l0-4= 1.69 x 10-4dk/k

g) Worth of the 8 edge pin elements removed = (92.080 - 86.975) x 1.900 x 10-4 - (92.080 - 55.078) x 1.990 x l0-4= -63.93 x l0-4 dk/k

*Resulting total reactivity change*

Assuming separability, the worth of replacing 69 central pin elements by plate elements is 66.58 x 10-4 dk/k and the worth of replacing 66 edge plate elements by pin elements is -2.16 x 10-4 dk/k. The reactivity change resulting from replacing the pin elements by plate elements at the core centre, the plate elements by pin elements at the core boundary and removing the 8 elements at the core edge is 0.49 x l0-4 dk/k.

(As in the case of the Assembly 23 measurement we can express this approximately as the difference in rod positions at the beginning and end of the sequence multiplied by the average of the rod worths in the core before and after the removal of the edge elements,

~ (87.450 - 86.975) x 1.945 x l0-4 dk/k = ~ 0.92 x l0-4 dk/k

The difference due to the difference in worth of absolute rod insertion in the two different sized cores is negligible.)

*Uncertainty in the reactivity change*

The random uncertainties on each reactivity measurement are ~ ± 0.5 x l0-4 dk/k arising primarily from reproducibility. Systematic uncertainties arise from the errors in the plutonium contents of the mixed oxide pins (± 0.2%) and the metal plates (± 0.1%) and are about ± 0.05 x l0-4 dk/k per element at the core centre (which for 69 elements is ± 3.5 x l0-4 ) and ± 0.03 x l0-4 dk/k per element at the core edge (which for 66 elements is ± 2 x l0-4 ).

The systematic uncertainty associated with the calibration of the control rods is (±5%) or ± 0.03 x 10-4 dk/k.

*Combining these uncertainties quadratically gives a total uncertainty of ± 4.1 x l0-4 dk/k.*

***On the above basis a critical core configuration can be defined. This is the core shown in Figure 1.23. It is the difference in keff relative to the value for Assembly 25 which is to be calculated, the measured value of this difference being 0.49* *± 4.1 x l0-4 dk/k.* *It is included with the criticality benchmarks in Section 3.1.1.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  |  | *3C* | *3C* | *3C* | *3C* | *3C* |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  | *3E* | *3E* | 3L | 3L | 3L | 3L | 3L | *3C* | *3C* |  |  |  |  |  |
| 51 |  |  |  |  | *3E* | 3H | 3H | 3B | 3B | 3B | 3B | 3B | 3H | 3H | *3E* |  |  |  |  |
| 50 |  |  |  | *3E* | 3A | 4 | 3D | 3B | 3B | 3B | 3B | 3B | 3D | 2 | 3A | *3E* |  |  |  |
| 49 |  |  | *3C* | 3B | 3D | 3RC | 3E | 3C | 3C | 3C | 3RC | 3RC | 3E | 3RC | 3D | 3B | *3RC* |  |  |
| 48 |  |  | *3C* | 9 | 3D | 3RC | 3E | 1C | 1C | 1CD | 1C | 1C | 3E | 3RC | 3D | 3D | *3RC* |  |  |
| 47 |  | *3C* | 3A | 3J | 3RA | 3TE | 1C | 1RE | 1C | 1C | 1C | 1C | 1C | 3TE | 3RA | 3J | 3A | *3C* |  |
| 46 |  | *3C* | 3A | 6 | 3RA | 3TE | 1C | 1RE | 1C | 1C | 1C | 1C | 1C | 3TE | 3RA | 8 | 3A | *3C* |  |
| 45 |  | *3C* | 3B | 3E | 3E | 3E | 1C | 1C | 1C | 1C | 1C | 1C | 1CD | 3E | 3E | 3E | 3B | *3C* |  |
| 44 |  | *3C* | 3A | 7 | 3D | 3TE | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 3E | 3D | 5 | 3A | *3C* |  |
| 43 |  | *3C* | 3A | 3J | 3D | 3TE | 1C | 1C | 1C | 1CD | 1RE | 1RE | 1C | 3TE | 3D | 3J | 3A | *3C* |  |
| 42 |  |  | *3RC* | 3D | 3D | 3RC | 3E | 1C | 1C | 1CD | 1C | 1C | 3E | 3RC | 3D | 3E | *3C* |  |  |
| 41 |  |  | *3RC* | 3D | 3D | 3RC | 3E | 3RC | 3RC | 3C | 3C | 3C | 3E | 3RC | 3D | 3E | *3C* |  |  |
| 40 |  |  |  | *3C* | 3A | 1 | 3H | 3B | 3B | 3B | 3B | 3B | 3H | 3 | 3A | *3C* |  |  |  |
| 39 |  |  |  |  | *3E* | 3H | 3H | 3B | 3B | 3B | 3B | 3B | 3H | 3H | *3E* |  |  |  |  |
| 38 |  |  |  |  |  | *3C* | *3C* | 3L | 3L | 3L | 3L | 3L | *3E* | *3E* |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  | *3C* | *3C* | *3C* | *3C* | *3C* |  |  |  |  |  |  |  |

Figure 1.22 Central Plate Zone in Assembly 23A

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  | 387 | 3C3 | 3C3 | 3C3 | 3C3 | 387 |  |  |  |  |  |  |  |
| 52 |  |  |  |  | 303 | 3C3 | 3C3 | 387 | 387 | 387 | 387 | 387 | 3C3 | 3C3 | 303 |  |  |  |  |
| 51 |  |  |  | 3C3 | 303 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 303 | 3C3 |  |  |  |
| 50 |  |  | 3C3 | 3C3 | 3A1 | 4 | 303 | 387 | 387 | 387 | 387 | 387 | 303 | 2 | 3A1 | 304 | 304 |  |  |
| 49 |  |  | 3C3 | 387 | 303 | 3C3 | 304 | *Z* | *Z* | *Z* | *Y* | *Z* | 304 | 3C3 | 303 | 387 | 3C3 |  |  |
| 48 |  |  | 3C3 | 9 | 303 | 3C3 | *Z* | *Z* | *Z* | *Z* | *Y* | *Z* | *Z* | 3C3 | 303 | 303 | 3C3 |  |  |
| 47 |  | 3C3 | 3A1 | 3J6 | 3A1 | *Z* | *Z* | *Y* | *Y* | *Y* | *Y* | *Y* | *Z* | *Z* | 3A1 | 3J2 | 3A1 | 3C3 |  |
| 46 |  | 3C3 | 3A1 | 6 | 3A1 | *Z* | *Z* | *Z* | *Y* | *Y* | *Y* | *Y* | *Z* | *Z* | 3A1 | 8 | 3A1 | 3C3 |  |
| 45 |  | 3C3 | 387 | 304 | 304 | *Y* | *Y* | *Y* | *Y* | *Y* | *Y* | *Y* | Y | *Z* | 305 | 301 | 387 | 3C3 |  |
| 44 |  | 3C3 | 3A1 | 7 | 303 | *Y* | *Y* | *Y* | *Y* | *Y* | *Y* | *Y* | *Z* | *Z* | 303 | 5 | 3A1 | 3C3 |  |
| 43 |  | 3C3 | 3A1 | 3J6 | 303 | *Z* | *Z* | *Y* | *Y* | *Y* | *Y* | Z | *Z* | Y | 303 | 3J2 | 3A1 | 3C3 |  |
| 42 |  |  | 3C3 | 303 | 303 | 3C3 | *Y* | *Z* | *Y* | *Z* | *Z* | *Z* | *Z* | 3C3 | 303 | 304 | 3C3 |  |  |
| 41 |  |  | 3C3 | 303 | 303 | 3C3 | 304 | *Z* | *Y* | *Z* | *Z* | *Z* | 304 | 3C3 | 303 | 304 | 3C3 |  |  |
| 40 |  |  | 3C3 | 3C3 | 3A1 | 1 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 3 | 3A1 | 3C3 | 3C3 |  |  |
| 39 |  |  |  | 3C3 | 304 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 303 | 3C3 |  |  |  |
| 38 |  |  |  |  | 304 | 3C3 | 3C3 | 387 | 387 | 387 | 387 | 387 | 3C3 | 3C3 | 303 |  |  |  |  |
| 37 |  |  |  |  |  |  |  | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 301 |  |  |  |  |  |  |

Figure 1.23 Central Plate Zone in Assembly 25

The plate geometry elements are denoted by Y and Z, the difference between these two types being in the “dummy” plates which replace the sodium plates.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  | *C* | *B* | *B* | *A* | *A* | *B* | *D* |  |  |  |  |  |  |
| 52 |  |  |  |  | *C* | *A* | *A* |  |  |  |  |  | *A* | *A* | *C* |  |  |  |  |
| 51 |  |  |  | *B* | *C* |  |  |  |  |  |  |  |  |  | *C* | *B* |  |  |  |
| 50 |  |  | *B* | *B* |  |  |  |  |  |  |  |  |  |  |  | *C* | *C* |  |  |
| 49 |  | *D* | *A* |  |  |  |  | 2 | 2 | 2 | 2 | 2 |  |  |  |  | *A* |  |  |
| 48 |  | *D* | *A* |  |  |  | 3 | 2 | 2 | 2 | 2 | 2 | 3 |  |  |  | *A* | *D* |  |
| 47 |  | *B* |  |  |  | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 3 | 3 |  |  |  | *B* |  |
| 46 |  | *A* |  |  |  | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 3 | 3 |  |  |  | *B* |  |
| 45 |  | *A* |  |  |  | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 3 | 3 |  |  |  | *A* |  |
| 44 |  | *B* |  |  |  | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 3 | 3 |  |  |  | *A* |  |
| 43 |  | *B* |  |  |  | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 3 | 3 |  |  |  | *B* |  |
| 42 |  | *D* | *A* |  |  |  | 3 | 2 | 2 | 2 | 2 | 2 | 3 |  |  |  | *A* | *D* |  |
| 41 |  |  | *A* |  |  |  |  | 2 | 2 | 2 | 2 | 2 |  |  |  |  | *A* | *D* |  |
| 40 |  |  | *C* | *C* |  |  |  |  |  |  |  |  |  |  |  | *B* | *B* |  |  |
| 39 |  |  |  | *B* | *C* |  |  |  |  |  |  |  |  |  | *C* | *B* |  |  |  |
| 38 |  |  |  |  | *C* | *A* | *A* |  |  |  |  |  | *A* | *A* | *C* |  |  |  |  |
| 37 |  |  |  |  |  |  | *D* | *B* | *A* | *A* | *B* | *B* | *C* |  |  |  |  |  |  |

Figure 1.24 Sequence of Element Changes in Assembly 25

The order of replacement of the central pin elements by plate elements is the 25 elements denoted by 1, followed by the 20 elements denoted by 2 and then the 24 elements denoted by 3. The edge element replacements follow the sequence A, B and C, with the fuelled elements denoted by D being replaced by blanket elements.

### 1.4.3 Description of the Material Data

#### Components of Special Elements used for Reactivity Worth and Cell Reaction Rate Distribution Measurements.

Table 1.M27 The Half-thickness Plutonium Plate, PUJ16

Pu241/Am241 corrected to JULY 1982

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage weight |
|  |  |  |
| AL | 0.472 | 1.317 |
|  |  |  |
| PU238 | 0.008 | 0.022 |
| PU239 | 32.253 | 89.987 |
| PU240 | 2.816 | 7.857 |
| PU241 | 0.271 | 0.756 |
| PU242 | 0.016 | 0.045 |
| AM241 | 0.006 | 0.017 |
|  |  |  |
| Total | 35.842 |  |

**Can region:**

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage weight |
|  |  |  |
| C | 0.0040 | 0.040 |
| SI | 0.0607 | 0.600 |
| P | 0.0020 | 0.020 |
| S | 0.0015 | 0.015 |
| TI | 0.0303 | 0.300 |
| CR | 1.8198 | 18.000 |
| MN | 0.1264 | 1.250 |
| FE | 7.0037 | 69.275 |
| NI | 1.0615 | 10.500 |
|  |  |  |
| Total | 10.099 |  |

Table 1.M28 The Mixed Oxide Plate, PUIV4.

This is used in the Plutonium Enrichment Measurements and in the plutonium oxide element C22 04A

The reference date for Pu241/Am241 is 25.1.71 *(not corrected for Pu241 decay)*

**Core region**:

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage weight |
|  |  |  |
| C | 0.0168 | 0.013 |
| O | 15.4510 | 11.824 |
| AL | 0.0168 | 0.013 |
| SI | 0.0168 | 0.013 |
| FE | 0.0168 | 0.013 |
| NI | 0.0168 | 0.013 |
|  |  |  |
| U234 | 0.0040 | 0.003 |
| U235 | 0.6120 | 0.468 |
| U238 | 85.4890 | 65.419 |
| NP237 | 0.0010 | 0.001 |
| PU239 | 25.7100 | 19.674 |
| PU240 | 2.8860 | 2.208 |
| PU241 | 0.2920 | 0.223 |
| PU242 | 0.0260 | 0.020 |
| AM241 | 0.1237 | 0.095 |
|  |  |  |
| Total | 130.6786 |  |

**For Pu241 and Am241, to obtain values for June /1981 reduce the Pu241 content by multiplying by the factor = 0.605 and add the difference, 0.395 times the original Pu241 content, to the Am241.**

**Can region**

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage by weight |
|  |  |  |
| H | 0.000086 | 0.0005 |
| C | 0.008580 | 0.05 |
| SI | 0.070356 | 0.41 |
| P | 0.003432 | 0.02 |
| S | 0.003432 | 0.02 |
| CR | 3.071630 | 17.90 |
| MN | 0.255683 | 1.49 |
| FE | 11.921030 | 69.47 |
| NI | 1.714280 | 9.99 |
| NB | 0.111540 | 0.65 |
|  |  |  |
| Total | 17.159970 |  |

Table 1.M29 The Plutonium Plate PUII8

*(not corrected for Pu-241 decay)*

**Core region**:

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage by weight |
|  |  |  |
| H | 0.0012 | 0.002 |
| C | 0.0098 | 0.013 |
| AL | 0.0098 | 0.013 |
| SI | 0.0098 | 0.013 |
| FE | 0.0098 | 0.013 |
| NI | 0.0098 | 0.013 |
| GA | 1.2800 | 1.762 |
|  |  |  |
| NP237 | 0.0230 | 0.032 |
| PU239 | 67.4920 | 92.924 |
| PU240 | 3.5100 | 4.833 |
| PU241 | 0.1920 | 0.264 |
| AM241 | 0.0845 | 0.116 |
|  |  |  |
| Total | 72.6316 |  |

Pu241 and Am241 Values for June /1981 (Correction Factor Pu241 = Pu241 x 0.605)

**Can region:**

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percentage by weight |
| **Steel region** |  |  |
| H | 0.000081 | 0.0005 |
| C | 0.011291 | 0.07 |
| SI | 0.054842 | 0.34 |
| P | 0.003226 | 0.02 |
| S | 0.003226 | 0.02 |
| CR | 2.925974 | 18.14 |
| MN | 0.151622 | 0.94 |
| FE | 11.494230 | 71.26 |
| NI | 1.485571 | 9.21 |
|  |  |  |
| Total | 16.130040 |  |
| **Copper region** |  |  |
| CU | 5.87 |  |
|  |  |  |
| Overall total | 22.00 |  |
|  |  |  |

Table 1.M30 Plates used in the Reactivity Worth Measurements

**STSTBR8 Stainless steel**

PLATE THICKNESS -------- 0.3172 ± 0.0005 cm

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Weight (%) |
|  |  |  |
| H | 0.0003 | 0.0005 |
| C | 0.1268 | 0.2000 |
| AL | 0.0635 | 0.1000 |
| SI | 0.5074 | 0.8000 |
| TI | 0.1903 | 0.3000 |
| CR | 11.4821 | 18.1000 |
| MN | 0.6977 | 1.1000 |
| FE | 44.0116 | 69.3995 |
| NI | 6.1513 | 9.7000 |
| CU | 0.0635 | 0.1000 |
| MO | 0.1268 | 0.2000 |
|  |  |  |
| Total | 63.4213 | 100.0000 |

**STSTF8T** Stainless steel

PLATE THICKNESS -------- 0.2963 cm

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Weight (%) |
|  |  |  |
| H | 0.0001 | 0.0004 |
| C | 0.0053 | 0.0230 |
| AL | 0.0162 | 0.0702 |
| SI | 0.1130 | 0.4894 |
| P | 0.0063 | 0.0273 |
| S | 0.0023 | 0.0100 |
| TI | 0.0600 | 0.2598 |
| CR | 4.1800 | 18.1028 |
| MN | 0.4156 | 1.7999 |
| FE | 15.6250 | 67.6691 |
| NI | 2.6090 | 11.2991 |
| CU | 0.0162 | 0.0702 |
| NB | 0.0023 | 0.0100 |
| MO | 0.0390 | 0.1689 |
|  |  |  |
| Total | 23.0903 | 100.0000 |

**STSTSR4**

This is a stainless steel plate corresponding approximately, in weight and dimensions, to the can of a sodium plate, or a "dummy" plate (weight 17.60 g). It replaces a UO2 plate in the reactivity perturbation measurements. It is recommended to use the data in Table 1.M.4.

**GII8 Graphite**

PLATE THICKNESS -------- 0.31775 ± 0.0005 cm

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Weight (%) |
|  |  |  |
| H | 0.0003 | 0.002 |
| C | 13.8470 | 99.984 |
| S | 0.0005 | 0.004 |
| FE | 0.0014 | 0.010 |
|  |  |  |
| TOTAL | 13.8492 | 100.000 |

**ALF2 45% Aluminium**

PLATE THICKNESS -------- 1.27 cm

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Weight (%) |
|  |  |  |
| AL | 32.8400 | 99.690 |
| SI | 0.0033 | 0.010 |
| MN | 0.0020 | 0.006 |
| FE | 0.0955 | 0.290 |
| CU | 0.0014 | 0.004 |
|  |  |  |
| TOTAL | 32.9422 | 100.000 |

**AL2O34 Aluminium oxide**

PLATE THICKNESS 0.6317 ± 0.0005 cm

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Weight (%) |
|  |  |  |
| H | 0.0014 | 0.0023 |
| B10 | 0.0012 | 0.0020 |
| B11 | 0.0049 | 0.0081 |
| O | 28.6050 | 47.0786 |
| AL | 32.1476 | 52.9090 |
|  |  |  |
| TOTAL | 60.7601 | 100.0000 |

**AL8 Aluminium**

PLATE THICKNESS -------- 0.3167 cm

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Weight (%) |
|  |  |  |
| AL | 21.6200 | 99.690 |
| SI | 0.0022 | 0.010 |
| MN | 0.0013 | 0.006 |
| FE | 0.0629 | 0.290 |
| CU | 0.0009 | 0.004 |
|  |  |  |
| Total | 21.6873 | 100.000 |

Table 1.M.31 The Pins used in the Reactivity Worth Measurements

**MSTPINA The mild steel pin**

Note: The hydrogen content assumes that it was present as *5* ppm of the steel and as 4 mg/cm2 in the MkII blacking.

|  |  |  |
| --- | --- | --- |
| Nuclide | Weight (g) | Percent Weight |
|  |  |  |
| H | 0.00118 | 0.0007 |
| C | 0.25 | 0.1527 |
| SI | 0.08 | 0.0489 |
| P | 0.026 | 0.0159 |
| S | 0.075 | 0.0458 |
| MN | 1.28 | 0.7819 |
| FE | 162.0 | 98.9542 |
|  |  |  |
| Total | 163.7122 |  |

The compositions given in the ZEBRA Database do not include trace impurities for the following components.

Two "6 inch" pins were used, giving a total length of 29.5 cm. To indicate that the weights refer to the two pins a number 2 is placed in front of the component identifier.

**2ALPINA**

AL 55.34 g

TOTAL CORE WEIGHT IS 55.34 g

**2ALOPINA**

O 35.88 g

AL 40.32 g

TOTAL CORE WEIGHT IS 76.20 g

**2CPINA**

C 35.04 g

TOTAL CORE WEIGHT IS 35.04 g

### 1.4.4 Description of Temperature Data

Where information has been given the measurements have been corrected to a temperature of 300K and this temperature should be assumed. Measurements could have been made at temperatures up to about 340K.

### 1.4.5 Additional Relevant Information.

None.

## 1.5 Description of Reactivity Coefficient Measurements

**Measurements were made of the variation of reactivity with time (associated with Pu241 decay) and the variation with temperature. These were used to correct reactivity measurements but are not proposed as benchmarks.**

#### Pu241 Decay.

The variation of reactivity with time, associated with the decay of Pu241 to Am241, was measured and found to be -78 x 10-6 dk per month (ZTN22/10). *This measurement was made to correct the measured reactivity of cores to the reference date, June 1981 and is not proposed as a benchmark measurement.*

#### Temperature Corrections

*Measurements were made in each of the assemblies to relate changes in the control rod setting to changes in the core temperature in order to correct the measured assembly reactivities to values at 300K, the temperature applicable to calculation. These are described in Section 1.1.4. These are not proposed as benchmark measurements.*

## 1.6 Description of Kinetics Measurements

The measurements made to calibrate the control rod reactivity worths in terms of delayed neutron data are described in Section 1.4.6. The control rods were calibrated by inverse kinetics (see ZTN22-3 for details). *These are part of the reactivity scale calibration and are not proposed as benchmark experiments.*

## 1.7 Description of Reaction-Rate Distribution Measurements

### 1.7.1 Overview.

#### Axial Reaction Rate Scans Through Cells

To provide additional data for checking cell calculation methods reaction rate scans were measured in the standard cells of Assembly 22 and in modified cells. One modification involved combining the plutonium plates from two cells, thus forming a double sized cell. Another consisted of replacing the plutonium plate by two half-thickness plates and then separating them in the cell. The reaction rates which were measured were F49, F28, C28, Rh103(n,n’) and In115(n,n’) (and F40 in the standard cell). These measurements are described in ZTN22-14 together with the MURAL/FGL5 calculations made to compare with them.

#### Multichamber Scanning Measurements

Measurements of the Pu239 fission rate distributions using the installed multichamber scanning system were made in each assembly, and in the intermediate assemblies. The measurements were made in 20 core elements and at 5 axial levels (-38.03 cm, -19.23, -0.52, 18.31 and 37.06cm, the core half height in Assembly 22 being 44.66 cm). These positions correspond to the sodium plate at the top of the plate geometry cell which is 11 cells below the centre line, 6 cells below, 1 cell below, 5 cells above and 10 cells above.

It is necessary to model the control rods in calculations of these distributions. The boron absorber sections at the tops of the rods can cause an axial asymmetry Details of the compositions of the rods have been given in Section 1.1 but have not been prepared, in the present document, in a form suitable for direct use in the calculation of the reaction rate distributions.

#### Axial and Radial Reaction Rate Scan Measurements through Assemblies made using Foils .

A series of axial and radial reaction rate scans were made for Pu239 fission, U238 fission, and capture, in Assemblies 24 and 25 and the provisional results were presented in graphical form in ZTN22-10 Figures 11 to 14. The measurements extended through the core and axial and radial blanket regions. The uncertainties had not been assessed in detail, but on the basis of previous experience the uncertainties were judged to be less than 1% in the core region rising to about 3% in the outer blanket regions.

These have not been analysed in the present document.

### 1.7.2A Description of the Experimental Configuration

The assembly configurations and the experimental geometry of the environment of the measurements are described in Section 1.1.

The positions and dimensions of the multichambers are shown in Figure 1.7B and described in Section 1.1.2.

### 1.7.2B Methods

Details of the foils used in the scan measurements are given in ZTN22-14. (These foil measurements are not being proposed as benchmark measurements.)

The multichamber scanning system is described in BTN/30 and the measurements in the Cadenza cores in ZTN22-10.

### 1.7.2C Results

#### Reaction Rate Scan Measurements in the Standard Plate Geometry Cells of Assembly 22 and in Modified Cells.

In the standard cell the Pu239 fission rate is about 2% higher in the plutonium plate than in the UO2 plate, the standard deviation on individual measurements being about ± 0.4%. For U238 fission the range is about 25%, the value in the plutonium plate being about 20% higher than in the UO2 plate (the standard deviation being about ± 0.5%). For Rh103(n,n’) the variation is also large, about ± 8%, and for In113(n,n’) it is about ± 10% with a larger standard deviation of about ± 1% to ± 2%. For U238 capture the variation is not significant.

For the cell with the half-thickness plutonium plates the variations are not significant for Pu239 fission and U238 capture, and are correspondingly smaller for the other reactions. In the case of the double thickness plutonium plate the variations are correspondingly greater.

In ZTN22-14 the measurements were compared with calculations made using a one-dimensional cell model and the variation was underestimated for the threshold reactions, in particular for U238 fission. A calculation for this reaction made using a three-dimensional cell model was indicating satisfactory agreement.

It is probably sufficient to calculate the U238 fission rate distribution as part of the validation of a cell calculation method. The measurements were corrected for the global axial variation of the cell fluxes in the reactor. Reference should be made to ZTN22-14 for a comprehensive description of the measurements and the MURAL/FGL5 cell code analysis.

#### Measurements made using the Multichamber Scanning System.

Results are presented in ZTN22-10. A scan made in Core 22B (scan 285) is reproduced in Figures 1.25 A to E and the loading and control rod positions are given below the Figure 1.25A. The chambers were located in the same positions in all assemblies and the differences between the fission rates were small and understandable in terms of the changes in core dimensions. Normalisation is to the value 10000 at the core centre.

The differences between the measurements made in Core 24 and Core 22A are presented in Figs 1.26 A to E (scan 291 in Core 24 compared with scan 238 in Core 22A, these having similar control rod settings) and the core loadings and control rod positions are given below Figure 1.26A. In this case the normalisation of each set of measurements is to the same total counts. In the analyses of these scan measurements the ZEBRA team took into account the control rod insertion. A comparison is also made in ZTN22-10 between a scan measurement made in Core 25 and one in Core 23.

The installed fission chamber system is shown in Figure 1.27. It has a limitation when used for the accurate determination of axial distributions. It is difficult to locate and measure chamber deposits to better than ~l mm, and this is further complicated by the effects of settling and thermal expansion. A 1mm shift in the effective core centre plane is equivalent to an approximate change of 0.5% in the fission-rate at the 37.06 position.

The uncertainties in the relative fission rates are

±0.4% (from the relative mass determination)

±0.1 - 0.3% (from the uncertainty in axial position, the uncertainty depending on the flux gradient)

±0.25% (counting statistics)

a total uncertainty of about ±0.6%

The insertion of the chamber in the element results in a change in the local cell composition, although the effect of this on the relative fission rates is considered to be negligibly small.

The measurements show that the CADENZA cores appear symmetrical in the all-rods-raised configuration.

### 1.7.3 Description of the Material Data

The material data for the environment of the measurements is that described for the criticality models in Section 1.1

The details of the compositions of the chambers used to make the multichamber scan measurements are given in Section 1.1.4.

### 1.7.4 Description of Temperature Data

Temperature data for the measurements have not been documented. They are probably in the range 300K to 340K.

### 1.7.5 Additional Relevant Information.

None.

## 1.8 Description of Power Distribution Measurements

Not measured.

## 1.9 Description of Isotopic Measurements

Not measured.

## 1.10 Other Miscellaneous Types of Measurements

None measured.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 |
| 53 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  |  |  |  | 3291 |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  | 4588 |  |  |  |  |  |  |  |  |
| 49 |  |  | 3799 |  |  |  |  |  |  |  |  |  | 3780 |  |  |
| 48 |  |  |  |  |  |  |  |  | 5470 |  |  |  |  |  |  |
| 47 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 46 |  |  |  |  |  |  | 6005 |  |  |  |  |  |  |  |  |
| 45 |  | 4007 |  | 5157 |  | 5853 |  | 6048 |  | 5871 |  | 5131 |  | 4031 |  |
| 44 |  |  |  |  |  |  |  |  | 6021 |  |  |  |  |  |  |
| 43 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  | 5486 |  |  |  |  |  |  |  |  |
| 41 |  |  | 3760 |  |  |  |  |  |  |  |  |  | 3822 |  |  |
| 40 |  |  |  |  |  |  |  |  | 4602 |  |  |  |  |  |  |
| 39 |  |  |  |  |  |  |  |  |  |  |  | 3263 |  |  |  |
| 38 |  |  |  |  |  |  | 3334 |  |  |  |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Figure 1.25A The Plutonium Fission Rate Distribution, Assembly 22B Level 1 (z = -38.03 cm)

Assembly 22B scan number 285. (25.09.1981) 215 element core. Normalised to 10,000 at core centre.

Initial control rod settings:

CR7 119.443 cm

CR8 119.738 cm

CR9 92.612 cm

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 |
| 53 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  |  |  |  | 4990 |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  | 6831 |  |  |  |  |  |  |  |  |
| 49 |  |  | 5701 |  |  |  |  |  |  |  |  |  | 5615 |  |  |
| 48 |  |  |  |  |  |  |  |  | 8148 |  |  |  |  |  |  |
| 47 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 46 |  |  |  |  |  |  | 8857 |  |  |  |  |  |  |  |  |
| 45 |  | 6017 |  | 7651 |  | 8703 |  | 8961 |  | 8714 |  | 7628 |  | 6046 |  |
| 44 |  |  |  |  |  |  |  |  | 8827 |  |  |  |  |  |  |
| 43 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  | 8115 |  |  |  |  |  |  |  |  |
| 41 |  |  | 5641 |  |  |  |  |  |  |  |  |  | 5729 |  |  |
| 40 |  |  |  |  |  |  |  |  | 6862 |  |  |  |  |  |  |
| 39 |  |  |  |  |  |  |  |  |  |  |  | 4897 |  |  |  |
| 38 |  |  |  |  |  |  | 4997 |  |  |  |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Figure 1.25B The Plutonium Fission Rate Distribution, Assembly 22B Level 2 (z = -19.23 cm)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 |
| 53 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  |  |  |  | 5562 |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  | 7594 |  |  |  |  |  |  |  |  |
| 49 |  |  | 6307 |  |  |  |  |  |  |  |  |  | 6280 |  |  |
| 48 |  |  |  |  |  |  |  |  | 9107 |  |  |  |  |  |  |
| 47 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 46 |  |  |  |  |  |  | 9892 |  |  |  |  |  |  |  |  |
| 45 |  | 6653 |  | 8511 |  | 9597 |  | 9999 |  | 9708 |  | 8530 |  | 6709 |  |
| 44 |  |  |  |  |  |  |  |  | 9857 |  |  |  |  |  |  |
| 43 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  | 9079 |  |  |  |  |  |  |  |  |
| 41 |  |  | 6217 |  |  |  |  |  |  |  |  |  | 6356 |  |  |
| 40 |  |  |  |  |  |  |  |  | 7632 |  |  |  |  |  |  |
| 39 |  |  |  |  |  |  |  |  |  |  |  | 5435 |  |  |  |
| 38 |  |  |  |  |  |  | 5574 |  |  |  |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Figure 1.25C The Plutonium Fission Rate Distribution, Assembly 22B Level 3 (z = -0.52 cm)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 |
| 53 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  |  |  |  | 4978 |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  | 6799 |  |  |  |  |  |  |  |  |
| 49 |  |  | 5650 |  |  |  |  |  |  |  |  |  | 5643 |  |  |
| 48 |  |  |  |  |  |  |  |  | 8131 |  |  |  |  |  |  |
| 47 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 46 |  |  |  |  |  |  | 8825 |  |  |  |  |  |  |  |  |
| 45 |  | 5964 |  | 7601 |  | 8525 |  | 8930 |  | 8690 |  | 7654 |  | 6042 |  |
| 44 |  |  |  |  |  |  |  |  | 8871 |  |  |  |  |  |  |
| 43 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  | 8028 |  |  |  |  |  |  |  |  |
| 41 |  |  | 5579 |  |  |  |  |  |  |  |  |  | 5732 |  |  |
| 40 |  |  |  |  |  |  |  |  | 6878 |  |  |  |  |  |  |
| 39 |  |  |  |  |  |  |  |  |  |  |  | 4886 |  |  |  |
| 38 |  |  |  |  |  |  | 4977 |  |  |  |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Figure 1.25D The Plutonium Fission Rate Distribution, Assembly 22B Level 4 (z = +18.31 cm)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 |
| 53 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  |  |  |  | 3306 |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  | 4544 |  |  |  |  |  |  |  |  |
| 49 |  |  | 3740 |  |  |  |  |  |  |  |  |  | 3794 |  |  |
| 48 |  |  |  |  |  |  |  |  | 5506 |  |  |  |  |  |  |
| 47 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 46 |  |  |  |  |  |  | 5997 |  |  |  |  |  |  |  |  |
| 45 |  | 3993 |  | 5087 |  | 5832 |  | 6066 |  | 5887 |  | 5164 |  | 4083 |  |
| 44 |  |  |  |  |  |  |  |  | 6032 |  |  |  |  |  |  |
| 43 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  | 5445 |  |  |  |  |  |  |  |  |
| 41 |  |  | 3771 |  |  |  |  |  |  |  |  |  | 3846 |  |  |
| 40 |  |  |  |  |  |  |  |  | 4584 |  |  |  |  |  |  |
| 39 |  |  |  |  |  |  |  |  |  |  |  | 3212 |  |  |  |
| 38 |  |  |  |  |  |  | 3317 |  |  |  |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Figure 1.25E The Plutonium Fission Rate Distribution, Assembly 22B Level 1 (z = +37.06 cm)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 |
| 53 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  | 535 |  |  |  |  |  |  |  |  |
| 49 |  |  | 889 |  |  |  |  |  |  |  |  |  | 931 |  |  |
| 48 |  |  |  |  |  |  |  |  | 176 |  |  |  |  |  |  |
| 47 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 46 |  |  |  |  |  |  | 12 |  |  |  |  |  |  |  |  |
| 45 |  | 831 |  | 308 |  | 23 |  | 22 |  | 58 |  | 361 |  | 752 |  |
| 44 |  |  |  |  |  |  |  |  | 121 |  |  |  |  |  |  |
| 43 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  | 141 |  |  |  |  |  |  |  |  |
| 41 |  |  | 998 |  |  |  |  |  |  |  |  |  | 873 |  |  |
| 40 |  |  |  |  |  |  |  |  | 535 |  |  |  |  |  |  |
| 39 |  |  |  |  |  |  |  |  |  |  |  | 1193 |  |  |  |
| 38 |  |  |  |  |  |  | 1350 |  |  |  |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Figure 1.26A The Plutonium Fission Rate Distribution in Core 24 relative to that in Core 22.

Fractional differences in units of 1 in10000, ((Core24/Core22A) - 1 )x104

The measurements in each core are normalised to the same total counts.

Level 1 (z = -38.03 cm)

Assembly 22A scan number 238. (20.01.1981) 215 element core loading.

Initial control rod settings: CR7 119.441 cm CR8 119.751 cm CR9 71.204 cm

Assembly 24 scan number 291. (20.01.1981) 222 element core loading.

Initial control rod settings: CR7 119.443 cm CR8 119.739 cm CR9 66.331 cm

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 |
| 53 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  | -25 |  |  |  |  |  |  |  |  |
| 49 |  |  | 360 |  |  |  |  |  |  |  |  |  | 427 |  |  |
| 48 |  |  |  |  |  |  |  |  | -388 |  |  |  |  |  |  |
| 47 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 46 |  |  |  |  |  |  | -500 |  |  |  |  |  |  |  |  |
| 45 |  | 253 |  | -281 |  | -526 |  | -566 |  | -502 |  | -259 |  | 235 |  |
| 44 |  |  |  |  |  |  |  |  | -545 |  |  |  |  |  |  |
| 43 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  | -468 |  |  |  |  |  |  |  |  |
| 41 |  |  | 366 |  |  |  |  |  |  |  |  |  | 375 |  |  |
| 40 |  |  |  |  |  |  |  |  | -28 |  |  |  |  |  |  |
| 39 |  |  |  |  |  |  |  |  |  |  |  | 722 |  |  |  |
| 38 |  |  |  |  |  |  | 826 |  |  |  |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Figure 1.26B The Plutonium Fission Rate Distribution in Core 24 relative to that in Core 22.

Fractional differences in units of 1 in10000, ((Core24/Core22) - 1 )x 104

Level 2 (z = -19.23 cm)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 |
| 53 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  | -148 |  |  |  |  |  |  |  |  |
| 49 |  |  | 247 |  |  |  |  |  |  |  |  |  | 227 |  |  |
| 48 |  |  |  |  |  |  |  |  | -529 |  |  |  |  |  |  |
| 47 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 46 |  |  |  |  |  |  | -703 |  |  |  |  |  |  |  |  |
| 45 |  | 157 |  | -393 |  | -657 |  | -694 |  | -658 |  | -370 |  | 123 |  |
| 44 |  |  |  |  |  |  |  |  | -723 |  |  |  |  |  |  |
| 43 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  | -528 |  |  |  |  |  |  |  |  |
| 41 |  |  | 244 |  |  |  |  |  |  |  |  |  | 197 |  |  |
| 40 |  |  |  |  |  |  |  |  | -115 |  |  |  |  |  |  |
| 39 |  |  |  |  |  |  |  |  |  |  |  | 566 |  |  |  |
| 38 |  |  |  |  |  |  | 682 |  |  |  |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Figure 1.26C The Plutonium Fission Rate Distribution in Core 24 relative to that in Core 22.

Fractional differences in units of 1 in10000, ((Core24/Core22) - 1 )x 104

Level 3 (z = -0.52 cm)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 |
| 53 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  | -19 |  |  |  |  |  |  |  |  |
| 49 |  |  | 388 |  |  |  |  |  |  |  |  |  | 444 |  |  |
| 48 |  |  |  |  |  |  |  |  | -404 |  |  |  |  |  |  |
| 47 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 46 |  |  |  |  |  |  | -559 |  |  |  |  |  |  |  |  |
| 45 |  | 333 |  | -248 |  | -503 |  | -531 |  | -468 |  | -254 |  | 241 |  |
| 44 |  |  |  |  |  |  |  |  | -528 |  |  |  |  |  |  |
| 43 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  | -611 |  |  |  |  |  |  |  |  |
| 41 |  |  | 419 |  |  |  |  |  |  |  |  |  | 349 |  |  |
| 40 |  |  |  |  |  |  |  |  | -35 |  |  |  |  |  |  |
| 39 |  |  |  |  |  |  |  |  |  |  |  | 766 |  |  |  |
| 38 |  |  |  |  |  |  | 810 |  |  |  |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Figure 1.26D The Plutonium Fission Rate Distribution in Core 24 relative to that in Core 22.

Fractional differences in units of 1 in10000, ((Core24/Core22) - 1 )x 104

Level 4 (z = +18.31 cm)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 |
| 53 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  | 613 |  |  |  |  |  |  |  |  |
| 49 |  |  | 1030 |  |  |  |  |  |  |  |  |  | 1071 |  |  |
| 48 |  |  |  |  |  |  |  |  | 334 |  |  |  |  |  |  |
| 47 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 46 |  |  |  |  |  |  | 81 |  |  |  |  |  |  |  |  |
| 45 |  | 964 |  | 391 |  | 112 |  | 103 |  | 131 |  | 355 |  | 949 |  |
| 44 |  |  |  |  |  |  |  |  | 37 |  |  |  |  |  |  |
| 43 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  | 276 |  |  |  |  |  |  |  |  |
| 41 |  |  | 1049 |  |  |  |  |  |  |  |  |  | 917 |  |  |
| 40 |  |  |  |  |  |  |  |  | 636 |  |  |  |  |  |  |
| 39 |  |  |  |  |  |  |  |  |  |  |  | 1419 |  |  |  |
| 38 |  |  |  |  |  |  | 1500 |  |  |  |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Figure 1.26E The Plutonium Fission Rate Distribution in Core 24 relative to that in Core 22.

Fractional differences in units of 1 in10000, ((Core24/Core22) - 1 )x104

Level 5 (z = +37.06 cm)



Figure 1.27 The Chambers of the Multi-chamber Scanning System being Loaded into a Double Element.

# 2. EVALUATION OF EXPERIMENTAL DATA

## 2.1 Evaluation of Critical or Subcritical Configuration Data

### 2.1.1 keff Values of the Four Assemblies, 22, 23, 24 and 25.

The experimental keff values given in Section 1.1 include corrections for raising the control rods out of the core, for the decay of Pu241 to Am241 (to give keff values for the reference date of June 1981) and for differences in temperature from 300K. Corrections were also made to simplify the reference core models by replacing the control rods and special elements by standard core elements. The uncertainties include allowances for the uncertainties in core height, diameter and plutonium content. These were considered to be the major sources of uncertainty in the dimensions and composition (as it affects the calculation of the keff values). Additional uncertainties have been included for the uncertainty in the core radius and the treatment of the inter-element gaps. The total uncertainties are 7.7 x 10-4 for the plate geometry cores and 12.7 x 10-4 for the pin geometry cores.

The resulting keff values and uncertainties based on the measured corrections made to derive measured reference assembly models are reproduced below in Table 2.1 (and are as given in Table 1.5).

Table 2.1 K-effective values and Uncertainties based on the Analyses made by the Measurers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Core 22 | Core 23 | Core 24 | Core 25 |
|  | Plate geometry  Sodium present | Pin geometry  Sodium present | Plate geometry  Sodium voided | Pin geometry  Sodium voided |
| **k-values of Reference Models** | **1.00217**  **± 0.00077** | **1.00162**  **± 0.00127** | **1.00228**  **± 0.00077** | **1.00132**  **± 0.00127** |

The steel super-lattice grid plates were omitted from the reference model of the assemblies derived by the ZEBRA measurement team but are included in the models proposed in the present document. The plates are 0.25 cm thick and 30.4 cm long. and coincide approximately with the axial blankets, being (nominally) between the planes at 50.2cm and 80.6 cm above and below the mid-plane. They correspond to a horizontally smeared density of 0.154 g/cc. The effect of including the steel homogeneously was calculated in ZTN22-13 (page 10) as 0.00008 and so was ignored as a correction. However, it should be noted that this is in contrast to the effect calculated for Zebra Assembly MZA using a spherical model - being 10 times larger at 0.0008 ± 0.0004 dk (MTN-45). A smaller figure was calculated for the larger core, Zebra Assembly MZB, -0.00056 ± 0.0003 dk (MTN-60) using an improved cylindrical model. These values are both significantly higher than the value calculated in ZTN22-13. Because of this uncertainty it is proposed to model these grid plates.

Other potential sources of uncertainty are discussed below. These concern the uncertainties in the other constituents of the core, in addition to the plutonium for which an uncertainty estimate has been made.

Calculations have been made using a simplified RZ geometry model and the core compositions of the Assembly 23 C type pin (using ERANOS with CARNAVAL-IV nuclear data). The core composition (reproduced in Appendix A.3) has been varied by increasing the plutonium, uranium oxide, and steel contents by 1% in turn. The results are as follows:

Table 2.2 Sensitivity of k-effective values to Changes in Composition.

|  |  |  |
| --- | --- | --- |
| Core Composition | keff | difference relative to the reference or voided core |
| Reference core (without H) | 0.98393 |  |
| Sodium voided core (without H) | 0.97029 | -0.01364 |
|  |  |  |
| Ref. +1% plutonium | 0.98905 | +0.00512 |
| Voided core . +1% plutonium | 0.97545 | +0.00516 |
|  |  |  |
| Ref. +1% uranium oxide | 0.98360 | -0.00033 |
| Voided core . +1% uranium oxide | 0.97006 | -0.00023 |
|  |  |  |
| Ref. +1% steel | 0.98405 | +0.00012 |
| Voided core . +1% steel | 0.97036 | +0.00007 |
|  |  |  |
| Reference core with H | 0.98445 | +0.00052 |
| Voided core with H | 0.97059 | +0.00030 |

It can be seen that the keff values and sodium voiding reactivity change are insensitive to changes in uranium oxide and steel compositions below the 1% level. If the uncertainty in the hydrogen content is assumed to be **±** 30% the associated uncertainty in the keff value of the reference core is ~ ± 2 x 10-4 dk/k and in the sodium voiding effect it is **±** 0.7 x 10-4 dk/k.

In the course of the sodium removal experiments the sodium plates were weighed (ZTN22-4). The weight of the plates in the 27 elements studied (1944 plates in all) was 0.2% higher than the value corresponding to the ZEBRA Database weight, 29.58 g per plate compared with the database figure of 29.52 g per plate (11.82 g sodium plus 17.70 g steel). This could imply a systematic error of ± 0.5% in the sodium content or ± 0.3% in the steel content of the sodium plates (or a combination of systematic errors in both the sodium and steel content).

The total steel in a plate geometry cell is made up as follows:

Pu plate 20.73 g

2 x UO2 plates 40.34 g

3 x Na plates 51.1 g

Steel plate 24.7 g

Sheath 42.73 g

Total 181.6 g

Because of probable cancellations of uncertainties between the systematic errors in the different steel components it is proposed to take the uncertainty in the total steel content of the plate cells to be ± 0.2% the associated uncertainty in keff being about 0.2 x 10-4 dk/k.

The uncertainties on the sodium contents of the pin cell mini-calandria are given with the mini-calandria data. They range from about ±0.2% to ±0.8%. Taking the systematic uncertainty to be ± 0.5% is probably an overestimate. The uncertainties quoted for the steel of the mini-calandria also range from about ±0.2% to ±0.8% and a systematic uncertainty of ± 0.5% is again probably an overestimate. When this is combined with the uncertainties in the other steel components, cans, tubes and sheath, the net systematic uncertainty in the steel content of the pin cells will reduce to about ± 0.3% or about 0.4 x 10-4 dk/k.

The measured differences in reactivity between the Cores 22 and 24, and between Cores 23 and 25, due to the removal or addition of sodium are about -130 x 10-4 dk/k. An uncertainty of ±0.5% in the sodium content of Cores 22 and 23 would result in an uncertainty of ±0.7 x 10-4 dk/k which is not significant in comparison with the uncertainties on the keff values given in Table 1.5.

Concerning the modelling of the plate geometry components (using a three dimensional square section representation of the plate) the MONK-JEF-2.2 Monte Carlo calculations (described in Section 3.1.1) of the difference between a three dimensional representation and a smeared two-dimensional representation gave differences of 40x10-4 dk/k. The uncertainties in the plate core dimensions have not been documented (and there is also the effect of the rounded corners of some of the plate core components). However, it is judged that the uncertainty would not contribute more than about 1x10-4 dk/k and so can be ignored. In the case of the pin geometry cells the effect of modelling simplifications, representing the cells as single cylindrical geometry pin cells rather than pin clusters, gave differences of about 20 x10-4 dk/k and so it is again considered that uncertainties in the dimensions of the minicalandria components do not significantly add to the uncertainties in keff.

A possible additional source of uncertainty is the alignment of the core sections of neighbouring elements but there are no estimates of this.

It can be mentioned that in the original analysis extrapolated all pin geometry cores were defined, based on measurements. These have the following keff values. However, these models have not been evaluated in the present document.

|  |  |
| --- | --- |
| Core | Extrapolated Experimental keff values |
| Extrapolated Flooded Pin Core | 1.0010 ± 0.0013 |
| Extrapolated Voided Pin Core | 1.0003 ± 0.0013 |

#### Possible effect of Back Scattering from the Materials Beyond the Axial and Radial Shielding.

The steel shielding is sufficiently thick to effectively isolate the core and blanket regions from the small fraction of neutrons scattered back from the structure of the facility lying beyond the assembly as defined here. These, as can be seen in Figures 1.1, 1.2, are the continuations of the element sheaths above and below the assembly, the spacer tubes in the elements and the base plate and top shield doors. To the side there is the space between the assembly and the biological shield. A calculation was made using the MONK-JEF-2.2 Monte Carlo code for Core 22 in which the thickness of the steel shield was increased by 3.4 cm on the radial shield radius and 6 cm at the top and bottom. This gave an increase in keff from 1.0001 ± 0.0001 to 1.0004 ± 0.0001, an increase of 0.0003 ± 0.00014. It is considered that the reflection of neutrons from the structures beyond the steel reflector/shielding would be less than this.

**It is concluded that all of the significant corrections and sources of uncertainty have been included in Table 1.5 and these data are recommended as the measured critical assembly data.**

### 2.1.2 Reactivity Differences between Assemblies.

**An essential component of the benchmark is the comparison of calculation with the differences between the keff values of the four Assemblies, that is the differences between the values of (C-E) calculated for the different assemblies.** The uncertainties in the differences between the keff values are as shown in Tables 2.3 and 2.4 (reproduced from Tables 1.6 and 1.7).

Table 2.3 Uncertainties affecting the values of the Differences between the keff values for Pin versus Plate Geometry Cores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Assembly | 22A | 23A | 24 | 25 |
| Type | Na-F1ooded Plate | Na-F1ooded Pin | Na-Voided Plate | Na-Voided Pin |
| **Total relative uncertainty** | ± 0.00131 | | ± 0.00130 | |

Table 2.4 Uncertainties affecting the values of the Differences between the keff values for Sodium Filled versus Sodium Voided Cores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Assembly | 22A | 24 | 23A | 25 |
| Type | Na-F1ooded Plate | Na-Voided Plate | Na-F1ooded Pin | Na-Voided Pin |
| **Total relative uncertainty)** | ± 0.00036 | | ± 0.00088 | |

In the case of the sodium filled versus the sodium voided cores the effects of possible uncertainties in the differences between the material contents of the normal and voided cores have been judged to be negligible. Even with an uncertainty of 0.2% in the difference in total steel content between the cores the contribution to the uncertainty in the differences in keff is negligibly small (see Table 2.2).

**The keff values, and the associated keff difference values, and uncertainties given in Table 2.1, 2.3 and 2.4 are recommended as the measured values and uncertainties to use with the specified benchmark assembly descriptions.**

The transition from one core to another was made in stages, with the changes being balanced using the control rods. The rod worths were recalibrated at points during the transition. In this way the reactivity change in going from one assembly to another was measured. The measurements are described in ZTN22-10, which gives the results for each stage of the transition. *However the quoted uncertainties on the resulting differences are larger than the values given in Tables 2.3 and 2.4 and so they are not recommended as benchmarks.*

### 2.1.3 The Two Intermediate Assemblies having Plate Zones at the Centres of the Pin Geometry Cores.

In Section 1.4.7 the measurements made of the reactivity difference between Core 23 and the modified core with the central plate geometry zone are described. This modified core is also specified as a critical core, as is the corresponding modified version of Core 25 with the central plate geometry zone. The cores are defined by Figures 1.22 and 1.23. **The differences between the values of reactivity for the intermediate cores and the reference cores, Core 23 and Core 25, as given in Table 2.5, are the recommended benchmarks.**

Table 2.5 The Reactivity Differences between the Reference Assemblies and the Versions with the central Plate Geometry Zones.

Difference between Assembly 23 and the plate zone version (12.8 ± 3.1) x 10-4 dk/k.

Difference between Assembly 25 and the plate zone version (0.5 ± 4.1) x l0-4 dk/k.

## 2.2 Evaluation of Buckling and Extrapolation Length Data

*These were not derived for the CADENZA cores.*

## 2.3 Evaluation of Spectral Characteristics Data

### 2.3.1 Spectral Index Measurements in the Plate Geometry Assembly 22

As described in Section 1.3 the measurements were made using both fission chambers and foils. Fission chamber measurements were made for U235, U238, Pu239, Pu240 and Pu241. The foil measurements were made for fission in U235, U238 and Pu239 and capture in U238. As described in ZTN22-9, corrections were applied for the radial and axial variations in the reaction rates to obtain cell average values. The corrections for F25, F28 and C28 were based on measurements made of the radial and axial variations within the uranium oxide plates and on the surfaces, for the different plates in a cell, whereas the correction to the measurement made for F49 in the steel plate next to the plutonium plate was based on calculations made using the MURAL collision probability cell code. This was an increase of 0.65% ± 0.3%.

The fission chamber measurements of F28/F25, F25/F49, F40/F49 and F4l/F49 were made using absolutely-calibrated fission chambers in a half-element in the central core location (50,45). The fission chamber foils were located 1.0 ± 0.5 mm above the sodium plate.

It is possible to approach the question of the assessment of uncertainties by looking at the consistency between the measurements made in Core 22 and in other ZEBRA cores and also at the consistency between the measurements made by the ZEBRA team and also by other teams (using their own equipment) in both ZEBRA and in the IRMA intercomparison measurements made in the French Assembly MASURCA.

### 2.3.2A Comparisons with Measurements made in other ZEBRA assemblies.

Measurements were made in a region of basically identical core cells to those in Core 22 in the annular core region of the radially heterogeneous assembly BZD. This had a large central blanket region and was built in three versions. BZD/1 contained half inserted mock-up control rods in the core region, BZD/2 contained control rod followers and BZD/3 had a uniform annular core region. These environmental effects could result in the overall spectrum being different from that in Assembly 22 but the results of the fission chamber measurements are broadly consistent with the Assembly 22 values as can be seen from the results of the comparison of the chamber measurements presented in Table 2.6. The measurements made in BZD/1 are described in BTN-131 and those in BZD/3 in BTN-118.

Table 2.6 Comparison of Fission Chamber Measurements made in Core 22 and the cores BZD/1 and BZD/3 which used the Same Core Cell as Core 22 but in a Radially Heterogeneous Core Arrangement (central blanket zone).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Core 22 | BZD/1 | BZD/3 | Percent diff BZD/1 -Core22 | Percent diff BZD/3 -Core22 |
| F28/F25 Chamber | 0.03483  (± 0.4%r 0.6%s) | 0.03473  (± 0.7%) | 0.03398  (± 0.4%r 0.6%s) | -0.3% | -2.2 |
| F25/F49 Chamber | 0.960  (± 0.4%r 1.0%s) | 0.975  (± 1.1%) | 0.9775  (± 0.1%r 1.0%s) | +1.5% | +1.8% |
| F40/F49 Chamber | 0.2594  (± 0.9%r 1.8%s) | 0.2574  (± 2.0%) | 0.2578  (± 0.1%r 2.2%s) | -0.8% | -0.6% |
| F41/F49 Chamber | 1.217  (± 0.5%r 3.8%s) | 1.229  (± 3.2%) | 1.237  (± 0.1%r 3.4%s) | +1.0% | +1.6% |

‘r’ denotes a random uncertainty and ‘s’ a systematic uncertainty. Examples of the sources of the systematic errors are the foil and chamber mass calibrations and the corrections made to obtain the cell averaged values. These would be common to the measurements in other cell configurations and in other ZEBRA assemblies.

The conclusion drawn from these comparisons is that the chamber measurements made in the Zebra 22 assembly are consistent with those made in the earlier cores to within the quoted uncertainties (bearing in mind the possible effects on the neutron spectrum of the differences in core geometry, such as the nearness of blanket elements).

The BZD values of F25/F49 ratios have been reduced by 1% to take account of the revised value of the Pu239 half-life used in the alpha assay.

*However, it is stated in BTN-131, that the threshold fission ratios have been increased to allow for inelastic scattering in the surrounding steel, the increase being 1.5% for F28/F25 and 0.6% for F40/F49. Because of difficulties in modelling the chambers and their surroundings it is also proposed there that additional modelling uncertainties should be included, these being ± 1.0% for F25/F49 and F41/F49 and ± 4.0% for F28/F25 and F40/F49.*

These comparisons with the measurements made in the BZD cores show that the measured values have only a small sensitivity to changes in core geometry and dimensions.

A similar good consistency of the measurements is found between other assemblies which had the same, or similar, core region cells. The comparison can be extended to earlier cores with different basic cells, comparing the (C-E)/E% values. These are not as consistent but this could be a consequence of the differences in composition.

### 2.3.2B Intercomparisons with the Measurements made by Other Groups.

The reaction rate ratio measurements were made in Core 22 by the AEEW ZEBRA Group and also by a team of scientists from ANL. The results are given in Table 2.7 for both the cell average values and the chamber measurements.

Table 2.7 Reaction Rate Ratio Measurements in Assembly 22

|  |  |  |  |
| --- | --- | --- | --- |
| Reaction rate ratio | Measured by AEEW team | Measured by ANL team | (ANL/AEEW –1)% |
|  |  |  |  |
| F28/F25  (Cell Average) | 0.03634  (± 1.1%r 0.6%s) | 0.03757  (± 0.6%r 1.6%s) | +3.4 ± 2.0 |
| F25/F49  (Cell Average) | 0.959  (± 1.1%r 1.0%s) | 0.941  (± 0.6%r 1.0%s) | -1.9 ± 1.8 |
| C28/F49  (Cell Average) | 0.1266  (± 0.9%r 0.5%s) | 0.1226  (± 0.6%r 1.2%s) | -3.2 ± 1.5 |
| F28/F25 (Chamber) | 0.03483  (± 0.4%r 0.6%s) | 0.03566  (± 0.4%r 1.6%s) | +2.4 ± 1.8 |
| F25/F49 (Chamber) | 0.960  (± 0.4%r 1.0%s) | 0.948  (± 0.3%r 1.6%s) | -1.3 ± 1.9 |
| F40/F49 (Chamber) | 0.2594  (± 0.9%r 1.8%s) |  |  |
| F41/F49 (Chamber) | 1.217  (± 0.5%r 3.8%s) |  |  |

The agreement is not within the estimated standard deviations for the F28/F25 and C28/F49 measurements.

A further insight into the confidence one can have in the measurements made by the AEEW Winfrith team is provided by the IRMA inter-comparison exercise carried out in the MASURCA facility at Cadarache in France. Several teams participated in the exercise and Table 2.8 compares their measurements with those made by the AEEW team (ZTN/IRMA/1 and 2, 1988).

Table 2.8 Comparison of the Reaction Rate Ratio Measurements made in MASURCA by different Participants in the IRMA Intercomparisons.

Comparisons are with the measurements made by the AEE Winfrith, UK, team.

{(Participant/AEEW)-1)%}

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Relative Cell Average Ratios  {(Participant/AEEW)-1}% | | | |
| Participant | C28/F25  Thermal | C28/F25  Absolute | F28/F25 | F49/F25 |
| KfK Karlsruhe, Germany |  | +9.1 | +4.8 | + 2.3 |
| CEN-SCK Mol, Belgium (Chambers)  (Foils) |  | +4.7 | +2.7  +0.7 | +0.3 |
| ENEA, Italy |  | +5.3 | +0.2 | - |
| CEA, Cadarache, France | +4.0 | +5.0 | +0.6 | +1.7 |
| EIR, Switzerland | +2.4 | +4.0 | +2.5 | +0.8, +1.0 |
| ANL, USA(CEA Foils)  (ANL Foils) | +4.5  -4.1 |  | +2.9  +0.7 | -1.0 |
| CEA/SEN France | -1.0 |  | - | - |
| Mean of the IRMA measurements relative to AEEW measurement | +3.4 ± 3.6 | | +1.9 ± 1.6 | +0.8 + 1.3 |

The final row compares the averages of all of the measurements with those of the AEEW team. What one sees is that the measurements of the AEEW team are broadly consistent with the averages but are near the lower limit of the range (for the measurements relative to U235 fission). Also one sees that the uncertainties in the average values are larger than those given for the ZEBRA Assembly 22 measurements in Table 2.6.

A reduction of 2% in the U235 fission rate in the AEEW measurements would result in a better consistency with the other IRMA participants and also with the ANL measurements in the Cadenza core, Assembly 22. However, a discrepancy in the C28/F49 ratio would remain (+2.6% in the case of the IRMA measurements and -3.2% in the case of the ANL measurement in Assembly 22. Note, however the large discrepancy between the ANL measurement using the CEA foils and the ANL foils in the IRMA measurements).

Comparison measurements were made in the ZEBRA Bizet programme with KfK and CEN teams and the results are summarised in Table 2.9. The differences presented here are not consistent with those obtained in the IRMA intercomparisons.

Table 2.9 Intercomparisons made in the ZEBRA Bizet Programme. Differences relative to the Winfrith Measurements (in percent).

|  |  |  |  |
| --- | --- | --- | --- |
|  | Relative Cell Average Ratios  {(Participant/AEEW)-1}% | | |
| Participant | C28/F25 | F28/F25 | F49/F25 |
| KfK | -0.5 | -3.8 | +0.8 |
| CEN | -4.0 | +0.5 | -0.2 |

An inter-calibration of AEEW and KfK U235 and Pu239 fission chambers has also been made (BTN-38). In this inter-calibration it was concluded that to give consistency with the KfK chambers the masses in the AEEW chambers should be increased (or in the KfK chambers reduced) by 1.3% ± 0.3% (U235) and 0.6% ± 0.2% (Pu239). However, measurements were also made comparing the absolute fission rate in the AEEW U235 fission chamber with a gold absolute activation measurement. It was concluded that there was consistency between the two.

Table 2.10 Summary of Differences Relative to AEEW/ZEBRA Measurements.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Ratio | ANL (Core 22) | IRMA mean | KfK Bizet | CEN Bizet | Systematic Uncertainty |
| F28/F25 | +2.9% | +1.9% | -3.8% | +0.5% | ± 3% |
| F25/F49 | -1.6% | -0.8% | -0.8% | +0.2% | ± 1% |
| C28/F49 | -3.2% | +2.6% | -1.3% | -3.8% | ± 3% |

On the basis of these comparisons an estimate is made of the possible systematic errors in the AEEW/ZEBRA measurement techniques, and this is given in the final column.

### 2.3.3 Effects of Uncertainties in Composition and Dimensions.

In BTN-23 calculations of the effects of changing cell components in the core BZA are described. Fundamental mode calculations, using a specified buckling, for the inner core and outer core of the assembly are made replacing core components with alternatives. Changing the plutonium plate in an inner core cell from the Mk VIII plate (the standard plutonium plate used in Core 22) to a Mk V plate gave the largest effect for changes to the plutonium plate. Replacing the double sheath by a single sheath gave effects of a few tenths of a percent as did removing the trace quantities of hydrogen from the cell. Calculations were also made changing the sodium plate in an outer core cell. However, the main effect in this case was from the associated changes in the steel canning and H content.

The changes to keff and the reaction rate ratios for the inner core cell are given in Table 2.11. These were generally less than about 0.5%, with the largest effect being from removing the trace quantities of hydrogen from all the components. The hydrogen content has been estimated to be 5 ppm in many of the materials and it is considered that this estimate could be uncertain by about 50% and so an uncertainty in reaction rate ratios of 0.3%, arising from this source, is proposed. Uncertainties in the UO2, steel and sodium contents could add similar uncertainties bringing the total uncertainty from uncertainties in the composition to about ± 0.5% .

Table 2.11 Effects of Changes from the Standard Loading of the Inner Core Cell in BZD

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Change | keff | Changes in percent | | | | |
|  |  | (x10-4) | F25/F49 | F28/F49 | C28/F49 | F40/F49 | F41/F49 |
| Mk V Pu plate | 1% increase in Pu239  + reductions in Pu240 and Pu241 | +18.6 | -0.01 | 0.09 | -0.03 | 0.19 | -0.01 |
| H removed | H removed | -0.5 | -0.40 | 0.18 | -0.12 | 0.58 | -0.38 |
| Steel sheath changed | Double sheath replaced by the single sheath | -0.6 | -0.13 | 0.12 | -0.06 | 0.32 | -0.13 |

### 2.3.4 Recommended Spectral Index Values

The conclusions drawn from the above comparisons are that the measurements made in Core 22 by the AEEW (ZEBRA) team are typical of those made in other ZEBRA cores. For consistency it is proposed that these should be adopted for the benchmark. The decision about uncertainties has to balance the consistency argument against what is clearly a question over a possible systematic error in the AEEW measurement techniques. The recommended values are given in Table 2.12.

Table 2.12 Recommended Reaction Rate Ratio Measurements in Assembly 22

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Reaction rate ratio | Measured by AEEW team  (s.d. in percent) | Addition for chamber location and casing | Addition for core material contents | Total uncertainty in Benchmark Values |  | *(Possible systematic uncertainty*  *in Zebra techniques)* |
|  |  |  |  |  |  |  |
| F28/F25 (Cell Average) | 0.03634  (± 1.1%r 0.6%s) |  | ± 0.5% | ±1.3% |  | *( ± 3%)* |
| F25/F49 (Cell Average) | 0.959  (± 1.1%r 1.0%s) |  | ± 0.5% | ±1.6% |  | *( ± 1%)* |
| C28/F49 (Cell Average) | 0.1266  (± 0.9%r 0.5%s) |  | ± 0.5% | ±1.1% |  | *( ± 3%)* |
| F28/F25 (Chamber) | 0.03483  (± 0.4%r 0.6%s) | ± 4.2% | ± 0.5% | ±4.3% |  | *( ± 3%)* |
| F25/F49 (Chamber) | 0.960  (± 0.4%r 1.0%s) | ± 1% | ± 0.5% | ±1.6% |  | *( ± 1%)* |
| F40/F49 (Chamber) | 0.2594  (± 0.9%r 1.8%s) | ± 4.1% | ± 0.5% | ±4.6 |  |  |
| F41/F49 (Chamber) | 1.217  (± 0.5%r 3.8%s) | ± 1% | ± 0.5% | ±4.0% |  |  |

In column 5 the recommended uncertainties to be associated with the Zebra 22 benchmark measurements are given. However, these ignore the differences found in the intercomparisons with the results obtained by other measurement teams and the figures in the final column (figures in italics) gives an indication of the magnitude of the effect of these differences.

Because such intercomparisons are not taken into account in the benchmark measurements reported for other facilities these are not included in the uncertainties associated with the recommended Zebra benchmark values, this being considered to be the more consistent approach. When the C/E values obtained in the analyses of measurements made in different reactor facilities are compared these additional uncertainties should be borne in mind.

## 2.4 Evaluation of Reactivity Effects Data

Reactivity changes were measured relative to the change in insertion of a calibrated control rod, usually FR9, required to maintain criticality, and expressed in terms of standard cms of movement of the rod. The standard cm is the reactivity change resulting from a 1 cm movement at the point of maximum reactivity change with movement of the rod. Other control rod movements are then expressed in terms of equivalent standard cms. This requires the "rod profile" to be measured, the relative changes in reactivity with rod movement at different levels of insertion.

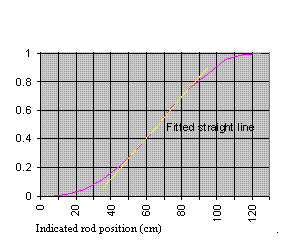


Figure 2.1 The Measured Relative Reactivity Worth Profile of FR9 and the Fitted Straight Line giving the "Standard cm" Equivalence.

The "standard cm" of movement was calibrated by "inverse kinetics" measurements to give reactivity changes in absolute terms. This equivalence depends on the delayed neutron data used to interpret the measurements, and uncertainties in relative fission rates and importances, and introduces a systematic uncertainty of ±5%. The delayed neutron data used are tabulated in Section 1.4.6. Relative reactivity worth measurements are not affected by this uncertainty. For the calibration of a single rod the sum of the random components is given as ± 1.3%, as described in Section 1.4.

Alternative reactivity scales could be considered, such as that based on the comparison of the measured and calculated effect of changes in the plutonium content of cells.

The differences in reactivity between different types of element, such as the plate geometry and pin geometry elements, were measured for single elements and groups of 9 elements. Sodium voiding and "flooding" measurements were also made, with the changes being made to the central group of cells or mini-calandria, and the upper and lower groups of core cells or mini-calandria. Different materials were also introduced into these groups of cells and the resulting changes in reactivity measured.

The transition from one core to another core was made in stages, with the change in reactivity in each stage being measured. This required the calibrated control rod to be recalibrated at each stage.

In addition to the uncertainty in the conversion of the measured control rod movement into absolute reactivity units there are the uncertainties in the measured control rod movement arising from reproducibility and drift. These have been assessed for the measurements presented in Section 1.4.

Some changes in components produce a change in core height. This has been taken into account in the measured values and the associated uncertainties assessed. Measurements were made with different thickness steel plates to determine the correction

Changes in the associated steel content also accompanied the sodium voiding and flooding measurements. The components were weighed and the effects of the changes in the steel contents assessed.

There is also the possibility of an interaction between the perturbation and the control rod worth. Corrections of up to 1.6% were required for this effect in the case of the enrichment perturbation measurements.

The effects of uncertainties in the dimensions and compositions of core components in the environment of the measurements will act via the neutron flux and importance spectrum. As has been seen in the discussion on the reaction rate ratio measurements the uncertainty resulting from the calculated flux spectrum uncertainty is considered to be 0.5% at most. The effect associated with the neutron importance spectrum is considered to be even smaller and thus these are negligible compared with the other uncertainties. However, we note that the reason for making measurements in both plate and pin geometry has been to make it possible to include in the assessment of uncertainties an examination of the consistency between measurements made using completely independent core materials.

***The sources of uncertainty and their values for each type of measurement have been evaluated by the measurers and their values have been adopted. They are described in Section 1.4.***

### 2.4.1 Delayed Neutron Data and the Reactivity Scale.

Details of the calibration of the control rods are given in ZTN22-3. For the absolute calibration of the rods the applied step changes in reactivity were in the range 2.5 to 6.5 x 10-4 dk/k. The measurements could be reanalysed using updated effective delayed neutron data, if required.

Analyses of the plutonium enrichment experiments give confidence in the accuracy of the reactivity scale. Calculations have been made using the MONK Monte Carlo code and both the JEF-2.2 and ENDF/B-VI-version 6 nuclear data libraries for the cores with and without the MOX plate replacing a UOX plate in each cell of an element. The standard deviation of each calculation is ±1x 10-4 dk and so the difference has a standard deviation of ± 1.4x10-4. This corresponds to an accuracy of about ±7% and the accuracy of the average for two measurements made in a core is about ±5%. The agreement with measurement is in all cases within this range of uncertainty. (The uncertainties quoted for the measured worths do not include the ±5% systematic uncertainty in the reactivity scale.)

**MONK-JEF-2.2 Calculations of Plutonium Enrichment measurements**

|  |  |  |
| --- | --- | --- |
|  | MONK-Jef-2.2 keff | Measured worth |
| Core 22B Full height model | 1.0004 *±* 0.0001 |  |
|  |  |  |
| Core 22 with central Pu enriched element | 1.0023 *±* 0.0001 |  |
| Reactivity worth of added Pu | 0.0019 *±* 0.00014 | 0.001945 *±* 0.00003 |
|  |  |  |
| Core 22 with 2 off-central Pu enriched elements | 1.0023 *±* 0.0001 |  |
| Reactivity worth of added Pu | 0.0019 *±* 0.00014 | 0.00175 *±* 0.00003 |
|  |  |  |
| Core24 Full height model using the X dummy | 0.9997 *±* 0.0001 |  |
|  |  |  |
| Core 24 with central Pu enriched element | 1.0013 *±* 0.0001 |  |
| Reactivity worth of added Pu | 0.0016 *±* 0.00014 | 0.00 173*±* 0.00003 |

**MONK-ENDF/B-VI -6 Calculations of Plutonium Enrichment Measurements**

|  |  |  |
| --- | --- | --- |
|  | MONK-B-VI-6 keff | Measured worth |
| Core 22B Full height model | 1.0083 *±* 0.0001 |  |
|  |  |  |
| Core 22 with central Pu enriched element | 1.0103 *±* 0.0001 |  |
| Reactivity worth of added Pu | 0.0020 *±* 0.00014 | 0.001945 *±* 0.00003 |
|  |  |  |
| Core 22 with 2 off-central Pu enriched elements | 1.0100 *±* 0.0001 |  |
| Reactivity worth of added Pu | 0.0017 *±* 0.00014 | 0.00175 *±* 0.00003 |
|  |  |  |
| Core24 Full height model using the X dummy | 1.0092 *±* 0.0001 |  |
|  |  |  |
| Core 24 with central Pu enriched element | 1.0110 *±* 0.0001 |  |
| Reactivity worth of added Pu | 0.0018*±* 0.00014 | 0.00 173*±* 0.00003 |

To summarise, these calculations give confidence in the reactivity scale and its estimated systematic uncertainty of ±5%.

### 2.4.2 Reactivity Differences between Assemblies.

The transition from one core to another was made in stages, with the changes being balanced using the control rods. The rod worths were recalibrated at points during the transition. In this way the reactivity change in going from one assembly to another was measured. Corrections were made for temperature differences from 300K and Pu241 decay.

In the case of the transition from Core 22 to Core 24 there is an associated change in core height and a small change in steel content. The difference in core height has been taken into account in the core criticality models and the uncertainties in these models have been assessed more fully and so are preferred.

In the case of the transition from Core 25 to Core23 there is no change in core height and the change in steel content is very small. Because of the complication of treating the plate elements at the core edge one can consider the core with the plate elements already "flooded". This is a core of 237 elements, 168 flooded pin elements and the remainder flooded plate elements.

*The reactivity change resulting from voiding just the 168 pin elements in this 237 element version of Core 23 can then be considered as a benchmark measurement.*

### 2.4.3 Measurements Replacing Elements either Singly or in Groups of 9.

Measurements were made of the reactivity effect of replacing one type of element by another, both single elements and groups of 9 elements and at both the central position and off-central positions. The changes were made in a region free from non-standard elements.

The uncertainties treated arise from reactor drift due to temperature changes, uncertainties in control rod profile, changes in core height and material composition uncertainties. In addition there is the systematic uncertainty in the reactivity scale.

*The results given in Section 1.4.7.2, Tables 1.17 to 1.20, treat these sources of uncertainty and are recommended as benchmarks.*

### 2.4.4 Enrichment Measurements.

To measure the reactivity effects of changing the plutonium content of cells mixed-oxide plates displaced a set of U02 plates in the core cells of elements in Core 22. In Core 23A, plutonium oxide pins replaced U02 pins in an element.

A correction was made for the interaction between the reactivity perturbation and the control rod movement.

The systematic uncertainties arise from the uncertainty in the plutonium content of a mixed-oxide plate and in a mixed-oxide pin. Other sources of error are associated with the control rod profile, and the inverse kinetics measurements. There is also the systematic uncertainty in the reactivity scale which is to be combined with the above uncertainties.

*The measurements described in Section 1.4.7.3, Table 1.21, are recommended as benchmarks.*

The analyses of these experiments give confidence in the accuracy of the reactivity scale, as is described in Section 2.4.1. There is agreement with calculation for the average of the two measurements to within the ±5% standard deviation of the combined Monte Carlo statistics.

### 2.4.5 The Reactivity Effects of Changes in Cell Heterogeneity in Assembly 22

The changes made were to combine pairs of standard plutonium plates and also to replace the standard plates by pairs of half-thickness plates and then to separate them. The changes were made in central cells of either one element or a group of 9 elements.

The uncertainties arose from the sources described above.

*The measurements described in Section 1.4.7.4, Table 1.22 are recommended as benchmarks.*

### 2.4.6 Small Sample Reactivity Worth Measurements.

The materials used in the reactivity perturbation measurements included UO2, sodium, carbon, oxygen, aluminium, steel, and copper.

Measurements were made in all four cores. Corrections were made for element differences and changes in core height. The uncertainties arise from the uncertainties in control rod profile, reproducibility and drifts, and the changes in core height (in the case of the plate geometry cores). In addition there is the systematic uncertainty of ±5% associated with the absolute calibration of the control rods in terms of the delayed neutron scale.

*These measurements described in Section 1.4.7.5, Tables 1.23 to 1.29, are recommended as benchmarks.*

### 2.4.7 Sodium Voiding Reactivity Measurements.

In Core 22 and Core 24 the sodium plates were replaced by the voided plates, which have nominally the same thickness and steel content as the sodium plates. All the plates being interchanged were weighed and the differences in thickness measured. The changes were made either over the whole core section or the central group of core cells and the upper and lower two groups of core cells. Uncertainties were assessed for the effects of Rod Profile, Reproducibility and Drifts, Core Height Changes, and Weight of Steel (which was taken to be a negligible correction).

Measurements were also made in Cores 23 and 25 involving the middle, and the top plus bottom mini-calandria in the 9 elements. The uncertainties arose from the same sources as for the plate geometry measurements although they differed in magnitude. Essentially there was no change in core height and the differences in steel weights were negligibly small.

*These measurements, described in Section 1.4.2C.6, Tables 1.30 to 1.32, are recommended as benchmarks.*

### 2.4.8 Reactivity Equivalence of Arrays of Plate Elements at the Centres of the Pin Geometry Assemblies 23 and 25.

In these measurements arrays of pin geometry elements were replaced with plate elements in central zones of the cores and the plate geometry elements at the core boundary were replaced by pin geometry elements and the numbers of edge elements reduced to maintain the critical system. The changes were made in stages, with the change in reactivity being measured at each stage using the recalibrated control rods. The overall reactivity change of the replacement of pin elements by plate elements, and the removal of edge elements, was thus measured by adding the individual components.

*It is recommended that these measurements, described in Section 1.4.2C.7, be used to define two additional critical core configurations, as shown for the final configurations of the changes. The differences between the keff values calculated for these two critical configurations and the corresponding Cores 23 and 25, respectively, are then to be compared with the measured differences presented in Section 1.4.2C.7.*

## 2.5 Evaluation of Reactivity Coefficients Data

The reactivity effects of Pu241 decay, and temperature changes, given in the ZTN documents have been adopted for the corrections made to the measured keff values. *They are not recommended as benchmark measurements.*

## 2.6 Evaluation of Kinetics Data

The control rods were calibrated using inverse kinetics. *The data* *are not recommended as benchmark measurements*.

## 

## 2.7 Evaluation of Reaction-Rate Distributions

### 2.7.1 Reaction Rate Scan Measurements in Standard Plate Geometry Cells and in Modified Cells.

To provide additional data for checking cell calculation methods axial reaction rate scans were measured in the standard cells of Assembly 22 and in modified cells. One modification involved combining the plutonium plates from two cells, thus forming a double sized cell. Another consisted of replacing the plutonium plate by two half-thickness plates and then separating them in the cell. The reaction rates which were measured were F49, F28, C28, Rh103(n,n’) and In115(n,n’), and F40 in the standard cell. These measurements are presented in ZTN22-14 together with the MURAL/FGL5 cell calculations made to compare with them. The measured rates were corrected for the global axial variation of the reaction rates. Agreement was found between the 3D cell model calculations and measurement.

***These are not being evaluated as benchmarks*** *because of uncertainty about their usefulness. The largest variation, and the most statistically significant set of measurements is for the U238 fission rate and this would be the most suitable reaction to calculate. Reference should be made to ZTN22-14 for details of the foils and their positions in the cells, together with the results of the measurements and the associated uncertainties.*

### 2.7.2 Multi-chamber Scanning System Measurements.

Measurements of the Pu239 fission rate distributions using the installed multi-chamber scanning system were made in each assembly, and in the intermediate assemblies. Results are given in Section 1.7.2C for the measurement in Core 22B and also the differences between the measurements in Core 24 and Core 22A, these being the most comparable from the point of view of control rod insertion. The uncertainties in the measurements, as estimated by the measurers, are also summarised, the total uncertainty being about ±0.6%. The normalisation for the Core 22B measurement is to a central value of 10,000 and for the comparison between the Core 24 measurement and the Core 22A measurement it is normalised to the sum of the measured values being the same in each assembly.

***These Core 22 and Core 24 measurements are considered suitable to be adopted as benchmarks.***

***However the modelling of the specific control rod insertion in these measurements has not been derived for these measurements in the present document (Section 3) although the detail of the rods has been included.***

*The additional measured values for Core 25 relative to Core 23 can be found in ZTN22-10 but have not been evaluated here as benchmarks.*

### 2.7.3 Axial and Radial Reaction Rate Scan Measurements.

A series of axial and radial reaction rate scans were made for Pu239 fission, U238 fission and capture, in Assemblies 24 and 25 and the provisional results were presented in graphical form in ZTN22-10 , Figures 11 to 14. The measurements extended through the core and axial and radial blanket regions. The uncertainties had not been assessed in detail, but on the basis of previous experience the uncertainties were judged to be less than 1% in the core region, rising to about 3% in the outer blanket regions.

*However, because the results reported in ZTN22-10 are only provisional, and are in graphical form, they have not been evaluated and recommended as benchmark measurements. Nevertheless, they could be useful.*

## 2.8 Evaluation of Power Distribution Data

Not measured.

## 2.9 Evaluation of Isotopic Measurements

Not measured.

## 2.10 Evaluation of other Miscellaneous Types of Measurements

Not measured.

# 3. BENCHMARK SPECIFICATIONS

### Overview of the Calculational Methodology and the Models.

The XYZ geometry models are based on XY geometry plans describing the arrays of square section elements which form the assemblies.

The elements consist of axial arrays of cells contained within the square element sheaths. The calculational models therefore involve setting up the data for the three stages:

(a) the cells,

(b) the elements

(c) the arrays of elements.

In the following sections these three components are described in detail. The same approach is involved in the models used to calculate all assembly properties: criticality, spectral indices, reactivity worths and reaction rate distributions. The calculations of criticality require the most accurate modelling, with accuracies of better than 0.1%, whereas a less accurate model could be used for calculating the other properties. This could imply continuous energy Monte Carlo calculations of the criticality but deterministic methods are required for calculating the localised reactivity worth measurements (if accurate Monte Carlo perturbation methods are not available).

As described in Section 1 the elements are located on the base-plate and are arranged in groups of 5x5. These groups are separated by a small gap of 0.2665 cm by the mild steel super-lattice grids of width 0.25 cm which are above and below the core sections of the elements and hold the elements in place. These grids extend (nominally) between 50.2 cm and 80.6 cm above and below the mid plane and are 30.4 cm high, being situated in the blanket/shielding areas of the elements. The approximation is made that the grids fill the space of 0.2665 cm between the groups of 5x5 elements and the density of the mild steel plates is reduced by the factor 0.25/0.2665. These grid plates are represented in the more detailed calculational models but simplified uniform lattice models, in which they are not represented, have also been set up.

The distance between the centres of elements within a group of 5x5 is 5.3721 cm and the overall average spacing is 5.4254 cm (the distance between the centres of two superlattices divided by 5). The models which include the representation of the superlattice spacing have an irregular lattice layout and consequently are more suitable for Monte Carlo calculations. For deterministic calculations it is usual to assume that the elements are located in a regular lattice having the average spacing of elements in the assembly, 5.4254 cm.

Figure 3.1 illustrates the plan view of a plate cell in an element sheath. The plates are treated as square with a width of 5.067 cm. The plutonium, uranium oxide and sodium plates are treated as consisting of a square core region which is surrounded by canning material. As is shown in the Figures in Section 1.1.2A the edge regions of the canned plates do not have a simple geometry but they are represented in calculations as being rectangular parallelepipeds. The core region is also represented as being a rectangular parallelepiped, although the corners of some core regions are rounded. The width of the mini-calandria in the calculational model is also taken to be 5.067 cm.

The element sheath has an inner width of 5.102 cm and an outer width of 5.2544 cm. There is therefore a small gap between the edge of the plate, or minicalandria, and the inner face of the element sheath, a width of 5.067 cm compared with the inner width of the element of 5.102 cm, an average gap of 0.035/2 = 0.0175 cm. This gap will not be aligned in all of the plates and mini-calandria in an element. Similarly, there is a small gap between the elements in the 5x5 arrays, the element outer width being 5.2544 cm compared with the lattice spacing of 5.3721 cm, a gap of 0.1177 cm , but again this gap cannot be assumed to be regular because of possible bowing of elements over the 3 metre length.

The gaps between the plates, or mini-calandria, and element sheath, and between elements, are represented in the first calculational model, denoted as Model A and shown diagrammatically in Figure 3.1. Treating these as uniform streaming gaps is probably not a realistic physical model and an uncertainty to allow for this modelling approximation has been included in the overall uncertainty. Ignoring the streaming gaps by homogenising over them is also probably not realistic, the real effect being between the two models.

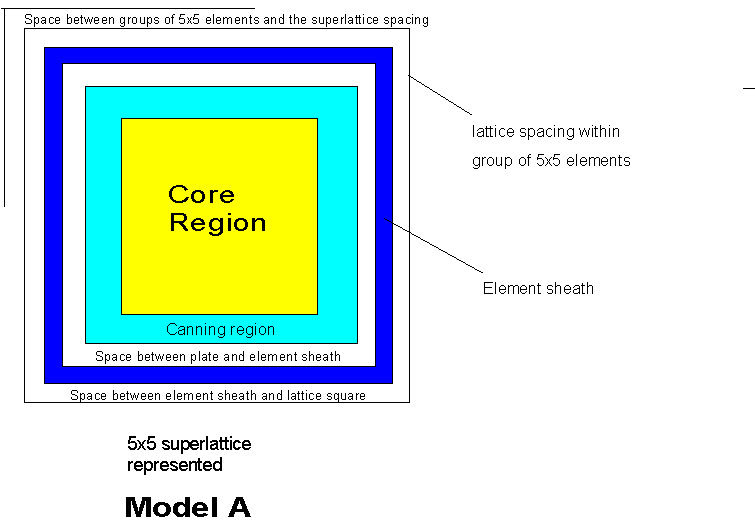
In Model B these gaps are eliminated and the steel of the element sheath is smeared over the space between the plate edges and the lattice square boundary. The gaps between the groups of 5x5 elements are preserved and the superlattice grid plates are included. Model B is considered to be as valid a model as Model A and the difference between calculations made using the two models is considered to be an uncertainty in the modelling applying to both models .

In Model C there is a further simplification. A lattice which is uniform over the whole assembly is adopted and the steel of the element sheath is smeared over the enlarged lattice spacing of 5.4254 cm square. The steel of the superlattice grid plates, separating the arrays of 5x5 elements, is ignored in this model.

For deterministic calculations a further simplification is adopted (Model E, see Figure 3.18). This is called the MURAL model because it is the representation developed for use in the MURAL collision probability cell code. In the case of the plate geometry cells the simplification is to combine the canning in the edge region of the plates with the element sheath material so that in each plane there are only two regions, the plate core region and the outer steel canning plus element sheath region. In the case of the mini-calandria the walls of the mini-calandria are combined with the element sheath and smeared over the lattice area between the pin cells and the lattice boundary.

When the original analyses were performed (in the early 1980s) the models were simplified still further. The material in each plate layer was homogenised transversely, combining the core material with the plate edge material and the associated element sheath steel for the layer having the thickness of the core region. The axial layers containing canning material were similarly homogenised. (The magnitude of the approximation involved is discussed in the paper “Calculations to compare different ways of modelling the plate geometry cells of the Zebra fast critical assembly, MZA”

Rowlands, Annals of Nuclear Energy (2009)). The pin cells were approximated as coupled 1D cylindrical geometry cells with the calandria walls plus the element sheath treated as the outer region of the 1D cell representation. More refined multipin methods were developed during the course of the analysis. Streaming effects were treated separately and modified diffusion coefficients calculated. This approach is mentioned because it could guide the choice of deterministic cell modelling methods.

Figure 3.1 Diagram of a Plate within an Element Sheath (Drawing not to scale)

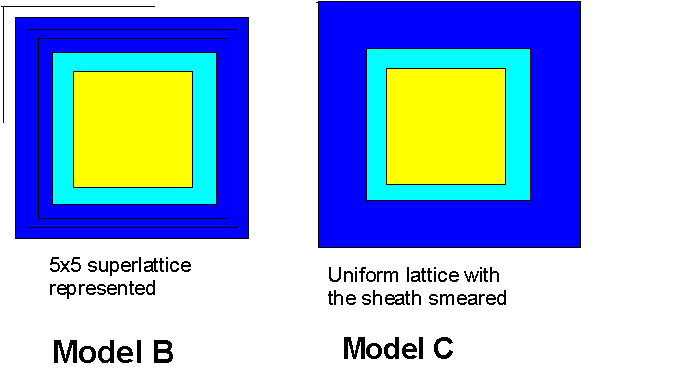
****

Figure 3.2 Diagram of Simplified Models in which the Gaps between the Plates (or Mini-calandria), the Element Sheath and the Superlattice Grid are Eliminated.

In Model B the superlattice spacing is preserved (but the lattice plates are omitted) and in Model C a uniform lattice is adopted, eliminating the gaps between the groups of 5x5 elements. (Drawing not to scale.)

## 3.1 Critical or Subcritical Configuration Benchmark Specifications

### 3.1.1 Description of the Calculational Methodology and the Models

Critical configuration models are defined for the four Assemblies, 22, 23, 24 and 25 and also for the intermediate assemblies which have regions of plate geometry elements in central regions of Assemblies 23 and 25. The assemblies comprise a Core region, with Axial Blanket and Axial Steel Reflector regions above and below the core. The core is surrounded radially by the Radial Blanket region around which is the Radial Steel Reflector region. Both the axial and radial blanket regions (also called breeder regions in some documents) consist of natural uranium plates or blocks contained within the steel element tubes. The core height is approximately the same in all assemblies but the radial dimensions of the cores differ.

The regions beyond the steel reflector regions are calculated to have a negligibly small effect on keff. Increasing the steel region above and below the core by 6 cm and the radius by 3.4 cm increased keff by 0.0003 +/- 0.00014. These added dimensions were selected to overestimate the possible effect. (The different values for the axial and radial directions were chosen because of the different amounts of material in the two directions and they produce rounded numbers for the dimensions.)

There are two basic types of core region: plate geometry and pin geometry. Each of these is used in one of two forms, either containing sodium or "voided" of sodium.

The models are simplifications of the actual assemblies in that some elements have been replaced by "standard" core elements. This was done on the basis of measurements made on the cores and is described in Section 1.1.2B. The further simplification is that the geometries of the plates and pins are made more uniform. Plate cans are assumed to have rectangular shapes, in place of the actual irregular edge regions (which can be seen in Figures1.9 to 1.15) and the canning material is distributed uniformly over the resulting volume. Also, the rounded corners of the core regions of plates are made square. The top and bottom end regions of the pins and calandria end plates are similarly treated as single uniform rectangular regions.

Two types of simplification of the reference model, Model A, are considered, simplifications of the cell geometries (preserving the total weights of materials) and changing from the superlattice arrangement of elements to a uniform array of elements. It is considered important, though, to preserve the separate representation of the core regions of the plates in the assembly core region and this implies the use of a "3D" model of the core cells (although this could be an approximate 3D model as was used in the earlier analyses made using the MURAL cell code and now included in the ECCO cell code in the ERANOS system).

Reference benchmark models are defined first, these being denoted as Model A. These require a full three dimensional representation at the cell level and are suitable for Monte Carlo calculations. Following this simplified models are defined more suitable for deterministic calculations. These are formed by homogenising selected neighbouring regions, such as the gaps on either side of the element sheaths (Model B), and changing to a plan model of the core in which the superlattice structure is replaced by a uniform lattice of elements (Model C). Further simplifications are considered (Model M) in which the edge regions of canned plates are combined with the steel of the element sheath, and the outer walls of the calandria are combined with the sheath in a similar way. Corrections to the keff values of the reference model (Model A) have been calculated using continuous energy Monte Carlo for these various simplifications.

To obtain accurate results, the heterogeneity of the cell structure and associated streaming effects must be treated.

#### The Arrangement of Elements in the Core Regions.

The arrangements of the core elements to form the core region arrays are shown in the following Figures. The core regions are surrounded by radial blanket elements. The outer radius of the radial blanket is the same in all of the assemblies and is surrounded by the radial shield elements, as shown in Figure 1.7A.

##### Core plans of the plate geometry Assemblies 22 and 24.

All of the core elements of Assembly 22 are taken to be of type 1C (or more fully described as type C22+01C) which use the Mark VIII plutonium plate, PUVIII8. In Section 1.1.2B corrections have been made to the keff values for the replacement of the control rods, the special elements and non-standard elements (in particular the element C22+01D which used the Mark IX plutonium plate) by these elements. The plan of the core is shown in Figure 3.3.

The core was built in two versions, 22A and 22B which differed in the axial orientation of the core cells. The individual core cells have an axial asymmetry. In Core 22A the core region cells all had the same orientation in an element whereas in Core 22B alternate cells were inverted. In this way axial symmetry was produced. The reactivity change was insignificant, as described in Section 1.1.2B. The symmetrical version, Core 22B, is modelled here, although comparison is sometimes made with measurements made in Core 22A. An advantage of the symmetrical version is that a half height model can be calculated.

In the case of Assembly 24, the three types of “dummy” plate, which replace the sodium plate of Assembly 22, are represented. These are denoted by X, Y and Z and the core plan is shown in Figure 3.4. Again the cells have been simplified to use just the one type of plutonium plate, PUVIII8, the same as in Core 22, with the corrections to k-effective having been based on measurements. The only change compared with the Core 22 element (1C) is the replacement of the sodium plate by a “dummy” plate having about the same thickness and steel content but no sodium. The differences are discussed later.

##### Core plans of the pin geometry Assemblies 23 and 25.

All of the core elements of Assemblies 23 and 25 are either mini-calandria elements (denoted by 3A, 3B, 3C etc in Core 23 and 3C3, 303 etc in Core 25, see Section 1.1.2B) or are the same plate elements as used in Cores 22 and 24 respectively. These plate elements are situated at the core radial boundary. Again the special elements, non-standard elements and control rods have been replaced by these standard core elements in the calculational model, with k-effective adjustments based on measurements, as described in Section 1.1.2B, and summarised in Table 1.5.

The core plan of Core 23 is shown in Figure 3.5A and Core 25 in Figure 3.5B.

##### Core plans of the arrays of plate elements at the centres of the Pin Geometry Assemblies 23 and 25.

These core plans are shown in Figures 3.6A and 3.6B.

##### Positions of the control rods

For accurate calculations of reaction rate distribution measurements, such as the multi-chamber Pu239 fission rate scans, account should be taken of the control rod insertion and the axial bias introduced by the boron absorber sections at the tops of the rods. For this purpose details of the control rod components were included in Section 1.1. The positions of the rods are shown in the Figures in Section 1 (Figures 1.8A, 1.8B).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  |  |  | 1C | 1C | 1C |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |  |  |  |  |
| 51 |  |  |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |  |  |  |
| 50 |  |  |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |  |  |
| 49 |  |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |  |
| 48 |  |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |  |
| 47 |  |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |  |
| 46 |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |
| 45 |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |
| 44 |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |
| 43 |  |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |  |
| 42 |  |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |  |
| 41 |  |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |  |
| 40 |  |  |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |  |  |
| 39 |  |  |  |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |  |  |
| 38 |  |  |  |  |  | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 1C |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  | 1C | 1C | 1C |  |  |  |  |  |  |  |  |

Figure 3.3 Calculational Model of the Assembly 22 Core (Fissile Elements)

In Assembly 22B the Elements 1C etc. are replaced by Elements 10C etc., the axially symmetrical versions of the core elements. The reactivity difference between the two versions, 22A and 22B, is negligibly small.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  | Z | Z | Z | Z | Z | Z | Z |  |  |  |  |  |  |
| 52 |  |  |  |  |  | Z | Z | Y | Y | Y | Y | Y | Z | Z |  |  |  |  |  |
| 51 |  |  |  | Z | Z | Y | Y | Y | Y | X | Y | Y | Y | Y | Z | Z |  |  |  |
| 50 |  |  |  | Z | Y | Y | Y | Y | Y | X | Y | Y | Y | Y | Y | Z |  |  |  |
| 49 |  |  | Z | Y | Y | Y | Y | X | X | Y | X | X | Y | Y | Y | Y | Z |  |  |
| 48 |  | Z | Z | Y | Y | Y | X | X | X | Y | X | X | X | Y | Y | Y | Z |  |  |
| 47 |  | Z | Y | Y | Y | X | X | X | X | X | X | X | X | X | Y | Y | Y | Z |  |
| 46 |  | Z | Y | Y | Y | X | X | X | X | X | X | X | X | X | Y | Y | Y | Z |  |
| 45 |  | Z | Y | Y | Y | X | X | X | X | X | X | X | X | X | Y | Y | Y | Z |  |
| 44 |  | Z | Y | Y | Y | X | X | X | X | X | X | X | X | X | Y | Y | Y | Z |  |
| 43 |  | Z | Y | Y | Y | X | X | X | X | X | X | X | X | X | Y | Y | Y | Z |  |
| 42 |  |  | Z | Y | Y | Y | X | X | X | X | X | X | X | Y | Y | Y | Z | Z |  |
| 41 |  |  | Z | Y | Y | Y | Y | X | X | X | X | X | Y | Y | Y | Y | Z |  |  |
| 40 |  |  |  | Z | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Z |  |  |  |
| 39 |  |  |  | Z | Z | Y | Y | Y | Y | Y | Y | Y | Y | Y | Z | Z |  |  |  |
| 38 |  |  |  |  |  | Z | Z | Y | Y | Y | Y | Y | Z | Z |  |  |  |  |  |
| 37 |  |  |  |  |  |  | Z | Z | Z | Z | Z | Z | Z |  |  |  |  |  |  |

Figure 3.4 Calculational Model of the Assembly 24 Core (Fissile Elements)

X, Y and Z denote the three types of “dummy” plate which replace the Assembly 22 sodium plates:

X = STNAVR4 and Y = STNAVS4 are steel rings and Z = STNAV4 is “honeycomb” shaped.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  |  | *1C* | *1C* | *1C* | *1C* | *1C* | *1C* |  |  |  |  |  |  |
| 52 |  |  |  |  |  | *1C* | *1C* | 3L | 3L | 3L | 3L | 3L | *1C* | *1C* |  |  |  |  |  |
| 51 |  |  |  | *1C* | *1C* | 3H | 3H | 3B | 3B | 3B | 3B | 3B | 3H | 3H | *1C* | *1C* |  |  |  |
| 50 |  |  |  | *1C* | 3A | 3D | 3D | 3B | 3B | 3B | 3B | 3B | 3D | 3D | 3A | *1C* |  |  |  |
| 49 |  |  | *1C* | 3B | 3D | 3C | 3E | 3C | 3C | 3C | 3C | 3C | 3E | 3C | 3D | 3B | *1C* |  |  |
| 48 |  |  | *1C* | 3D | 3D | 3C | 3E | 3C | 3C | 3C | 3C | 3C | 3E | 3C | 3D | 3D | *1C* |  |  |
| 47 |  | *1C* | 3A | 3J | 3A | 3E | 3E | 3C | 3C | 3C | 3C | 3C | 3E | 3E | 3A | 3J | 3A | *1C* |  |
| 46 |  | *1C* | 3A | 3D | 3A | 3E | 3E | 3C | 3C | 3C | 3C | 3C | 3E | 3E | 3A | 3D | 3A | *1C* |  |
| 45 |  | *1C* | 3B | 3E | 3E | 3E | 3E | 3C | 3C | 3C | 3C | 3C | 3E | 3E | 3E | 3E | 3B | *1C* |  |
| 44 |  | *1C* | 3A | 3D | 3D | 3E | 3E | 3C | 3C | 3C | 3C | 3C | 3E | 3E | 3D | 3D | 3A | *1C* |  |
| 43 |  | *1C* | 3A | 3J | 3D | 3E | 3E | 3C | 3C | 3C | 3C | 3C | 3E | 3E | 3D | 3J | 3A | *1C* |  |
| 42 |  |  | *1C* | 3D | 3D | 3C | 3E | 3C | 3C | 3C | 3C | 3C | 3E | 3C | 3D | 3E | *1C* |  |  |
| 41 |  |  | *1C* | 3D | 3D | 3C | 3E | 3C | 3C | 3C | 3C | 3C | 3E | 3C | 3D | 3E | *1C* |  |  |
| 40 |  |  |  | *1C* | 3A | 3D | 3H | 3B | 3B | 3B | 3B | 3B | 3H | 3D | 3A | *1C* |  |  |  |
| 39 |  |  |  | *1C* | *1C* | 3H | 3H | 3B | 3B | 3B | 3B | 3B | 3H | 3H | *1C* | *1C* |  |  |  |
| 38 |  |  |  |  |  | *1C* | *1C* | 3L | 3L | 3L | 3L | 3L | *1C* | *1C* |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  | *1C* | *1C* | *1C* | *1C* | *1C* |  |  |  |  |  |  |  |

Figure 3.5A Assembly 23 Model (Fissile Elements)

The control rods have been replaced by the 3D elements, and the special elements 3RA by 3A, 3TE by 3E, etc.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |
| 53 |  |  |  |  |  |  | *Z* | *Z* | *Z* | *Z* | *Z* | *Z* | *Z* |  |  |  |  |  | |  |
| 52 |  |  |  |  | *Y* | *Z* | *Z* | 387 | 387 | 387 | 387 | 387 | *Z* | *Z* | *Y* |  |  |  | |  |
| 51 |  |  |  | *Z* | *Y* | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | *Y* | *Z* |  |  | |  |
| 50 |  |  | *Y* | *Y* | 3A1 | 3C3 | 303 | 387 | 387 | 387 | 387 | 387 | 303 | 3C3 | 3A1 | *Y* | *Y* |  | |  |
| 49 |  | *Z* | *Z* | 387 | 303 | 3C3 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 304 | 3C3 | 303 | 387 | *Z* |  | |  |
| 48 |  | *Y* | *Z* | 3C3 | 303 | 3C3 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 304 | 3C3 | 303 | 303 | *Z* | *Y* | |  |
| 47 |  | *Y* | 3A1 | 3J6 | 3A1 | 305 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 301 | 305 | 3A1 | 3J2 | 3A1 | *Y* | |  |
| 46 |  | *Z* | 3A1 | 3C3 | 3A1 | 305 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 305 | 305 | 3A1 | 3C3 | 3A1 | *Z* | |  |
| 45 |  | *Z* | 387 | 304 | 304 | 305 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 301 | 304 | 305 | 301 | 387 | *Z* | |  |
| 44 |  | *Z* | 3A1 | 3C3 | 303 | 305 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 301 | 304 | 303 | 3C3 | 3A1 | *Z* | |  |
| 43 |  | *Y* | 3A1 | 3J6 | 303 | 305 | 305 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 305 | 305 | 303 | 3J2 | 3A1 | *Y* | |  |
| 42 |  | *Y* | *Z* | 303 | 303 | 3C3 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 304 | 3C3 | 303 | 304 | *Y* | *Y* | |  |
| 41 |  |  | *Z* | 303 | 303 | 3C3 | 304 | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 304 | 3C3 | 303 | 304 | *Z* | *Z* | |  |
| 40 |  |  | *Y* | *Y* | 3A1 | 3C3 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 3C3 | 3A1 | *Y* | *Y* |  | |  |
| 39 |  |  |  | *Z* | *Y* | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | *Y* | *Z* |  |  | |  |
| 38 |  |  |  |  | *Y* | *Z* | *Z* | 387 | 387 | 387 | 387 | 387 | *Z* | *Z* | *Y* |  |  |  | |  |
| 37 |  |  |  |  |  |  | *Z* | *Z* | *Z* | *Z* | *Z* | *Z* | *Z* |  |  |  |  |  | |  |

Figure 3.5B Assembly 25 Model (Fissile Elements)

The pin geometry elements are to be treated as being the same as the Assembly 23 elements occupying the same positions, minus the sodium region material in them (sodium plus associated trace elements), that is, the same as in the pin geometry elements shown in Figure 3.5A. The difference between the actual steel content of the core and that in this model is about 0.1%. The correspondence is as follows

3A1 3A

387 3B, 3L, 3H

3C3 3C

303 3D

301, 304, and 305 3E

3J2 and 3J6 3J

The elements 3B, 3L and 3H have the same pin cell pattern but different calandria.

Note, also, that a symmetrical pattern of 8 outer 3C3 elements have replaced 3D elements. These have pins of the same enrichment. Consequently it is considered to be an acceptable approximation to take the Assembly 23 pin geometry array with the sodium removed.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  |  | 3C | 3C | 3C | 3C | 3C |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  | 3E | 3E | 3L | 3L | 3L | 3L | 3L | 3C | 3C |  |  |  |  |  |
| 51 |  |  |  |  | 3E | 3H | 3H | 3B | 3B | 3B | 3B | 3B | 3H | 3H | 3E |  |  |  |  |
| 50 |  |  |  | 3E | 3A | 3D | 3D | 3B | 3B | 3B | 3B | 3B | 3D | 3D | 3A | 3E |  |  |  |
| 49 |  |  | 3C | 3B | 3D | 3C | 3E | 3C | 3C | 3C | 3RC | 3RC | 3E | 3C | 3D | 3B | 3C |  |  |
| 48 |  |  | 3C | 3D | 3D | 3C | 3E | 1C | 1C | 1CD | 1C | 1C | 3E | 3C | 3D | 3D | 3C |  |  |
| 47 |  | 3C | 3A | 3J | 3A | 3E | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 3E | 3A | 3J | 3A | 3C |  |
| 46 |  | 3C | 3A | 3D | 3A | 3E | 1C | 1E | 1C | 1C | 1C | 1C | 1C | 3E | 3A | 3D | 3A | 3C |  |
| 45 |  | 3C | 3B | 3E | 3E | 3E | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 3E | 3E | 3E | 3B | 3C |  |
| 44 |  | 3C | 3A | 3D | 3D | 3E | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 3E | 3D | 3D | 3A | 3C |  |
| 43 |  | 3C | 3A | 3J | 3D | 3E | 1C | 1C | 1C | 1C | 1C | 1C | 1C | 3E | 3D | 3J | 3A | 3C |  |
| 42 |  |  | 3C | 3D | 3D | 3C | 3E | 1C | 1C | 1C | 1C | 1C | 3E | 3C | 3D | 3E | 3C |  |  |
| 41 |  |  | 3C | 3D | 3D | 3C | 3E | 3C | 3C | 3C | 3C | 3C | 3E | 3C | 3D | 3E | 3C |  |  |
| 40 |  |  |  | 3C | 3A | 3D | 3H | 3B | 3B | 3B | 3B | 3B | 3H | 3D | 3A | 3C |  |  |  |
| 39 |  |  |  |  | 3E | 3H | 3H | 3B | 3B | 3B | 3B | 3B | 3H | 3H | 3E |  |  |  |  |
| 38 |  |  |  |  |  | 3C | 3C | 3L | 3L | 3L | 3L | 3L | 3E | 3E |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  | 3C | 3C | 3C | 3C | 3C |  |  |  |  |  |  |  |

Figure 3.6A Calculational Model of the Central Plate Zone in Assembly 23

The outer ring of plate geometry elements has been replaced by pin geometry elements.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  | 387 | 3C3 | 3C3 | 3C3 | 3C3 | 387 |  |  |  |  |  |  |  |
| 52 |  |  |  |  | 303 | 3C3 | 3C3 | 387 | 387 | 387 | 387 | 387 | 3C3 | 3C3 | 303 |  |  |  |  |
| 51 |  |  |  | 3C3 | 303 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 303 | 3C3 |  |  |  |
| 50 |  |  | 3C3 | 3C3 | 3A1 | 3C3 | 303 | 387 | 387 | 387 | 387 | 387 | 303 | 3C3 | 3A1 | 304 | 304 |  |  |
| 49 |  |  | 3C3 | 387 | 303 | 3C3 | 304 | *Z* | *Z* | *Z* | *Y* | *Z* | 304 | 3C3 | 303 | 387 | 3C3 |  |  |
| 48 |  |  | 3C3 | 3C3 | 303 | 3C3 | *Z* | *Z* | *Z* | *Z* | *Y* | *Z* | *Z* | 3C3 | 303 | 303 | 3C3 |  |  |
| 47 |  | 3C3 | 3A1 | 3J6 | 3A1 | *Z* | *Z* | *Y* | *Y* | *Y* | *Y* | *Y* | *Z* | *Z* | 3A1 | 3J2 | 3A1 | 3C3 |  |
| 46 |  | 3C3 | 3A1 | 3C3 | 3A1 | *Z* | *Z* | *Z* | *Y* | *Y* | *Y* | *Y* | *Z* | *Z* | 3A1 | 3C3 | 3A1 | 3C3 |  |
| 45 |  | 3C3 | 387 | 304 | 304 | *Y* | *Y* | *Y* | *Y* | *Y* | *Y* | *Y* | Y | *Z* | 305 | 301 | 387 | 3C3 |  |
| 44 |  | 3C3 | 3A1 | 3C3 | 303 | *Y* | *Y* | *Y* | *Y* | *Y* | *Y* | *Y* | *Z* | *Z* | 303 | 3C3 | 3A1 | 3C3 |  |
| 43 |  | 3C3 | 3A1 | 3J6 | 303 | *Z* | *Z* | *Y* | *Y* | *Y* | *Y* | Z | *Z* | Y | 303 | 3J2 | 3A1 | 3C3 |  |
| 42 |  |  | 3C3 | 303 | 303 | 3C3 | *Y* | *Z* | *Y* | *Z* | *Z* | *Z* | *Z* | 3C3 | 303 | 304 | 3C3 |  |  |
| 41 |  |  | 3C3 | 303 | 303 | 3C3 | 304 | *Z* | *Y* | *Z* | *Z* | *Z* | 304 | 3C3 | 303 | 304 | 3C3 |  |  |
| 40 |  |  | 3C3 | 3C3 | 3A1 | 3C3 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 3C3 | 3A1 | 3C3 | 3C3 |  |  |
| 39 |  |  |  | 3C3 | 304 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 303 | 3C3 |  |  |  |
| 38 |  |  |  |  | 304 | 3C3 | 3C3 | 387 | 387 | 387 | 387 | 387 | 3C3 | 3C3 | 303 |  |  |  |  |
| 37 |  |  |  |  |  |  |  | 3C3 | 3C3 | 3C3 | 3C3 | 3C3 | 301 |  |  |  |  |  |  |

Figure 3.6B Calculational Model of the Central Plate Zone in Assembly 25

These Assembly 25 pin geometry elements are to be assumed to have the compositions of the following Assembly 23 pin geometry elements minus the sodium region material (sodium plus trace elements in the sodium).

3A1 3A

387 3B

3C3 3C

303 3D

301, 304, and 305 3E

3J2 and 3J6 3J

Note that the outer ring of plate geometry elements has been replaced by pin geometry elements.

### 3.1.2 Dimensions

#### Element Dimensions and the Lattice Spacing.

Within a group of 5x5 elements held between the superlattice grid plates the pitch of the elements in the square lattice is 5.3721 cm. The gap between the groups of 5x5 elements is 0.2665 cm. When a uniform grid is adopted over the whole assembly (as is done in some simplified models) the square lattice pitch becomes 5.4254 cm.

The dimensions of the steel element sheath which holds the core and blanket components is: inside width =5.102 cm and outside width = 5.2544 cm, the thickness of the walls of the sheath being 0.0762 cm . There is a small gap between the element sheath and the lattice cell boundary. The width of the plates, and also of the calandria, which fit inside the element sheaths, is nominally 5.067 cm and this is the value adopted in Model A. There is thus a small gap between the plates, or calandria, and the sheath, equal to 0.035/2 = 0.0175 cm. The gap between the elements within the arrays of 5x5 is 5.3721 – 5.2544 = 0.1177 cm and the gap between the element sheath and the cell boundary is 0.05885 cm.

The steel bars of the radial reflector are not contained in an element sheath. They have a square section of width 5.08 cm.

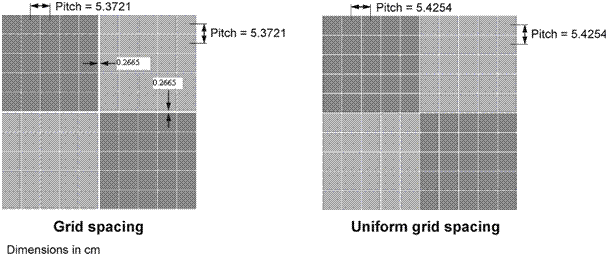


Figure 3.7 The Lattice Dimensions of Model A and of a Model with a Uniform Array of Elements

#### The Superlattice Grid Plates

In the core sections of the assemblies the space between the groups of 5x5 elements is a void but in the axial blanket and reflector regions superlattice grid plates are located. They are assumed to have a width of 0.2665 cm, so as to fill the width of the gaps. They are located, axially, between the planes 50.2 cm and 80.6 cm above and below the mid plane and are 30.4 cm high.

#### Dimensions of the Components used in the Plate Geometry Assemblies, 22 and 24.

##### Dimensions of the plates and plate cells used in the models.

Simplifications have been made to the dimensions and as a consequence some of the data are different from the dimensions and compositions given in other documents. The widths of all the plates have been assumed to be the same, 5.067 cm, whereas they can differ slightly from this value. Using the same value for all plates simplifies the representation of the outer region of the components. Also simplifications have been made to the dimensions of some plates, such as the sodium voided or "dummy" plates which replace the sodium plate in Core 24, with all plates of a particular type assumed to have the same dimensions.

Table 3.D1 Dimensions of the Core Region Plates.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Plate height or thickness | Assumed Width | Volume | Core height or thickness | Core width | Core volume | Can volume |
|  | cm | cm | cm3 | cm | cm | cm3 | cm3 |
| Pu metal | 0.3274 | 5.067 | 8.4058 | 0.236 | 4.671 | 5.1491 | 3.2567 |
| UO2 | 0.6313 | 5.067 | 16.2083 | 0.558 | 4.851 | 13.1310 | 3.0773 |
| Sodium | 0.613694 | 5.067 | 15.7563 | 0.541 | 4.963 | 13.3256 | 2.4307 |
| STNAVR4 | 0.616 | 5.067 | (ring) | 0.616 | 4.6 |  | 2.1841 |
| STNAVS4 | 0.616 | 5.067 | (ring) | 0.616 | 4.6 |  | 2.1841 |
| STNAV4 | 0.616 | 5.067 | 15.8155 |  |  |  |  |
| 40%steel | 0.317 | 5.067 | (8.1388) | 0.317 | \*3.925 | \*4.8836 | 3.2552 |

*\*The core region is a void in the case of the 40% Steel plate. This has been assumed to be a square frame in place of the gate shaped frame (see Figure 1.15).*

The edge regions of the cans have been assumed to have the same density as the top and bottom regions whereas they are less dense because they do not completely fill the space between the core region of a plate and the outer 5.067 cm square boundary.

The thickness of the sodium plate has been reduced from the nominal value of 0.616 cm given in the ZEBRA Database to 0.613694 cm to be consistent with the measured core height, it being assumed that it is the sodium filled plate which is compressed.

There are three types of “voided sodium” plate replacement. STNAVR4 and STNAVS4 are circular rings and STNAV4 “honeycomb” shaped. The core regions are voids in the case of the ring shaped sodium replacement plates.

The 22 standard core cells of Assembly 22 have a height of 3.748082 cm and the two upper and lower cells a height of 3.431082 cm making a total core height of 89.32 cm.

In Assembly 24 each cell is 0.006918 cm higher (3.755 cm and 3.438 cm, respectively) and the core height is 0.166 cm higher, a height of 89.486 cm.

The dimensions of the plates are shown in the following figures:



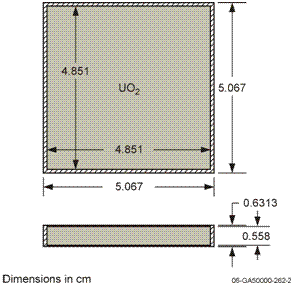
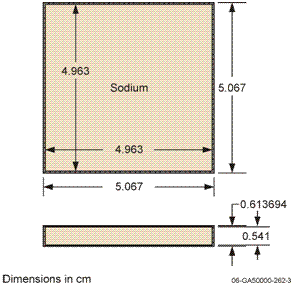


Figure 3.8 Dimensions of the Plutonium Metal and Uranium Oxide Plates



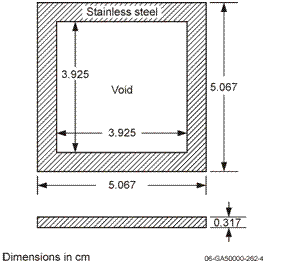
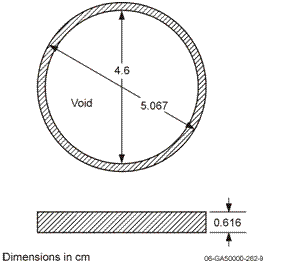


Figure 3.9 Dimensions of the Sodium and 40% Steel Plates



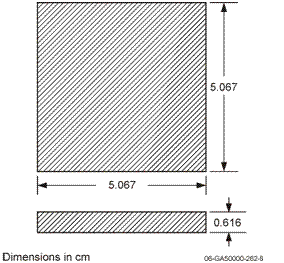


Figure 3.10 Dimensions of the two types of "Sodium Dummy" Plate, the Ring and "Honeycomb" Plates.

Table 3.D2 Dimensions of the Axial Blanket Region Natural Uranium Plates

|  |  |  |  |
| --- | --- | --- | --- |
|  | Thickness | Width | Volume |
|  | cm | cm | cm3 |
| U8 | 0.317 | 5.067 | 8.1388 |
| U2 | 1.2723 | 5.067 | 32.6657 |
| U3 | 7.6225 | 5.067 | 195.7038 |

The axial blanket sections consist of 31 U8 plates followed by 10 U2 plates and 1 U3 block, a height of 30.1725 cm.

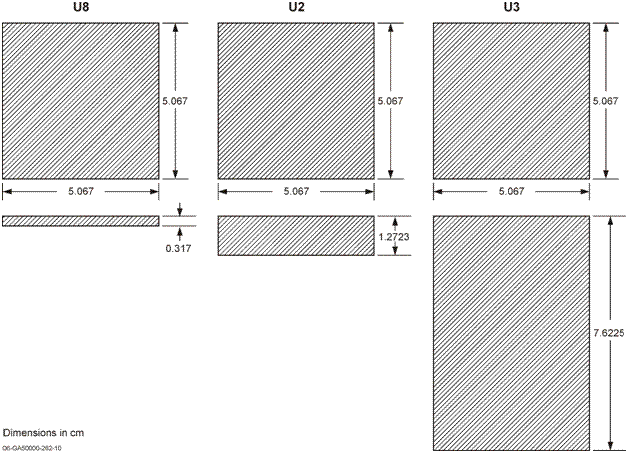


Figure 3.11 Dimensions of the Uranium Metal Plates.

Table 3.D3 Dimensions of the Axial Shielding Region Mild Steel Blocks

|  |  |  |  |
| --- | --- | --- | --- |
|  | Thickness | Width | Volume |
|  | cm | cm | cm3 |
| MST3 | 7.60628 | 5.067 | 195.2874 |

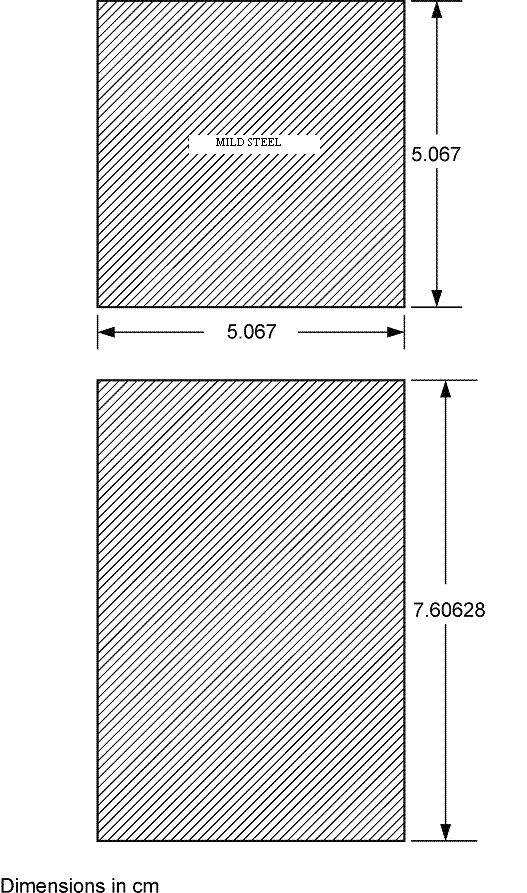


Figure 3.12 Dimensions of the Mild Steel Blocks used in the Axial Shielding Region.

Table 3.D4 Dimensions of the Element Sheaths and the Lattice Spacings

|  |  |
| --- | --- |
|  | (cm) |
| WALL THICKNESS | 0.0762 |
| INSIDE WIDTH | 5.1020 |
| OUTSIDE WIDTH | 5.2544 |
| AVERAGE PITCH WITHIN GROUPS OF 5x5 ELEMENTS | 5.3721 |
| GAP BETWEEN GROUPS OF 5x5 ELEMENTS | 0.2665 |
| AVERAGE PITCH OVERALL | 5.4254 |

The sheath is assumed to be the mild steel double element sheath, DSHEATH A, although some single sheaths were also used. These have a very similar average composition.

There are several ways in which the element sheath has been modelled in the past: firstly, over the region from the inside width of 5.102 cm to the outside width of 5.2544 cm (which is the representation used in the present Model A), secondly smeared over the space between the plate edges, 5.067 cm, and the average pitch within the lattice of 5.3721 cm and thirdly using the average pitch between elements of superlattices, 5.4254 cm. Based on the area between the plates, which have a width of 5.067 cm, and the overall average pitch of the uniform lattice, 5.4254 cm, the area is (5.4254)2 – (5.067) 2 = 3.76048 cm2. The actual area of the steel is (5.2544)2 – (5.102) 2 = 1.57832 cm2, less than half of the above figure. Smearing over the average pitch (as has been done in some previous calculational models) reduces the steel density by a factor of ~ 2.4. However, representing the gaps in calculation also poses problems because the components might deflect or move to fill these gaps and so it is not evident that representing the gaps in the model treats the streaming effects any more correctly than smearing the steel of the sheath over the gaps.

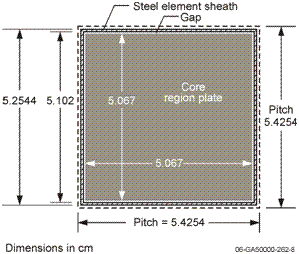
****

Figure 3.13 Radial Dimensions of the Element in a Model with a Uniform Lattice Spacing

***Representation of components within an element sheath.***

In the following Tables the dimensions of the cell components are summarised.

The core cells of Core 22B are denoted by Cell 1, 2, 11 and 12. Core cell 11 is the axial inverse of Core cell 1 and Core cell 12 is the axial inverse of Core cell 2. Cell 2 is the same as Core cell 1 but with the steel plate removed. The core section consists of 24 cells, the top and bottom cells having the steel plate removed to give a better height match with the pin geometry cores. The cells of Core 24 are similar and are denoted by Cell CC-24-1, etc.

The cell axial dimensions differ between Cores 22 and 24 because of the smaller thickness of the sodium plate compared with the voided plates (due to compression effects). Note, however, that in the analyses in the ZEBRA documentation the sodium plate has been taken to have the same thickness as the nominal value, which is the same as that of the "dummy" plates, and a correction made to the keff value. In the present document the axial dimensions of the two cores are different, with the thickness of the sodium plate corresponding to the measured core height.

Table 3.D5 Model of Cell 1 in Assembly 22.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cell 1** |  | Gap | Steel Sheath | Gap | Plate Total Width and Core Region Widths | |
| Can and Core Regions of Individual Plates | | 5.3721 -  5.2544 cm | 5.2544 -5.102 cm | 5.102 –5.067 cm | Width 5.067 cm | |
| Height  cm | Thickness cm |  |  |  | Edge region | Core region |
| 3.748082 | 0.036347 |  |  |  | Na can | |
| 3.711735 | 0.541 | Na can | Na core (width 4.963) |
| 3.170735 | 0.036347 | Na can | |
| 3.134388 | 0.03665 | UO2 can | |
| 3.097738 | 0.558 | UO2 can | UO2 core (width 4.851) |
| 2.539738 | 0.03665 | UO2 can | |
| 2.503088 | 0.036347 | Na can | |
| 2.466741 | 0.541 | Na can | Na core (width 4.963) |
| 1.925741 | 0.036347 | Na can | |
| 1.889394 | 0.0457 | Pu can | |
| 1.843694 | 0.236 | Pu can | Pu core (width 4.671) |
| 1.607694 | 0.0457 | Pu can | |
| 1.561994 | 0.317 | 40% Steel | Void region (3.925) |
| 1.244994 | 0.03665 | UO2 can | |
| 1.208344 | 0.558 | UO2 can | UO2 core (width 4.851) |
| 0.650344 | 0.03665 | UO2 can | |
| 0.613694 | 0.036347 | Na can | |
| 0.577347 | 0.541 | Na can | Na core (width 4.963) |
| 0.036347 | 0.036347 | Na can | |

Cell 11 is the inverse of this and cells 2 and 12 omit the 40%Steel plate.

Table 3.D6 Dimensions which Differ in Cell 2

(i.e. above the position of the 40%Steel plate in Cell 1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cell 2** |  | Gap | Sheath | Gap |  | |
| Height  cm | Thickness cm |  |  |  | Edge region | Core region |
| 3.431082 | 0.036347 |  |  |  | Na can | |
| 3.394735 | 0.541 | Na can | Na core (width 4.963) |
| 2.853735 | 0.036347 | Na can | |
| 2.817388 | 0.03665 | UO2 can | |
| 2.780738 | 0.558 | UO2 can | UO2 core (width 4.851) |
| 2.222738 | 0.03665 | UO2 can | |
| 2.186088 | 0.036347 | Na can | |
| 2.149741 | 0.541 | Na can | Na core (width 4.963) |
| 1.608741 | 0.036347 | Na can | |
| 1.572394 | 0.0457 | Pu can | |
| 1.526694 | 0.236 | Pu can | Pu core (width 4.671) |
| 1.290694 | 0.0457 | Pu can | |
| 1.244994 | 0.03665 | UO2 can | |

Table 3.D7 Model of Cell 11 in Assembly 22.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cell 11** |  | Gap | Steel Sheath | Gap | Plate Total Width and Core Region Widths | | | |
| Can and Core Regions of Individual Plates | | 5.3721 -  5.2544 cm | 5.2544 -5.102 cm | 5.102 –5.067 cm | Width 5.067 cm | | | |
| Height  cm | Thickness cm |  |  |  | Edge region | Core region | | |
| 3.748082 | 0.036347 |  |  |  | Na can | | | |
| 3.711735 | 0.541 | Na can | Na core (width 4.963) | | |
| 3.170735 | 0.036347 | Na can | | | |
| 3.134388 | 0.03665 | UO2 can | | | |
| 3.097738 | 0.558 | UO2 can | UO2 core (width 4.851) | | |
| 2.539738 | 0.03665 | UO2 can | | | |
| 2.503088 | 0.317 | 40% Steel | | Void region (3.925) | |
| 2.186088 | 0.0457 | Pu can | | | |
| 2.140388 | 0.236 | Pu can | | Pu core (width 4.671) | |
| 1.904388 | 0.0457 | Pu can | | | |
| 1.858688 | 0.036347 | Na can | | | |
| 1.822341 | 0.541 | Na can | | | Na core (width 4.963) |
| 1.281341 | 0.036347 | Na can | | | |
| 1.244994 | 0.03665 | UO2 can | | | |
| 1.208344 | 0.558 | UO2 can | UO2 core (width 4.851) | | |
| 0.650344 | 0.03665 | UO2 can | | | |
| 0.613694 | 0.036347 | Na can | | | |
| 0.577347 | 0.541 | Na can | Na core (width 4.963) | | |
| 0.036347 | 0.036347 | Na can | | | |

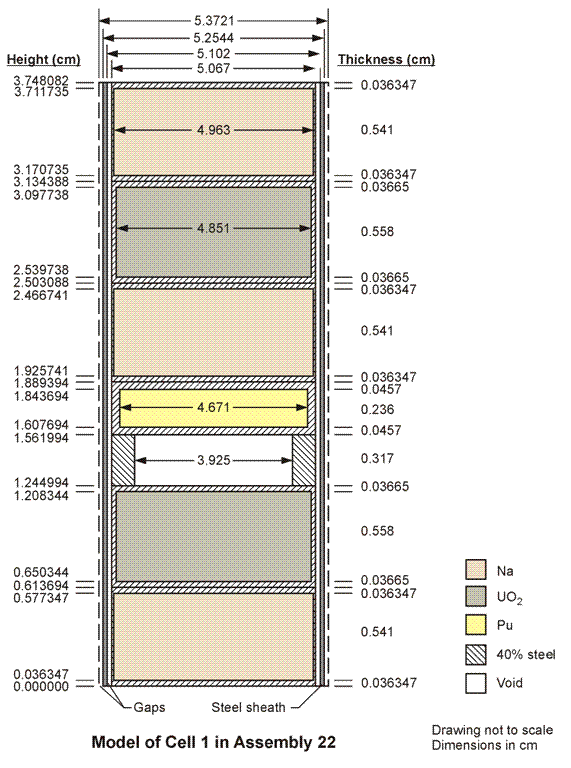
Cell 12 omits the 40%Steel plate.

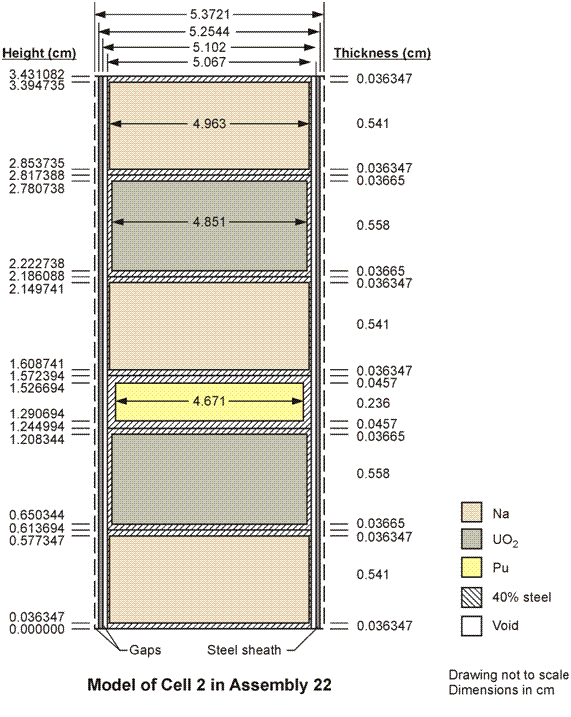
Table 3.D8 Dimensions which Differ in Cell 12

(i.e. above the position of the 40%Steel plate in Cell 11)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cell 12** |  | Gap | Sheath | Gap |  | |
| Height  cm | Thickness cm |  |  |  | Edge region | Core region |
| 3.431082 | 0.036347 |  |  |  | Na can | |
| 3.394735 | 0.541 | Na can | Na core (width 4.963) |
| 2.853735 | 0.036347 | Na can | |
| 2.817388 | 0.03665 | UO2 can | |
| 2.780738 | 0.558 | UO2 can | UO2 core (width 4.851) |
| 2.222738 | 0.03665 | UO2 can | |
| 2.186088 | 0.0457 | Pu can | |

Figure 3.14A Model A Dimensions of the Cells in Assembly 22. Cell 1.



 Figure 3.14B Model A Dimensions of the Cells in Assembly 22. Cell 2.

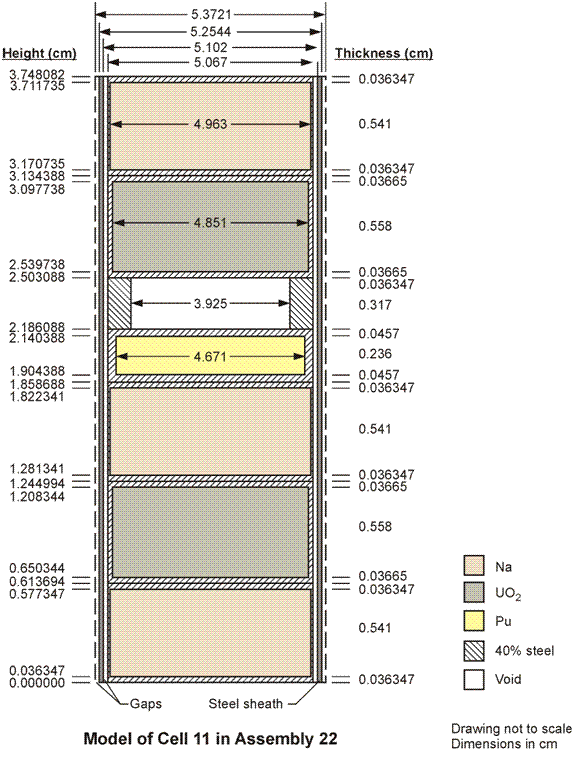


Figure 3.14C Model A Dimensions of the Cells in Assembly 22. Cell 11.

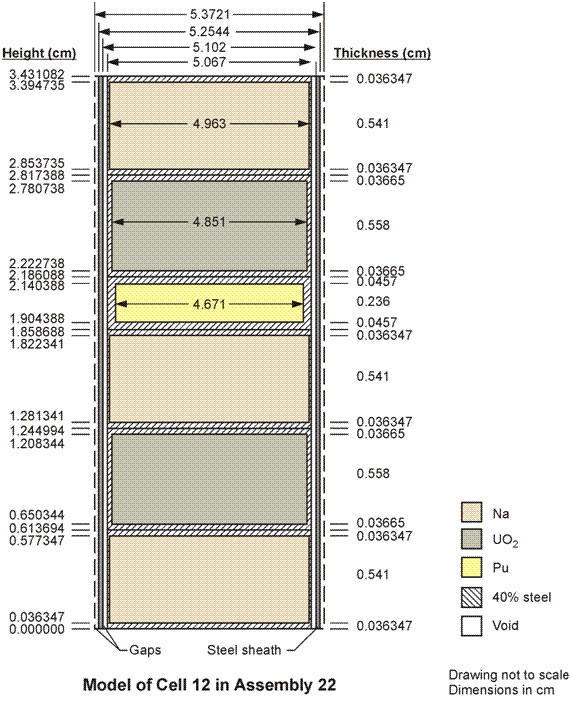


Figure 3.14D Model A Dimensions of the Cells in Assembly 22. Cell 12.

Table 3.D9 Model of Cell CC-24-1 in Assembly 24.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cell**  **CC-24-1** |  | 5.3721 -  5.2544 | 5.2544 -5.102 cm | 5.102 –5.067 cm | Width 5.067 cm | |
| Height  cm | Thickness cm | Gap | Steel Sheath | Gap | Edge region | Core region |
| 3.75500 | 0.616 |  |  |  | Na plate replacement | |
| 3.13900 | 0.03665 | UO2 can | |
| 3.10235 | 0.558 | UO2 can | UO2 core (width 4.851) |
| 2.54435 | 0.03665 | UO2 can | |
| 2.50770 | 0.616 | Na plate replacement | |
| 1.89170 | 0.0457 | Pu can | |
| 1.84600 | 0.236 | Pu can | Pu core (width 4.671) |
| 1.61000 | 0.0457 | Pu can | |
| 1.56430 | 0.317 | 40% Steel | Void region (3.925) |
| 1.24730 | 0.03665 | UO2 can | |
| 1.21065 | 0.558 | UO2 can | UO2 core (width 4.851) |
| 0.65265 | 0.03665 | UO2 can | |
| 0.61600 | 0.616 | Na plate replacement | |

Cell 11 is the inverse of this and cells 2 and 12 omit the 40%Steel plate.

Table 3.D10 Dimensions which differ in Cell CC-24-2

(i.e. above the position of the 40%Steel plate in Cell CC-24-1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cell**  **CC-24-2** |  |  |  |  |  | |
| Height  cm | Thickness cm | Gap | Sheath | Gap | Edge region | Core region |
| 3.43800 | 0.616 |  |  |  | Na plate replacement | |
| 2.82200 | 0.03665 | UO2 can | |
| 2.78535 | 0.558 | UO2 can | UO2 core (width 4.851) |
| 2.22735 | 0.03665 | UO2 can | |
| 2.19070 | 0.616 | Na plate replacement | |
| 1.57470 | 0.0457 | Pu can | |
| 1.52900 | 0.236 | Pu can | Pu core (width 4.671) |
| 1.29300 | 0.0457 | Pu can | |
| 1.24730 | 0.03665 | UO2 can | |

Table 3.D11 Model of Cell CC-24-11 in Assembly 24.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Cell**  **CC-24-11** |  | 5.3721 -  5.2544 | 5.2544 -5.102 cm | 5.102 –5.067 cm | Width 5.067 cm | | |
| Height  cm | Thickness cm | Gap | Steel Sheath | Gap | Edge region | Core region | |
| 3.75500 | 0.616 |  |  |  | Na plate replacement | | |
| 3.13900 | 0.03665 | UO2 can | | |
| 3.10235 | 0.558 | UO2 can | UO2 core (width 4.851) | |
| 2.54435 | 0.03665 | UO2 can | | |
| 2.50770 | 0.317 | 40% Steel | | Void region (3.925) |
| 2.19070 | 0.0457 | Pu can | | |
| 2.14500 | 0.236 | Pu can | | Pu core (width 4.671) |
| 1.90900 | 0.0457 | Pu can | | |
| 1.86330 | 0.616 | Na plate replacement | | |
| 1.24730 | 0.03665 | UO2 can | | |
| 1.21065 | 0.558 | UO2 can | UO2 core (width 4.851) | |
| 0.65265 | 0.03665 | UO2 can | | |
| 0.61600 | 0.616 | Na plate replacement | | |

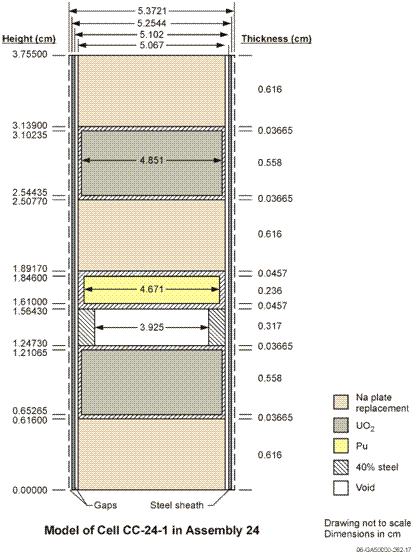
Cell 12 omits the 40%Steel plate.

Table 3.D12 Dimensions which differ in Cell CC-24-12

(i.e. above the position of the 40%Steel plate in Cell CC-24-11)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cell**  **CC-24-12** |  |  |  |  |  | |
| Height  cm | Thickness cm | Gap | Sheath | Gap | Edge region | Core region |
| 3.43800 | 0.616 |  |  |  | Na plate replacement | |
| 2.82200 | 0.03665 | UO2 can | |
| 2.78535 | 0.558 | UO2 can | UO2 core (width 4.851) |
| 2.22735 | 0.03665 | UO2 can | |
| 2.19070 | 0.0457 | Pu can | |

Figure 3.15A Model A Dimensions of the Cells in Assembly 24. Cell CC-24-1.



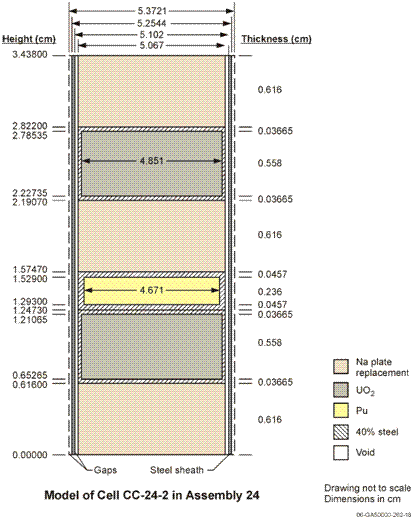


Figure 3.15B Model A Dimensions of the Cells in Assembly 24. Cell CC-24-2.

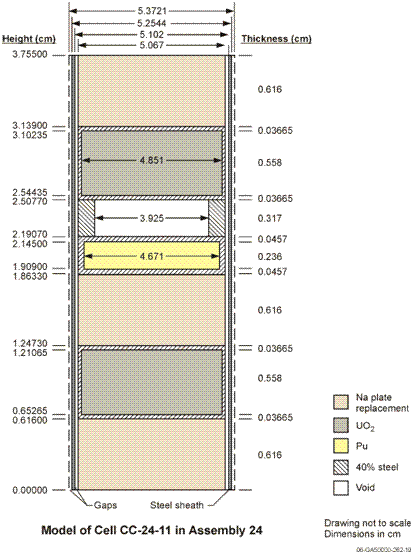


Figure 3.15C Model A Dimensions of the Cells in Assembly 24. Cell CC-24-11.

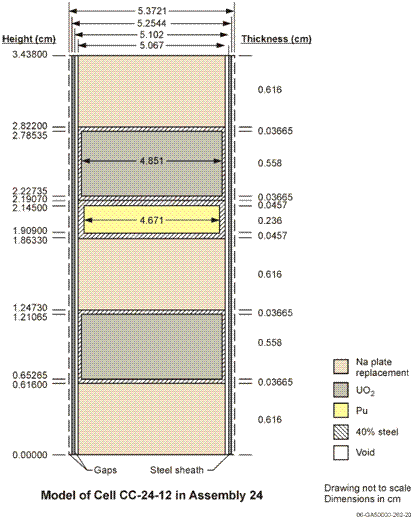


Figure 3.15D Model A Dimensions of the Cells in Assembly 24. Cell CC-24-12.

Figure 3.16 Dimensions of the Core Elements

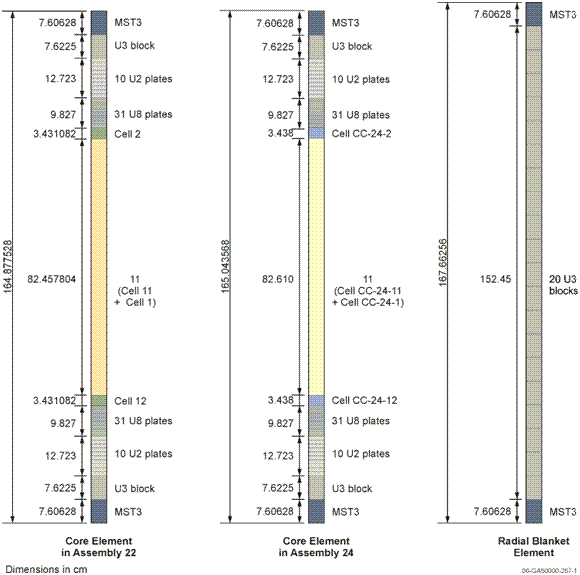


Table 3.D13 Axial Dimensions of a Core Element in Assembly 22

|  |  |  |
| --- | --- | --- |
|  |  | **Height of section (cm)** |
| Upper Axial Steel Reflector | 1 MST3 | 7.60628 |
| Upper Axial Natural Uranium Blanket | 1 U3 block | 7.6225 |
| 10 x U2 plates | 12.723 |
| 31 x U8 plates | 9.827 |
| Cell 2 |  | 3.431082 |
| 11 x (Cell 11 + Cell 1) | 22 x 3.748082 | 82.457804 |
| Cell 12 |  | 3.431082 |
| Lower Axial Natural Uranium Blanket | 31 x U8 plates | 9.827 |
| 10 x U2 plates | 12.723 |
| 1 U3 block | 7.6225 |
| Lower Axial Steel Reflector | 1 MST3 | 7.60628 |
|  |  |  |
| **Total core** |  | 89.319968 |
| **Total upper blanket region** |  | 30.1725 |
| **Total height** |  | 164.877528 |
|  |  |  |
| **Half height** |  | 82.438764 |

Table 3.D14 Axial Dimensions of Assembly 24 Core Elements containing the Sodium Dummy Plates (thickness 0.616 cm)

|  |  |  |
| --- | --- | --- |
|  |  | **Height of section (cm)** |
| Cell CC-24-2 |  | 3.438 |
| 11 x (Cell CC-24-11 + Cell CC-24-1) | 22 x 3.755 | 82.610 |
| Cell CC-24-12 |  | 3.438 |
| **Total core** |  | 89.486 |
| **Total upper blanket region** |  | 30.1725 |
| **Upper steel reflector region** |  | 7.60628 |
| **Total height** |  | 165.04356 |
|  |  |  |
| **Half height** |  | 82.52178 |

Table 3.D15 Axial Dimensions of a Radial Blanket Element

|  |  |  |
| --- | --- | --- |
|  |  | **Height of section (cm)** |
| Upper Axial Steel Reflector | 1 MST3 | 7.60628 |
| Radial Blanket section | 20 x U3 | 152.45 |
| Lower Axial Steel Reflector | 1 MST3 | 7.60628 |
|  |  |  |
| **Total** |  | 167.66256 |

These elements are contained in the mild steel element sheaths.

Table 3.D16 Dimensions of the Radial Shield Element

|  |  |  |
| --- | --- | --- |
|  |  | **Height of section (cm)** |
| Steel bar | MST9F10. | 300 |

The square bar is not contained in a sheath and has a width of 5.08 cm.

#### 262-12Dimensions of the Components used in the Pin Geometry Assemblies, 23 and 25.

Table 3.D17 Dimensions of the Mini-calandria Components.

The calandria contain a 4x4 array of fuel pellet columns. The pellet columns are contained in cans which fit inside tubes in the calandria.

|  |  |
| --- | --- |
| Calculational model. 4x4 array of pins in a square box. | **(cm, cm2 or cm3)** |
|  |  |
| **Fuel pellet column** |  |
| Fuel pellet radius | 0.423 |
| Fuel pellet column length | 29.18 |
| Fuel pellet area | 0.562122 |
| Fuel pellet column volume | 16.4027 |
| Volume of 16 fuel pellet columns | 262.4432 |
| Distance of fuel column from the bottom of the calandria | 0.44 |
| Distance of fuel column from the top of the calandria | 0.11 |
| Total height of the calandria | 29.730 |
| Pin pitch | 1.19 |
|  |  |
| Assumed length of the cans and tubes (same as fuel) | 29.18 |
| **Fuel can** |  |
| Fuel can inner radius | 0.4305 |
| Fuel can outer radius | 0.4685 |
| Pin can area (pi x (0.4685 sq – 0.4305 sq)) | 0.107323 |
| Pin can volume (area x 29.18 cm) | 3.131685 |
|  |  |
| **Calandria tubes** |  |
| Calandria tube inner radius | 0.488 |
| Calandria tube outer radius | 0.513 |
| Tube area (pi x (0.513 sq – 0.488 sq) | 0.078618 |
| Volume of 16 tubes (length 29.18 cm) | 36.7052 |
|  |  |
| Total area enclosed by a Calandria tube (pi x 0.513 sq) | 0.826770 |
| Area occupied by the 16 calandria tubes plus fuel pins | 13.2283 |
| Volume occupied by tubes + fuel pins (length 291.8) | 386.0018 |
|  |  |
| Inner width of the calandria | 4.90 |
| Inner area of calandria | 24.010 |
|  |  |
| **Sodium region** |  |
| Area assumed occupied by sodium (4.9 sq. minus tubes) | 10.7817 |
| Assumed volume of sodium (height same as fuel column) | 314.6100 |
|  |  |
| **End regions** |  |
| Top end region volume (4.9 sq. x 0.11) | 2.6411 |
| Bottom end region volume (4.9 sq. x 0.44) | 10.5644 |
| Total end region volume | 13.2055 |
|  |  |
| **Calandria walls** |  |
| Area of calandria outer walls (5.067 sq. – 4.9 sq.) | 1.664489 |
| Volume of calandria outer walls (length 29.73) | 49.4853 |
| Volume of walls plus end regions | 62.6908 |
|  |  |
| Width of calandria | 5.067 |
| Height of calandria | 29.73 |
| Total Volume of calandria | 763.3026 |

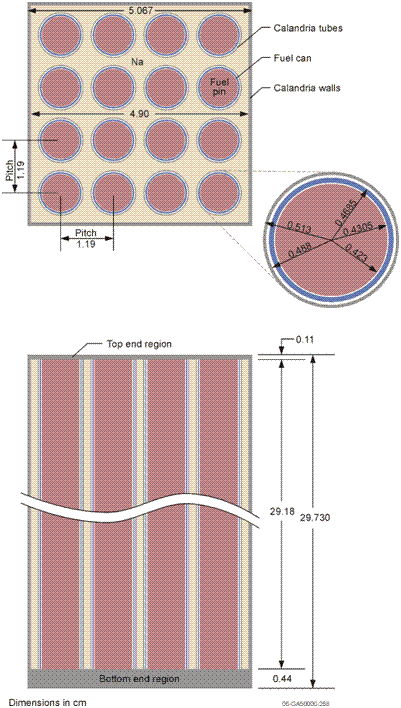


Figure 3.17 Dimensions of the Pin Geometry Cells.

The calculational model assumes that the calandria outer wall extends the full height of 29.73 cm and that there is a top and bottom slab region of thickness 0.11 cm and 0.44 cm, respectively, within the calandria.

The fuel, cans and calandria tubes extend between these two slab regions. The sodium is also between these two slabs. Three calandria are contained in each mild steel sheath, one above the other.

The core sections of the elements consist of the three mini-calandria, making a total core height of 3 x 29.73 = 89.19 cm. This compares with the height of the Assembly 22 core of 89.32 cm. The axial blanket and shield regions are the same as in Assembly 22. The axial thickness of the natural uranium axial blanket sections is 30.1725 cm and the steel axial shielding regions are 7.60628 cm thick.

Core 23A represents the original version in which PUPINE and F fuel pins were inverted. To minimise variations in the fuel lengths from element to element these pins where turned round in Core 23B. This placed the steel shims, which adjust the stack-heights of pellets and which on average are 0.2 cm thick, at the lower end of all the pins. The calculational model is based on Core 23B.

##### The pins used in reactivity worth measurements

These are the pins CPINA, MSTPINA, ALPINA and ALOPINA.

For all these pins the dimensions proposed for use in calculations are:

TOTAL LENGTH OF PIN ------- 29.5 cm

PIN RADIUS ---------------- 0.4685 cm

It is assumed that the pins rest on the bottom plate of the calandria, 0.11 cm from the bottom of the calandria, and reach to within 0.12 cm of the top of the calandria. If it is assumed that they have the same length as the fuel pins, 29.18 cm, there is a height difference of 0.32 cm, which is about 1% of the length of the pin and a small approximation compared with the other uncertainties.

### 3.1.3 Material Data

**Atomic densities are given in units of atoms/barn.cm.** The IRPhEP recommended atomic weights and Avogadro's Number have been used to calculate them. The atomic densites are given both in tables and in text form. The text form values for the reference cores can be found in the models set up in Appendix A whereas the text form values for the simplified models are given below the tables.

#### Atomic Densities of the Components in Assemblies 22 and 24.

In calculating the volumes and densities of core and can regions of plates, rounded corners have been made square and the material in the edge regions of cans has been assumed to fill the squared off rectangular regions enclosing the width of the plate. Weights of components are preserved. Because the edge regions of the canned plates are not well defined, or accurately treated, a standard width of 5.067cm has been adopted. The value given in the ZEBRA Database is sometimes slightly different from this.

If h denotes the height (or thickness) of the core region, and w its width, then the volume of the core region is taken to be:

Vcore = h.w2.

thus ignoring any curved corners.

If H denotes the plate height, and W its width, the volume of the plate is H.W2 and the volume of the can region is taken to be:

Vcan = (H.W2 - h.w2).

Irregular edge regions are being enlarged to fill the squared off volume, weights being preserved.

If the height (or thickness) of the core region isn't specified but the height (or thickness) of the plate, H, and the canning material thickness, t, are specified then the height of the core region is taken to be:

h = H - 2.t

Table 3.M1 The Plutonium Metal Plate, PUVIII8.

*The Pu241 and Am241 data relate to the reference date for the Cadenza cores of June 1981*

Core region height 0.236 cm, width 4.671 cm, volume = 5.1491 cm3

|  |  |
| --- | --- |
|  | Atoms/barn.cm |
| Nuclide |  |
|  |  |
| H | 1.2764E-04 |
| C | 4.2260E-04 |
| N | 2.4215E-05 |
| O | 8.8450E-05 |
| AL | 2.2973E-05 |
| SI | 1.4158E-05 |
| CR | 3.5989E-06 |
| MN | 1.4902E-06 |
| FE | 1.6335E-05 |
| NI | 8.5688E-06 |
| GA | 2.0166E-03 |
| U238 | 6.8782E-07 |
| PU238 | 3.0461E-05 |
| PU239 | 2.8920E-02 |
| PU240 | 6.9095E-03 |
| PU241 | 7.3960E-04 |
| PU242 | 1.8699E-04 |
| AM241 | 4.5718E-04 |
|  |  |
| Total | 3.9991E-02 |

Can region height 0.3274 cm, assumed width 5.067 cm, volume = 3.2567 cm3

|  |  |
| --- | --- |
|  | Atoms/barn.cm |
| Nuclide |  |
|  |  |
| H | 1.3760E-05 |
| C | 1.1393E-04 |
| SI | 3.6607E-04 |
| P | 1.3731E-05 |
| CR | 9.4011E-03 |
| MN | 8.5931E-04 |
| FE | 3.5542E-02 |
| NI | 4.1646E-03 |
| CU | 1.6613E-02 |
|  |  |
| Total | 6.7088E-02 |

Table 3.M2 The Natural Uranium Oxide Plate, UO23R4.

Core region height 0.558 cm, width 4.851 cm, Volume = 13.1310 cm3

|  |  |
| --- | --- |
|  | Atoms/barn.cm |
| Nuclide |  |
|  |  |
| H | 3.1852E-05 |
| C | 1.1837E-05 |
| O | 4.6122E-02 |
| AL | 3.3995E-06 |
| SI | 2.3024E-05 |
| MN | 8.3479E-08 |
| FE | 1.3139E-06 |
| NI | 1.2503E-06 |
| MO | 3.3462E-07 |
|  |  |
| U235 | 1.6585E-04 |
| U238 | 2.2894E-02 |
|  |  |
| Total | 6.9254E-02 |

Can region height 0.6313 cm, assumed width 5.067 cm, Volume = 3.0773 cm3

|  |  |
| --- | --- |
|  | Atoms/barn.cm |
| Nuclide |  |
|  |  |
| H | 1.8834E-05 |
| C | 1.2695E-04 |
| SI | 6.3794E-04 |
| P | 3.4708E-04 |
| S | 3.5660E-05 |
| CR | 1.3673E-02 |
| MN | 8.4655E-04 |
| FE | 4.7796E-02 |
| NI | 8.3368E-03 |
|  |  |
| Total | 7.1819E-02 |

Table 3.M3 The Sodium Plate, NASTDL4.

**Thickness of the sodium plate.**

*The thickness of the sodium plate has been reduced from its nominal value of 0.616 cm to 0.613694 cm to give a total core height of 89.32 cm for the 24 plate cells, equal to that actually measured*. The sodium plate was chosen for adjustment because these components have a tendency to compress. It is the steel can region which has been compressed and so if it is wished to use a model with the same plate thickness (0.616 cm) as for the voided Core 24 it is the can region compositions which should be modified and the core region thickness left unchanged.

Core region height 0.541 cm, width 4.963 cm, Volume = 13.3256 cm3

|  |  |
| --- | --- |
|  | Atoms/barn.cm |
| Nuclide |  |
|  |  |
| H | 1.3900E-05 |
| O | 5.6492E-06 |
| NA | 2.3225E-02 |
| CA | 3.6083E-06 |
| FE | 1.6184E-07 |
|  |  |
| Total | 2.3248E-02 |

Can region height 0.613694 cm, assumed width 5.067 cm, Volume = 2.4307 cm3

|  |  |
| --- | --- |
|  | Atoms/barn.cm |
| Nuclide |  |
|  |  |
| H | 2.1631E-05 |
| C | 2.9290E-04 |
| SI | 6.0867E-04 |
| P | 3.2795E-05 |
| S | 3.3219E-05 |
| CR | 1.4759E-02 |
| MN | 1.3570E-03 |
| FE | 5.5054E-02 |
| NI | 7.0982E-03 |
| NB | 3.1147E-04 |
|  |  |
| Total | 7.9569E-02 |

Table 3.M4 Sodium Dummy Plates.

The plates STNAVR4 and STNAVS4 are rings and STNAV4 is “honeycomb” shaped.

For a ring shaped piece, with outer diameter 5.067 cm, inner diameter 4.6 cm and thickness 0.616 cm, the volume is 2.1841 cm3.

**Note the circular outer and inner boundaries and the central void region of the rings.**

For the plate STNAV4 of height 0.616 cm, and assuming smearing over a width of 5.067 cm, the volume is 15.8155 cm3.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Atoms/barn.cm | | |
| PLATENAME: | STNAVR4 | STNAVS4 | STNAV4 |
|  |  |  |  |
| Volume (cm3) | 2.1841 | 2.1841 | 15.8155 |
| Nuclide |  |  |  |
|  |  |  |  |
| H | 2.4073E-05 | 2.4073E-05 | 3.3245E-06 |
| C | 2.7547E-04 | 2.5251E-04 | 3.3477E-05 |
| SI | 7.5592E-04 | 7.4610E-04 | 1.2169E-04 |
| P | 4.5399E-05 | 1.7803E-05 | 4.9764E-06 |
| S | 1.2036E-05 | 1.7195E-05 | 2.5076E-06 |
| CR | 1.6594E-02 | 1.6248E-02 | 2.4643E-03 |
| MN | 1.1688E-03 | 1.5006E-03 | 1.9518E-04 |
| FE | 5.9245E-02 | 5.9881E-02 | 8.0717E-03 |
| NI | 9.9342E-03 | 9.4005E-03 | 1.2195E-03 |
| NB | 4.0746E-04 | 3.7393E-04 | 5.2657E-05 |
|  |  |  |  |
| TOTAL | 8.8462E-02 | 8.8462E-02 | 1.2169E-02 |

Table 3.M5 The 40% Stainless Steel Plate, STSTF8.

The 40% void was achieved by cutting out sections of the plate. The plate is gate shaped , with a central cross-piece retained, but is assumed to have the shape of a square picture frame (with an inner square section void region).

PLATE height 0.317 cm, (the ***CORE region is assumed to be a square void***, height 0.317 cm, width 3.925 cm). Plate width 5.067 cm, Volume of steel region = 0.317.(5.0672 - 3.9252) = 3.2552 cm3

|  |  |
| --- | --- |
| Nuclide | Atoms/barn.cm |
|  |  |
| H | 1.8355E-05 |
| C | 8.7794E-05 |
| AL | 1.1862E-04 |
| SI | 7.9703E-04 |
| P | 4.0018E-05 |
| S | 1.4422E-05 |
| TI | 2.4806E-04 |
| CR | 1.5908E-02 |
| MN | 1.4972E-03 |
| FE | 5.5367E-02 |
| NI | 8.7976E-03 |
| CU | 5.0365E-05 |
| NB | 5.0000E-06 |
| MO | 8.0988E-05 |
|  |  |
| Total | 8.3030E-02 |

##### The uranium blanket and steel reflector regions.

Immediately above and below both the pin and plate geometry core cells there is a region of natural uranium metal pieces, about 30 cm in length. Next to the core there are 31 U8 plates followed by 10 U2 plates and 1 U3 block.

The cores are surrounded by radial blanket elements, each containing 20 U3 blocks, 152.45 cm in height. The centre of this region is closely aligned with the centre of the core region so that the upper and lower extremities of the uranium region are close to those of the axial blanket regions.

Table 3.D18 Blanket Region Natural Uranium Components, U8, U2 and U3

|  |  |  |  |
| --- | --- | --- | --- |
|  | Thickness (cm) | Width (cm) | Volume (cm3) |
|  |  |  |  |
| U8 | 0.317 | 5.067 | 8.1388 |
| U2 | 1.2723 | 5.067 | 32.6657 |
| U3 | 7.6225 | 5.067 | 195.7038 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | Atoms/barn.cm | | |
| Plate | U8 | U2 | U3 |
| Nuclide |  |  |  |
|  |  |  |  |
| H | 4.4048E-05 | 4.3899E-05 | 4.4574E-05 |
| C | 4.9283E-04 | 4.6047E-04 | 4.7140E-04 |
| SI | 2.1076E-04 | 1.9692E-04 | 2.0160E-04 |
| FE | 1.0599E-04 | 9.9032E-05 | 1.0138E-04 |
|  |  |  |  |
| U235 | 3.3369E-04 | 3.3962E-04 | 3.4209E-04 |
| U238 | 4.6021E-02 | 4.6785E-02 | 4.7156E-02 |
|  |  |  |  |
| Total | 4.7208E-02 | 4.7925E-02 | 4.8317E-02 |

Table 3.D19 Axial Reflector Mild Steel Block.

Above and below the uranium axial blanket regions there is a single mild steel block, MST3.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Thickness (cm) | Width (cm) | Volume (cm3) |
|  |  |  |  |
| MST3 | 7.60628 | 5.067 | 195.2874 |

Table 3.D20 Mild Steel Block, MST3.

|  |  |
| --- | --- |
|  | Atoms/barn.cm |
| Plate | MST3 |
| Nuclide |  |
|  |  |
| H | 2.5700E-05 |
| C | 5.1066E-04 |
| AL | 1.3989E-04 |
| TI | 3.9416E-05 |
| CR | 2.7222E-05 |
| MN | 3.2634E-04 |
| FE | 8.3806E-02 |
| NI | 4.8234E-05 |
| CU | 4.4548E-05 |
| MO | 9.8355E-06 |
|  |  |
| Total | 8.4978E-02 |

**The radial steel reflector region.**

The radial blanket elements are surrounded by steel bars, MST9F10, 5.08 cm square and about 3 m long, extending axially beyond the region of interest in the core and radial blanket. These bars are not contained in sheaths.

The average density has been calculated based on both the actual square width of 5.08 cm (volume 25.8064 cm3 per 1 cm length) and the average element spacing of 5.4254 cm, (the volume being 29.435 cm3 per 1 cm length).

Table 3.M6 The Steel Bar MST9F10. Total length ~3 m

|  |  |  |
| --- | --- | --- |
|  | Atoms/barn.cm | |
|  | 5.08 cm width | 5.4254 width |
| Nuclide |  |  |
|  |  |  |
| H | 4.6306E-05 | 4.0597E-05 |
| C | 6.8972E-04 | 6.0468E-04 |
| SI | 3.1158E-04 | 2.7317E-04 |
| P | 4.2944E-05 | 3.7649E-05 |
| S | 3.7110E-05 | 3.2535E-05 |
| MN | 7.1275E-04 | 6.2488E-04 |
| FE | 8.1432E-02 | 7.1392E-02 |
|  |  |  |
| Total | 8.3272E-02 | 7.3006E-02 |

**The Superlattice Grid Plates.**

The superlattice grid plates have a width of 0.25 cm but are treated as being of width 0.2665 cm, so as to fill the width of the gaps between the groups of 5x5 elements. The density is reduced by the factor 0.25/0.2665 = 0.938. The plates are located, axially, between the planes 50.2 cm and 80.6 cm above and below the mid plane and are 30.4 cm high. The region between -50.2 cm and +50.2 cm, relative to the centre plane, is treated as void in Model A.

The composition of the superlattice grid plates is assumed to be the same as that of the mild steel sheath MSHTH, reduced by the factor 0.938.

|  |  |
| --- | --- |
|  | Atoms/barn.cm |
| Nuclide |  |
|  |  |
| H | 2.4856E-04 |
| C | 2.9201E-04 |
| SI | 4.3326E-05 |
| P | 1.1555E-05 |
| S | 4.3523E-05 |
| MN | 2.5798E-04 |
| FE | 7.3146E-02 |
|  |  |
| Total | 7.4043E-02 |

Table 3.M7 The Mild Steel Sheath.

The data for DSHEATH A (the majority component used) are assumed in the calculations.

(Note: The weight figures for the double sheath, DSHEATH A, are per single element and are per 1 cm length and corresponding to a single column of plates).

The area of steel, based on the dimensions of the sheath, inside width =5.102 cm, outside width = 5.2544 cm is 1.57832 cm2, a volume per 1 cm length of 1.57832 cm3. Based on these dimensions the atomic densities are as follows:

**DSHEATH A**

|  |  |
| --- | --- |
|  | Atoms/barn.cm |
| Nuclide |  |
|  |  |
| H | 7.5712E-05 |
| C | 2.3825E-04 |
| AL | 1.9798E-05 |
| CR | 3.6690E-06 |
| MN | 2.5697E-04 |
| FE | 7.7524E-02 |
| NI | 1.4302E-05 |
| CU | 2.2216E-05 |
|  |  |
| Total | 7.8155E-02 |

The alternative sheath used for some elements is the single sheath MSHTH

**MSHTH**

|  |  |
| --- | --- |
|  | Atoms/barn.cm |
| Nuclide |  |
|  |  |
| H | 2.6499E-04 |
| C | 3.1131E-04 |
| SI | 4.6190E-05 |
| P | 1.2319E-05 |
| S | 4.6400E-05 |
| MN | 2.7503E-04 |
| FE | 7.7981E-02 |
|  |  |
| Total | 7.8937E-02 |

#### Compositions of the Pin Geometry Cells

Table 3.M8 Compositions of the Fuel.

**(**The Pu241 and Am241 data have been adjusted to June 1981, the reference date for the CADENZA cores)

The total pin length includes the end caps and spacers, the length of the fuel pellet column being 29.18 cm and the length of the mini-calandria 29.73 cm.

Atomic densities of the fuel pellet column

**(Radius = 0.423 cm, Height = 29.18 cm**, **Volume = 16.4027 cm3)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PUPINA | PUPINB | PUPINC | PUPIND | PUPINE | PUPINF |
| U234 | 1.3805E-06 | 1.3177E-06 | 1.2863E-06 | 1.4118E-06 | 1.1295E-06 | 1.1452E-06 |
| U235 | 1.4114E-04 | 1.3457E-04 | 1.2997E-04 | 1.4266E-04 | 1.1465E-04 | 1.1526E-04 |
| U236 | 7.9324E-07 | 7.4658E-07 | 7.3103E-07 | 7.9324E-07 | 6.3771E-07 | 6.3771E-07 |
| U238 | 1.9379E-02 | 1.8472E-02 | 1.7843E-02 | 1.9584E-02 | 1.5739E-02 | 1.5824E-02 |
| PU238 | 3.7786E-06 | 5.8915E-06 | 6.9094E-06 | 4.7348E-06 | 9.4851E-06 | 9.5005E-06 |
| PU239 | 2.9689E-03 | 3.7341E-03 | 4.4708E-03 | 3.0189E-03 | 6.0438E-03 | 6.0112E-03 |
| PU240 | 6.7253E-04 | 9.5200E-04 | 1.0602E-03 | 7.5441E-04 | 1.5103E-03 | 1.5285E-03 |
| PU241 | 7.0350E-05 | 1.1199E-04 | 1.1598E-04 | 8.8443E-05 | 1.7707E-04 | 1.9723E-04 |
| PU242 | 1.7488E-05 | 2.7984E-05 | 3.0047E-05 | 2.0961E-05 | 4.1953E-05 | 4.4380E-05 |
| AM241 | 4.7854E-05 | 5.5789E-05 | 5.7784E-05 | 4.0742E-05 | 8.1559E-05 | 6.8035E-05 |
|  |  |  |  |  |  |  |
| H | 3.2784E-05 | 3.2784E-05 | 3.2784E-05 | 3.2784E-05 | 3.2784E-05 | 3.2784E-05 |
| O | 4.6606E-02 | 4.6993E-02 | 4.7434E-02 | 4.7314E-02 | 4.7299E-02 | 4.7482E-02 |
| AL | 1.1702E-05 |  | 1.9730E-05 | 1.8914E-05 | 9.5250E-06 | 1.4287E-05 |
| SI |  | 9.0199E-06 | 7.9741E-06 | 2.5099E-05 | 4.5753E-05 |  |
| CA | 7.8782E-06 |  |  | 1.5940E-05 | 3.2062E-05 | 6.7514E-05 |
| CR |  |  |  |  |  | 4.9427E-06 |
| FE | 5.6537E-06 |  | 7.6916E-06 | 6.9027E-06 | 1.0321E-05 | 1.1505E-05 |
| NI |  | 5.4424E-06 | 1.0947E-05 | 1.4138E-05 |  | 2.1895E-06 |
|  |  |  |  |  |  |  |
| Total | 6.9967E-02 | 7.0537E-02 | 7.1230E-02 | 7.1085E-02 | 7.1149E-02 | 7.1415E-02 |

Table 3.M9 Compositions of the Fuel Pin Cans and End Regions.

Notes: These weights are obtained from the average total steel weight in a pin, average weights for an end cap and a spacer disc, the estimated average number of spacers in a pin and the bonded compositions of the various steels.

Hydrogen has been assumed present at 5 ppm, based on a survey for steel components. This figure has been used for all steels.

**Atomic densities in atoms/barn.cm Volume 3.131685 cm3**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Element | PUPINA | PUPINB | PUPINC | PUPIND | PUPINE | PUPINF |
|  |  |  |  |  |  |  |
| H | 2.6710E-05 | 2.2895E-05 | 2.6710E-05 | 2.4802E-05 | 2.4802E-05 | 2.4802E-05 |
| C | 1.3288E-04 | 2.3695E-04 | 1.3609E-04 | 2.0172E-04 | 7.3646E-05 | 7.2045E-05 |
| AL |  |  |  | 6.4142E-06 | 6.4142E-06 | 4.2762E-06 |
| SI | 8.5585E-04 | 1.1571E-03 | 8.3531E-04 | 8.9693E-04 | 1.0476E-03 | 1.0544E-03 |
| P | 3.7870E-05 | 4.1596E-05 | 3.6008E-05 | 3.4145E-05 | 1.3658E-05 | 1.3658E-05 |
| S | 2.4585E-05 | 2.2786E-05 | 2.4585E-05 | 8.9942E-06 | 1.7389E-05 | 1.7989E-05 |
| TI |  |  |  | 2.8916E-05 | 2.8916E-05 | 2.1687E-05 |
| CR | 1.8218E-02 | 1.4981E-02 | 1.7856E-02 | 1.5910E-02 | 1.6102E-02 | 1.6284E-02 |
| MN | 1.5646E-03 | 1.5751E-03 | 1.5331E-03 | 1.1586E-03 | 9.8006E-04 | 9.8357E-04 |
| FE | 5.9675E-02 | 5.3171E-02 | 5.8512E-02 | 5.5753E-02 | 5.6794E-02 | 5.7354E-02 |
| CO |  |  |  | 4.2418E-06 | 4.2418E-06 | 3.2629E-06 |
| NI | 8.9153E-03 | 8.8137E-03 | 8.7515E-03 | 7.6341E-03 | 8.0503E-03 | 8.1453E-03 |
| CU |  |  |  | 6.0522E-06 | 6.0522E-06 | 4.5391E-06 |
| NB |  | 2.9391E-04 |  |  |  |  |
| MO |  |  |  | 2.2047E-06 | 2.1446E-05 | 2.1246E-05 |
|  |  |  |  |  |  |  |
| Total | 8.9451E-02 | 8.0316E-02 | 8.7711E-02 | 8.1670E-02 | 8.3171E-02 | 8.4005E-02 |

Table 3.M10 Atomic Densities of the UO2 Pins

Note: The uranium used in U02PIND and U02PINE was obtained from two sources. The U235 content of one batch has been measured as 0.00722, 0.00717, 0.00724 and 0.00721 giving an average of 0.00721. The larger batch has U235 content determinations of 0.00705, 0.00695 and 0.00691, averaging 0.00697. The two batches were randomly mixed in making the pellets and an overall average U235 content of 0.0071 has been taken for these pins.

**Atomic density** **of the fuel pins** (Volume 16.4027 cm3)

|  |  |  |  |
| --- | --- | --- | --- |
| Element | UO2PINC | U02PIND | U02PINE |
|  |  |  |  |
| U234 | 9.7268E-07 | 9.5699E-07 | 9.5699E-07 |
| U235 | 1.7084E-04 | 1.7073E-04 | 1.7098E-04 |
| U238 | 2.3588E-02 | 2.3573E-02 | 2.3607E-02 |
|  |  |  |  |
| H | 3.2784E-05 | 3.2784E-05 | 3.2784E-05 |
| C | 3.2095E-05 |  |  |
| O | 4.7501E-02 | 4.7478E-02 | 4.7547E-02 |
| AL | 2.3812E-05 | 9.5250E-06 | 9.5250E-06 |
| SI | 4.0001E-05 | 1.3726E-05 | 1.3726E-05 |
| CA | 1.2825E-05 | 4.7635E-06 | 4.7635E-06 |
| FE | 1.1176E-06 | 2.3009E-06 | 2.3009E-06 |
|  |  |  |  |
| Total | 7.1400E-02 | 7.1281E-02 | 7.1386E-02 |

**Atomic densities of the cans in the calculational model**. (Volume = 3.131685cm3)

|  |  |  |  |
| --- | --- | --- | --- |
| Element | U02PINC | U02PIND | U02PINE |
|  |  |  |  |
| H | 2.6710E-05 | 2.4802E-05 | 2.4802E-05 |
| C | 1.3288E-04 | 2.0493E-04 | 7.3646E-05 |
| AL |  | 5.7016E-06 | 5.7016E-06 |
| SI | 8.5585E-04 | 9.1748E-04 | 1.0544E-03 |
| P | 3.7870E-05 | 3.4766E-05 | 1.3658E-05 |
| S | 2.4585E-05 | 8.9942E-06 | 1.7989E-05 |
| TI |  | 2.6507E-05 | 2.6507E-05 |
| CR | 1.8255E-02 | 1.6284E-02 | 1.6195E-02 |
| MN | 1.5681E-03 | 1.1866E-03 | 9.8357E-04 |
| FE | 5.9792E-02 | 5.7041E-02 | 5.7100E-02 |
| CO |  | 3.9155E-06 | 3.9155E-06 |
| NI | 8.9349E-03 | 7.8144E-03 | 8.0995E-03 |
| MO |  | 2.0043E-06 | 2.1446E-05 |
| AU |  | 2.1373E-03 | 2.1373E-03 |
|  |  |  |  |
| Total | 8.9628E-02 | 8.5692E-02 | 8.5757E-02 |

##### Composition assumed for the calandria tubes and the top and bottom slab regions in the calculational models.

In the calculational model the compositions are simplified. The compositions of the calandria tubes and the upper and lower slab regions are taken to be the same for all the calandria and the variations in weight and composition of the calandria are assigned to the outer walls of the calandria. The masses are divided in the following way. 2 g of the fuel can weight is assigned to the end regions (a total of 16 x 2 g = 32 g), as is 30 g of the weight of the calandria, a total of 62 g assigned to the volume of 13.2055 cm3. 300 g is assigned to the calandria tubes, volume 36.7052 cm3. The trace elements in the fuel and the compositions of the cans vary between the different types of pin.

Table 3.M11 The Masses adopted for the Calandria Tubes and End Regions and the Corresponding Atomic Densities.

(Masses in g )

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Taken from Calandria. | In Tubes.  *Volume 36.7052 cm3* | To end plate regions | Fuel can contrib. | 16 x fuel can contrib. | Total in end plate regions.  *Volume 13.2055* cm3 |
|  |  |  |  |  |  |  |
| SI | 2 | 1.82 | 0.18 | 0.01 | 0.16 | 0.34 |
| CR | 58.7 | 53.2 | 5.5 | 0.37 | 5.92 | 11.42 |
| MN | 5 | 4.55 | 0.45 | 0.03 | 0.48 | 0.93 |
| FE | 228 | 206.83 | 21.17 | 1.4 | 22.4 | 43.57 |
| NI | 29.3 | 26.6 | 2.7 | 0.19 | 3.04 | 5.74 |
|  |  |  |  |  |  |  |
| Total | 323 | 293 | 30 | 2 | 32 | 62 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Tubes. Weight (g) | Percent by weight | Tubes Atoms/barn.cm | End plate. Weight (g) | Percent by weight | End plates Atoms/barn.cm |
|  |  |  |  |  |  |  |
| SI | 1.82 | 0.621 | 1.0632E-03 | 0.340 | 0.548 | 5.5206E-04 |
| CR | 53.20 | 18.157 | 1.6787E-02 | 11.420 | 18.419 | 1.0016E-02 |
| MN | 4.55 | 1.553 | 1.3588E-03 | 0.930 | 1.500 | 7.7198E-04 |
| FE | 206.83 | 70.590 | 6.0762E-02 | 43.570 | 70.274 | 3.5578E-02 |
| NI | 26.60 | 9.078 | 7.4360E-03 | 5.740 | 9.258 | 4.4601E-03 |
|  |  |  |  |  |  |  |
| Total | 293.00 | 100.000 | 8.7407E-02 | 62.000 | 100.000 | 5.1378E-02 |

**Assumed atomic composition of calandria tubes** (atoms/barn.cm)

SI 1.0632E-03 CR 1.6787E-02 MN 1.3588E-03 FE 6.0762E-02 NI 7.4360E-03

###### **Assumed composition of calandria top and bottom end plate regions** (atoms/barn.cm)

SI 5.5206E-04 CR 1.0016E-02 MN 7.7198E-04 FE 3.5578E-02 NI 4.4601E-03

##### Compositions of the mini-calandria.

Modified compositions of the mini-calandria outer walls in the calculational model

Table 3.M12 Atomic Densities of the Outer Mini-calandria Walls

(Assumed volume = 49.4853 cm3 ) (atoms/barn.cm)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Element | NACLI | NACLIIS | NACLIII | NACLIV | NACLV | VCLVI |
|  |  |  |  |  |  |  |
| H | 3.9844E-05 | 3.8637E-05 | 3.9844E-05 | 3.7430E-05 | 3.8637E-05 | 3.8637E-05 |
| C | 2.8167E-04 | 6.5351E-04 | 1.5948E-04 | 3.5158E-04 | 2.6343E-04 | 2.4762E-04 |
| SI | 6.0229E-04 | 9.7623E-04 | 7.7474E-04 | 8.2197E-04 | 6.4389E-04 | 9.5110E-04 |
| P | 7.3471E-05 | 4.7540E-05 | 5.2334E-05 | 6.2274E-05 | 6.8560E-05 | 4.5654E-05 |
| S | 3.6808E-05 | 3.3014E-05 | 2.4551E-05 | 1.6431E-05 | 1.7190E-05 | 2.3793E-05 |
| TI |  | 2.4400E-04 |  |  |  |  |
| CR | 1.4995E-02 | 1.4380E-02 | 1.4132E-02 | 1.3563E-02 | 1.3830E-02 | 1.3837E-02 |
| MN | 1.2214E-03 | 1.1060E-03 | 8.3089E-04 | 1.0026E-03 | 9.6934E-04 | 8.6191E-04 |
| FE | 4.8911E-02 | 4.7118E-02 | 5.0764E-02 | 4.7151E-02 | 4.9404E-02 | 4.8404E-02 |
| CO |  | 1.1151E-05 |  |  |  |  |
| NI | 7.2440E-03 | 7.4526E-03 | 7.6658E-03 | 6.4549E-03 | 7.2532E-03 | 6.8530E-03 |
| CU |  | 1.0341E-05 |  |  |  |  |
| MO |  | 3.4248E-06 | 2.4862E-05 | 8.8791E-06 | 8.8791E-06 | 2.4862E-05 |
|  |  |  |  |  |  |  |
| Total | 7.3405E-02 | 7.2074E-02 | 7.4469E-02 | 6.9470E-02 | 7.2497E-02 | 7.1288E-02 |

##### Contents of the sodium regions of the mini-calandria

Table 3.M13 Atomic Densities of the Sodium Region

(Assumed volume = 314.6100 cm3) (atoms/barn.cm)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Element | NACLI | NACLIIS | NACLIII | NACLIV | NACLV |
|  |  |  |  |  |  |
| H | 5.5075E-06 | 1.1205E-05 | 7.5966E-06 | 7.5966E-06 | 7.5966E-06 |
| O | 6.4605E-06 | 1.0767E-06 | 3.5892E-06 | 3.5892E-06 | 3.5892E-06 |
| NA | 2.4129E-02 | 2.4379E-02 | 2.3888E-02 | 2.4037E-02 | 2.3829E-02 |
| K |  |  | 3.4270E-07 | 3.4270E-07 | 3.4270E-07 |
| CA | 1.1080E-06 | 9.5521E-08 | 6.6865E-07 | 6.6865E-07 | 6.6865E-07 |
| FE | 3.0847E-07 |  |  |  |  |
|  |  |  |  |  |  |
| Total | 2.4142E-02 | 2.4391E-02 | 2.3900E-02 | 2.4049E-02 | 2.3841E-02 |

##### Average compositions for the standard cells.

Table 3.D21A Plate Cell Volume Fractions.

Based on the overall average lattice pitch of 5.4254 cm and the height of the standard cell, 3.748082 cm, the cell volume is 110.32466 cm3.

The fractions of the standard (central region) cell occupied by the different materials are as follows.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Material | Composition | Basic Volume | Total Volume | Fraction |
|  |  | cm3 | cm3 |  |
| 1 | Plutonium core | 5.1491 | 5.1491 | 0.046672 |
| 2 | Plutonium clad | 3.2567 | 3.2567 | 0.029519 |
| 3 | UO2 core x 2 | 13.1310 | 26.2620 | 0.238044 |
| 4 | UO2 clad x 2 | 3.0773 | 6.1546 | 0.055787 |
| 5 | Na core x 3 | 13.3256 | 39.9768 | 0.362356 |
| 6 | Na clad x 3 | 2.4307 | 7.2921 | 0.066097 |
| 7 | 40% steel plate | 3.2552 | 3.2552 | 0.029506 |
| 8 | Mild steel sheath | 5.9157 | 5.9157 | 0.053621 |
|  |  |  |  |  |
| Total |  |  |  | 0.881600 |

Table 3.D21B Pin Cell Volume Fractions.

The height of the mini-calandria pin cell is 29.73 cm and the corresponding volume based on the overall average lattice pitch of 5.4254 cm is 875.10151 cm3.

The fractions of the standard cell occupied by the different components are as follows.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Material | Composition | Basic Volume | Total Volume | Fraction |
|  |  | cm3 | cm3 |  |
| 1 | U-Pu/O2 fuel x 16 | 16.4027 | 262.4432 | 0.299900 |
| 2 | Fuel clad x 16 | 3.131685 | 50.1070 | 0.057259 |
| 3 | Mini-calandria tube x 16 |  | 36.7052 | 0.041944 |
| 4 | Coolant region |  | 314.6100 | 0.359513 |
| 5 | End plates |  | 13.2055 | 0.015090 |
| 6 | Mini-calandria walls |  | 49.4853 | 0.056548 |
| 7 | Mild steel sheath |  | 46.92345 | 0.053621 |
|  |  |  |  |  |
| Total |  |  |  | 0.883874 |

Mini-calandria cell type 3A is considered, which has 16 identical type PUPINC fuel pins and the mini-calandria is NACLI.

The void regions are about 12% in both cases.

Table 3.M14 Average Compositions of the Chosen Plate and Pin Cells

(atoms/barn.cm)

|  |  |  |
| --- | --- | --- |
| Material | Standard plate cell  (Cells 1 and 2) | Uniform pin cell  Cell Type 3A |
|  |  |  |
| H | 0.0000261 | 0.0000197 |
| C | 0.0000677 | 0.0000365 |
| N | 0.0000011 | - |
| O | 0.0109852 | 0.0142278 |
| NA | 0.0084157 | 0.0086747 |
| AL | 0.0000064 | 0.0000070 |
| SI | 0.0001163 | 0.0001372 |
| P | 0.0000231 | 0.0000062 |
| S | 0.0000046 | 0.0000035 |
| CA | 0.0000013 | 0.0000004 |
| TI | 0.0000073 | - |
| CR | 0.0024855 | 0.0027258 |
| MN | 0.0002203 | 0.0002393 |
| FE | 0.0131461 | 0.0133609 |
| NI | 0.0013182 | 0.0012940 |
| CU | 0.0004931 | 0.0000012 |
| GA | 0.0000941 | - |
| NB | 0.0000207 | - |
| MO | 0.0000025 | - |
|  |  |  |
| U234 |  | 0.0000004 |
| U235 | 0.0000395 | 0.0000390 |
| U236 |  | 0.0000002 |
| U238 | 0.0054497 | 0.0053511 |
|  |  |  |
| PU238 | 0.0000014 | 0.0000021 |
| PU239 | 0.0013498 | 0.0013408 |
| PU240 | 0.0003225 | 0.0003180 |
| PU241 | 0.0000345 | 0.0000348 |
| PU242 | 0.0000087 | 0.0000090 |
| AM241 | 0.0000213 | 0.0000173 |

These values are very close to those obtained in the earlier analysis and reported in NEACRP-L-300.

#### Compositions for the Simplified Models.

Data have been derived for a set of simplified models and calculations have been made to compare these with the reference model, **Model A**. The models are illustrated in Figure 3.18.

**Model B** involves the homogenisation of the sheath over the space between the plates, or mini-calandria, and the 5.3721 cm square lattice cell boundary.

There is a gap between the sheath and the plates and also outside the sheath in the reference Model A. Homogenising the sheath over these inner and outer gaps (that is, over the area between the 5.067 cm square area of the plates and the 5.3721 cm square lattice area), but still representing the gaps between the 5x5 element superlattices and the superlattice grid plates, produces Model B.

**Model C** consists of a uniform lattice of square cells of size 5.4254 cm with homogenisation of the sheath over the space between the plates, or mini-calandria, and this larger square lattice cell boundary. The lattice is thus regular over the whole plan of the assembly.

The sheath is homogenised over the space between the plates and the superlattice averaged lattice cell (that is, over the area between the 5.067 cm square area of the plates, or mini-calandria, and the 5.4254 cm square lattice cell area corresponding to the average cell spacing over the superlattices), thus also eliminating the gaps between the 5x5 element superlattices and slightly changing the positions of the elements. The superlattice grid plates are not taken into account in the compositions.

**Model D** has the core represented as in Model C but with the blanket and shield regions homogenised with the sheath over the lattice cell – a radial homogenisation of the blanket regions and shield regions to produce uniform compositions.

**Model E** is a further simplification of the core region cells of Models C and D. The plate cells are reduced to two radial regions, the core and an average of the edge region cans and the sheath (the MURAL cell model). The pin cells have the cans and the calandria tubes homogenised over the space between the fuel pins and the outer boundary of the tubes. The calandria walls are homogenised with the sheath material over the space between the inner dimension of the wall and the lattice cell boundary.

**Models AS, BS, CS etc, where the S denotes a Single type of Core Element.** The core elements of Assembly 24 use 3 different types of “dummy” replacement sodium plate. In Model S just one type is represented, the dominant type. The pin geometry assemblies 23 and 25 contain several types of pin geometry element and also an outer ring of plate geometry elements. In Model S there is only one type of core element represented, the dominant pin geometry element (which occupies the central region).

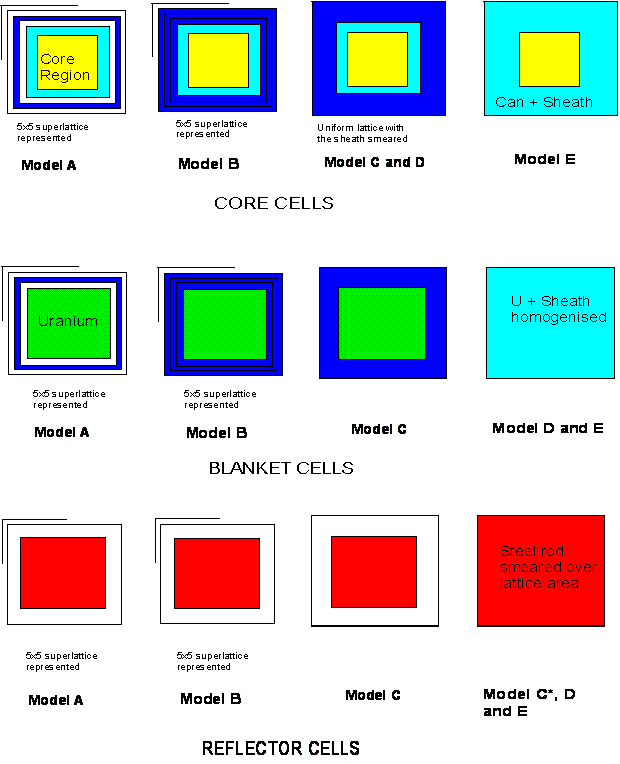


Figure 3.18 Simplified Models of Cells

##### Compositions of the simplified models.

The simplified models are shown in Figure 3.18 and the corrections to be made to the reference keff values are discussed in Section 3.1.5.

**Mild steel sheath smeared over the area between the plate edges and the lattice cell boundary.**

**Model B**. The area of steel (or volume per 1 cm length) based on the dimensions of the sheath, inside width =5.102 cm, outside width = 5.2544 cm is (5.2544)2 – (5.102) 2 = 1.57832 cm2. The density is smeared over the space between the plate edges, 5.067 cm, and the cell boundary, 5.3721 cm, an area of (5.3721)2 – (5.067) 2 = 28.85946 – 25.67449 = 3.18497 cm2 (this smearing reduces the density by a factor of 0.495553).

**Model C**. The density is smeared over the space between the plate edges, 5.067 cm, and the average pitch between elements of superlattices, 5.4254 cm, an area of (5.4254)2 – (5.067) 2 = 29.43497 – 25.67449 = 3.76048 cm2 (this smearing reduces the density by a factor of 0.419712).

Figures are also given in the table for the atomic densities of the sheath smeared over the lattice area of 5.4254x5.4254 = 29.4350, a factor of 0.0536205 reduction relative to the densities for the area of 1.57832 cm2. These are the densities contributed by the sheath when the plate and sheath are smeared together over the lattice area of (5.2544)2. Smearing a plate of width 5.067 cm over the lattice pitch of 5.4254 cm involves reducing the atomic densities by the factor 0.8722445.

Table 3.M15 Sheath Material Smeared over the area between the Plates, or Calandria, and the Lattice Cell Boundary, based on a Lattice Spacing of 5.3721 cm or 5.4254 cm

Smeared atomic densities (Atoms/barn.cm)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nuclide | Sheath | Sheath smeared over lattice area to 5.3721 cm | Sheath Smeared over lattice area to 5.4254 cm | Smeared over a lattice area of  5.42542 cm2 |
|  |  | Model B | Model C |  |
| Area cm2 | 1.57832 | 3.18497 | 3.76048 | 29.4350 |
|  |  |  |  |  |
| Factor |  | 0.495553 | 0.419712 | 0.0536205 |
|  |  |  |  |  |
| H | 7.5712E-05 | 3.7519E-05 | 3.1777E-05 | 4.0597E-06 |
| C | 2.3825E-04 | 1.1807E-04 | 9.9996E-05 | 1.2775E-05 |
| AL | 1.9798E-05 | 9.8110E-06 | 8.3095E-06 | 1.0616E-06 |
| CR | 3.6690E-06 | 1.8182E-06 | 1.5399E-06 | 1.9673E-07 |
| MN | 2.5697E-04 | 1.2734E-04 | 1.0785E-04 | 1.3779E-05 |
| FE | 7.7524E-02 | 3.8417E-02 | 3.2538E-02 | 4.1569E-03 |
| NI | 1.4302E-05 | 7.0874E-06 | 6.0027E-06 | 7.6688E-07 |
| CU | 2.2216E-05 | 1.1009E-05 | 9.3243E-06 | 1.1912E-06 |
|  |  |  |  |  |
| Total | 7.8155E-02 | 3.8730E-02 | 3.2803E-02 | 4.1907E-03 |

The above tabular values are here repeated in text form for the convenience of users.

**Atomic densities for the sheath smeared over the area between the plates (5.067 cm square) and the lattice boundary**

(a) Model B, the lattice area (5.3721 cm square):

H 3.7519E-05 C 1.1807E-04 AL 9.8110E-06 CR 1.8182E-06

MN 1.2734E-04 FE 3.8417E-02 NI 7.0874E-06 CU 1.1009E-05

(b) Model C, the superlattice averaged lattice area, (5.4254 cm square):

H 3.1777E-05 C 9.9996E-05 AL 8.3095E-06 CR 1.5399E-06

MN 1.0785E-04 FE 3.2538E-02 NI 6.0027E-06 CU 9.3243E-06

**Model D, the smearing of the blanket and shield regions, together with the sheath, over the superlattice average lattice cell area, 5.4254 cm square.**

**Smearing the uranium blanket regions.**

These are homogenised with the sheath. The factors to be applied are 0.8722445 to the uranium atomic compositions and 0.0536205 to the sheath atomic compositions (relative to the sheath density for the area 1.57832 cm2).

Table 3.M16 Smeared Atomic Densities for the Natural Uranium Plate, U8, plus Sheath.

(Atoms/barn.cm)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nuclide | Uranium plate | Reduced density of smeared uranium | Reduced smeared sheath density | Combined atomic densities |
|  |  |  |  |  |
| Factor |  | 0.8722445 | 0.0536205 |  |
|  |  |  |  |  |
| H | 4.4048E-05 | 3.8421E-05 | 4.0597E-06 | 4.2481E-05 |
| C | 4.9283E-04 | 4.2987E-04 | 1.2775E-05 | 4.4265E-04 |
| AL |  |  | 1.0616E-06 | 1.0616E-06 |
| SI | 2.1076E-04 | 1.8383E-04 |  | 1.8383E-04 |
| CR |  |  | 1.9673E-07 | 1.9673E-07 |
| MN |  |  | 1.3779E-05 | 1.3779E-05 |
| FE | 1.0599E-04 | 9.2449E-05 | 4.1569E-03 | 4.2493E-03 |
| NI |  |  | 7.6688E-07 | 7.6688E-07 |
| CU |  |  | 1.1912E-06 | 1.1912E-06 |
|  |  |  |  |  |
| U235 | 3.3369E-04 | 2.9106E-04 |  | 2.9106E-04 |
| U238 | 4.6021E-02 | 4.0142E-02 |  | 4.0142E-02 |
|  |  |  |  |  |
| Total | 4.7208E-02 | 4.1177E-02 | 4.1907E-03 | 4.5368E-02 |

The above tabular values are here repeated in text form:

**Atomic densities for the natural uranium plate, U8, homogenised with the sheath:**

H 4.2481E-05 C 4.4265E-04 AL 1.0616E-06 SI 1.8383E-04

CR 1.9673E-07 MN 1.3779E-05 FE 4.2493E-03 NI 7.6688E-07

CU 1.1912E-06

U235 2.9106E-04 U238 4.0142E-02

Table 3.M17 Smeared Atomic Densities for the Natural Uranium Plate, U2, plus Sheath.

(Atoms/barn.cm)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nuclide | Uranium plate | Reduced density of smeared uranium | Reduced smeared sheath density | Combined atomic densities |
|  |  |  |  |  |
| Factor |  | 0.8722445 | 0.0536205 |  |
|  |  |  |  |  |
| H | 4.3899E-05 | 3.8291E-05 | 4.0597E-06 | 4.2351E-05 |
| C | 4.6047E-04 | 4.0164E-04 | 1.2775E-05 | 4.1442E-04 |
| AL |  |  | 1.0616E-06 | 1.0616E-06 |
| SI | 1.9692E-04 | 1.7176E-04 |  | 1.7176E-04 |
| CR |  |  | 1.9673E-07 | 1.9673E-07 |
| MN |  |  | 1.3779E-05 | 1.3779E-05 |
| FE | 9.9032E-05 | 8.6380E-05 | 4.1569E-03 | 4.2433E-03 |
| NI |  |  | 7.6688E-07 | 7.6688E-07 |
| CU |  |  | 1.1912E-06 | 1.1912E-06 |
|  |  |  |  |  |
| U235 | 3.3962E-04 | 2.9623E-04 |  | 2.9623E-04 |
| U238 | 4.6785E-02 | 4.0808E-02 |  | 4.0808E-02 |
|  |  |  |  |  |
| Total | 4.7925E-02 | 4.1802E-02 | 4.1907E-03 | 4.5993E-02 |

The above tabular values are here repeated in text form:

**Atomic densities for the natural uranium plate, U2, homogenised with the sheath:**

H 4.2351E-05 C 4.1442E-04 AL 1.0616E-06 SI 1.7176E-04

CR 1.9673E-07 MN 1.3779E-05 FE 4.2433E-03 NI 7.6688E-07

CU 1.1912E-06

U235 2.9623E-04 U238 4.0808E-02

Table 3.M18 Smeared Atomic Densities for the Natural Uranium Plate, U3, plus Sheath.

(Atoms/barn.cm)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nuclide | Uranium plate | Reduced density of smeared uranium | Reduced smeared sheath density | Combined atomic densities |
|  |  |  |  |  |
| Factor |  | 0.8722445 | 0.0536205 |  |
|  |  |  |  |  |
| H | 4.4574E-05 | 3.8879E-05 | 4.0597E-06 | 4.2939E-05 |
| C | 4.7140E-04 | 4.1118E-04 | 1.2775E-05 | 4.2396E-04 |
| AL |  |  | 1.0616E-06 | 1.0616E-06 |
| SI | 2.0160E-04 | 1.7584E-04 |  | 1.7584E-04 |
| CR |  |  | 1.9673E-07 | 1.9673E-07 |
| MN |  |  | 1.3779E-05 | 1.3779E-05 |
| FE | 1.0138E-04 | 8.8428E-05 | 4.1569E-03 | 4.2453E-03 |
| NI |  |  | 7.6688E-07 | 7.6688E-07 |
| CU |  |  | 1.1912E-06 | 1.1912E-06 |
|  |  |  |  |  |
| U235 | 3.4209E-04 | 2.9839E-04 |  | 2.9839E-04 |
| U238 | 4.7156E-02 | 4.1132E-02 |  | 4.1132E-02 |
|  |  |  |  |  |
| Total | 4.8317E-02 | 4.2144E-02 | 4.1907E-03 | 4.6335E-02 |

The above tabular values are here repeated in text form:

**Atomic densities for the natural uranium block, U3, homogenised with the sheath:**

H 4.2939E-05 C 4.2396E-04 AL 1.0616E-06 SI 1.7584E-04

CR 1.9673E-07 MN 1.3779E-05 FE 4.2453E-03 NI 7.6688E-07

CU 1.1912E-06

U235 2.9839E-04 U238 4.1132E-02

Table 3.M19 Smeared Atomic Densities for the Mild Steel Axial Reflector Block,

MST3, plus Sheath, averaged over the lattice spacing of 5.4254 cm.

Area (5.067) 2 cm2 (Atoms/barn.cm)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nuclide | Mild steel block | Smeared atomic densities | Smeared sheath atomic densities | Combined block and sheath atomic densities |
|  |  |  |  |  |
| Factor |  | 0.8722445 |  |  |
|  |  |  |  |  |
| H | 2.5700E-05 | 2.2417E-05 | 4.0597E-06 | 2.6476E-05 |
| C | 5.1066E-04 | 4.4542E-04 | 1.2775E-05 | 4.5820E-04 |
| AL | 1.3989E-04 | 1.2202E-04 | 1.0616E-06 | 1.2308E-04 |
| TI | 3.9416E-05 | 3.4380E-05 |  | 3.4380E-05 |
| CR | 2.7222E-05 | 2.3744E-05 | 1.9673E-07 | 2.3941E-05 |
| MN | 3.2634E-04 | 2.8465E-04 | 1.3779E-05 | 2.9843E-04 |
| FE | 8.3806E-02 | 7.3099E-02 | 4.1569E-03 | 7.7256E-02 |
| NI | 4.8234E-05 | 4.2072E-05 | 7.6688E-07 | 4.2839E-05 |
| CU | 4.4548E-05 | 3.8857E-05 | 1.1912E-06 | 4.0048E-05 |
| MO | 9.8355E-06 | 8.5790E-06 |  | 8.5790E-06 |
|  |  |  |  |  |
| Total | 8.4978E-02 | 7.4122E-02 | 4.1907E-03 | 7.8312E-02 |

The above tabular values are here repeated in text form:

**Atomic densities for Axial Reflector MST3 mild steel block homogenised with the sheath:**

H 2.6476E-05 C 4.5820E-04 AL 1.2308E-04 TI 3.4380E-05

CR 2.3941E-05 MN 2.9843E-04 FE 7.7256E-02 NI 4.2839E-05

CU 4.0048E-05 MO 8.5790E-06

#### Model E, Simplified Core Cells.

**The plate geometry cells.**

The canning of the plates is homogenised with the sheath material to form a cell with two square radial regions, the core region and the edge region (the MURAL model). The edge region of the plate is homogenised with the sheath and the upper and lower can regions are separately merged with the sheath. There are two ways of representing the cell. One is with just the edge region merged, producing three layers of two regions each. The other is to homogenise the upper and lower can regions with the sheath to produce a single upper and lower region above and below the two region core section.

**The can of the Plutonium Metal Plate, PUVIII8.**

**Smearing the edge region canning material of the plate with the sheath.**

Can end region height 0.236 cm, plate core width 4.671 cm, plate outer width 5.067 cm, can edge region area = 3.856248 cm2. Smearing the edge region material with the wrapper material involves reducing the edge material density by the factor 3.856248/(3.856248+3.76048), a factor = 0.5062866, and the smeared sheath factor is therefore 0.4937133.

Table 3.M20 The Edge Region of the Plutonium Plate Combined with the Sheath and averaged over the space between the plate core and the lattice square of side 5.4254 cm. (Atoms/barn.cm)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nuclide | Canning material | Reduced Atomic density | Sheath reduced atomic densities | Combined Atomic density |
|  |  |  |  |  |
| Area | 3.856248 |  |  | 7.616728 |
|  |  |  |  |  |
| Smearing Factor |  | 0.5062866 | 0.4937133 |  |
|  |  |  |  |  |
| H | 1.3760E-05 | 6.9665E-06 | 1.5689E-05 | 2.2655E-05 |
| C | 1.1393E-04 | 5.7681E-05 | 4.9370E-05 | 1.0705E-04 |
| AL |  |  | 4.1025E-06 | 4.1025E-06 |
| SI | 3.6607E-04 | 1.8534E-04 |  | 1.8534E-04 |
| P | 1.3731E-05 | 6.9518E-06 |  | 6.9518E-06 |
| CR | 9.4011E-03 | 4.7597E-03 | 7.6028E-07 | 4.7604E-03 |
| MN | 8.5931E-04 | 4.3506E-04 | 5.3249E-05 | 4.8831E-04 |
| FE | 3.5542E-02 | 1.7994E-02 | 1.6064E-02 | 3.4059E-02 |
| NI | 4.1646E-03 | 2.1085E-03 | 2.9636E-06 | 2.1114E-03 |
| CU | 1.6613E-02 | 8.4109E-03 | 4.6035E-06 | 8.4155E-03 |
|  |  |  |  |  |
| Total | 6.7088E-02 | 3.3966E-02 | 1.6195E-02 | 5.0161E-02 |

The above tabular values are here repeated in text form:

**Atomic densities of the edge region of the Pu plate smeared with the sheath:**

H 2.2655E-05 C 1.0705E-04 AL 4.1025E-06 SI 1.8534E-04

P 6.9518E-06 CR 4.7604E-03 MN 4.8831E-04 FE 3.4059E-02

NI 2.1114E-03 CU 8.4155E-03

##### Radial smearing of the top and bottom can regions of the plutonium plate with the wrapper to give an equivalent one-dimensional plate.

The can atomic densities are multiplied by the factor 0.8722445 and the wrapper atomic densities by the factor 0.0536205 (relative to the wrapper densities for the area 1.57832 cm2).

Table 3.M21 Smeared Atomic Densities for the Upper and Lower Canning Region of the Plutonium Plate averaged with the sheath over the lattice square of side 5.4254 cm.

(Atoms/barn.cm)

|  |  |  |  |
| --- | --- | --- | --- |
| Nuclide | Can Reduced Atomic density | Wrapper reduced atomic densities | Combined Atomic density |
|  |  |  |  |
| Smearing Factor | 0.8722445 | 0.0536205 |  |
|  |  |  |  |
| H | 1.2002E-05 | 4.0597E-06 | 1.6062E-05 |
| C | 9.9375E-05 | 1.2775E-05 | 1.1215E-04 |
| AL |  | 1.0616E-06 | 1.0616E-06 |
| SI | 3.1930E-04 |  | 3.1930E-04 |
| P | 1.1977E-05 |  | 1.1977E-05 |
| CR | 8.2001E-03 | 1.9673E-07 | 8.2003E-03 |
| MN | 7.4953E-04 | 1.3779E-05 | 7.6331E-04 |
| FE | 3.1001E-02 | 4.1569E-03 | 3.5158E-02 |
| NI | 3.6325E-03 | 7.6688E-07 | 3.6333E-03 |
| CU | 1.4491E-02 | 1.1912E-06 | 1.4492E-02 |
|  |  |  |  |
| Total | 5.8517E-02 | 4.1907E-03 | 6.2708E-02 |

The above tabular values are here repeated in text form:

**Atomic densities of the can smeared with the sheath over the whole 5.4254 cm lattice area:**

H 1.6062E-05 C 1.1215E-04 AL 1.0616E-06 SI 3.1930E-04

P 1.1977E-05 CR 8.2003E-03 MN 7.6331E-04 FE 3.5158E-02

NI 3.6333E-03 CU 1.4492E-02

##### Smearing the can region of the uranium oxide plate.

**Smearing the edge region of the plate with the wrapper**

The core region height is 0.558 cm, and the width is 4.851 cm. The overall width of the plate is 5.067 cm. The area of the edge region is therefore 2.14229 cm2. Smearing this with the wrapper region involves a reduction in density by the factor 2.14229/(2.14229 + 3.76048) = 0.36293. The factor for the smeared wrapper is 0.63707.

Table 3.M22 Smeared Atomic Densities. Smearing the UO2 Plate Edge Region with the Sheath over the space between the plate core and the lattice square of side 5.4254 cm

(atomic densities in Atoms/barn.cm).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nuclide | Canning material Atomic density | Can Reduced Atomic density | Sheath reduced atomic densities | Combined Atomic density |
|  |  |  |  |  |
| Volume | 3.0773 |  |  |  |
|  |  |  |  |  |
| Factor |  | 0.36293 | 0.63707 |  |
|  |  |  |  |  |
| H | 1.8834E-05 | 6.8354E-06 | 2.0244E-05 | 2.7080E-05 |
| C | 1.2695E-04 | 4.6074E-05 | 6.3705E-05 | 1.0978E-04 |
| AL |  |  | 5.2937E-06 | 5.2937E-06 |
| SI | 6.3794E-04 | 2.3153E-04 |  | 2.3153E-04 |
| P | 3.4708E-04 | 1.2597E-04 |  | 1.2597E-04 |
| S | 3.5660E-05 | 1.2942E-05 |  | 1.2942E-05 |
| CR | 1.3673E-02 | 4.9623E-03 | 9.8104E-07 | 4.9633E-03 |
| MN | 8.4655E-04 | 3.0724E-04 | 6.8710E-05 | 3.7595E-04 |
| FE | 4.7796E-02 | 1.7347E-02 | 2.0728E-02 | 3.8075E-02 |
| NI | 8.3368E-03 | 3.0257E-03 | 3.8242E-06 | 3.0295E-03 |
| CU |  |  | 5.9403E-06 | 5.9403E-06 |
|  |  |  |  |  |
| Total | 7.1819E-02 | 2.6065E-02 | 2.0898E-02 | 4.6963E-02 |

The above tabular values are here repeated in text form:

**Atomic densities of the edge region of the UO2 plate smeared with the sheath:**

H 2.7080E-05 C 1.0978E-04 AL 5.2937E-06 SI 2.3153E-04

P 1.2597E-04 S 1.2942E-05 CR 4.9633E-03 MN 3.7595E-04

FE 3.8075E-02 NI 3.0295E-03 CU 5.9403E-06

##### Smearing the top and bottom can regions of the UO2 plate with the wrapper to give an equivalent one-dimensional plate.

The can atomic densities are multiplied by the factor 0.8722445 and the wrapper atomic densities by the factor 0.0536205 (relative to the densities for the area 1.57832 cm2).

Table 3.M23 Smeared Atomic Densities. Smearing the Upper and Lower Canning Region of the UO2 plate with the Sheath over the lattice square of side 5.4254 cm.

(Atoms/barn.cm)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nuclide | Canning material Atomic density | Can Reduced Atomic density | Sheath reduced atomic density | Combined Atomic density |
|  |  |  |  |  |
| Factor |  | 0.8722445 | 0.0536205 |  |
|  |  |  |  |  |
| H | 1.8834E-05 | 1.6428E-05 | 4.0597E-06 | 2.0488E-05 |
| C | 1.2695E-04 | 1.1073E-04 | 1.2775E-05 | 1.2351E-04 |
| AL |  |  | 1.0616E-06 | 1.0616E-06 |
| SI | 6.3794E-04 | 5.5644E-04 |  | 5.5644E-04 |
| P | 3.4708E-04 | 3.0274E-04 |  | 3.0274E-04 |
| S | 3.5660E-05 | 3.1104E-05 |  | 3.1104E-05 |
| CR | 1.3673E-02 | 1.1926E-02 | 1.9673E-07 | 1.1926E-02 |
| MN | 8.4655E-04 | 7.3840E-04 | 1.3779E-05 | 7.5218E-04 |
| FE | 4.7796E-02 | 4.1690E-02 | 4.1569E-03 | 4.5847E-02 |
| NI | 8.3368E-03 | 7.2717E-03 | 7.6688E-07 | 7.2725E-03 |
| CU |  |  | 1.1912E-06 | 1.1912E-06 |
|  |  |  |  |  |
| Total | 7.18E-02 | 6.2644E-02 | 4.1907E-03 | 6.7503E-02 |

The above tabular values are here repeated in text form:

**Atomic densities of the can smeared with the sheath over the whole lattice area:**

H 2.0448E-05 C 1.2351E-04 AL 1.0616E-06 SI 5.5644E-04

P 3.0274E-04 S 3.1104E-05 CR 1.1926E-02 MN 7.5218E-04

FE 4.5847E-02 NI 7.2725E-03 CU 1.1912E-06

##### Smearing the canning of the sodium plate with the sheath

**Smearing the edge region of the plate with the wrapper**

Core region height 0.541 cm, width 4.963 cm. Edge region area (5.067 cm)2 – (4.963 cm) 2 = 1.04312 cm2 . Smearing with the wrapper involves a reduction in density by the factor

1.04312/(1.04312 + 3.76048) = 0.217154. The (reduced density) wrapper densities are reduced by the factor 0.782846.

Table 3.M24 Smeared Atomic Densities. Smearing the Sodium Plate Edge Region with the Sheath over the space between the plate core and the lattice square of side 5.4254 cm.

(atomic densities in Atoms/barn.cm).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nuclide | Canning material  Atomic density | Can reduced Atomic density | Sheath reduced atomic densities | Combined Atomic density |
|  |  |  |  |  |
| Volume (cm3) | 2.4307 |  |  |  |
|  |  |  |  |  |
| Factor |  | 0.217154 | 0.782846 |  |
|  |  |  |  |  |
| H | 2.1631E-05 | 4.6973E-06 | 2.4877E-05 | 2.9574E-05 |
| C | 2.9290E-04 | 6.3604E-05 | 7.8282E-05 | 1.4189E-04 |
| AL |  |  | 6.5050E-06 | 6.5050E-06 |
| SI | 6.0867E-04 | 1.3218E-04 |  | 1.3218E-04 |
| P | 3.2795E-05 | 7.1216E-06 |  | 7.1216E-06 |
| S | 3.3219E-05 | 7.2136E-06 |  | 7.2136E-06 |
| CR | 1.4759E-02 | 3.2050E-03 | 1.2055E-06 | 3.2062E-03 |
| MN | 1.3570E-03 | 2.9468E-04 | 8.4433E-05 | 3.7911E-04 |
| FE | 5.5054E-02 | 1.1955E-02 | 2.5472E-02 | 3.7427E-02 |
| NI | 7.0982E-03 | 1.5414E-03 | 4.6992E-06 | 1.5461E-03 |
| CU |  |  | 7.2995E-06 | 7.2995E-06 |
| NB | 3.1147E-04 | 6.7637E-05 |  | 6.7637E-05 |
|  |  |  |  |  |
| Total | 7.9569E-02 | 1.7279E-02 | 2.5679E-02 | 4.2958E-02 |

The above tabular values are here repeated in text form:

**Atomic densities for the sodium plate edge can region, smeared with the sheath:**

H 2.9574E-05 C 1.4189E-04 AL 6.5050E-06 SI 1.3218E-04

P 7.1216E-06 S 7.2136E-06 CR 3.2062E-03 MN 3.7911E-04

FE 3.7427E-02 NI 1.5461E-03 CU 7.2995E-06 NB 6.7637E-05

##### Smearing the top and bottom can regions with the wrapper to give an equivalent one-dimensional plate.

The can atomic densities are multiplied by the factor 0.8722445 and the wrapper atomic densities by the factor 0.0536205 (relative to the densities for the area 1.57832 cm2).

Table 3.M25 Smeared Atomic Densities. Smearing the Upper and Lower Canning Region of the Sodium Plate with the Sheath over the lattice square of side 5.4254 cm.

(Atoms/barn.cm)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nuclide | Canning material  Atomic density | Reduced Atomic density | Sheath reduced atomic densities | Combined Atomic density |
|  |  |  |  |  |
| Factor |  | 0.8722445 | 0.0536205 |  |
|  |  |  |  |  |
| H | 1.9035E-05 | 1.8868E-05 | 4.0597E-06 | 2.2927E-05 |
| C | 1.2831E-04 | 2.5548E-04 | 1.2775E-05 | 2.6826E-04 |
| AL | 0.0 |  | 1.0616E-06 | 1.0616E-06 |
| SI | 6.4475E-04 | 5.3091E-04 |  | 5.3091E-04 |
| P | 3.5078E-04 | 2.8605E-05 |  | 2.8605E-05 |
| S | 3.6041E-05 | 2.8975E-05 |  | 2.8975E-05 |
| CR | 1.3819E-02 | 1.2873E-02 | 1.9673E-07 | 1.2874E-02 |
| MN | 8.5559E-04 | 1.1836E-03 | 1.3779E-05 | 1.1974E-03 |
| FE | 4.8306E-02 | 4.8021E-02 | 4.1569E-03 | 5.2177E-02 |
| NI | 8.4258E-03 | 6.1914E-03 | 7.6688E-07 | 6.1921E-03 |
| CU | 0.0 |  | 1.1912E-06 | 1.1912E-06 |
| NB |  | 2.7168E-04 |  | 2.7168E-04 |
|  |  |  |  |  |
| Total | 7.2585E-02 | 6.9404E-02 | 4.1907E-03 | 7.3594E-02 |

The above tabular values are here repeated in text form:

**Atomic densities of the can smeared with the sheath over the whole lattice area:**

H 2.2927E-05 C 2.6826E-04 AL 1.0616E-06 SI 5.3091E-04

P 2.8605E-05 S 2.8975E-05 CR 1.2874E-02 MN 1.1974E-03

FE 5.2177E-02 NI 6.1921E-03 CU 1.1912E-06 NB 2.7168E-04

##### Smearing the 40% steel plate with the wrapper to produce a uniform 1D plate.

In the MONK model the PLATE has height 0.317 cm, (CORE, assumed void, height 0317 cm, width 3.925 cm) Plate width assumed to be 5.067 cm, Volume 3.2552 cm3. The area is thus 10.2688 cm2.

The steel plate contains void regions but in the MURAL model it was smeared across the lattice area. The densities were thus reduced by the factor 10.2688/ (5.4254)2 = 0.348864

Table 3.M26 Smeared Atomic Densities. The 40%Steel Plate Smeared with the Sheath over the lattice square of side 5.4254 cm. (Atoms/barn.cm)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Nuclide | Atomic density | Reduced Atomic density | Sheath reduced atomic densities | Combined Atomic density Smeared over lattice cell | Smeared over the reduced area outside the central void |
|  |  |  |  |  |  |
| Area (cm2) | 10.2688 |  | 29.43497 |  | 14.02934 |
|  |  |  |  |  |  |
| Factor |  | 0.348864 | 0.0536205 |  | 2.0981 |
|  |  |  |  |  |  |
| H | 1.8355E-05 | 6.4034E-06 | 4.0597E-06 | 1.0463E-05 | 2.1952E-05 |
| C | 8.7794E-05 | 3.0628E-05 | 1.2775E-05 | 4.3403E-05 | 9.1064E-05 |
| AL | 1.1862E-04 | 4.1382E-05 | 1.0616E-06 | 4.2444E-05 | 8.9052E-05 |
| SI | 7.9703E-04 | 2.7806E-04 |  | 2.7806E-04 | 5.8340E-04 |
| P | 4.0018E-05 | 1.3961E-05 |  | 1.3961E-05 | 2.9292E-05 |
| S | 1.4422E-05 | 5.0313E-06 |  | 5.0313E-06 | 1.0556E-05 |
| TI | 2.4806E-04 | 8.6539E-05 |  | 8.6539E-05 | 1.8157E-04 |
| CR | 1.5908E-02 | 5.5497E-03 | 1.9673E-07 | 5.5499E-03 | 1.1644E-02 |
| MN | 1.4972E-03 | 5.2232E-04 | 1.3779E-05 | 5.3610E-04 | 1.1248E-03 |
| FE | 5.5367E-02 | 1.9316E-02 | 4.1569E-03 | 2.3472E-02 | 4.9247E-02 |
| NI | 8.7976E-03 | 3.0692E-03 | 7.6688E-07 | 3.0699E-03 | 6.4410E-03 |
| CU | 5.0365E-05 | 1.7571E-05 | 1.1912E-06 | 1.8762E-05 | 3.9365E-05 |
| NB | 0.000005 | 1.7443E-06 |  | 1.7443E-06 | 3.6597E-06 |
| MO | 8.0988E-05 | 2.8254E-05 |  | 2.8254E-05 | 5.9280E-05 |
|  |  |  |  |  |  |
| Total | 8.3030E-02 | 2.8966E-02 | 4.1907E-03 | 3.3157E-02 | 6.9567E-02 |

The above tabular values are here repeated in text form:

**Atomic densities for the 40% steel plate, smearing with the sheath over the whole area of the lattice cell.**

H 1.0463E-05 C 4.3403E-05 AL 4.2444E-05 SI 2.7806E-04

P 1.3961E-05 S 5.0313E-06 TI 8.6539E-05 CR 5.5499E-03

MN 5.3610E-04 FE 2.3472E-02 NI 3.0699E-03 CU 1.8762E-05

NB 1.7443E-06 MO 2.8254E-05

**Smearing over the area between the central square void and the cell boundary.**

H 2.1952E-05 C 9.1064E-05 AL 8.9052E-05 SI 5.8340E-04

P 2.9292E-05 S 1.0556E-05 TI 1.8157E-04 CR 1.1644E-02

MN 1.1248E-03 FE 4.9247E-02 NI 6.4410E-03 CU 3.9365E-05

NB 3.6597E-06 MO 5.9280E-05

##### Smearing the atomic densities of the sodium dummy plates over the plate area

The plates STNAVR4 and STNAVS4 are rings and STNAV4 is “honeycomb” shaped.

For a ring shaped piece, with outer diameter 5.067 cm, inner diameter 4.6 cm and thickness 0.616 cm, the area is 3.54567 and the volume is 2.1841 cm3.

Smearing the material over the lattice area of 5.067x5.067 reduces the atomic densities by the factor 3.54567/25.6745 = 0.138101:

Table 3.M27 Smeared Atomic Densities. Smearing the Sodium Dummy Plates over the Plate Area

(Atoms/barn.cm)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Nuclide | Atomic density | Smeared over plate area |  | Atomic density | Smeared over plate area |
|  |  |  |  |  |  |
| PLATENAME | STNAVR4 | STNAVR4 |  | STNAVS4 | STNAVS4 |
|  |  |  |  |  |  |
| Area (cm2) | 3.54567 | 25.6745 |  | 3.54567 | 25.6745 |
|  |  |  |  |  |  |
| Factor |  | 0.138101 |  |  | 0.138101 |
|  |  |  |  |  |  |
| H | 2.4073E-05 | 3.3245E-06 |  | 2.4073E-05 | 3.3245E-06 |
| C | 2.7547E-04 | 3.8043E-05 |  | 2.5251E-04 | 3.4872E-05 |
| SI | 7.5592E-04 | 1.0439E-04 |  | 7.4610E-04 | 1.0304E-04 |
| P | 4.5399E-05 | 6.2696E-06 |  | 1.7803E-05 | 2.4586E-06 |
| S | 1.2036E-05 | 1.6622E-06 |  | 1.7195E-05 | 2.3746E-06 |
| CR | 1.6594E-02 | 2.2916E-03 |  | 1.6248E-02 | 2.2439E-03 |
| MN | 1.1688E-03 | 1.6141E-04 |  | 1.5006E-03 | 2.0723E-04 |
| FE | 5.9245E-02 | 8.1818E-03 |  | 5.9881E-02 | 8.2696E-03 |
| NI | 9.9342E-03 | 1.3719E-03 |  | 9.4005E-03 | 1.2982E-03 |
| NB | 4.0746E-04 | 5.6271E-05 |  | 3.7393E-04 | 5.1640E-05 |
|  |  |  |  |  |  |
| TOTAL | 8.8462E-02 | 1.2217E-02 |  | 8.8462E-02 | 1.2217E-02 |

For the plate STNAV4 of height 0.616 cm, and assuming smearing over a plate width of 5.067 cm, the area is 25.6745 cm3

|  |  |
| --- | --- |
| Nuclide | Atomic density  Smeared over plate area |
| PLATENAME: | STNAV4 |
|  |  |
| Area (cm2) | 25.6745 |
|  |  |
| H | 3.3245E-06 |
| C | 3.3477E-05 |
| SI | 1.2169E-04 |
| P | 4.9764E-06 |
| S | 2.5076E-06 |
| CR | 2.4643E-03 |
| MN | 1.9518E-04 |
| FE | 8.0717E-03 |
| NI | 1.2195E-03 |
| NB | 5.2657E-05 |
|  |  |
| TOTAL | 1.2169E-02 |

##### 

##### Atomic densities of the dummy plates when smeared over the lattice area and combined with the sheath material.

The atomic densities averaged over the plate area of 25.6745 cm2 are multiplied by the factor 0.8722445 and combined with the smeared sheath material.

Table 3.M28 The Reduced Atomic Densities of the Dummy Plates before combining with the Sheath, based on the area 5.42542 cm2.

(Atoms/barn.cm)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nuclide | Smeared sheath densities | Dummy plates smeared over the lattice area of 29.43497 cm. Plate densities reduced by the factor 0.8722445 | | |
|  |  |  |  |  |
| PLATE: |  | STNAVR4 | STNAVS4 | STNAV4 |
|  |  |  |  |  |
| Area (cm2) | 29.43497 | 29.43497 | 29.43497 | 29.43497 |
|  |  |  |  |  |
| H | 4.0597E-06 | 2.8998E-06 | 2.8998E-06 | 2.8998E-06 |
| C | 1.2775E-05 | 3.3183E-05 | 3.0417E-05 | 2.9200E-05 |
| AL | 1.0616E-06 |  |  |  |
| SI |  | 9.1054E-05 | 8.9876E-05 | 1.0614E-04 |
| P |  | 5.4686E-06 | 2.1445E-06 | 4.3406E-06 |
| S |  | 1.4498E-06 | 2.0712E-06 | 2.1872E-06 |
| CR | 1.9673E-07 | 1.9988E-03 | 1.9572E-03 | 2.1495E-03 |
| MN | 1.3779E-05 | 1.4079E-04 | 1.8076E-04 | 1.7024E-04 |
| FE | 4.1569E-03 | 7.1365E-03 | 7.2131E-03 | 7.0405E-03 |
| NI | 7.6688E-07 | 1.1966E-03 | 1.1323E-03 | 1.0637E-03 |
| CU | 1.1912E-06 |  |  |  |
| NB |  | 4.9082E-05 | 4.5043E-05 | 4.5930E-05 |
|  |  |  |  |  |
| TOTAL | 4.1907E-03 | 1.0656E-02 | 1.0656E-02 | 1.0614E-02 |

Table 3.M29 Atomic Densities of the Smeared Dummy Plates combined with the Sheath Material

Densities uniformly smeared over the lattice square of side 5.4254 cm.

(Atoms/barn.cm)

|  |  |  |  |
| --- | --- | --- | --- |
| Nuclide | Dummy plates smeared over the lattice area of 29.43497 cm and combined with the sheath material | | |
|  |  |  |  |
| PLATE: | STNAVR4 | STNAVS4 | STNAV4 |
|  |  |  |  |
| Area (cm2) | 29.43497 | 29.43497 | 29.43497 |
|  |  |  |  |
| H | 6.9595E-06 | 6.9595E-06 | 6.9595E-06 |
| C | 4.5958E-05 | 4.3192E-05 | 4.1975E-05 |
| AL | 1.0616E-06 | 1.0616E-06 | 1.0616E-06 |
| SI | 9.1054E-05 | 8.9876E-05 | 1.0614E-04 |
| P | 5.4686E-06 | 2.1445E-06 | 4.3406E-06 |
| S | 1.4498E-06 | 2.0712E-06 | 2.1872E-06 |
| CR | 1.9990E-03 | 1.9574E-03 | 2.1497E-03 |
| MN | 1.5457E-04 | 1.9454E-04 | 1.8402E-04 |
| FE | 1.1293E-02 | 1.1370E-02 | 1.1197E-02 |
| NI | 1.1974E-03 | 1.1331E-03 | 1.0645E-03 |
| CU | 1.1912E-06 | 1.1912E-06 | 1.1912E-06 |
| NB | 4.9082E-05 | 4.5043E-05 | 4.5930E-05 |
|  |  |  |  |
| TOTAL | 1.4847E-02 | 1.4847E-02 | 1.4805E-02 |

The above tabular values are here repeated in text form:

**Atomic densities for the plates smeared with the sheath material over the whole lattice cell area:**

**STNAVR4**

H 6.9595E-06 C 4.5958E-05 AL 1.0616E-06 SI 9.1054E-05

P 5.4686E-06 S 1.4498E-06 CR 1.9990E-03 MN 1.5457E-04

FE 1.1293E-02 NI 1.1974E-03 CU 1.1912E-06 NB 4.9082E-05

**STNAVS4**

H 6.9595E-06 C 4.3192E-05 AL 1.0616E-06 SI 8.9876E-05

P 2.1445E-06 S 2.0712E-06 CR 1.9574E-03 MN 1.9454E-04

FE 1.1370E-02 NI 1.1331E-03 CU 1.1912E-06 NB 4.5043E-05

**STNAV4**

H 6.9595E-06 C 4.1975E-05 AL 1.0616E-06 SI 1.0614E-04

P 4.3406E-06 S 2.1872E-06 CR 2.1497E-03 MN 1.8402E-04

FE 1.1197E-02 NI 1.0645E-03 CU 1.1912E-06 NB 4.5930E-05

##### Model of the dummy plates with a central square void region

The dummy plates STNAVR4 and STNAVS4 are ring shaped, with a central circular void region. To model these in square geometry we can introduce a central square shaped void region, the square having side 4.6 cm (area 21.16 cm2). This is a fraction 0.718873 of the lattice area, the area occupied by the steel being (5.4254)2 – (4.6) 2 = 29.43497 – 21.16 = 8.27497 cm2. The densities of the components have to be increased by the factor 29.43497 / 8.27497 = 3.55711 when used with this model.

Table 3.M30 Atomic Densities of the Smeared Dummy Plates combined with the Sheath Material when there is a Central Square Hole of Side 4.6 cm.

(Atoms/barn.cm)

|  |  |  |  |
| --- | --- | --- | --- |
| Nuclide | Dummy plates plus sheath smeared over the region between the central 4.6 cm square hole and the lattice boundary | | |
|  |  |  |  |
| PLATE: | STNAVR4 | STNAVS4 |  |
|  |  |  |  |
| Area (cm2) | 8.27497 | 8.27497 |  |
|  |  |  |  |
| H | 2.4756E-05 | 2.4756E-05 |  |
| C | 1.6348E-04 | 1.5364E-04 |  |
| AL | 3.7762E-06 | 3.7762E-06 |  |
| SI | 3.2389E-04 | 3.1970E-04 |  |
| P | 1.9452E-05 | 7.6282E-06 |  |
| S | 5.1571E-06 | 7.3675E-06 |  |
| CR | 7.1107E-03 | 6.9627E-03 |  |
| MN | 5.4982E-04 | 6.9200E-04 |  |
| FE | 4.0172E-02 | 4.0444E-02 |  |
| NI | 4.2592E-03 | 4.0304E-03 |  |
| CU | 4.2372E-06 | 4.2372E-06 |  |
| NB | 1.7459E-04 | 1.6022E-04 |  |
|  |  |  |  |
| TOTAL | 5.2811E-02 | 5.2811E-02 |  |

The above tabular values are here repeated in text form:

**Atomic densities for the ring shaped dummy elements smeared over the area outside the central 4.6 cm square void region:**

**STNAVR4**

H 2.4756E-05 C 1.6348E-04 AL 3.7762E-06 SI 3.2389E-04

P 1.9452E-05 S 5.1571E-06 CR 7.1107E-03 MN 5.4982E-04

FE 4.0172E-02 NI 4.2592E-03 CU 4.2372E-06 NB 1.7459E-04

**STNAVS4**

H 2.4756E-05 C 1.5364E-04 AL 3.7762E-06 SI 3.1970E-04

P 7.6282E-06 S 7.3675E-06 CR 6.9627E-03 MN 6.9200E-04

FE 4.0444E-02 NI 4.0304E-03 CU 4.2372E-06 NB 1.6022E-04

#### Simplified Models of the Pin Geometry Assemblies 23 and 25.

Various simplifications were made in the original analyses of these assemblies, made in the 1980s.

The outer rings of plate geometry elements were replaced by pin geometry elements.

The same pin array was used for all elements (the one which occupies the central area of the cores and contains the pin array adopted in most pin geometry elements). This uses pins having two different enrichments.

Alternatively, instead of having a mixed pin array a uniform array of identical pins was used in the model.

Each of these simplifications involved a calculated correction to the experimental k-effective value, based on measurements of the relative worths of different elements. Details can be found in the ZTN/22 series of notes.

Further simplifications were to homogenise the element sheaths over the areas between the mini-calandria walls and the lattice area and to combine the sheath and mini-calandria walls to produce a single region as in Models C and E. This simplification is calculated here. The additional simplification calculated here is to combine the fuel pin can with the calandria tube and to eliminate the void regions.

An additional simplification to the pin cell calculations made in the original analyses (but not studied here) was to introduce the material of the minicalandria boxes and sheath into each pin cell calculation as an outer region surrounding each pin, and to then treat pin clusters. This was done to enable pin cluster collision probability calculations to be made in the MURAL cell code.

##### Homogenisation of the pin cell canning and calandria tube material

Table 3.D22 The Dimensions of the Pin Cell, Pellet Column, Canning and Calandria Tubes.

(dimensions in cm, and cm2.)

|  |  |
| --- | --- |
|  | cm, cm2 |
| **Fuel pellet column** |  |
| Fuel pellet column length | 29.18 |
| Fuel pellet radius | 0.423 |
| Fuel pellet area | 0.562122 |
|  |  |
| Void gap area (pi x (0.43052 - 0.4232)) | 0.0201101 |
|  |  |
| **Fuel can** |  |
| Fuel can inner radius | 0.4305 |
| Fuel can outer radius | 0.4685 |
| Pin can area (pi x (0.46852 – 0.43052)) | 0.107323 |
| Fuel can area fraction | 0.4055318 |
|  |  |
| Void gap area (pi x (0.4882 – 0.46852) | 0.0585962 |
|  |  |
| **Calandria tubes** |  |
| Calandria tube inner radius | 0.488 |
| Calandria tube outer radius | 0.513 |
| Tube area (pi x (0.5132 – 0.4882) | 0.078618 |
| Tube area fraction | 0.2970679 |
|  |  |
| Area of can + tube + void gaps | 0.2646477 |

Homogenising the can and tube over the area between the outer radius of the fuel pin and the outer radius of the tube involves combining 0.4055318 times the can material densities with 0.2970679 times the tube material densities.

Table 3.M31 Atomic Densities of the Tubes and the Scaled Atomic Densities.

(Atoms/barn.cm)

|  |  |  |
| --- | --- | --- |
| Nuclide | At. density | At. density  x 0.2970679 |
|  |  |  |
| SI | 1.0632E-03 | 3.1584E-04 |
| CR | 1.6787E-02 | 4.9869E-03 |
| MN | 1.3588E-03 | 4.0366E-04 |
| FE | 6.0762E-02 | 1.8050E-02 |
| NI | 7.4360E-03 | 2.2090E-03 |
|  |  |  |
| Total | 8.7407E-02 | 2.5966E-02 |

Table 3.M32 Atomic Densities of the Cans

(Atoms/barn.cm)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Nuclide | PUPINA | PUPINB | PUPINC | PUPIND | PUPINE | PUPINF |
|  |  |  |  |  |  |  |
| H | 2.6710E-05 | 2.2895E-05 | 2.6710E-05 | 2.4802E-05 | 2.4802E-05 | 2.4802E-05 |
| C | 1.3288E-04 | 2.3695E-04 | 1.3609E-04 | 2.0172E-04 | 7.3646E-05 | 7.2045E-05 |
| AL |  |  |  | 6.4142E-06 | 6.4142E-06 | 4.2762E-06 |
| SI | 8.5585E-04 | 1.1571E-03 | 8.3531E-04 | 8.9693E-04 | 1.0476E-03 | 1.0544E-03 |
| P | 3.7870E-05 | 4.1596E-05 | 3.6008E-05 | 3.4145E-05 | 1.3658E-05 | 1.3658E-05 |
| S | 2.4585E-05 | 2.2786E-05 | 2.4585E-05 | 8.9942E-06 | 1.7389E-05 | 1.7989E-05 |
| TI |  |  |  | 2.8916E-05 | 2.8916E-05 | 2.1687E-05 |
| CR | 1.8218E-02 | 1.4981E-02 | 1.7856E-02 | 1.5910E-02 | 1.6102E-02 | 1.6284E-02 |
| MN | 1.5646E-03 | 1.5751E-03 | 1.5331E-03 | 1.1586E-03 | 9.8006E-04 | 9.8357E-04 |
| FE | 5.9675E-02 | 5.3171E-02 | 5.8512E-02 | 5.5753E-02 | 5.6794E-02 | 5.7354E-02 |
| CO |  |  |  | 4.2418E-06 | 4.2418E-06 | 3.2629E-06 |
| NI | 8.9153E-03 | 8.8137E-03 | 8.7515E-03 | 7.6341E-03 | 8.0503E-03 | 8.1453E-03 |
| CU |  |  |  | 6.0522E-06 | 6.0522E-06 | 4.5391E-06 |
| NB |  | 2.9391E-04 |  |  |  |  |
| MO |  |  |  | 2.2047E-06 | 2.1446E-05 | 2.1246E-05 |
|  |  |  |  |  |  |  |
| Total | 8.9451E-02 | 8.0316E-02 | 8.7711E-02 | 8.1670E-02 | 8.3171E-02 | 8.4005E-02 |

Table 3.M33 Scaled Atomic Densities of the Cans (x 0.4055318)

(Atoms/barn.cm)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Nuclide | PUPINA | PUPINB | PUPINC | PUPIND | PUPINE | PUPINF |
|  |  |  |  |  |  |  |
| H | 1.0832E-05 | 9.2847E-06 | 1.0832E-05 | 1.0058E-05 | 1.0058E-05 | 1.0058E-05 |
| C | 5.3887E-05 | 9.6091E-05 | 5.5189E-05 | 8.1804E-05 | 2.9866E-05 | 2.9217E-05 |
| AL |  |  |  | 2.6012E-06 | 2.6012E-06 | 1.7341E-06 |
| SI | 3.4707E-04 | 4.6924E-04 | 3.3874E-04 | 3.6373E-04 | 4.2484E-04 | 4.2759E-04 |
| P | 1.5357E-05 | 1.6869E-05 | 1.4602E-05 | 1.3847E-05 | 5.5388E-06 | 5.5388E-06 |
| S | 9.9700E-06 | 9.2404E-06 | 9.9700E-06 | 3.6474E-06 | 7.0518E-06 | 7.2951E-06 |
| TI |  |  |  | 1.1726E-05 | 1.1726E-05 | 8.7948E-06 |
| CR | 7.3880E-03 | 6.0753E-03 | 7.2412E-03 | 6.4520E-03 | 6.5299E-03 | 6.6037E-03 |
| MN | 6.3450E-04 | 6.3875E-04 | 6.2172E-04 | 4.6985E-04 | 3.9745E-04 | 3.9887E-04 |
| FE | 2.4200E-02 | 2.1563E-02 | 2.3728E-02 | 2.2610E-02 | 2.3032E-02 | 2.3259E-02 |
| CO |  |  |  | 1.7202E-06 | 1.7202E-06 | 1.3232E-06 |
| NI | 3.6154E-03 | 3.5742E-03 | 3.5490E-03 | 3.0959E-03 | 3.2647E-03 | 3.3032E-03 |
| CU |  |  |  | 2.4544E-06 | 2.4544E-06 | 1.8407E-06 |
| NB |  | 1.1919E-04 |  |  |  |  |
| MO |  |  |  | 8.9408E-07 | 8.6970E-06 | 8.6159E-06 |
|  |  |  |  |  |  |  |
| Total | 3.6275E-02 | 3.2571E-02 | 3.5570E-02 | 3.3120E-02 | 3.3728E-02 | 3.4067E-02 |

Table 3.M34 Combined Can Plus Tube Homogenised Atomic Number Densities

(Atoms/barn.cm)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Nuclide | PUPINA | PUPINB | PUPINC | PUPIND | PUPINE | PUPINF |
|  |  |  |  |  |  |  |
| H | 1.0832E-05 | 9.2847E-06 | 1.0832E-05 | 1.0058E-05 | 1.0058E-05 | 1.0058E-05 |
| C | 5.3887E-05 | 9.6091E-05 | 5.5189E-05 | 8.1804E-05 | 2.9866E-05 | 2.9217E-05 |
| AL |  |  |  | 2.6012E-06 | 2.6012E-06 | 1.7341E-06 |
| SI | 6.6291E-04 | 7.8508E-04 | 6.5458E-04 | 6.7957E-04 | 7.4068E-04 | 7.4343E-04 |
| P | 1.5357E-05 | 1.6869E-05 | 1.4602E-05 | 1.3847E-05 | 5.5388E-06 | 5.5388E-06 |
| S | 9.9700E-06 | 9.2404E-06 | 9.9700E-06 | 3.6474E-06 | 7.0518E-06 | 7.2951E-06 |
| TI |  |  |  | 1.1726E-05 | 1.1726E-05 | 8.7948E-06 |
| CR | 1.2375E-02 | 1.1062E-02 | 1.2228E-02 | 1.1439E-02 | 1.1517E-02 | 1.1591E-02 |
| MN | 1.0382E-03 | 1.0424E-03 | 1.0254E-03 | 8.7351E-04 | 8.0111E-04 | 8.0253E-04 |
| FE | 4.2250E-02 | 3.9613E-02 | 4.1778E-02 | 4.0660E-02 | 4.1082E-02 | 4.1309E-02 |
| CO |  |  |  | 1.7202E-06 | 1.7202E-06 | 1.3232E-06 |
| NI | 5.8244E-03 | 5.7832E-03 | 5.7580E-03 | 5.3049E-03 | 5.4737E-03 | 5.5122E-03 |
| CU |  |  |  | 2.4544E-06 | 2.4544E-06 | 1.8407E-06 |
| NB |  | 1.1919E-04 |  |  |  |  |
| MO |  |  |  | 8.9408E-07 | 8.6970E-06 | 8.6159E-06 |
|  |  |  |  |  |  |  |
| Total | 6.2241E-02 | 5.8537E-02 | 6.1536E-02 | 5.9086E-02 | 5.9694E-02 | 6.0033E-02 |

The above tabular values are here repeated in text form:

**PUPINA**

H 1.0832E-05 C 5.3887E-05 SI 6.6291E-04 P 1.5357E-05

S 9.9700E-06 CR 1.2375E-02 MN 1.0382E-03 FE 4.2250E-02

NI 5.8244E-03

**PUPINB**

H 9.2847E-06 C 9.6091E-05 SI 7.8508E-04 P 1.6869E-05

S 9.2404E-06 CR 1.1062E-02 MN 1.0424E-03 FE 3.9613E-02

NI 5.7832E-03 NB 1.1919E-04

**PUPINC**

H 1.0832E-05 C 5.5189E-05 SI 6.5458E-04 P 1.4602E-05

S 9.9700E-06 CR 1.2228E-02 MN 1.0254E-03 FE 4.1778E-02

NI 5.7580E-03

**PUPIND**

H 1.0058E-05 C 8.1804E-05 AL 2.6012E-06 SI 6.7957E-04

P 1.3847E-05 S 3.6474E-06 TI 1.1726E-05 CR 1.1439E-02

MN 8.7351E-04 FE 4.0660E-02 CO 1.7202E-06 NI 5.3049E-03

CU 2.4544E-06 MO 8.9408E-07

**PUPINE**

H 1.0058E-05 C 2.9866E-05 AL 2.6012E-06 SI 7.4068E-04

P 5.5388E-06 S 7.0518E-06 TI 1.1726E-05 CR 1.1517E-02

MN 8.0111E-04 FE 4.1082E-02 CO 1.7202E-06 NI 5.4737E-03

CU 2.4544E-06 MO 8.6970E-06

**PUPINF**

H 1.0058E-05 C 2.9217E-05 AL 1.7341E-06 SI 7.4343E-04

P 5.5388E-06 S 7.2951E-06 TI 8.7948E-06 CR 1.1591E-02

MN 8.0253E-04 FE 4.1309E-02 CO 1.3232E-06 NI 5.5122E-03

CU 1.8407E-06 MO 8.6159E-06

##### Homogenisation of the calandria walls and the sheath.

Table 3.D23 Dimensions of the Calandria Walls

|  |  |
| --- | --- |
| **Calandria walls** | (cm, cm2) |
|  |  |
| Inner width of the calandria (cm) | 4.9 |
| Outer width of the calandria (cm) | 5.067 |
| Area of calandria outer walls (5.067 sq. – 4.9 sq.) (cm2) | 1.66449 |
|  |  |
| Outer width of lattice cell (averaged over the supercell) (cm) | 5.4254 |
| Area of the homogenised sheath (5.4254 sq. – 5.067 sq.) (cm2) | 3.76048 |
|  |  |
| Total area of region (5.4254 sq. – 4.9 sq.) (cm2) | 5.42497 |
|  |  |
| Calandria wall fraction | 0.30682 |
| Homogenised sheath fraction | 0.69318 |

Table 3.M35 Atomic Density Contributed by the Smeared Sheath

(Atoms/barn.cm)

|  |  |  |
| --- | --- | --- |
| Nuclide | Sheath Smeared over lattice area to 5.4254 cm square | Sheath at density to be Smeared with the calandria wall x0.69318 |
|  |  |  |
| Area cm2 | 3.76048 | 5.42497 |
|  |  |  |
| H | 3.1777E-05 | 2.2027E-05 |
| C | 9.9996E-05 | 6.9315E-05 |
| AL | 8.3095E-06 | 5.7600E-06 |
| CR | 1.5399E-06 | 1.0674E-06 |
| MN | 1.0785E-04 | 7.4759E-05 |
| FE | 3.2538E-02 | 2.2555E-02 |
| NI | 6.0027E-06 | 4.1610E-06 |
| CU | 9.3243E-06 | 6.4634E-06 |
|  |  |  |
| Total | 3.2803E-02 | 2.2738E-02 |

Table 3.M36 Atomic Densities of the Calandria Walls

(Atoms/barn.cm)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Nuclide | NACLI | NACLIIS | NACLIII | NACLIV | NACLV | VCLVI |
|  |  |  |  |  |  |  |
| H | 3.9844E-05 | 3.8637E-05 | 3.9844E-05 | 3.7430E-05 | 3.8637E-05 | 3.8637E-05 |
| C | 2.8167E-04 | 6.5351E-04 | 1.5948E-04 | 3.5158E-04 | 2.6343E-04 | 2.4762E-04 |
| SI | 6.0229E-04 | 9.7623E-04 | 7.7474E-04 | 8.2197E-04 | 6.4389E-04 | 9.5110E-04 |
| P | 7.3471E-05 | 4.7540E-05 | 5.2334E-05 | 6.2274E-05 | 6.8560E-05 | 4.5654E-05 |
| S | 3.6808E-05 | 3.3014E-05 | 2.4551E-05 | 1.6431E-05 | 1.7190E-05 | 2.3793E-05 |
| TI |  | 2.4400E-04 |  |  |  |  |
| CR | 1.4995E-02 | 1.4380E-02 | 1.4132E-02 | 1.3563E-02 | 1.3830E-02 | 1.3837E-02 |
| MN | 1.2214E-03 | 1.1060E-03 | 8.3089E-04 | 1.0026E-03 | 9.6934E-04 | 8.6191E-04 |
| FE | 4.8911E-02 | 4.7118E-02 | 5.0764E-02 | 4.7151E-02 | 4.9404E-02 | 4.8404E-02 |
| CO |  | 1.1151E-05 |  |  |  |  |
| NI | 7.2440E-03 | 7.4526E-03 | 7.6658E-03 | 6.4549E-03 | 7.2532E-03 | 6.8530E-03 |
| CU |  | 1.0341E-05 |  |  |  |  |
| MO |  | 3.4248E-06 | 2.4862E-05 | 8.8791E-06 | 8.8791E-06 | 2.4862E-05 |
|  |  |  |  |  |  |  |
| Total | 7.3405E-02 | 7.2074E-02 | 7.4469E-02 | 6.9470E-02 | 7.2497E-02 | 7.1288E-02 |

Table 3.M37 Atomic Densities of the Walls Scaled by the Factor 0.30682

(Atoms/barn.cm)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Element | NACLI | NACLIIS | NACLIII | NACLIV | NACLV | VCLVI |
|  |  |  |  |  |  |  |
| H | 1.2225E-05 | 1.1855E-05 | 1.2225E-05 | 1.1484E-05 | 1.1855E-05 | 1.1855E-05 |
| C | 8.6422E-05 | 2.0051E-04 | 4.8932E-05 | 1.0787E-04 | 8.0826E-05 | 7.5975E-05 |
| AL |  |  |  |  |  |  |
| SI | 1.8479E-04 | 2.9953E-04 | 2.3771E-04 | 2.5220E-04 | 1.9756E-04 | 2.9182E-04 |
| P | 2.2542E-05 | 1.4586E-05 | 1.6057E-05 | 1.9107E-05 | 2.1036E-05 | 1.4008E-05 |
| S | 1.1293E-05 | 1.0129E-05 | 7.5327E-06 | 5.0414E-06 | 5.2742E-06 | 7.3002E-06 |
| TI |  | 7.4864E-05 |  |  |  |  |
| CR | 4.6008E-03 | 4.4121E-03 | 4.3360E-03 | 4.1614E-03 | 4.2433E-03 | 4.2455E-03 |
| MN | 3.7475E-04 | 3.3934E-04 | 2.5493E-04 | 3.0762E-04 | 2.9741E-04 | 2.6445E-04 |
| FE | 1.5007E-02 | 1.4457E-02 | 1.5575E-02 | 1.4467E-02 | 1.5158E-02 | 1.4851E-02 |
| CO |  | 3.4213E-06 |  |  |  |  |
| NI | 2.2226E-03 | 2.2866E-03 | 2.3520E-03 | 1.9805E-03 | 2.2254E-03 | 2.1026E-03 |
| CU |  | 3.1728E-06 |  |  |  |  |
| MO |  | 1.0508E-06 | 7.6282E-06 | 2.7243E-06 | 2.7243E-06 | 7.6282E-06 |
|  |  |  |  |  |  |  |
| Total | 2.2522E-02 | 2.2114E-02 | 2.2849E-02 | 2.1315E-02 | 2.2244E-02 | 2.1873E-02 |

Table 3.M38 Atomic Density of the Calandria Walls and Sheath Combined

(Atoms/barn.cm)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Element | NACLI | NACLIIS | NACLIII | NACLIV | NACLV | VCLVI |
|  |  |  |  |  |  |  |
| H | 3.4252E-05 | 3.3882E-05 | 3.4252E-05 | 3.3511E-05 | 3.3882E-05 | 3.3882E-05 |
| C | 1.5574E-04 | 2.6983E-04 | 1.1825E-04 | 1.7719E-04 | 1.5014E-04 | 1.4529E-04 |
| AL | 5.7600E-06 | 5.7600E-06 | 5.7600E-06 | 5.7600E-06 | 5.7600E-06 | 5.7600E-06 |
| SI | 1.8479E-04 | 2.9953E-04 | 2.3771E-04 | 2.5220E-04 | 1.9756E-04 | 2.9182E-04 |
| P | 2.2542E-05 | 1.4586E-05 | 1.6057E-05 | 1.9107E-05 | 2.1036E-05 | 1.4008E-05 |
| S | 1.1293E-05 | 1.0129E-05 | 7.5327E-06 | 5.0414E-06 | 5.2742E-06 | 7.3002E-06 |
| TI |  | 7.4864E-05 |  |  |  |  |
| CR | 4.6018E-03 | 4.4131E-03 | 4.3370E-03 | 4.1625E-03 | 4.2444E-03 | 4.2465E-03 |
| MN | 4.4951E-04 | 4.1410E-04 | 3.2969E-04 | 3.8238E-04 | 3.7217E-04 | 3.3921E-04 |
| FE | 3.7562E-02 | 3.7011E-02 | 3.8130E-02 | 3.7022E-02 | 3.7713E-02 | 3.7406E-02 |
| CO |  | 3.4213E-06 |  |  |  |  |
| NI | 2.2268E-03 | 2.2908E-03 | 2.3562E-03 | 1.9847E-03 | 2.2296E-03 | 2.1068E-03 |
| CU | 6.4634E-06 | 9.6362E-06 | 6.4634E-06 | 6.4634E-06 | 6.4634E-06 | 6.4634E-06 |
| MO |  | 1.0508E-06 | 7.6282E-06 | 2.7243E-06 | 2.7243E-06 | 7.6282E-06 |
|  |  |  |  |  |  |  |
| Total | 4.5261E-02 | 4.4852E-02 | 4.5587E-02 | 4.4053E-02 | 4.4982E-02 | 4.4611E-02 |

The above tabular values are here repeated in text form:

##### Compositions of the combined calandria walls and sheath, homogenised over the region between the inner surface of the calandria wall (4.9cm square) and the lattice cell boundary (5.4254 cm square)

**NACLI**

H 3.4252E-05 C 1.5574E-04 AL 5.7600E-06 SI 1.8479E-04

P 2.2542E-05 S 1.1293E-05 CR 4.6018E-03 MN 4.4951E-04

FE 3.7562E-02 NI 2.2268E-03 CU 6.4634E-06

**NACLIIS**

H 3.3882E-05 C 2.6983E-04 AL 5.7600E-06 SI 2.9953E-04

P 1.4586E-05 S 1.0129E-05 TI 7.4864E-05 CR 4.4131E-03

MN 4.1410E-04 FE 3.7011E-02 CO 3.4213E-06 NI 2.2908E-03

CU 9.6362E-06 MO 1.0508E-06

**NACLIII**

H 3.4252E-05 C 1.1825E-04 AL 5.7600E-06 SI 2.3771E-04

P 1.6057E-05 S 7.5327E-06 CR 4.3370E-03 MN 3.2969E-04

FE 3.8130E-02 NI 2.3562E-03 CU 6.4634E-06 MO 7.6282E-06

**NACLIV**

H 3.3511E-05 C 1.7719E-04 AL 5.7600E-06 SI 2.5220E-04

P 1.9107E-05 S 5.0414E-06 CR 4.1625E-03 MN 3.8238E-04

FE 3.7022E-02 NI 1.9847E-03 CU 6.4634E-06 MO 2.7243E-06

**NACLV**

H 3.3882E-05 C 1.5014E-04 AL 5.7600E-06 SI 1.9756E-04

P 2.1036E-05 S 5.2742E-06 CR 4.2444E-03 MN 3.7217E-04

FE 3.7713E-02 NI 2.2296E-03 CU 6.4634E-06 MO 2.7243E-06

**VCLVI**

H 3.3882E-05 C 1.4529E-04 AL 5.7600E-06 SI 2.9182E-04

P 1.4008E-05 S 7.3002E-06 CR 4.2465E-03 MN 3.3921E-04

FE 3.7406E-02 NI 2.1068E-03 CU 6.4634E-06 MO 7.6282E-06

##### Atomic densities for the UO2 fuel pin canning plus the tube in the calculational model which combines them over the area between the UO2 pin and the tube outer boundary.

Table 3.M39 Atomic Densities for the UO2 Fuel Pin Canning Plus the Tube

(Atoms/barn.cm)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nuclide | U02PINC can | Scaled | Scaled tube | Combined can and tube |
|  |  |  |  |  |
| factor |  | x 0.4055318 |  |  |
|  |  |  |  |  |
| H | 2.6710E-05 | 1.0832E-05 |  | 1.0832E-05 |
| C | 1.3288E-04 | 5.3887E-05 |  | 5.3887E-05 |
| SI | 8.5585E-04 | 3.4707E-04 | 3.1584E-04 | 6.6291E-04 |
| P | 3.7870E-05 | 1.5357E-05 |  | 1.5357E-05 |
| S | 2.4585E-05 | 9.9700E-06 |  | 9.9700E-06 |
| CR | 1.8255E-02 | 7.4030E-03 | 4.9869E-03 | 1.2390E-02 |
| MN | 1.5681E-03 | 6.3591E-04 | 4.0366E-04 | 1.0396E-03 |
| FE | 5.9792E-02 | 2.4248E-02 | 1.8050E-02 | 4.2298E-02 |
| NI | 8.9349E-03 | 3.6234E-03 | 2.2090E-03 | 5.8324E-03 |
|  |  |  |  |  |
| Total | 8.9628E-02 | 3.6347E-02 | 2.5966E-02 | 6.2313E-02 |

The above tabular values are here repeated in text form:

**Atomic densities for the combined UO2 fuel pin can and tube**

H 1.0832E-05 C 5.3887E-05 SI 6.6291E-04 P 1.5357E-05

S 9.9700E-06 CR 1.2390E-02 MN 1.0396E-03 FE 4.2298E-02

NI 5.8324E-03

### 3.1.4 Temperature data.

The reference temperature is 300K.

### 3.1.5 Experimental and Benchmark Model keff Parameters

#### The values given in this section are for the Reference Model, Model A.

The keff values of the 4 critical systems, and the associated uncertainties are given in the following Table 3.2.

Table 3.2 Keff  values and Uncertainties

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Core 22 | Core 23 | Core 24 | Core 25 |
|  | Plate geometry  Sodium present | Pin geometry  Sodium present | Plate geometry  Sodium voided | Pin geometry  Sodium voided |
| **k-values of Reference Models** | **1.00217**  **±0.00077** | **1.00162**  **± 0.00127** | **1.00228**  **± 0.00077** | **1.00132**  **± 0.00127** |

In the comparisons with calculation these have been reduced to 4 places of decimals.

The pin geometry cores with plate geometry zones at the centre are to be calculated as critical assemblies, but it is the differences between the values calculated for these cores and for the pin geometry cores which are to be compared with measurement.

**For the version of Core 23 with the 45 element plate zone at the centre**

the difference in keff relative to Core 23 is:

(+12.75 ± 3.1) x 10-4 dk/k, implying a **keff value for the core of 1.00290 ± 0.00131**

**For the version of Core 25 with the 69 element plate zone at the centre**

the difference in keff relative to Core 25 is:

(+0.49 ± 4.1) x l0-4 dk/k, implying a **keff value for the core of 1.00137 ± 0.00133**

In addition to the keff values the differences between the values of keff for the different cores are to be derived. The uncertainties associated with these differences are as follows.

Table 3.3 Uncertainties affecting the Comparison of keff values for Pin versus Plate Geometry Cores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Assembly | 22 | 23 | 24 | 25 |
| Type | Na-F1ooded Plate | Na-F1ooded Pin | Na-Voided Plate | Na-Voided Pin |
| **Total relative uncertainty** | ± 0.00131 | | ± 0.00130 | |

Table 3.4 Uncertainties affecting the Comparison of keff values for Sodium Filled versus Sodium Voided Cores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Assembly | 22 | 24 | 23 | 25 |
| Type | Na-F1ooded Plate | Na-Voided Plate | Na-F1ooded Pin | Na-Voided Pin |
| **Total relative uncertainty** | ± 0.00036 | | ± 0.00088 | |

Table 3. 5 Uncertainties affecting the Comparison of keff values for the central plate zones in the pin geometry cores, Assembly 23 and 25

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Assembly | 23 | 23+Central plate zone | 25 | 25+Central plate zone |
| Type | Na-F1ooded | Na-Voided | Na-F1ooded | Na-Voided |
| **Total relative uncertainty** | ± 0.00031 | | ± 0.00041 | |

#### Results obtained using Monte Carlo methods for simplified models.

Several ways in which the representation of the cores can be simplified have been explored, these being illustrated in Figure 3.1, 3.2 and 3.18. Calculations have been made using different ways to represent the element sheaths and to treat the superlattice spacings and grid plates (Models B and C).

There is a gap between the sheath and the plates and also between the sheath and the lattice boundary in the most detailed model, Model A. Homogenising the sheath over these inner and outer gaps (that is, over the area between the 5.067 cm square area of the plates and the 5.3721 cm square lattice area), and still representing the gaps between the 5x5 element superlattices and the lattice grid plates, produces Model B.

In Model C a uniform lattice of 5.4254 cm square lattice cells is adopted over the whole reactor and the sheath is homogenised over the space between the plates and the cell boundary (that is, over the area between the 5.067 cm square area of the plates and the 5.4254 cm square lattice cell area corresponding to the average spacing over the superlattices). This also eliminates the gaps between the 5x5 element superlattices and slightly changes the positions of the elements.

In Model CS a further simplification is made that there is just one type of core element. Model CS is the same as Model C for Assembly 22 because this core has only one type of element. In Assembly 24, the sodium plates of Assembly 22 are replaced by so-called “dummy” plates containing approximately the same quantity of steel and having about the same thickness as the sodium plates. There is a slight difference in thickness because the sodium plates are measured to be compressed by the weight of the stack of plates above and this difference is taken into account in the models. Three different “dummy” plates were used but the simplified Model CS uses just one type of “dummy” plate. In the case of the simplified MCNP models CS of the Cadenza pin geometry cores, Assemblies 23 and 25 a further approximation has been made. There is an outer ring of plate geometry elements in these cores and these have been replaced in the simplified models by pin geometry elements. In Zebra 23 the effect of replacing 44 plate elements in the outer radial ring (out of the total in the ring of 49 plate elements) by pin elements was measured to be a reduction in reactivity of 0.7 x 10-4 dk. In Zebra 25 the reactivity effect of replacing 66 of the 69 plate elements by pin geometry elements was measured to be a reduction in reactivity of 2.1 x 10-4 dk. These reactivity changes are small compared with the uncertainty in the measured reactivities of these cores and so it is considered acceptable to make this approximation. Furthermore the cores have been approximated as containing just the one type of pin geometry element, the dominant one, type C, containing the pins of type A and E.

Calculations have been made using the MCNP Monte Carlo code (Los Alamos National Laboratory, X-5 Monte Carlo Team) to estimate the effects of these different approximations.

Table 3.6A Comparison of MCNP/JEFF-3.1 k-eff values Calculated using Different Models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Assembly 22 | Assembly 23 | Assembly 24 | Assembly 25 |
|  |  |  |  |  |
| Reference Model A | 1.00614 *±* 0.00015  1.00619 *±* 0.00014 | 1.00836 *±* 0.00016  1.00826 *±* 0.00016 | 1.00482 *±* 0.00015 | 1.00687 *±* 0.00015 |
| Model B | 1.00639 *±* 0.00016 | 1.00831 *±* 0.00014 | 1.00526 *±* 0.00016 | 1.00723 *±* 0.00014 |
| B - A | +0.0002 *±* 0.0002 | 0.0000 *±* 0.0002 | +0.0004 *±* 0.0002 | +0.0004 *±* 0.0002 |
|  |  |  |  |  |
| Model C | 1.00594 *±* 0.00015 | 1.00849 *±* 0.00014 | 1.00495 *±* 0.00015 | 1.00722 *±* 0.00015 |
| C - A | -0.0002 *±* 0.0002 | +0.0002 *±* 0.0002 | +0.0001 *±* 0.0002 | +0.0004 *±* 0.0002 |
|  |  |  |  |  |
| Model CS |  | 1.00818 *±* 0.00015 | 1.00499 *±* 0.00016 | 1.00668 *±* 0.00015 |
| CS - A |  | -0.0002 *±* 0.0002 | +0.0002 *±* 0.0002 | -0.0002 *±* 0.0002 |

The quoted standard deviations are the ones calculated by MCNP from the variation about the mean for individual stages of the calculation. However, other factors can affect the accuracy of results, such as the initial fission source distribution, the number of settling stages and the number of histories per stage. Calculations made for the pin geometry Assemblies 23 and 25 have shown some convergence problems, in particular for the sodium voided Assembly 25, and so the number of settling stages has been increased from 100 to 200 for Assembly 25. There is also the question of how accurately the modelling is being reproduced in the code, representing the arrays of components within cells, cells within elements, forming groups of elements and then arrays of these groups.

The results looks to be consistent. The differences between the MCNP/JEFF-3.1 calculations for models A and B, and between models A and CS range up to 0.0004 *±* 0.0002.

**It is concluded that Models A, B, C and CS are equally valid as representations of the assemblies and the same measured value of k-effective can be used for all of these models of the assemblies.**

**Models D and E.** Calculations have also been made using the MONK Monte Carlo code (SercoAssurance, Winfrith, UK) for modified versions of Model C in which the blanket and shield (or reflector) regions are homogenised with the sheath or neighbouring void regions to produce radially homogeneous blanket and shield regions (Model D). Simplifications to the core cells have also been explored in Model E. In the case of the plate cells the sheath has been homogenised with the neighbouring plate canning material so as to reduce to two radial regions the representation of the plates in a lattice cell. The pin cells have been simplified by combining the cans and calandria tubes and combining calandria walls and sheath (eliminating void gaps).

Table 3.6B Comparison of MONK/JEF-2.2 k-effective values Calculated using Different Models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Assembly 22 | Assembly 23 | Assembly 24 | Assembly 25 |
|  |  |  |  |  |
| Reference Model A | 1.0005 *±* 0.0001 | 1.0038 *±* 0.0001 | 1.0000 *±* 0.0001 | 1.0032 *±* 0.0001 |
|  |  |  |  |  |
| Model D | 1.0013 *±* 0.0003 | 1.0058 *±* 0.0002 | 1.0009 *±* 0.0003 | 1.0046 *±* 0.0002 |
| D - A | 0.0008 *±* 0.0003 | 0.0020 *±* 0.0003 | 0.0016 *±* 0.0003 | 0.0021 *±* 0.0003 |
|  |  |  |  |  |
| Model E | 1.0027 *±* 0.0002 | 1.0059 *±* 0.0002 | 1.0023 *±* 0.0002 | 1.0049 *±* 0.0002 |
| E - A | 0.0022 *±* 0.0002 | 0.0021 *±* 0.0003 | 0.0023 *±* 0.0003 | 0.0017 *±* 0.0003 |

***If Model D or E is used it is recommended that the measured value of k-effective be increased by 0.0015 and the uncertainty be increased by*** *±* ***0.0010.***

## 3.2 Benchmark-Model Specifications for Buckling and Extrapolation-Length Measurements

Not measured

## 3.3 Benchmark-Model Specifications for Spectral Characteristics Measurements

### 3.3.1 Description of the Calculational Methodology and Model

#### Central Reaction Rate Ratios in Assembly 22.

These are to be calculated using the criticality model of Assembly 22. There are two types of measurement, the cell averaged reaction rate ratio in the central region of the core and the measurement on the mid-plane of a half element at the centre of the reactor.

The measured cell averaged value is to be compared with the ratios of the calculated components of the neutron balance for the central cell (or a central group of cells) of the reactor divided by the cell averaged atomic density of the material. This can be calculated using either Monte Carlo or a whole reactor calculation made using homogenised cell averaged cross-sections derived in the usual way from cell calculations.

For the calculation of the fission chamber measurements the half-element at the centre of the core should be modelled and the fission rates calculated in the flux at the central surface of the half element. Alternatively, supplementary cell calculations could be made relating the reaction rate at the boundary of the cell plus the average rate through the cell (not the cell averaged rate, which is the rate weighted with the atomic density of the material) to the cell averaged value. A method which has been used is to combine the value calculated for the upper surface of the sodium plate (or within the sodium plate) with the cell flux averaged value, because half of the flux incident on the foil comes from above and originates from the edge regions of all the plates in a cell.

### 3.3.2 Dimensions

Any of the models described in Section 3.1 as suitable for making criticality calculations for Assembly 22 would also be suitable for calculating the central spectral indices.

### 3.3.3 Material Data

See Section 3.1.

### 3.3.4 Temperature Data

Records of the temperature at which the measurements were performed are not available. For the purposes of the calculations, the models and temperatures used for the criticality calculations can be adopted.

### 3.3.5 Experimental and Benchmark Reaction Rate Ratios

The measured values which are to be compared with calculation are those given in Table 2.12, reproduced on the next page.

Table 3.8 Recommended Reaction Rate Ratio Measurements in the Central Region of Assembly 22

|  |  |  |
| --- | --- | --- |
| Reaction rate ratio | Measured by AEEW team | Total uncertainty in Recommended Benchmark Values |
|  |  |  |
| F28/F25 (Cell Average) | 0.03634 | ±1.3% |
| F25/F49 (Cell Average) | 0.959 | ±1.6% |
| C28/F49 (Cell Average) | 0.1266 | ±1.1% |
| F28/F25 (Chamber) | 0.03483 | ±4.3% |
| F25/F49 (Chamber) | 0.960 | ±1.6% |
| F40/F49 (Chamber) | 0.2594 | ±4.6 |
| F41/F49 (Chamber) | 1.217 | ±4.0% |

It should also be noted that intercomparison measurements have shown significant differences between the measurements made by different groups and they could all be affected by unidentified systematic uncertainties associated with the techniques used by the group.

Table 3.9 Possible systematic uncertainties associated with the Zebra techniques

|  |  |
| --- | --- |
| Reaction rate ratio | Uncertainty |
|  |  |
| F28/F25 (Cell Average) | ± 3% |
| F25/F49 (Cell Average) | ± 1% |
| C28/F49 (Cell Average) | ± 3% |
| F28/F25 (Chamber) | ± 3% |
| F25/F49 (Chamber) | ± 1% |

## 3.4 Benchmark-Model Specifications for Reactivity Effects Measurements

### 3.4.1 Description of the Calculational Methodology and Model

The types of measurement considered here are the element replacement measurements and the modified cell measurements (including the sodium voiding measurements). Depending on the size of the change it can be calculated either by direct calculation of the keff values for the modified system, relative to the unperturbed critical assembly, or using perturbation theory methods. It is the whole element, or group of 9 elements, or group of cells, which must be calculated and not simply a perturbation theory calculation for the addition or replacement of the single material component. This is so that the effects of the changes in spectra on the cross-sections of neighbouring materials (such as changes in resonance shielding) are taken into account. Also, it should be noted that a correction has already been applied to the measured value for any change in core height resulting from the replacement of a component in the cells. This requires that atomic densities must be used which are consistent with the dimensions remaining unaltered.

The reactivity changes can be considered relative to a standard, such as the change in plutonium enrichment, or in absolute terms, when the ±5% systematic uncertainty in the absolute reactivity scale must be applied.

Both standard components (as described in Section 3.1) and special components (as described in Section 3.4.2 and 3.4.3) are involved in the measurements. These should be used together with the criticality models described in Section 3.1.

### 3.4.2 Dimensions

Any of the XYZ geometry models described in Section 3.1 as suitable for making criticality calculations would also be suitable as the unperturbed core to which the perturbation is to be applied.

### 3.4.3 Material Data

The standard core materials are described in Section 3.1.

#### Components used in Reactivity Worth Experiments and in Non-Standard Elements.

##### Alternative plutonium plates *(Corrected for Pu-241 decay)*

The plutonium plates used in the cells D (PUIX8) and E (PUX8) are compared here with the plate used in the standard element cells C (PUVIII8).

The can thickness of all plates is 0.0457 cm. All plates are taken to have the same thickness as the standard PUVIII8 plate, 0.3274 cm and the same core thickness of 0.2360 cm

Core region thickness 0.236 cm, width 4.671 cm, volume = 5.1491 cm3

Plate thickness 0.3274 cm, assumed width 5.067 cm, volume of canning = 3.2567 cm3.

Table 3.M40 Atomic Densities for the Alternative Core Region Plutonium Plates

**CORE REGION** (atoms/barn.cm)

|  |  |  |  |
| --- | --- | --- | --- |
| Plate | PUVIII8 | PUIX8 | PUX8 |
|  |  |  |  |
| H | 1.2764E-04 | 1.5085E-04 | 1.0443E-04 |
| C | 4.2260E-04 | 2.8043E-04 | 2.9406E-04 |
| N | 2.4215E-05 | 9.1849E-06 | 1.0020E-05 |
| O | 8.8450E-05 | 5.7017E-05 | 4.5322E-05 |
| AL | 2.2973E-05 | 2.2973E-05 | 2.1673E-05 |
| SI | 1.4158E-05 | 2.8317E-05 | 1.5824E-05 |
| CR | 3.5989E-06 | 6.0731E-06 | 4.2737E-06 |
| MN | 1.4902E-06 | 1.7031E-06 | 1.0644E-06 |
| FE | 1.6335E-05 | 1.2984E-05 | 1.4869E-05 |
| NI | 8.5688E-06 | 2.6703E-05 | 1.6141E-05 |
| GA | 2.0166E-03 | 2.1106E-03 | 2.2328E-03 |
|  |  |  |  |
| U238 | 6.8782E-07 | 5.2569E-06 | 1.4248E-06 |
| PU238 | 3.0461E-05 | 3.5374E-05 | 3.3899E-05 |
| PU239 | 2.8919E-02 | 2.8880E-02 | 2.8991E-02 |
| PU240 | 6.9095E-03 | 6.9197E-03 | 6.8842E-03 |
| PU241 | 7.2648E-04 | 7.3353E-04 | 7.3004E-04 |
| PU242 | 1.8698E-04 | 1.7974E-04 | 1.8457E-04 |
| AM241 | 4.7029E-04 | 4.6228E-04 | 4.3486E-04 |
|  |  |  |  |
| Total | 3.9990E-02 | 3.9922E-02 | 4.0021E-02 |

**CAN REGION Atomic Densities** (atoms/barn.cm)

|  |  |  |  |
| --- | --- | --- | --- |
|  | PUVIII8 | PUIX8 | PUX8 |
|  |  |  |  |
| H | 1.3760E-05 | 1.3760E-05 | 1.3576E-05 |
| C | 1.1393E-04 | 1.1303E-04 | 1.2040E-04 |
| SI | 3.6607E-04 | 3.6500E-04 | 5.1983E-04 |
| P | 1.3731E-05 | 1.3414E-05 | 2.6680E-05 |
| S | 0.0000E+00 | 0.0000E+00 | 1.5459E-05 |
| TI | 0.0000E+00 | 0.0000E+00 | 5.7544E-06 |
| CR | 9.4011E-03 | 9.3780E-03 | 9.9599E-03 |
| MN | 8.5931E-04 | 8.5733E-04 | 8.5240E-04 |
| FE | 3.5542E-02 | 3.5455E-02 | 3.3817E-02 |
| NI | 4.1646E-03 | 4.1542E-03 | 4.8344E-03 |
| CU | 1.6613E-02 | 1.6613E-02 | 1.6855E-02 |
|  |  |  |  |
| **Total** | 6.7088E-02 | 6.6962E-02 | 6.7020E-02 |

Table 3.M41 Atomic Densities for the Half-thickness Plutonium Plate, PUJ16

Values corrected for Pu241 decay to June 1981 (Pu-241 half-life = 14.35 years, = 0.0483), Factor = 0.605.

**Core region**: core height 0.115 cm, width 4.76 cm, core volume = 2.6056cm3

|  |  |
| --- | --- |
|  | Atoms/barn.cm |
| Nuclide |  |
|  |  |
| AL | 4.0431E-03 |
|  |  |
| PU238 | 7.7672E-06 |
| PU239 | 3.1183E-02 |
| PU240 | 2.7112E-03 |
| PU241 | 1.5720E-04 |
| PU242 | 1.5277E-05 |
| AM241 | 1.0839E-04 |
|  |  |
| Total | 3.8226E-02 |

**Can region:** plate height 0.155 cm, width assumed in model 5.067 cm,

can thickness = 0.02 cm, can volume = 1.3739 cm3.

|  |  |
| --- | --- |
|  | Atoms/barn.cm |
| Nuclide |  |
|  |  |
| C | 1.4597E-04 |
| SI | 9.4733E-04 |
| P | 2.8303E-05 |
| S | 2.0501E-05 |
| TI | 2.7738E-04 |
| CR | 1.5341E-02 |
| MN | 1.0085E-03 |
| FE | 5.4969E-02 |
| NI | 7.9277E-03 |
|  |  |
| Total | 8.0666E-02 |

Table 3.M42 Atomic Densities for the Mixed Oxide Plate used in the Plutonium Enrichment and Element Replacement Measurements, PUIV4.

(Corrected for Pu241 decay)

Core region volume = 13.4708 cm3

|  |  |
| --- | --- |
| Nuclide | Atoms/barn.  cm |
|  |  |
| C | 6.2529E-05 |
| O | 4.3173E-02 |
| AL | 2.7835E-05 |
| SI | 2.6741E-05 |
| FE | 1.3448E-05 |
| NI | 1.2797E-05 |
|  |  |
| U234 | 7.6405E-07 |
| U235 | 1.1640E-04 |
| U238 | 1.6054E-02 |
| NP237 | 1.8859E-07 |
| PU239 | 4.8080E-03 |
| PU240 | 5.3746E-04 |
| PU241 | 3.2762E-05 |
| PU242 | 4.8018E-06 |
| AM241 | 4.4331E-05 |
|  |  |
| Total | 6.4915E-02 |
|  |  |
| Core height | 0.55312 cm |
| Core width | 4.953 cm |

**Can region dimensions**: Plate width assumed in model = 5.067 cm, can volume = 2.64764 cm3

|  |  |
| --- | --- |
| Nuclide | Atoms/barn.  cm |
|  |  |
| H | 1.9408E-05 |
| C | 1.6248E-04 |
| SI | 5.6978E-04 |
| P | 2.5202E-05 |
| S | 2.4341E-05 |
| CR | 1.3437E-02 |
| MN | 1.0586E-03 |
| FE | 4.8552E-02 |
| NI | 6.6436E-03 |
| NB | 2.7307E-04 |
|  |  |
| Total | 7.0765E-02 |
|  |  |
| Plate height | 0.6278 cm |
| Can thickness | 0.03734 cm |

(The ZEBRA Database value of the TOTAL PLATE WIDTH is slightly less ------------ 5.0620 cm)

Table 3.M43 Atomic Densities for the Plutonium Plate PUII8

(Corrected for Pu-241 decay)

**Core region**: thickness = 0.2159 cm, width = 4.671 cm, Volume = 4.71056 cm3

|  |  |
| --- | --- |
| Nuclide | Atoms/barn.cm |
|  |  |
| H | 1.5221E-04 |
| C | 1.0431E-04 |
| AL | 4.6434E-05 |
| SI | 4.4609E-05 |
| FE | 2.2434E-05 |
| NI | 2.1347E-05 |
| GA | 2.3470E-03 |
|  |  |
| NP237 | 1.2404E-05 |
| PU239 | 3.6094E-02 |
| PU240 | 1.8693E-03 |
| PU241 | 6.1607E-05 |
| AM241 | 8.5037E-05 |
|  |  |
| Total | 4.0861E-02 |

**Can region:** plate thickness = 0.3175 ±0.0005 cm, plate width =5.067 cm

Can thickness = 0.0508 cm, can volume = 3.44109 cm3

|  |  |
| --- | --- |
| Nuclide | Atoms/barn.cm |
|  |  |
| H | 1.4064E-05 |
| C | 1.6451E-04 |
| SI | 3.4173E-04 |
| P | 1.8227E-05 |
| S | 1.7604E-05 |
| CR | 9.8481E-03 |
| MN | 4.8299E-04 |
| FE | 3.6019E-02 |
| NI | 4.4298E-03 |
| **Additional material** |  |
| CU | 1.6166E-02 |
|  |  |
| Overall total | 6.7502E-02 |

Table 3.M43B Atomic Densities for the Uranium Oxide Plate UO24R4 a component in the Mixed Oxide Plate Element C22±04A used in the Element Replacement Measurements.

This plate contains silver-copper braze material, which can have a significant effect on reactivity. However there are only 11 of these plates in a C22±04A element (one per cell, CC22-06A).

CORE

|  |  |
| --- | --- |
| Material | Atoms/barn.cm |
|  |  |
| Volume | 13.0425 (cm3) |
|  |  |
| H | 2.4503E-05 |
| C | 3.0842E-05 |
| O | 4.5733E-02 |
| SI | 1.3190E-05 |
| FE | 6.6332E-06 |
|  |  |
| U234 | 1.1871E-06 |
| U235 | 1.6462E-04 |
| U238 | 2.2694E-02 |
|  |  |
| Total | 6.8668E-02 |
|  |  |
| Core thickness | 0.55424 cm |
| Core width | 4.851 cm |

CAN

|  |  |
| --- | --- |
| Material | Atoms/barn.cm |
|  |  |
| Volume | 3.0785 (cm3) |
|  |  |
| H | 1.7335E-05 |
| C | 1.4546E-04 |
| SI | 6.0964E-04 |
| P | 2.2563E-05 |
| S | 2.1792E-05 |
| CR | 1.2365E-02 |
| MN | 9.7951E-04 |
| FE | 4.3411E-02 |
| NI | 6.0134E-03 |
| CU | 8.1603E-04 |
| AG | 1.2368E-03 |
|  |  |
| TOTAL | 6.5639E-02 |
|  |  |
| Can thickness | 0.03683 cm |
| Plate thickness | 0.6279 cm |
| Plate width | 5.067 cm |

TOTAL VOLUME ------------------ 16.1210 (cm3)

Table 3.M44 Stainless Steel Plates STSTBR8 (bright) and STSTDL8 (dull) used in the Reactivity Worth Measurements

|  |  |  |
| --- | --- | --- |
|  | STSTBR8 | STSTDL8 |
|  |  |  |
| Volume | 8.14395 cm3 | 8.30826 cm3 |
| Nuclide | Atoms/barn.cm | Atoms/barn.cm |
| H | 2.3265E-05 | 2.3115E-05 |
| C | 7.8091E-04 | 7.7587E-04 |
| AL | 1.7381E-04 | 1.7269E-04 |
| SI | 1.3358E-03 | 1.3272E-03 |
| TI | 2.9384E-04 | 2.9195E-04 |
| CR | 1.6325E-02 | 1.6220E-02 |
| MN | 9.3901E-04 | 9.3295E-04 |
| FE | 5.8278E-02 | 5.7902E-02 |
| NI | 7.7510E-03 | 7.7009E-03 |
| CU | 7.3801E-05 | 7.3324E-05 |
| MO | 9.7764E-05 | 9.7133E-05 |
|  |  |  |
| Total | 8.6072E-02 | 8.5517E-02 |
|  |  |  |
| Plate width | 5.067 cm | 5.067 cm |
| Plate thickness | 0.3172 cm | 0.3274 cm |

Table 3.M45 GII8 Graphite Plate used in the Reactivity Worth Measurements

|  |  |
| --- | --- |
| Nuclide | Atoms/barn.cm |
|  |  |
| Volume | 8.15807 cm3 |
|  |  |
| H | 2.0286E-05 |
| C | 8.5101E-02 |
| S | 1.2751E-06 |
| FE | 1.8306E-06 |
|  |  |
| TOTAL | 8.5125E-02 |
|  |  |
| Plate width | 5.067 cm |
| Plate thickness | 0.31775 cm |

Table 3.M46 AL2O34 Aluminium Oxide Plate used in the Reactivity Worth Measurements

|  |  |
| --- | --- |
| Nuclide | Atoms/barn.cm |
|  |  |
| Volume | 16.21858 cm3 |
|  |  |
| H | 5.1483E-05 |
| B10 | 4.5063E-06 |
| B11 | 1.6599E-05 |
| O | 6.6386E-02 |
| AL | 4.4240E-02 |
|  |  |
| TOTAL | 1.1070E-01 |
|  |  |
| Plate width | 5.067 cm |
| Plate thickness | 0.6317 cm |

Table 3.M47 ALG8 Aluminium Plate used in the Reactivity Worth Measurements

|  |  |
| --- | --- |
| Nuclide | Atoms/barn.cm |
|  |  |
| Volume | 8.1311 cm3 |
|  |  |
| AL | 5.9345E-02 |
| SI | 5.8135E-06 |
| MN | 1.7122E-06 |
| FE | 8.3580E-05 |
| CU | 1.0248E-06 |
|  |  |
| Total | 5.9437E-02 |
|  |  |
| Plate width | 5.067 cm |
| Plate thickness | 0.3167 cm |

**STSTSR4**

This plate corresponds approximately, in weight and dimensions, to a sodium "dummy" plate(weight 17.60 g). It replaces a UO2 plate in the reactivity perturbation measurements. In the absence of data it is suggested that the "dummy" plate STNAV4 be used as a replacement for it in calculations.

##### The pins used in the reactivity worth measurements

The total length of the pins is 29.5 cm.

For all pins the recommended radius is 0.4685 cm:

Table 3.M48 MSTPINA The Mild Steel Pin

Note: The hydrogen content assumes that it was present as *5* ppm of the steel and as 4 mg/cm2 in the MkII blacking.

|  |  |
| --- | --- |
| Nuclide | Atoms/barn.cm |
|  |  |
| Volume | 20.3419 cm3 |
|  |  |
| H | 3.4660E-05 |
| C | 6.1620E-04 |
| SI | 8.4327E-05 |
| P | 2.4851E-05 |
| S | 6.9234E-05 |
| MN | 6.8975E-04 |
| FE | 8.5876E-02 |
|  |  |
| Total | 8.7395E-02 |

The compositions given in the ZEBRA Database do not include trace impurities for the following components.

Two "6 inch" pins were used, giving a total length of 29.5 cm. To indicate that the weights refer to the two pins a number 2 is placed in front of the component identifier.

Table 3.M49 The Pins, 2ALPINA, 2ALOPINA and 2CPINA

**2ALPINA**

|  |  |  |
| --- | --- | --- |
|  | Weight | Atoms/barn.cm |
| AL | 55.34 g | 6.0719E-02 |

**2ALOPINA**

|  |  |  |
| --- | --- | --- |
|  | Weight | Atoms/barn.cm |
| O | 35.88 g | 6.6391E-02 |
| AL | 40.32 g | 4.4239E-02 |
| Total | 76.20 g | 1.1063E-01 |

**2CPINA**

|  |  |  |
| --- | --- | --- |
|  | Weight | Atoms/barn.cm |
| C | 35.04 g | 8.6365E-02 |

### 3.4.4 Temperature data.

The temperature was not specified. The temperature of the criticality model is 300K and this should be used for the reactivity worth measurements.

### 3.4.5 Experimental and Benchmark Model Reactivity Worth Measurements

The measured values to be calculated are tabulated in Section 1.4.7 and are as follows:

Element replacements: Section 1.4.7.2, Tables 1.17 to 1.20.

Plutonium addition measurements: Section 1.4.7.3, Table 1.21.

Changes in cell heterogeneity: Section 1.4.7.4, Table 1.22.

Cell component replacement measurements: Section 1.4.7.5, Tables 1.23 to 1.29.

Sodium voiding reactivity measurements: Section 1.4.7.6, Tables 1.31 and 1.32.

## 3.5 Benchmark-Model Specifications for Reactivity Coefficient Measurements

Not considered as benchmarks.

## 3.6 Benchmark-Model Specifications for Kinetics Measurements

Not considered as a benchmark.

## 3.7 Benchmark-Model Specifications for Reaction Rate Distribution Measurements

### 3.7.1 Description of the Calculational Methodology and Model

The criticality model must be modified to take into account a possible asymmetry introduced by the asymmetrical loadings of the control rods, with an absorber section being at the top ends of the rods and the regulating rod being partly inserted.

### 3.7.2 Dimensions of the Zebra Control Rods

In addition to the data for the critical core models given in Section 3.1.2 the control rod dimensions and compositions are required, unless some other method is used to allow for the axial tilt.

The materials used in the control rods were chosen to match the core and blanket regions of the neighbouring elements but with a boron absorber section above the upper blanket region. The blanket regions consist of natural uranium plates. The 9 control rods occupy the places of single elements. The control rods were loaded so that when raised the centre line of the core section coincided with the centre line of the core section of the standard core elements. When lowered, the centre line of the boron absorber section took that position. In the experiments requiring a representation of the rods all of the rods can be treated as in the withdrawn position excepting for the fine regulating rod FR9.

The control rods comprise a square tube moving within an outer square tube. The inner tube is loaded with plates. All plates are assumed to be 4.318 cm square (an area of 18.6451 cm2). The control rod outer tube has an assumed outer dimension of 5.2544 cm square, the same as the standard elements. Details of the dimensions and components of the rods are given in Section 1.1 but the components and dimensions are repeated here for convenience.

Table 3.D24 Control Rod Components and Dimensions

**Control Rod Plate Identifiers (All plates are 4.318 cm square)**

|  |  |  |
| --- | --- | --- |
| Identifier | Type of Plate | Thickness (cm) |
| PUXIVC8 | Pu metal Mk.XIV | 0.3207 |
| U02C4R4 | U02 (4 radiused corners) | 0.6279 |
| NASTMC4 | Sodium | 0.616 |
| STSTCF8 | Stainless steel | 0.3180 |
| UC8 | Natural uranium | 0.3167 |
| ALCG8 | 45% aluminium | 0.3167 |
| B10C2 | B10 | 1.27 |

**Control rod sheath**

|  |  |
| --- | --- |
| Identifier | Type of sheath |
| CRSHEATH | Single element rod |

**Control Rod Cells**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Core region** |  | **Boron absorber region cell patterns** | | |
|  |  | Cell CB22-02A | Cell CB22-03A | Cell CB22-04A |
| NASTMC4 |  | ALCG8 | 3 x ALCG8 | 10 x ALCG8 |
| U02C4R4 |  | B10C2 | B10C2 | B10C2 |
| PUXIVC8 |  | 2 x ALCG8 | 5 x ALCG8 | 19 x ALCG8 |
| U02C4R4 |  | B10C2 | B10C2 | B10C2 |
| STSTCF8 |  | 2 x ALCG8 | 5 x ALCG8 | 10 x ALCG8 |
| NASTMC4 |  | B10C2 | B10C2 |  |
| U02C4R4 |  | ALCG8 | 3 x ALCG8 |  |
| PUXIVC8 |  | B10C2 |  |  |
| U02C4R4 |  | 2 x ALCG8 |  |  |
| NASTMC4 |  | B10C2 |  |  |
|  |  | 2 x ALCG8 |  |  |
|  |  | B10C2 |  |  |
|  |  | ALCG8 |  |  |
| Cell height |  | Cell height | | |
| 5.319 cm |  | 11.104 cm | 8.877 cm | 14.891 cm |

**Control Elements**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Region | Element Type  C22-02B  Rods 1, 2, 3, 4, 5, 6 | Element Type C22-02C  Rods 5+6 | Element Type  C22-02D  Rod 9 | Height (cm) |
| Top blanket | 23 x UC8 | 23 x UC8 | 22 x UC8 | See note (a), |
| Absorber | 8 x CB22-02A | 10 x CB22-03A | 6 x CB22-04A | See note (b) |
| Middle blanket | 95 x UC8 | 95 x UC8 | 94 x UC8 | See note (c) |
| Core | 17xCC22-04A | 17xCC22-04A | 17xCC22-04A | 90.42 |
| Lower blanket | 178 x UC8 | 178 x UC8 | 178 x UC8 | 56.37 |

Notes:

(a) 23 UC8 plates have a height of 7.28 cm and 22 a height of 6.97 cm.

(b) Absorber section lengths are:

C22-02B 88.83 cm

C22-02C 88.77 cm

C22-02D 89.35 cm

(c) The Height of the Upper Axial Blanket regions are:

Rods 1 to 8 30.09 cm

Rod 9 29.77 cm

Note: The heights of the UC8 regions differ from those given in ZTN22-1 and ZTN22-11, the thickness of the plates used here being the ZEBRA Database value of 0.3167 cm (and not the value 0.3176 used in ZTN22-1 and ZTN22-11). The height of the core section also differs by 0.03 cm per cell. There are also small differences in the heights of the absorber sections which have been kept consistent with the adopted plate thicknesses.

### 3.7.3 Compositions of the Zebra Control Rods

Table 3.M50 Control Rod Plate PUXIVC8

PLATE CORE COMPOSITION

(Corrected for Pu241 decay)

|  |  |
| --- | --- |
| Nuclide | Atomic density |
|  | Atoms/barn.cm |
| H | 1.7728E-04 |
| C | 2.2315E-04 |
| N | 1.2757E-05 |
| O | 6.7010E-05 |
| AL | 2.6490E-05 |
| SI | 1.9086E-05 |
| TI | 3.7321E-06 |
| CR | 6.8731E-06 |
| FE | 9.5989E-06 |
| NI | 1.5223E-05 |
| CU | 2.8120E-06 |
| ZN | 2.7327E-06 |
| GA | 2.4398E-03 |
| U238 | 9.0075E-06 |
| NP237 | 7.5379E-07 |
| PU238 | 4.2786E-05 |
| PU239 | 3.1238E-02 |
| PU240 | 6.9151E-03 |
| PU241 | 7.8299E-04 |
| PU242 | 2.0965E-04 |
| AM241 | 3.1848E-04 |
|  |  |
| Total | 4.2524E-02 |
|  |  |
| Volume, cm3 | 3.37021 |

**PU PLATE CAN COMPOSITION**

|  |  |
| --- | --- |
| Nuclide | Atomic density |
|  | Atoms/barn.cm |
| H | 1.1449E-05 |
| C | 1.1529E-04 |
| SI | 2.5475E-04 |
| P | 2.6079E-05 |
| S | 1.2234E-05 |
| CR | 8.0982E-03 |
| MN | 6.5536E-04 |
| FE | 2.8779E-02 |
| NI | 3.9746E-03 |
|  |  |
| Cu | 1.5254E-02 |
|  |  |
| Total | 5.7182E-02 |
|  |  |
| Volume, cm3 | 2.60927 |

Table 3.M51 Control Rod Plate UO2C4R4

PLATE CORE COMPOSITION

|  |  |
| --- | --- |
| Nuclide | Atomic density |
|  | Atoms/barn.cm |
| H | 2.3728E-05 |
| C | 3.0136E-05 |
| SI | 1.2888E-05 |
| FE | 6.4814E-06 |
|  |  |
| O | 4.5094E-02 |
| U234 | 1.1599E-06 |
| U235 | 1.6225E-04 |
| U238 | 2.2363E-02 |
|  |  |
| Total | 6.7694E-02 |
|  |  |
| Volume, cm3 | 9.3168 |

PLATE CAN COMPOSITION

|  |  |
| --- | --- |
| Nuclide | Atomic density |
|  | Atoms/barn.cm |
| H | 1.6246E-05 |
| C | 1.3633E-04 |
| SI | 5.7406E-04 |
| P | 2.1146E-05 |
| S | 2.0424E-05 |
| CR | 1.1579E-02 |
| MN | 9.1710E-04 |
| FE | 4.0652E-02 |
| NI | 5.6316E-03 |
| CU | 9.1180E-04 |
| AG | 1.3545E-03 |
|  |  |
| Total | 6.1815E-02 |
|  |  |
| Volume, cm3 | 2.3905 |

Table 3.M52 Control Rod Plate UC8

PLATE COMPOSITION

|  |  |
| --- | --- |
| Nuclide | Atomic density |
|  | Atoms/barn.cm |
| C | 4.9248E-04 |
| SI | 2.1061E-04 |
| FE | 1.0592E-04 |
| U235 | 3.3280E-04 |
| U238 | 4.5875E-02 |
|  |  |
| Total | 4.7017E-02 |
|  |  |
| Volume, cm3 | 5.9049 |

Table 3.M53 Control Rod Plate STSTCF8 ("Reduced density" steel plate)

PLATE COMPOSITION

|  |  |
| --- | --- |
| Nuclide | Atomic density |
|  | Atoms/barn.cm |
| Volume (cm3) | 5.9291 |
|  |  |
| H | 7.0823E-06 |
| C | 3.3875E-05 |
| AL | 4.5770E-05 |
| SI | 3.0753E-04 |
| P | 1.5441E-05 |
| S | 5.5647E-06 |
| TI | 9.5714E-05 |
| CR | 6.1381E-03 |
| MN | 5.7769E-04 |
| FE | 2.1363E-02 |
| NI | 3.3946E-03 |
| CU | 1.9433E-05 |
| NB | 1.9293E-06 |
| MO | 3.1249E-05 |
|  |  |
| Total | 3.2037E-02 |

Table 3.M54 Control Rod Plate NASTMC4

PLATE CORE COMPOSITION

|  |  |
| --- | --- |
| Nuclide | Atomic density |
|  | Atoms/barn.cm |
| H | 1.2233E-05 |
| O | 5.3944E-06 |
| NA | 2.2032E-02 |
| CA | 3.3840E-06 |
| FE | 1.1039E-07 |
|  |  |
| Total | 2.2053E-02 |
|  |  |
| Volume, cm3 | 9.7684 |

CAN COMPOSITION

|  |  |
| --- | --- |
| Nuclide | Atomic density |
|  | Atoms/barn.cm |
| H | 2.2640E-05 |
| C | 2.2777E-04 |
| SI | 8.3286E-04 |
| P | 3.3857E-05 |
| S | 1.7061E-05 |
| CR | 1.6869E-02 |
| MN | 1.3347E-03 |
| FE | 5.5256E-02 |
| NI | 8.3452E-03 |
| NB | 3.6038E-04 |
|  |  |
| Total | 8.3300E-02 |
|  |  |
| Volume, cm3 | 1.7170 |

**Control Rod Absorber Regions**

The absorber regions are made up from aluminium plates, ALCG8 and the boron plates, B10C2.

Table 3.M55 Control Rod Plate ALCG8

PLATE CORE COMPOSITION

|  |  |
| --- | --- |
| Nuclide | Atomic density |
|  | Atoms/barn.cm |
| AL | 2.6702E-02 |
| SI | 4.8295E-05 |
| MN | 4.1768E-06 |
| FE | 3.2378E-05 |
| CU | 3.6110E-06 |
|  |  |
| Total | 2.6791E-02 |
|  |  |
| Volume cm3 | 5.9049 |

Table 3.M56 Control Rod Plate B10C2

PLATE CORE COMPOSITION

|  |  |
| --- | --- |
| Nuclide | Atomic density |
|  | Atoms/barn.cm |
| H | 2.2737E-04 |
| B10 | 4.9962E-02 |
| B11 | 3.9855E-03 |
| C | 7.3388E-04 |
| O | 7.5688E-04 |
| AL | 8.7111E-05 |
| SI | 1.5693E-04 |
| K | 6.0115E-05 |
| CR | 4.5203E-05 |
| FE | 7.3663E-05 |
| NI | 7.5095E-05 |
| CU | 3.6987E-05 |
|  |  |
| Total | 5.6200E-02 |
|  |  |
| Volume cm3 | 21.5479 |

PLATE CAN COMPOSITION

|  |  |
| --- | --- |
| Nuclide | Atomic density |
|  | Atoms/barn.cm |
| NI | 1.7836E-01 |
|  |  |
| Volume cm3 | 2.1314 |

**The Control Rod Sheath. (The combined inner and outer tubes)**

Table 3.M57 Control Rod Sheath CRSHEATH

|  |  |  |  |
| --- | --- | --- | --- |
| Nuclide | At density | At density | At density |
| Assumed Outer Width (cm) | 5.2544 | 5.3721 | 5.4254 |
| H | 9.9986E-05 | 8.7743E-05 | 8.2535E-05 |
| C | 2.7968E-04 | 2.4543E-04 | 2.3086E-04 |
| SI | 9.5685E-05 | 8.3969E-05 | 7.8984E-05 |
| P | 2.1691E-05 | 1.9035E-05 | 1.7905E-05 |
| S | 2.0949E-05 | 1.8384E-05 | 1.7293E-05 |
| MN | 2.6904E-04 | 2.3610E-04 | 2.2208E-04 |
| FE | 4.4294E-02 | 3.8871E-02 | 3.6563E-02 |
|  |  |  |  |
| Total | 4.5081E-02 | 3.9561E-02 | 3.7213E-02 |
|  |  |  |  |
| Area (cm2) | 8.9636 | 10.2143 | 10.8589 |

All plates are assumed to be 4.318 cm square and the control rod sheath has an assumed outer dimension of 5.2544 cm square, the same as the standard elements. The area occupied by the sheath material is then 8.9636 cm2.

In addition, atomic number densities are given for smearing over the lattice area of 5.3721 cm square (an area occupied by the sheath material of 10.2143 cm2) and the average core lattice area (including the superlattice grid) of 5.4254 cm square (an area of 10.8589 cm2).

### 3.7.4 Temperature Data.

The temperatures were not specified. The temperature of the criticality models is 300K and this should be used for the reaction rate distribution measurements.

### 3.7.5 Experimental and Benchmark Reaction Rate Distribution Measurements

#### The Multi-chamber Scan Measurements of Pu239 Fission Rates

Results are given in Section 1.7.2C Figures 1.25A to E, for the measurement in Core 22B (normalised to the central value of 10,000) and in Figures 1.26A to E for the differences between the measurements in Core 24 and Core 22A , which have similar levels of control rod insertion. Account should be taken of the control rod insertion and of the boron absorber sections in the top sections of the control rods. The rod insertions are given below Figures 1.25 A and 1.26 A. Essentially it is only CR9 which is partly inserted, the other rods being in the withdrawn positions.

The control rod insertions corresponding to the Assembly 22 scan results given in Figures 1.25A to E are:

CR7 119.443 cm, CR8 119.738 cm, CR9 92.612 cm

For the differences between the Assembly 24 and Assembly 22 scans the rod insertions are:

Assembly 22A, (215 element core loading)

CR7 119.441 cm, CR8 119.751 cm, CR9 71.204 cm

Assembly 24 (222 element core loading)

CR7 119.443 cm, CR8 119.739 cm, CR9 66.331 cm

## 3.8 Benchmark-Model Specifications for Power Distribution Measurements

Not measured

## 3.9 Benchmark-Model Specifications for Isotopic Measurements

Not measured

## 3.10 Miscellaneous

No other types of measurement included.

# 4. RESULTS OF SAMPLE CALCULATIONS

Calculations of keff and central reaction rate ratios have been made using the MONK continuous energy Monte Carlo code and the nuclear data libraries, JEF-2.2, JENDL-3.2 and ENDF/B-VI version 4 and the MCNP Monte Carlo code with the libraries JEFF-3.1 and JENDL-3.3. Two different versions of the JEF-2.2 library have been used in MONK, the Dice library version and the Bingo library version. These differ in the unresolved resonance region treatment of Pu239. (The first version of the Pu239 unresolved resonance region data is the standard version as generally distributed and the second is a corrected version used primarily in France.) All the libraries used were derived for a temperature of 300K or thereabouts.

The numbers of histories involved in the MONK Monte Carlo calculations giving an accuracy of ±2.10-4 are 20 million, and for the accuracy of ±1.10-4 are about 60 million. The MCNP calculations have a typical standard deviation of ±1.6x10-4 and are made for 20 million histories.

Comparisons are also made with the Zebra Assembly MZA which had a very similar core to Assembly 22 but a more realistic axial and radial blanket than the natural uranium blanket of the Cadenza Assemblies. The MZA blanket included sodium and steel.

## 4.1 Results of Calculations of the Critical or Subcritical Configurations.

### 4.1.1 Keff Values for the CADENZA Cores Calculated for the Reference Model (Model A)

Table 4.1A. MONK/Dice-JEF-2.2 k-effective Results

|  |  |  |  |
| --- | --- | --- | --- |
| Core | C  (Dice-JEF-2.2) | E | (C-E)/E%  (MONK/JEF-2.2) |
| Assembly 22B | 1.0005 *±* 0.0001 | 1.0022 ± 0.0008 | (-0.17 ± 0.08)% |
| Assembly 23 | 1.0038 *±* 0.0001 | 1.0016 *±* 0.0013 | (+0.22 ± 0.13)% |
| Assembly 24 | 1.0000 *±* 0.0001 | 1.0023 *±* 0.0008 | (-0.23 ± 0.08)% |
| Assembly 25 | 1.0032 *±* 0.0001 | 1.0013 ± 0.0013 | (+0.19 *±* 0.13)% |
|  |  |  |  |
| Core 23 with the central plate zone of 45 plate elements. | 1.0042 *±* 0.0002 | 1.0029 *±* 0.0013 | (+0.13 *±* 0.13)% |
| Assembly 25 with the central zone of 69 plate elements. | 1.0015 *±* 0.0002 | 1.0014 *±* 0.0013 | (+0.01 *±* 0.13)% |
|  |  |  |  |
| MZA | 1.0121 *±* 0.00015 | 1.0097 ± 0.0016 | (+0.24 ± 0.16)% |

Table 4.1B. Calculations using the Bingo-JEF-2.2 Library in MONK

This version of the JEF-2.2 Library includes the corrected Pu239 unresolved resonance region data.

|  |  |  |  |
| --- | --- | --- | --- |
| Core | C  (MONK/Bingo-JEF-2.2) | E | (C-E)/E%  (MONK/JEF-2.2) |
| Assembly 22B | 0.9931 *±* 0.0001 | 1.0022 ± 0.0008 | (-0.91 ± 0.08)% |
| Assembly 23 | 0.9959 *±* 0.0001 | 1.0016 *±* 0.0013 | (-0.57 ± 0.13)% |
| Assembly 24 | 0.9938 *±* 0.0002 | 1.0023 *±* 0.0008 | (-0.85 ± 0.08)% |
| Assembly 25 | 0.9965 *±* 0.0002 | 1.0013 ± 0.0013 | (-0.48 *±* 0.13)% |

Table 4.1C MONK9A/Dice-JENDL-3.2 k-effective Results

|  |  |  |  |
| --- | --- | --- | --- |
| Core | C  (JENDL-3.2) | E | (C-E)/E%  (JENDL-3.2) |
| Assembly 22B | 0.9956 *±* 0.0001 | 1.0022 ± 0.0008 | (-0.66 *±* 0.08)% |
| Assembly 23 | 0.9984 *±* 0.00011 | 1.0016 *±* 0.0013 | (-0.32 *±* 0.13)% |
| Assembly 24 | 0.9950 *±* 0.00015 | 1.0023 *±* 0.0008 | (-0.73 *±* 0.08)% |
| Assembly 25 | 0.9981 *±* 0.00015 | 1.0013 ± 0.0013 | (-0.32 *±* 0.13)% |
|  |  |  |  |
| Assembly 23 with the central zone of 45 plate elements. | 0.9985 *±* 0.0002 | 1.0029 *±* 0.0013 | (-0.44 *±* 0.13)%  (MONK8B) |
| Assembly 25 with the central zone of 69 plate elements. | 0.9965 *±* 0.0002 | 1.0014 *±* 0.0013 | (-0.49 *±* 0.13)%  (MONK8B) |
|  |  |  |  |
| MZA | 1.0076 *±* 0.00015 | 1.0097 ± 0.0016 | (-0.21 *±* 0.16)% |

Table 4.1D MONK/ENDF/B-VI-v4 k-effective Results

|  |  |  |  |
| --- | --- | --- | --- |
| Core | C (ENDF/B-VI-v4) | E | (C-E)/E%  (ENDF/B-VI-v4) |
| Assembly 22 | 1.0083 *±* 0.0001 | 1.0022 ± 0.0008 | (+0.61 *±* 0.08)% |
| Assembly 23 | 1.0107 *±* 0.0001 | 1.0016 *±* 0.0013 | (+0.91 *±* 0.13)% |
| Assembly 24 | 1.0095 *±* 0.0001 | 1.0023 *±* 0.0008 | (+0.72 *±* 0.08)% |
| Assembly25 | 1.0115 *±* 0.0001 | 1.0013 ± 0.0013 | (+1.02 *±* 0.13)% |
|  |  |  |  |
| Assembly 23 with the central zone of 45 plate elements. | 1.0107 *±* 0.0002 | 1.0029 *±* 0.0013 | (+0.78 *±* 0.13)% |
| Assembly 25 with the central zone of 69 plate elements. | 1.0100 *±* 0.0002 | 1.0014 *±* 0.0013 | (+0.87 *±* 0.13)% |
|  |  |  |  |
| MZA | 1.0165 *±* 0.00015 | 1.0097 ± 0.0016 | (+0.68 *±* 0.16)% |

Table 4.2 KENO5a+CONSYST+ABBN-93 k-effective Results

(Results provided by Anatoli Tsiboulia and Mikhail Semenov)

|  |  |  |  |
| --- | --- | --- | --- |
| Core | C | E | (C-E)/E% |
| Assembly 22 | 0.99968 *±* 0.00014 | 1.0022 ± 0.0008 | (-0.25 ± 0.08)% |
| Assembly 23 | 1.00181 *±* 0.00012 | 1.0016 *±* 0.0013 | (+0.02 ± 0.13)% |
| Assembly 24 | 1.00015 *±* 0.00014 | 1.0023 *±* 0.0008 | (-0.21 ± 0.08)% |

Table 4.3A MCNP/JENDL-3.3 k-effective Results

|  |  |  |  |
| --- | --- | --- | --- |
| Core | C  (JENDL-3.3) | E | (C-E)%  (JENDL-3.3) |
| Assembly 22B | 0.99656 *±* 0.00015 | 1.0022 ± 0.0008 | (-0.56 *±* 0.08)% |
| Assembly 23 | 0.99902 *±* 0.00015 | 1.0016 *±* 0.0013 | (-0.26 *±* 0.13)% |
| Assembly 24 | 0.99507 *±* 0.00016 | 1.0023 *±* 0.0008 | (-0.72 *±* 0.08)% |
| Assembly 25 | 0.99788 *±* 0.00014 | 1.0013 ± 0.0013 | (-0.34 *±* 0.13)% |
|  |  |  |  |
| Assembly 23 with the central zone of 45 plate elements. | 0.99972 *±* 0.00016 | 1.0029 *±* 0.0013 | (-0.32 *±* 0.13)% |
| Assembly 25 with the central zone of 69 plate elements. | 0.99647 *±* 0.00014 | 1.0014 *±* 0.0013 | (-0.49 *±* 0.13)% |
|  |  |  |  |
| MZA | 1.00948 ± 0.00015 | 1.0097 ± 0.0016 | (-0.02 *±* 0.16)% |

Table 4.3B MCNP/JEFF-3.1 k-effective Results

|  |  |  |  |
| --- | --- | --- | --- |
| Core | C  (JEFF-3.1) | E | (C-E)%  (JEFF-3.1) |
| Assembly 22B | 1.00614 *±* 0.00015 | 1.0022 ± 0.0008 | (0.39 *±* 0.08)% |
| Assembly 23 | 1.00831 *±* 0.00015 | 1.0016 *±* 0.0013 | (0.67 *±* 0.13)% |
| Assembly 24 | 1.00482 *±* 0.00015 | 1.0023 *±* 0.0008 | (0.25 *±* 0.08)% |
| Assembly 25 | 1.00687 *±* 0.00015 | 1.0013 ± 0.0013 | (0.56 *±* 0.13)% |
|  |  |  |  |
| Assembly 23 with the central zone of 45 plate elements. | 1.00845 *±* 0.00016 | 1.0029 *±* 0.0013 | (0.56 *±* 0.13)% |
| Assembly 25 with the central zone of 69 plate elements. | 1.00570 *±* 0.00016 | 1.0014 *±* 0.0013 | (0.43 *±* 0.13)% |
|  |  |  |  |
| MZA | 1.01418 ± 0.00015 | 1.0097 ± 0.0016 | (+0.45 *±* 0.16)% |

### 4.1.2 Differences Between the Values of (C-E) for k-effective for the Different Assemblies; the Pin-Plate Discrepancy and the Reactivity Change resulting from Sodium Voiding.

*Notes of explanation.*

The differences between the k-effective discrepancies, Δ(C-E), resulting from the change from pin to plate geometry are derived by taking the differences between the value of (C-E) for Core 23 and the value of (C-E) for Core 22, and similarly for Core 25 minus Core 24. These are the pin/plate discrepancies.

Similarly, the differences, Δ(C-E), between the value of (C-E) for Core 22 and the value of (C-E) for Core 24, and between Core 23 and Core 25, are the discrepancies in the calculation of the reactivity effect of sodium voiding.

Table 4.4A MONK/Dice JEF-2.2 Results for Δ(C-E) (x10-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Cores compared | Uncertainty in ΔC | Uncertainty in ΔE | Δ(C-E) (x10-4) |
| Pin – Plate C/E (flooded cores) | ± 2 | ± 13 | 39 *±* 13 |
| Pin – Plate C/E (voided cores) | ± 2 | ± 13 | 42 *±* 13 |
|  |  |  |  |
| Plate flooded - voided | ± 2 | ± 4 | 6 *±* 5 |
| Pin flooded - voided | ± 2 | ± 9 | 3 *±* 9 |
|  |  |  |  |
| Difference: Assembly 23 with plate zone – Assembly 23 | ± 3 | ± 3 | -7 *±* 4 |
| Assembly 25 with central plate zone – Assembly 25 | ± 3 | ± 4 | -11 *±* 5 |
|  |  |  |  |
| MZA –Zebra 22 (C-E) | ± 2 | ± 18 | 41± 18 |

Table 4.4B MONK/Bingo JEF-2.2 Results for Δ(C-E) (x10-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Cores compared | Uncertainty in ΔC | Uncertainty in ΔE | Δ(C-E) (x10-4) |
| Pin – Plate C/E (flooded cores) | ± 2 | ± 13 | 34 *±* 13 |
| Pin – Plate C/E (voided cores) | ± 2 | ± 13 | 37 *±* 13 |
|  |  |  |  |
| Plate flooded - voided | ± 2 | ± 4 | 6 *±* 5 |
| Pin flooded - voided | ± 2 | ± 9 | 9 *±* 9 |

Table 4.4C MONK9A/JENDL-3.2 Results for Δ(C-E) (x10-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Cores compared | Uncertainty in ΔC | Uncertainty in ΔE | Δ(C-E) (x10-4) |
| Pin – Plate C/E (flooded cores) | *±* 2 | *±* 13 | 34 *±* 13 |
| Pin – Plate C/E (voided cores) | *±* 2 | *±* 13 | 41 *±* 13 |
|  |  |  |  |
| Plate flooded - voided | ± 2 | *±* 4 | 7 *±* 5 |
| Pin flooded - voided | *±* 2 | *±* 9 | 0 *±* 9 |
|  |  |  |  |
| Difference: Assembly 23 with plate zone – Assembly 23 (MONK8b) | *±* 3 | *±* 3 | -6 *±* 4 |
| Assembly 25 with central plate zone – Assembly 25 (MONK8B) | *±* 3 | *±* 4 | -6 *±* 5 |
|  |  |  |  |
| MZA-Zebra 22 (C-E) | ± 2 | ± 18 | 45± 18 |

Table 4.4D MONK/ENDF/B-VI-v4 Results for Δ(C-E) (x10-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Cores compared | Uncertainty in ΔC | Uncertainty in ΔE | Δ(C-E) (x10-4) |
| Pin – Plate C/E (flooded cores) | *±* 2 | *±* 13 | 30 *±* 13 |
| Pin – Plate C/E (voided cores) | *±* 2 | *±* 13 | 30 *±* 13 |
|  |  |  |  |
| Plate flooded - voided | *±* 2 | *±* 4 | -11 *±* 5 |
| Pin flooded - voided | *±* 2 | *±* 9 | -11 *±* 9 |
|  |  |  |  |
| Difference: Assembly 23 with plate zone – Assembly 23 | *±* 3 | *±* 3 | -10 *±* 4 |
| Assembly 25 with central plate zone – Assembly 25 | *±* 3 | *±* 4 | -16 *±* 5 |
|  |  |  |  |
| MZA-Zebra 22 (C-E) | ± 2 | ± 18 | 7 ± 18 |

Table 4.5 KENO5a+CONSYST+ABBN-93 Results for Δ(C-E) (x10-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Cores compared | Uncertainty in ΔC | Uncertainty in ΔE | Δ(C-E) (x10-4) |
| Pin – Plate C/E (flooded cores) | *±* 2 | *±* 13 | 27 *±* 13 |
| Pin – Plate C/E (voided cores) |  | *±* 13 |  |
|  |  |  |  |
| Plate flooded - voided | *±* 2 | *±* 4 | -3.7 *±* 5 |
| Pin flooded - voided |  | *±* 9 |  |

Table 4.6A MCNP/JENDL-3.3 Results for Δ(C-E) (x10-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Cores compared | Uncertainty in ΔC | Uncertainty in ΔE | Δ(C-E) (x10-4) |
| Pin – Plate C/E (flooded cores) | *±* 2 | *±* 13 | 30 *±* 13 |
| Pin – Plate C/E (voided cores) | *±* 2 | *±* 13 | 38 *±* 13 |
|  |  |  |  |
| Plate flooded - voided | *±* 2 | *±* 4 | -16 *±* 5 |
| Pin flooded - voided | *±* 2 | *±* 9 | -8 *±* 9 |
|  |  |  |  |
| Assembly 23 with plate zone – Assembly 23 | *±* 3 | *±* 3 | -6 *±* 4 |
| Assembly 25 with central plate zone – Assembly 25 | *±* 3 | *±* 4 | -15 *±* 5 |
|  |  |  |  |
| MZA-Zebra 22 (C-E) | ± 2 | ± 18 | 54 ± 18 |

Table 4.6B MCNP/JEFF-3.1 Results for Δ(C-E) (x10-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Cores compared | Uncertainty in ΔC | Uncertainty in ΔE | Δ(C-E) (x10-4) |
| Pin – Plate C/E (flooded cores) | *±* 2 | *±* 13 | 28 *±* 13 |
| Pin – Plate C/E (voided cores) | *±* 2 | *±* 13 | 31 *±* 13 |
|  |  |  |  |
| Plate flooded - voided | *±* 2 | *±* 4 | -15 *±* 5 |
| Pin flooded - voided | *±* 2 | *±* 9 | -11 *±* 9 |
|  |  |  |  |
| Assembly 23 with plate zone – Assembly 23 | *±* 3 | *±* 3 | -11 *±* 4 |
| Assembly 25 with central plate zone – Assembly 25 | *±* 3 | *±* 4 | -13 *±* 5 |
|  |  |  |  |
| MZA-Zebra 22 (C-E) | ± 2 | ± 18 | 6 ± 18 |

### 4.1.3 Comments on the Results of the Monte Carlo k-effective Calculations.

The results of the calculations made using the six datasets, JEF-2.2, JENDL-3.2, ENDF/B-VI-Version 4, ABBN-93, JENDL-3.3 and JEFF-3.1 are very consistent in the discrepancies they show for the difference between the plate geometry and pin geometry cores. The pin-plate discrepancy is in the range 24 to 42 x 10-4 dk/k for all the data libraries, JEF-2.2, JENDL-3.2, ENDF/B-VI-V4, ABBN-93, JENDL-3.3 and JEFF-3.1, the standard deviation of the measured difference being ± 13 x 10-4 dk/k. (The lower figure of 24 x 10-4 is within two standard deviations of the measurement uncertainty.) These values compare with the discrepancy of 52 x 10-4 calculated by ANL, in the 1980s, using Monte Carlo methods and to the value of 48 x 10-4 calculated in the UK, at that time, using approximate 3D cell models. Using more recent datasets has reduced the discrepancy, but not eliminated it. Concerning the difference between the “flooded” and “sodium voided” cores, it is known that aspects of the sodium data in JEF-2.2 are unsatisfactory, in particular in the higher energy range.

The differences between the (C-E) values for the similar Zebra assemblies, MZA and Zebra 22, also deserve comment. These show a wide variation, ranging from agreement for MONK/ENDF-BVI-v4 and MCNP/JEFF-3.1 to discrepancies of about (40 ± 18) x10-4 for MONK/JEF-2.2 and MONK/JENDL-3.2 and (54 ± 18) x10-4 for MCNP/JENDL-3.3.

Although the systematic pin-plate discrepancies are now smaller they do appear to be real, and not within the uncertainties of measurement, nor of assembly composition and core height. Nuclear data uncertainties for the materials which are present in different proportions in the plate and pin geometry cores (for example, oxygen and copper) could contribute to the remaining difference. An error in modelling the cores might also be an explanation, although there is consistency between the present models and those used in the early 1980s for average cell compositions, and between the MONK, KENO and MCNP representations of the models. The differences between the (C-E) values for MZA and Zebra2 could be related to the differences in the nuclear data for blanket materials, Zebra 22 having a natural uranium blanket and MZA a simulation of a more realistic fast reactor blanket, including sodium diluent.

## 4.2 Results of Bucklings and Extrapolation Lengths Calculations

Not a benchmark

## 4.3 Results of Spectral Characteristics Calculations

#### Central Spectral Indices Measured in Assembly 22 Calculated using the Reference Model (Model A)

Table 4.8 Cell Averaged Reaction Rate Ratio Calculations using MONK/JEF-2.2

|  |  |  |  |
| --- | --- | --- | --- |
| Reaction rate ratio | Calculated  (MONK/JEF-2.2) | Measured | (C-E)/E% |
|  |  |  |  |
| F28/F25 | 0.03455 (± 0.57%) | 0.03634 (± 1.3%) | -4.9% (± 1.4%) |
|  |  |  |  |
| F25/F49 | 0.9655 (± 0.56%) | 0.959 (± 1.6%) | +0.7% (± 1.7%) |
|  |  |  |  |
| C28/F49 | 0.1236 (± 0.17%) | 0.1266 (± 1.1%) | -2.4% (± 1.1%) |
|  |  |  |  |
|  | Cell average calculation | Chamber measurement |  |
|  |  |  |  |
| F28/F25 (Chamber) | 0.03455 (± 0.57%) | 0.03483(± 4.3%) | (-0.8%)\* |
|  |  |  |  |
| F25/F49 (Chamber) | 0.9655 (± 0.56%) | 0.960 (± 1.6%) | (+0.6%)\* |
|  |  |  |  |
| F40/F49 (Chamber) | 0.2887 (± 0.4%) | 0.2594 (± 4.6%) |  |
|  |  |  |  |
| F41/F49 (Chamber) | 1.217 (± 0.5%) | 1.217 (± 4.0%) | (0.0%)\* |
|  |  |  |  |

\* Chamber measurement compared with a cell average calculation

Table 4.9 Cell Averaged Reaction Rate Ratio Calculations using MONK/JENDL-3.2

|  |  |  |  |
| --- | --- | --- | --- |
| Reaction rate ratio | Calculated  (MONK/JENDL-3.2) | Measured | (C-E)/E% |
|  |  |  |  |
| F28/F25 | 0.03495 (± 1.2%) | 0.03634 (± 1.3%) | -3.8% (± 1.8%) |
|  |  |  |  |
| F25/F49 | 0.974 (± 1.1%) | 0.959 (± 1.6%) | +1.6% (± 1.9%) |
|  |  |  |  |
| C28/F49 | 0.1235 (± 0.34%) | 0.1266 (± 1.1%) | -2.4% (± 1.2%) |
|  |  |  |  |
|  | Cell average calculation | Chamber measurement |  |
|  |  |  |  |
| F28/F25 (Chamber) | 0.03495 (± 1.2%) | 0.03483(± 4.3%) | (+0.3%)\* |
|  |  |  |  |
| F25/F49 (Chamber) | 0.974 (± 1.1%) | 0.960 (± 1.6%) | (+1.4%)\* |
|  |  |  |  |
| F40/F49 (Chamber) | 0.2908 (± 0.75%) | 0.2594 (± 4.6%) | (+12.1%)\* |
|  |  |  |  |
| F41/F49 (Chamber) | 1.324 (± 1.0%) | 1.217 (± 4.0%) | (+8.8%)\* |
|  |  |  |  |

\* Chamber measurement compared with a cell average calculation

Table 4.10 Cell Averaged Reaction Rate Ratio Calculations using MONK/ ENDF/B-VI-v4

|  |  |  |  |
| --- | --- | --- | --- |
| Reaction rate ratio | Calculated  (MONK/ENDF/B-VI-v4) | Measured | (C-E)/E% |
|  |  |  |  |
| F28/F25 | 0.03481 (± 0.7%) | 0.03634 (± 1.3%) | -4.2% (± 1.5%) |
|  |  |  |  |
| F25/F49 | 0.969 (± 0.7%) | 0.959 (± 1.6%) | +1.0% (± 1.7%) |
|  |  |  |  |
| C28/F49 | 0.1229 (± 0.2%) | 0.1266 (± 1.1%) | -3.0% (± 1.1%) |
|  |  |  |  |
|  | Cell average calculation | Chamber measurement |  |
|  |  |  |  |
| F28/F25 (Chamber) | 0.03481 (± 0.7%) | 0.03483(± 4.3%) | (-0.1%)\* |
|  |  |  |  |
| F25/F49 (Chamber) | 0.969 (± 0.7%) | 0.960 (± 1.6%) | (+0.9%)\* |
|  |  |  |  |
| F40/F49 (Chamber) | 0.3020 (± 0.4%) | 0.2594 (± 4.6%) | (+16.4%)\* |
|  |  |  |  |
| F41/F49 (Chamber) | 1.284 (± 0.6%) | 1.217 (± 4.0%) | (5.5%)\* |
|  |  |  |  |

\* Chamber measurement compared with a cell average calculation

All three datasets underestimate the cell averaged fission ratio measurement, F28/F25, by about 4% ±1.5%, and the value of C28/F49 by about 2.5% ± 1%. Note, however, the estimates of possible systematic uncertainties in the ZEBRA techniques of ±3% in F28/F25, ±1% in F25/F49 and ±3% in C28/F49. These are based on the comparisons with measurements made by the staff of other laboratories.

## 4.4 Results of Reactivity Effects Calculations

Presented here are the original calculations made by the ZEBRA team, in the early 1980s, to compare with the measurements, as described in ZTN22-13, together with MONK-JEF-2.2 Monte Carlo calculations of the reactivity effects of element replacements.

Th calculations made by the Zebra team began with the preparation of cell averaged 37 energy group macroscopic and microscopic cross-sections for all the cells, using the collision probability cell code MURAL in the single buckling search option, with the 2000-group adjusted cross-section set, FGL5. These cross-sections were then used in XYZ geometry TIGAR diffusion theory calculations and associated perturbation theory edits.

These calculations used the standard ZEBRA route, that is, one-dimensional slab geometry was used for the cells with the compositions smeared radially over the area of the average element pitch. (These calculations were made before the approximate 3D cell representation was developed and used in the later calculations of keff. This approximate 3D cell treatment is the method now incorporated in the ECCO cell code of the ERANOS system of codes.) Plutonium metal and U02 regions were separated axially from their cans and other diluent regions. The plate region thicknesses used differ slightly from those recommended in Section 3.1.2 in that the thickness of the sodium plates and their dummies are the same and are those from the ZEBRA Databank (i.e. 0.6l6 cm instead of the reduced thickness of 0.6l3694 cm adopted here for the compressed sodium plate). It is considered that these changes in cell lengths will give rise to negligible differences in calculated parameters for the cells and the XYZ models. (When calculating using the reduced height of the core with the sodium plates present the macroscopic cross-sections were multiplied by a factor of 1.00186 to correspond to reducing the height from 89.486 cm to the average measured core height of 89.32 cm.)

Similar slab geometry MURAL calculations were made for the plate cells containing the mixed-oxide plates, which were used in the enrichment perturbation experiments. The factor applied to correct for the difference between the height obtained from the plate thickness in the ZEBRA Database which gives the standard core height of 89.32 cm, was 0.99797,

For the pin cells, the cylindrical version of MURAL was used. Three regions were represented for the uniform pin cells, the first consisting of the oxide pellets, the second containing the steel of the pin can plus the minicalandria tube, and the third being one-sixteenth of the steel from the remainder of the minicalandria and the sheath and (where present) one-sixteenth of the sodium from the minicalandria. The radii of the regions were 4.230mm, 5.131mm and 7.6524mm respectively. For the minicalandria containing two pin types, a special version of MURAL prepared for such cells was used. In this version, separate sub-cells represent each of the two pins and contained the appropriate oxide pellets, the steel of the pin tube and the minicalandria tube, and one sixteenth of the remainder of the minicalandria plus the sheath. The coupling between the two pin cells was represented by input values for the probability of a neutron leaving one subcell type and entering another subcell or one of the same type. Macroscopic and microscopic cross-sections were produced as for the plate cells. No height correction factors were required for the macroscopic cross-sections as the minicalandria height in ZEBRA Database corresponded to one-third of the core height in the diffusion-theory calculations used for the pin cores.

Corrections were made to the diffusion coefficients to allow for the effects of neutron streaming in the dilute regions of the flooded and voided plate and pin cells. The factors were those obtained for the same plate and pin cells in the analysis of the heterogeneous BIZET assemblies (BTN-103). The corrections were greater for the voided cells than for the sodium flooded cells.

The blanket and reflector zones consist of uranium metal or steel pieces and were treated as homogeneous for the purposes of the reactivity perturbation studies. Cell-average macroscopic and microscopic cross-sections were prepared from the 37-group FD5 data in this case. Studies of methods of cross-section preparation for such reflector zones had shown this to be more suitable than using MURAL/FGL5 in the critical buckling search or k-effective options.

#### Deterministic Element Replacement Calculations made by the Zebra Team

First Order Perturbation Theory (FOP) calculations were made in XYZ geometry. Exact/FOP corrections were applied to the 9 element FOP results in Core 22, based on RZ geometry calculations. The factors for the absorption, fission, scatter, radial leakage and axial leakage terms were 0.986, 0.994, 0.907, 1.005 and 1.004 respectively for the introduction of 9 C22+03A pin elements and 0.988, 0.988, 0.919, 0.900 and 1.001 respectively for the introduction of 9 C22+04A mixed oxide plate elements. Because the resulting percentage changes to the total FOP calculated worths were small, it was considered that the corresponding corrections for the single element replacements were negligible compared with the experimental uncertainties and so the Exact values were not derived for these.

Table 4.11 FOP and Exact Perturbation Calculations for Element Replacements in Core 22 and Comparison with Experiment (from ZTN22-13) (Units 10-4 dk/k)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Position | Element Introduced | No. of Elements | Type of Calc. | Calc. (C) | Experiment (E) | C-E |
| 50,45 | C22+03A (Pins) | 9  1 | FOP  Exact  FOP | -11.85  -11.50  -1.374 | -18.16 ±0.27  -18.16 ±0.27  -2.10 ±0.05 | +6.3 ±0.3  +6.7 ±0.3  +0.73±0.05 |
| 50,42 | C22+03A (Pins) | 9  1 | FOP  Exact  FOP | -8.82 8.52 1.021 | -14.43 ±0.21  -14.43 ±0.21  -1.52 ±0.04 | +5.6 ±0.2  +5.9 ±0.2  +0.50±0.04 |
| 50,42 | C22+03C (Pins) | 9 | FOP | -4.26 | -9.48 ±0.21 | +5.2 ±0.2 |
| 50,39 | C22+03A (Pins) | 9  1 | FOP Exact FOP | -2.305  -2.09  -0.266 | -5.36 ±0.10  -5.36 ±0.10  -0.575 ±0.03 | +3.1 ±0.1  +3.3 ±0.1  +0.31 ±0.03 |
| 50,45 | C22+04A (Oxide Plates) | 9  1 | FOP Exact FOP | -30.04  -29.36  -3.444 | -35.02 ±0.51  -35.02 ±0.51  -4.10 ±0.06 | +5.0 ±0.5  +5.6 ±0.5  +0.66 ±0.06 |
| 50,42 | C22+04A (Oxide Plates) | 9  1 | FOP  Exact FOP | -24.25  -23.75  -2.774 | -27.55 ±0.40  -27.55 ±0.40  -3.09 ±0.05 | +3.3 ±0.4  +3.8 ±0.4  +0.32+0.05 |
| 50,39 | C22+04A (Oxide Plates) | 9  1 | FOP Exact FOP | -11.44 11.34 1.291 | -13.31 ±0.20  -13.31 ±0.20  -1.51 ±0,03 | +1.87±0.20  +1.97 ±0.20  +0.22 ±0.03 |

Note: In each case, the elements replaced C22+01C standard plate elements.

Table 4.12 FOP Calculations for Element Replacements in Core 24 and Comparison with Experiment (from ZTN22-13) (Units 10-4 dk/k)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Position | Element Introduced | No. of Elements | Calc. (C) | Experiment (E) | C-E |
| 50,45 | C24+30A (Pins) | 9  1 | -11.65  -1.344 | -17.45 ±0.27  -2.13 ±0.05 | 5.8 ±0.3  0.79 ±0.05 |
| 50,42 | C24+30A (Pins) | 9  1 | -8.99  -1.038 | -13.90 ±0.21  -1.68 ±0.04 | 4.9 ±0.2  0.64 ±0.04 |
| 50,39 | C24+30A (Pins) | 9  1 | -3.054  -0.354 | -6.13 ±0.10  -0.715 ±0.02 | 3.08 ±0.10  0.36 ±0.02 |
| 50,45 | C24+40A (Oxide Plates) | 9  1 | -28.57  -3.263 | -31.90 ±0.45  -3.71 ±0.06 | 3.3 ±0.5  0.45 ±0.06 |
| 50,42 | C24+40A (Oxide Plates) | 9  1 | -23.73  -2.709 | -26.29 ±0.38  -3.04 ±0.05 | 2.6 ±0.4  0.33 ±0.05 |
| 50,39 | C24+40A (Oxide Plates) | 9  1 | -12.60  -1.432 | -13.98 ±0.20  -1.567 ±0.03 | 1.4 ±0.2  0.13 ±0.03 |

Note: In each case, the elements replaced C22+01CY standard plate elements.

The experimental uncertainties in these tables are the random contributions from the rod profile and reproducibility and drifts during the measurements. The systematic uncertainties due to the plutonium contents of the fuel ((0.08 to 0.04) x 10-4 dk/k per element for the pin element replacements and (0.10 to 0.06) x 10-4 dk/k per element for the oxide plate element replacements) and the reactivity scale uncertainty of ±5% are not included.

#### Plutonium Enrichment Changes

The calculated values were obtained using FOP and XYZ diffusion theory, increased by 0.5% to correct for the use of FOP (based on comparisons of FOP and Exact results in XY geometry). The plate core results have been increased by a further 0.3% to allow for the presence of the end cells.

Table 4.13 Comparison of Calculated and Experimental Enrichment Worths

(uncertainty in the measured values ~ ±1.5%, excluding the systematic uncertainty of ±5%)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Core | Lattice Position | Calculated Worth (C) | Experimental Worth (E) | (C-E)/E% |
| 22 | 50,45  50,42  50,39/51 | 19.77  16.46  18.09 | 19.45  16.40  17.49 | +1.6 %  +0.4 %  +3.4 % |
| 23 | 50,45  50,42  50,39/51 | 15.69  13.01  14.49 | 16.09  13.32  14.58 | -0.25 %  -0.23 %  -0.6 % |
| 24 | 50,45  50,42  50,39 | 17.21  14.82  9.20 | 17.25  14.79  9.13 | -0.3 %  +0.2 %  +0.8 % |
| 25 | 50,45  50,42  50,39/51 | 13.92  11.90  14.58 | 14.13  12.09  14.66 | -1.5 %  -1.6 %  -0.5% |

The agreement between measurement and calculation gives confidence in the reactivity scale.

The experimental uncertainties (excluding the systematic contribution from the absolute reactivity scale calibration of 5%) arise from the control rod profile, the inverse-kinetics measurements, the plutonium contents, and the rod interaction corrections and are ~ ±1.5%.

#### Addition of Material Components to Cells

Calculations were made for Core 22 and Core 23 using both FOP and Exact Perturbation Theory. The analysis was made using only FOP for Core 24 and Core 25.

Table 4.14 Comparison of Measured and Calculated values of the Effects of Changes in the Plate Loading of Cells in Cores 22 and 24. (Units 10-4 dk/k)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Perturbation | Position | Core Section | Core 22 | | | Core 24 | | |
| FOP | Exact | Expt. (±0.04) | FOP | Expt. (±0.02) |
| ALF2→AL8 | 50,45 | C | -0.329 | -0.330 | -0.35 | -0.312 | -0.39 |
|  |  | T+B | -0.116 | -0.116 | -0.10 | -0.155 | -0.21 |
|  | 50,42 | C | -0.209 | -0.207 | -0.19 |  |  |
|  |  | T+B | -0.018 | -0.015 | +0.02 |  |  |
|  |  | All |  |  |  | -0.281 | -0.35 |
|  | 50,39/51 | All | +0.419 | +0.454 | +0.58 | +0.230 | +0.255 |
| ALF2→STSTBR8 | 50,45 | C | -1.032 | -1.026 | -1.09 | -0.961 | -1.06 |
|  |  | T+B | -0.665 | -0.654 | -0.70 | -0.743 | -0.84 |
|  | 50,42 | All | -1.147 | -1.130 | -1.19 | -1.250 | -1.39 |
|  | 50,39/51 | All | +0.084 | +0.122 | +0.20 | -0.454 | -0.48 |
| ALF2→AL2034 | 50,45 | C | -0.730 | -0.725 | -0.67 | -0.755 | -0.79 |
|  |  | T+B | -0.237 | -0.224 | -0.18 | -0.440 | -0.415 |
|  | 50,42 | C | -0.441 | -0.424 | -0.410. |  |  |
|  |  | T+B | +0.003 | +0.027 | +0.07 |  |  |
|  |  | All |  |  |  | -0.736 | -0.69 |
|  |  | All | 1.166 | 1.349 | 1.25 | 0.447 | +0.495 |
| ALF2→GII8 |  | C | -0.484 | -0.470 | -0.34 | -0.579 | -0.51 |
|  |  | T+B | -0.167 | -0.144 | 0.02 | -0.504 | -0.33 |
|  |  | C | -0.279 | -0.255 | -0.140 |  |  |
|  |  | T+B | +0.011 | +0.039 | 0.15 |  |  |
|  |  | All |  |  |  | -0.676 | -0.46 |
|  |  | All | 0.809 | 0.981 | 1.08 | 0.000 | +0.24 |

Table 4.15 Comparison of Measured and Calculated Effects of Changes in the Pin Loading of Cells in Cores 23 and 25. (Units 10-4 dk/k)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Perturbation | Position | Core 23 | | | Core 25 | |
|  |  | FOP | Exact | Expt | FOP | Expt. |
| MT→ALPINA | 50-45 C  T+B  50-39 All | -0.308  +0.028  +0.342 | -0.303  +0.025  +0.354 | -0.34 ±0.02  +0.03 ±0.02  +0.36 ±0.02 | -0.310  +0.010  +0.325 | -0.329 ±0.013 +0.013 ±0.013 +0.362 ±0.014 |
| MT→MSTPINA | 50-45 C  T+B  50-39/51 All | -0.685  -0.283  +0.322 | -0.677  -0.284  +0.357 | -0.77 ±0.02  +0.27 ±0.02  +0.37 ±0.02 | -0.665  -0.326  +0.160 | -0.747 ±0.015 -0.385 ±0.014 +0.178 ±0.013 |
| MT→CPINA | 50-45 C  T+B  50-39/51 All | -0.310  +0.163  +1.215 | -0.276  +0.193  +1.286 | -0.21 ±0.02  +0.25 ±0.02  +1.32 ±0.02 | -0.432  -0.035  +0.832 | -0.338 ±0.013 +0.055 ±0.013 +0.942 ±0.016 |
| ALPINA→ ALOPINA | 50-45 C  T+B  50-39 All | -0.184  +0.087  +0.366 | -0.169  +0.102  +0.428 | -0.17 ±0.02  +0.08 ±0. 02  +0.32 ±0.02 |  |  |

MT denotes an empty position being filled.

#### Sodium Voiding and Flooding

Cell calculations were made for the two configurations and the two sets of cell averaged macroscopic cross-sections were then used in two whole reactor perturbation theory calculations. The difference between the two cases was calculated simply by removing (or adding) the sodium from the cell. The cell height and the weight of steel were not changed. First order perturbation theory calculations were made to which corrections were applied based on a limited set of calculations of the differences between exact and first order perturbation theory.

A fit was made to the values of (C-E) to obtain scaling factors to be applied to the three perturbation theory components of the change in reactivity, the central term (absorption plus fission plus moderation) the radial leakage and the axial leakage. (Note, the fission term arises because of the change in spectrum and resonance shielding.)

Table 4.16 Comparison of Calculation and Experiment for the Small-Zone Sodium Worths in the Plate and Pin Geometry Cores (From ZTN22-13) (Units 10-6 dk/k)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Core | Lattice Position | Axial  Extent | FOP Calculated Worth | Corrected Calculated Worth | Measured Worth | (C-E) |
| 22 | 50,45 | M  T+B | 362.0  -143.3 | 376  -98 | 403 ±11  -84 ±12 | -27 ±11  -6 ±12 |
|  | 50,42 | M  T+B | 149.4  -301.0 | 175  -247 | 180 ±9  -236 ±12 | -5 ±9  -11 ±12 |
|  | 50,39 | M  T+B | -282.1  -600.6 | -233  -529 | -235 ±9  -506 ±13 | +2 ±9  -23 ±13 |
| 24 | 50,45 | M | -361.8 | -354 | -340 ±9 | -14 ±9 |
| 23 | 50,45 | M  T+B | +323.2  -279.5 | +344  -219 | +347 ±6  -211 ±5 | -3 ±6  -8 ±5 |
|  | 50,42 | M  T+B | +133.9  -387.8 | +167  -319 | +163 ±5  -321 ±6 | +4 ±5  +2 ±6 |
|  | 50,39 | M  T+B | -220.0  -553.4 | -163  -472 | -197 ±5  -498 ±7 | +34 ±5  +26 ±7 |
| 25 | 50,45 | M  T+B | -356.4  -13.8 | -344  -30 | -323 ±6  +80 ±6 | -21 ±6  -110 ±6 |
|  | 50,39 | M | +55.9 | +106 | +108 ±5 | -2 ±5 |

The Assembly 22 and 23 values are for sodium voiding and the Assembly 24 and 25 values are for sodium flooding.

The components of the FOP calculated values have been scaled using factors found in a comparison of first order and exact perturbation theory values of the components.

Each measurement occupied 9 elements in a 3 x 3 square, the region voided (or flooded) being either the middle 8 cells (M) or the top 8 plus bottom 8 cells (T+B). The Core 22 measurements were sodium voiding; the Core 24, sodium flooding.

The experimental uncertainties quoted are from the reactivity profile of FR9, reproducibility and drifts and the height-change correction. The further systematic error of ±5% from the experimental reactivity scale is not included.

**Table 4.17. MONK JEF-2.2 calculations of the reactivity changes resulting from element replacements (Groups of Pin versus Plate elements, etc).**

|  |  |  |  |
| --- | --- | --- | --- |
| **Cores with replacement elements, Pin versus Plate, MOX elements, etc** | **MONK9A-JEF-2.2 Calculated value** | **Measured value** | **C-E** |
| Reference Core 22 | 1.0004 *±* 0.0001 |  |  |
|  |  |  |  |
| Core 22 with 9 Central PinA elements | 0.9989 *±* 0.0001 |  |  |
| Worth of 9 PinA vs plate elements | -0.0015 *±* 0.00014 | -0.00182 *±* 0.000027 | 0.0003 *±* 0.00014 |
|  |  |  |  |
| Second run | 0.9991*±* 0.0001 |  |  |
|  | -0.0013*±* 0.00014 | -0.00182 *±* 0.000027 | 0.0005 *±* 0.00014 |
|  |  |  |  |
| Core 22 with 9 PinA elements at mid core radius | 0.9991 *±* 0.0001 |  |  |
| Worth of 9 Mid PinA vs plate elements | -0.0013 *±* 0.00014 | -0.00144 *±* 0.000021 | 0.0001*±* 0.00014 |
|  |  |  |  |
| Core 22 with 9 Edge region PinA elements | 1.0001*±* 0.0001 |  |  |
| Worth of 9 OffC PinA vs plate elements | -0.0003 *±* 0.00014 | -0.00054 *±* 0.0000 | 0.0002 *±* 0.00014 |
|  |  |  |  |
| Core 22 with 9 Central MOX plate elements | 0.9978 *±* 0.0001 |  |  |
| Worth of 9 MOX plate elements | -0.0026 *±* 0.00014 | -0.00350 *±* 0.00003 | 0.0009 *±* 0.00014 |
|  |  |  |  |
| Core 22 mid-radius 9 MOX elements | 0.9984 *±* 0.0001 |  |  |
| Worth of 9 Mid MOX vs metal elements | -0.0020 *±* 0.00014 | -0.00276 *±* 0.00004 | 0.0008 *±* 0.00014 |
|  |  |  |  |
| Core 22 with 9 Edge region MOX elements | 0.9996 *±* 0.0001 |  |  |
| Worth of 9 Edge Region MOX vs plate elements | -0.0008 *±* 0.00014 | -0.00133 *±* 0.0000 | 0.0005*±* 0.00014 |
|  |  |  |  |
| Core 22 with Pu enriched plate element | 1.0023 *±* 0.0001 |  |  |
|  | 0.0019 *±* 0.00014 | 0.001945 *±* 0.00003 | 0.0000 *±* 0.00014 |
|  |  |  |  |
| Core 22 with 2 edge Pu enriched element | 1.0023 *±* 0.0001 |  |  |
|  | 0.0019 *±* 0.00014 | 0.00175 *±* 0.00003 | 0.0001 *±* 0.00014 |
|  |  |  |  |
| Reference Flooded Pin Core, Core 23 | 1.0038 *±* 0.0001 | 1.0016 *±* 0.0013 |  |
|  |  |  |  |
| Z23 with 25 plate elements | 1.00625 *±* 0.0001 |  |  |
| Reactivity difference of 25 plate/pin | + 0.00245*±* 0.00014 | + 0.00315 | -0.0007 *±* 0.00014 |
|  |  |  |  |
| Z23 with 45 plate elements Run 1 | 1.0072 *±* 0.0002 |  |  |
| Reactivity difference of 45 plate/pin R1 | +0.0034 *±* 0.00022 | + 0.00493 | -0.0015 *±* 0.00022 |
|  |  |  |  |
| Z23 with 45 plate elements Run 2 | 1.0074 *±* 0.0001 |  |  |
| Reactivity difference of 45 plate/pin R2 | +0.0036 | + 0.00493 | -0.0013*±* 0.00014 |

Table 4.17. continued

|  |  |  |  |
| --- | --- | --- | --- |
| Reference Core24 Full height, X dummy | 0.9997 *±* 0.0001 |  |  |
|  |  |  |  |
| Core 24 with 9 Central MOX elements | 0.9972 *±* 0.0001 |  |  |
| Worth of 9 MOX elements | -0.0025 *±* 0.00014 | -0.00319 *±* 0.00005 | 0.0007 *±* 0.00014 |
|  |  |  |  |
| Core 24 with 9 Mid Radius MOX els. | 0.9976 *±* 0.0001 |  |  |
| Worth of 9 Mid MOX elements | -0.0021 *±* 0.00014 | -0.00263 *±* 0.00004 | 0.0005 *±* 0.00014 |
|  |  |  |  |
| Core 24 with 9 Edge MOX elements | 0.9986*±* 0.0001 |  |  |
| Worth of 9 Edge MOX vs plate elements | -0.0011 *±* 0.00014 | -0.00140 *±* 0.00002 | 0.0003 *±* 0.00014 |
|  |  |  |  |
| Core 24 with 9 Central PinA elements | 0.9984 *±* 0.00015 |  |  |
| Worth of 9 Central PinA elements | -0.0013 *±* 0.00018 | -0.001724 *±* 0.0000 | 0.0004 *±* 0.00018 |
|  |  |  |  |
| Core 24 with 9 Mid Radius PinA els. | 0.9986 *±* 0.0001 |  |  |
| Worth of 9 Mid PinA elements | -0.0011 *±* 0.00014 | -0.00139 *±* 0.0000 | 0.0003 *±* 0.00014 |
|  |  |  |  |
| Core 24 with 9 Edge PinA elements | 0.9991 *±* 0.0001 |  |  |
| Worth of 9 Edge PinA vs plate elements | -0.0006 *±* 0.00014 | -0.00061 *±* 0.0000 | 0.0000*±* 0.00014 |
|  |  |  |  |
| Core 24 with Pu enriched element | 1.0013 *±* 0.0001 |  |  |
| Worth of Pu enrichment | 0.0016 *±* 0.00014 | 0.00 173*±* 0.00003 | -0.00013 *±* 0.00014 |
|  |  |  |  |
| Core25 with 9 plate-pin replacements | 1.0043 *±* 0.0001 |  |  |
| Worth of 9 plate vs pins | 0.0011 *±* 0.00014 | 0.00178 *±* 0.0000 | -0.0007 *±* 0.00014 |
|  |  |  |  |

The effects of the plutonium enrichment of elements are well predicted but the reactivity effects of the replacement of plate elements by pin elements are not well predicted and the discrepancies are in the sense of the discrepancies between the keffective values of the plate versus pin geometry cores.

## 4.5 Results of Reactivity Coefficient Calculations

Not a benchmark.

## 4.6 Results of Kinetics Parameter Calculations

Not a benchmark.

## 4.7 Results of Reaction-Rate Distribution Calculations

**Not analysed.**

## 4.8 Results of Power Distribution Calculations

Not a benchmark.

## 4.9 Results of Isotopic Calculations

Not a benchmark.

# 5. REFERENCES

#### ZEBRA Technical Notes Describing the CADENZA Assemblies 22 to 25

ZTN22-1 Description of the Standard Loading of Core 22 G Ingram

ZTN22-2 Summary of K-Value Related Data for Cores 22 and 23 G Ingram

ZTN22-3 Calibration of Control Rods in Core 22 J Marshall and P M J Stone

ZTN22-4 Sodium Void and Material Worth Measurements in Core 22 - the CADENZA Plate Core J M Stevenson and S E Johnson

ZTN22-5 Material Worth Measurements in Core 24 – the Cadenza Voided Plate Core

S E Johnson and J M Stevenson

ZTN22-6 Material Worth Measurements in Zebra 23 and 25 – the Cadenza Pin Cores

S E Johnson and J M Stevenson

ZTN22-7 First Calculated Studies for the CADENZA Assemblies S E Johnson

ZTN22-8 Cell Heterogeneity and Sample Worth Measurement at the Centre of ZEBRA 22

J M Stevenson and S E Johnson

ZTN22-9 Reaction Rate Ratio Measurements in the Fissile Region of ZEBRA Assembly 22A B L H Burbridge, M F Murphy and Miss P A Smart

ZTN22-10 Summary of Further K-Value Related Data for the CADENZA Assemblies

B L H Burbridge, A D Knipe and J M Stevenson

ZTN22-11 Description of CADENZA Plate Assemblies 22 and 24 Miss P A Smart

ZTN22-13 First Analysis of the CADENZA Assemblies J M Stevenson

ZTN22-14 Comparison of Measured and Calculated Reaction Rates to Demonstrate Cell Heterogeneity in ZEBRA Assembly 22C

Miss A M Osmond and B L H Burbridge

#### Selected MOZART and BIZET Technical Notes.

MTN-54 Sodium removal measurements in plate and pin geometry in Zebra Assembly 12/2 - the second version of MZB J M Stevenson and S F Swoboda. Feb. 1973

BTN-19 Details of Pins and Mini-Calandria at Zebra J M Stevenson. Dec 1976

BTN-23 Comparison of properties of plate cells with different batches of ZEBRA plutonium metal plates and with different sodium plates J M Stevenson. S F Swoboda

Feb 1977

BTN-38 Intercomparison of SNEAK and ZEBRA fission chambers in NESTOR Thermal Column M F March, M F Murphy, W Scholtyssek and W H Taylor July 1977

BTN-39 Calibration of ZEBRA control rods in BZB/1

J Marshall and J M Stevenson July 1977

BTN-65 A description of the standard loading of BZC/1

G Ingram and J M Stevenson July 1978

BTN-75 Some notes on the calibration of ZEBRA control rods J Marshall Nov. 1978

BTN-103 First Analysis Results for Assembly BZC/1

S F Swoboda and J M Stevenson Feb. 1980

BTN-106 The Pin-Plate Discrepancy: Fact or Fiction? J E Sanders March 1980

BTN-118 Results of absolute neutron reaction rate determinations in the fissile and fertile regions of BZD/3 core in ZEBRA W H Taylor, M F Murphy M R March

Dec. 1980

BTN-131 Measurements and calculations of Reaction Rate Ratios in the Fissile Region of BZD/1 B L H Burbridge, B M Franklin, Miss P A Smart, J M Stevenson Aug. 1980

BTN-132 Revision of ZEBRA Mixed-Oxide Pin Data A D Knipe. Nov 1981

BTN-134 Revision of ZEBRA Uranium dioxide Pin Data A D Knipe. Nov 1981

#### Documents of the NEA Committee on Reactor Physics relating to the CADENZA Benchmark

NEACRP-A-445, J M Stevenson and J L Rowlands, “Description of the Pin and Plate geometry Cadenza Assemblies for the International Comparison of Calculations”

NEACRP-A-445 Addendum 1, J M Stevenson, “Influence of Supplementary Measurements in the Cadenza Assemblies on Calculational Models”, November 1982.

NEACRP-A-447, J L Rowlands and J M Stevenson, “Proposed International Comparison Calculations of Fast Critical Assemblies in Pin and Plate Geometry” July 1981.

NEACRP-A-614, M J Grimstone, J L Rowlands and J M Stevenson, “Progress Report on the International Comparison of Calculations for the CADENZA Assemblies (the Pin - Plate Benchmark)”

NEACRP-L-300, M J Grimstone, J L Rowlands and J M Stevenson, “Final Report on the International Comparison of Calculations for the CADENZA Assemblies (The Pin - Plate Benchmark)” August 1987

NEACRP-A-688, R D McKnight and P J Collins, “Pin-Plate Studies – A comparison of ZPPR-12 and CADENZA Results.

NEACRP-A-723, R D McKnight and P J Collins, “The State of CADENZA and ZPPR-12 Analysis.

#### Documents Describing the Multichamber Scanning System Chambers and Elements.

RPD/DWS/100 Description of the Multiscan Fission Chambers used in Zebra Cores 13 and 14 Miss P M Smith and D W Sweet. (Internal Winfrith document)

AEEW - M 1272 The Zebra Multichamber Scanning System R G Batt et al.

AEEW - R 1056 J Marshall, J E Sanders and D W Sweet.

#### 

#### Nuclear Data used in the Calculations.

The JEF-2.2 Nuclear Data Library JEF Report 17 April 2000.

JENDL-3.2

MTN81 The FGL5 and FD5 Cross-section Sets

J L Rowlands, C J Dean, M F James, J D MacDougall and R W Smith October 1973

The Production and Performance of the Adjusted Cross-section Set, FGL5. J L Rowlands et al. International Symposium on Physics of Fast Reactors, Tokyo, October 1973. Paper A30.

(Later revisions were made to the FGL5/FD5 library)

The ABBN-93 library.

For sensitivity calculations ERANOS was used with CARNAVAL-IV nuclear data.

#### Calculational Methods

The MONK Monte Carlo Code. SercoAssurance. Winfrith Technology Centre. UK.

The MCNP Monte Carlo Code. Los Alamos National Laboratory X-5 Monte Carlo Team, "MCNP-A General Monte Carlo N-Particle Transport Code, Version 5 - Vol. I: Overview and Theory," LA-UR-03-1987, Volume II: Users Guide," LA-CP-03-0245, LANL (2005).

The Use of the 2000 Energy Group Reactor Physics Code MURAL in the Investigation of Special Effects in Fast Reactors. J D MacDougall. International Symposium on Physics of Fast Reactors, Tokyo, October 1973. Paper A32.

Methods of Calculation of Streaming Corrected Diffusion Coefficients for Pin and Plate Cells in Fast Reactors. M J Grimstone. IAEA/NBA Meeting on Homogenisation Methods in Reactor Physics. Lugano 1978

TIGAR - A Speed and Storage Optimised 3D Diffusion Code. J D Matthews. COSMOS Note. Internal AEEW Document.

Superposition of Buckling Modes on to Cell Calculations and Applications in the Computer Programme WDSN. R J Brissenden and C Green. AEEW-M809.

# APPENDIX A. INPUT DATA USED IN THE CALCULATIONS

## A.1 MONK MONTE CARLO MODELS OF THE ASSEMBLIES.

**MONK9a is a hyperfine group Monte Carlo code (Serco-Assurance, Winfrith, UK).**

**K-effective values, and central reaction rate ratios (in the case of ZEBRA assembly 22) were calculated using MONK9a. Calculations were made using the nuclear data sets based on JEF-2.2, JENDL-3.2 and ENDFB-VI-v3. The input data listings for the Model A cases are given first, followed by the modifications to treat the simplified models.**

**Note: The data used in these models differs slightly from the data specified in Sections 1 to 3. The width of the UO2 plate has been taken to be 4.857 cm (instead of the value of 4.851 cm given in Section 1, this latter value being the current Zebra Database value) and the atomic densities for both the core region and the canning are correspondingly different.**

**The data for the UO2 pins are also slightly different. The values from the Zebra Database are the ones given in Section 1 to 3 whereas the values used in these MONK models are the values from the original NEACRP benchmark models.**

**The gap between the groups of 5x5 elements has been taken to be 0.2667 instead of the value 0.2665 cm given in the text. This difference is a consequence of the different values in use for the average lattice spacing, 5.42544 and the value 5.4254 cm given in the text.**

**MONK9A Continuous Energy Monte Carlo Code Models.**

## A1.1. Assembly 22B. The sodium filled plate geometry core. Model A.

### \* MONK9A Input Listing for Assembly 22B Model A,

\* Case with Grid Plates included

\* Assembly 22 is the Plate Geometry Version of the Cadenza cores.

\* Full height model

\* Reactor structure: elements arranged on a square grid

\* The 269 Core Elements contain Core Cells and an Axial Region Cell,

\* enclosed in a mild steel sheath and reflected in the midplane.

\* The standard plates have a width of 5.067 cm.

\* The Element sheath has an inner width 5.102 cm, outer width 5.2544 cm.

\* The elements occupy a lattice area of 5.3721 cm square.

\* Groups of 5x5 elements form the superlattice

\* with a space between them

\* The 332 Radial Blanket Elements contain 10 U3 blocks and a MST3 block

\* enclosed in a mild steel sheath with reflection in the midplane.

\* The radial shielding elements consist of the Steel bar MST9F10

\* which is about 3 00 cm high.

\* These are represented explicitly within an outer radius and also

\* homogenised (over the overall average lattice area) to fill the

\* remaining space in the outer cylinder (pitch 5.4254 cm)

\* Elements are grouped in square arrays containing 5x5 = 25 elements

\* and the Assembly is built from these.

\* A more regular array can be achieved by adding an exta ring of

\* elements to make the radius 95.9 cm

\* There is a gap between these groups of elements of 0.2667 cm

\* There are 9 types of 5x5 arrays, plus rotations (or reflections)

\* of some of these.

\* Core Element structure:

\* The element consists of combinations of the following cells:

\* Core Cell PART 1, Core Cell PART 2 , is an inversion of PART 1,

\* Core Cell PART 3, which is the same as PART 1

\* but with the 40%Steel plate omitted,

\* and the Upper Axial Region Cell, PART4.

\* This is reflected in the mid-plane.

\* Structure of Core Cell 1, PART 1, 7 plates. Cell height 3.748082 cm.

\* Enclosed in mild steel sheath.

\* Outer area of all plates is 5.067 cm x 5.067 cm

\* From the top down:

\* Sodium (0.613694 cm thick, core 0.541 cm x 4.963 cm square)

\* UO2 (0.6313 cm thick, core 0.558 cm x 4.857 cm square)

\* Sodium (0.613694 cm thick,)

\* Pu Metal (0.3274 cm thick, core 0.236 cm x 4.671cm x 4.671 cm)

\* 40%Steel (0.317 cm thick, void core 0.317 cm x 3.925 cm square)

\* UO2 (0.6313 cm thick)

\* Sodium (0.613694 cm thick)

\* Structure of Core Cell 2 PART 2. The inverse of PART 1

\* Structure of Core Cell PART 3. PART 1 without the 40%Steel plate.

\* Cell height 3.431082 cm.

\* Structure of the Axial Region cell. Enclosed in mild steel sheath.

\* Cell height From the top:

\* MST3 Block (7.60628 cm thick)

\* U3 Block (7.6225 cm thick,)

\* U2 region (10 plates, total thickness 12.723 cm )

\* U8 region (31 plates, total thickness 9.827 cm)

\* Structure of the Radial Blanket element.

\* Height of the reflected half height element

\* MST3 Block (7.60628 cm thick)

\* U3 Block composition (height above mid-plane to match the core

\* element blanket height of 74.83248 cm)

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* material 1 - Plutonium metal plate core

\* material 2 - Plutonium metal clad

\* material 3 - UO2 plate core

\* material 4 - UO2 plate clad

\* material 5 - Sodium plate core

\* material 6 - Sodium plate clad

\* material 7 - 40%Steel

\* material 8 - U8 natural uranium region

\* material 9 - U2 natural uranium region

\* material 10 - U3 natural uranium block

\* material 11 - MST3 Steel block

\* material 12 - Mild steel sheath

\* material 13 - Steel bar MST9F10 at actual density (width 5.08 cm)

\* material 14 - Steel bar averaged over the mean spacing of 5.4254 cm

\* material 15 - Plutonium metal plate core at reactor core centre

\* material 16 - UO2 plate core at reactor core centre

\* material 17 - Grid plate material

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

COLUMNS 1 132

BEGIN MATERIAL SPECIFICATION

NUMBER DENSITY

MATERIAL 1

U238 6.8782E-07 PU238 3.0461E-05 PU239 2.8920E-02

PU240 6.9095E-03 PU241 7.3960E-04 PU242 1.8699E-04

AM241 4.5718E-04

H1 1.2764E-04 C 4.2260E-04 N 2.4215E-05 O16 8.8450E-05

AL 2.2973E-05 SI 1.4158E-05 CR 3.5989E-06 MN 1.4902E-06

FE 1.6335E-05 NI 8.5688E-06 GA 2.0166E-03

MATERIAL 2

H1 1.3760E-05 C 1.1393E-04 SI 3.6607E-04 P 1.3731E-05

CR 9.4011E-03 MN 8.5931E-04 FE 3.5542E-02 NI 4.1646E-03

CU 1.6613E-02

MATERIAL 3

H1 3.1773E-05 C 1.1808E-05 O16 4.6008E-02 AL 3.3911E-06

SI 2.2967E-05 MN 8.3273E-08 FE 1.3107E-06 NI 1.2472E-06

MO 3.3379E-07 U235 1.6544E-04 U238 2.2837E-02

MATERIAL 4

H1 1.9035E-05 C 1.2831E-04 SI 6.4475E-04 P 3.5078E-04

S 3.6041E-05 CR 1.3819E-02 MN 8.5559E-04 FE 4.8306E-02

NI 8.4258E-03

MATERIAL 5

H1 1.3900E-05 O16 5.6492E-06 NA 2.3225E-02 CA 3.6083E-06

FE 1.6184E-07

MATERIAL 6

H1 2.1631E-05 C 2.9290E-04 SI 6.0867E-04 P 3.2795E-05

S 3.3219E-05 CR 1.4759E-02 MN 1.3570E-03 FE 5.5054E-02

NI 7.0982E-03 NB 3.1147E-04

MATERIAL 7

H1 1.8355E-05 C 8.7794E-05 AL 1.1862E-04 SI 7.9703E-04

P 4.0018E-05 S 1.4422E-05 TI 2.4806E-04 CR 1.5908E-02

MN 1.4972E-03 FE 5.5367E-02 NI 8.7976E-03 CU 5.0365E-05

NB 4.9781E-06 MO 8.0988E-05

MATERIAL 8

H1 4.4048E-05 C 4.9283E-04 SI 2.1076E-04 FE 1.0599E-04

U235 3.3369E-04 U238 4.6021E-02

MATERIAL 9

H1 4.3899E-05 C 4.6047E-04 SI 1.9692E-04 FE 9.9032E-05

U235 3.3962E-04 U238 4.6785E-02

MATERIAL 10

H1 4.4574E-05 C 4.7140E-04 SI 2.0160E-04 FE 1.0138E-04

U235 3.4209E-04 U238 4.7156E-02

MATERIAL 11

H1 2.5700E-05 C 5.1066E-04 AL 1.3989E-04 TI 3.9416E-05

CR 2.7222E-05 MN 3.2634E-04 FE 8.3806E-02 NI 4.8234E-05

CU 4.4548E-05 MO 9.8355E-06

MATERIAL 12

H1 7.5712E-05 C 2.3825E-04 AL 1.9798E-05 CR 3.6690E-06

MN 2.5697E-04 FE 7.7524E-02 NI 1.4302E-05 CU 2.2216E-05

MATERIAL 13

H1 4.6306E-05 C 6.8972E-04 SI 3.1158E-04 P 4.2944E-05

S 3.7110E-05 MN 7.1275E-04 FE 8.1432E-02

MATERIAL 14

H1 4.0597E-05 C 6.0468E-04 SI 2.7317E-04 P 3.7649E-05

S 3.2535E-05 MN 6.2488E-04 FE 7.1392E-02

MATERIAL 15

U238 6.8782E-07 PU238 3.0461E-05 PU239 2.8920E-02

PU240 6.9095E-03 PU241 7.3960E-04 PU242 1.8699E-04

AM241 4.5718E-04

H1 1.2764E-04 C 4.2260E-04 N 2.4215E-05 O16 8.8450E-05

AL 2.2973E-05 SI 1.4158E-05 CR 3.5989E-06 MN 1.4902E-06

FE 1.6335E-05 NI 8.5688E-06 GA 2.0166E-03

MATERIAL 16

H1 3.1773E-05 C 1.1808E-05 O16 4.6008E-02 AL 3.3911E-06

SI 2.2967E-05 MN 8.3273E-08 FE 1.3107E-06 NI 1.2472E-06

MO 3.3379E-07 U235 1.6544E-04 U238 2.2837E-02

MATERIAL 17

H1 4.6306E-05 C 6.8972E-04 SI 3.1158E-04 P 4.2944E-05

S 3.7110E-05 MN 7.1275E-04 FE 8.1432E-02

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN MATERIAL GEOMETRY

\*

\* Plate 1, the Pu metal plate

PART 1 NEST

BOX M1 -2.3355 -2.3355 0.0457 4.671 4.671 0.236

BOX M2 -2.5335 -2.5185 0.0 5.067 5.067 0.3274

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.3274

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.3274

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.3274

\*

\* Plate 2, the UO2 plate

PART 2 NEST

BOX M3 -2.4285 -2.4285 0.03665 4.857 4.857 0.558

BOX M4 -2.5335 -2.5335 0.0 5.067 5.067 0.6313

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.6313

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.6313

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.6313

\*

\* Plate 3, the sodium plate

PART 3 NEST

BOX M5 -2.4815 -2.4815 0.036347 4.963 4.963 0.541

BOX M6 -2.5335 -2.5335 0.0 5.067 5.067 0.613694

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.613694

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.613694

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.613694

\*

\* Plate 4, the 40% steel plate

PART 4 NEST

BOX M0 -1.9625 -1.9625 0.0 3.925 3.925 0.317

BOX M7 -2.5335 -2.5335 0.0 5.067 5.067 0.317

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.317

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.317

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.317

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Core Cell 1

PART 5 ARRAY

1 1 14 3 2 4 1 3 2 3 3 2 3 1 4 2 3

\* Core Cell 2

PART 6 ARRAY

1 1 6 3 2 3 1 2 3

\*

\* Core Cell 3

PART 7 ARRAY

1 1 6 3 2 1 3 2 3

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Axial blanket U8 section

PART 8 NEST

BOX M8 -2.5335 -2.5335 0.0 5.067 5.067 9.827

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 9.827

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 9.827

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 9.827

\*

\* Axial blanket U2 section

PART 9 NEST

BOX M9 -2.5335 -2.5335 0.0 5.067 5.067 12.723

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 12.723

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 12.723

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 12.723

\*

\* Axial blanket U3 section

PART 10 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 7.6225

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.6225

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.6225

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.6225

\*

\* Axial reflector MST3 section

PART 11 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 7.60628

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.60628

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.60628

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.60628

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Radial blanket U3 section (over core height)

PART 12 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 149.664968

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 149.664968

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 149.664968

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 149.664968

\*

\* Steel reflector bars (over assembly height)

PART 13 NEST

BOX M13 -2.54 -2.54 0.0 5.08 5.08 164.877528

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 164.877528

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* The Core Element (full height)

PART 14 ARRAY

1 1 21 11 10 9 8 6 (5)\*11 7 8 9 10 11

\*

\*The Radial Blanket element (full height)

PART 15 ARRAY

1 1 3 11 12 11

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Groups of 5x5 elements surrounded by the superlattice gap

\* Core group

PART 16 ARRAY

5 5 1 (14)\*25

\*

PART 17 OVERLAP

BOX P16 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Core bottom left corner group

PART 18 ARRAY

5 5 1 (15)\*3 (14)\*2 15 (14)\*4 15 (14)\*14

\*

PART 19 OVERLAP

BOX P18 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Core bottom right group

PART 20 ARRAY

5 5 1 (14)\*2 (15)\*3 (14)\*3 (15)\*2 (14)\*4 15 (14)\*10

\*

PART 21 OVERLAP

BOX P20 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Core top left corner group

PART 22 ARRAY

5 5 1 (14)\*10 15 (14)\*4 (15)\*2 (14)\*3 (15)\*3 (14)\*2

\*

PART 23 OVERLAP

BOX P22 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Core top right group

PART 24 ARRAY

5 5 1 (14)\*14 15 (14)\*4 15 (14)\*2 (15)\*3

\*

PART 25 OVERLAP

BOX P24 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Core bottom group

PART 26 ARRAY

5 5 1 (15)\*21 (14)\*3 15

\*

PART 27 OVERLAP

BOX P26 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Core top group

PART 28 ARRAY

5 5 1 15 (14)\*3 (15)\*21

\*

PART 29 OVERLAP

BOX P28 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Core left group

PART 30 ARRAY

5 5 1 (15)\*9 14 (15)\*4 14 (15)\*4 14 (15)\*5

\*

PART 31 OVERLAP

BOX P30 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Core right group

PART 32 ARRAY

5 5 1 (15)\*5 14 (15)\*4 14 (15)\*4 14 (15)\*9

\*

PART 33 OVERLAP

BOX P32 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Blanket element group

PART 34 ARRAY

5 5 1 (15)\*25

\*

PART 35 OVERLAP

BOX P34 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* top and bottom groups have Y=3

\* Shield bottom group

PART 36 ARRAY

5 3 1 (13)\*10 (15)\*5

\*

PART 37 OVERLAP

BOX P36 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M17 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M17 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\*

\* Shield top group

PART 38 ARRAY

5 3 1 (15)\*5 (13)\*10

\*

PART 39 OVERLAP

BOX P38 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M17 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M17 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Shield left group

PART 40 ARRAY

5 5 1 (13)\*4 15 (13)\*4 15 (13)\*4 15 (13)\*4 15 (13)\*4 15

\*

PART 41 OVERLAP

BOX P40 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Shield right group

PART 42 ARRAY

5 5 1 15 (13)\*4 15 (13)\*4 15 (13)\*4 15 (13)\*4 15 (13)\*4

\*

PART 43 OVERLAP

BOX P42 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\*Shield corner sections

\* Bottom left group

PART 44 ARRAY

5 5 1 (13)\*9 15 (13)\*3 (15)\*2 (13)\*2 (15)\*3 13 (15)\*4

\*

PART 45 OVERLAP

BOX P44 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Bottom right group

PART 46 ARRAY

5 5 1 (13)\*5 15 (13)\*4 (15)\*2 (13)\*3 (15)\*3 (13)\*2 (15)\*4 13

\*

PART 47 OVERLAP

BOX P46 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Top left group

PART 48 ARRAY

5 5 1 13 (15)\*4 (13)\*2 (15)\*3 (13)\*3 (15)\*2 (13)\*4 15 (13)\*5

\*

PART 49 OVERLAP

BOX P48 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* top right group

PART 50 ARRAY

5 5 1 (15)\*4 13 (15)\*3 (13)\*2 (15)\*2 (13)\*3 15 (13)\*9

\*

PART 51 OVERLAP

BOX P50 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 1, the lowest set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 52 ARRAY

5 3 1 (13)\*13 (15)\*2

PART 53 OVERLAP

BOX P52 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M17 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M17 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* Centre is Part 37

\* Right side

PART 54 ARRAY

5 3 1 (13)\*10 (15)\*2 (13)\*3

PART 55 OVERLAP

BOX P54 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M17 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M17 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* combine these arrays to form the row 1 array

PART 56 ARRAY

3 1 1 53 37 55

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 7, the top set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 57 ARRAY

5 3 1 (13)\*3 (15)\*2 (13)\*10

PART 58 OVERLAP

BOX P57 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M17 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M17 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* Centre is Part 39

\* Right side

PART 59 ARRAY

5 3 1 (15)\*2 (13)\*13

PART 60 OVERLAP

BOX P59 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M17 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M17 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* combine these arrays to form the row 7 array

PART 61 ARRAY

3 1 1 58 39 60

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 3, 7 groups, the two end groups being 3x5 arrays

\* Left hand array

PART 62 ARRAY

3 5 1 (13)\*11 15 (13)\*2 15

PART 63 OVERLAP

BOX P62 -8.05815 -13.43025 0.0 16.1163 26.8605 164.877528

BOX M17 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M17 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 164.877528

\* right hand array

PART 64 ARRAY

3 5 1 (13)\*9 15 (13)\*2 15 (13)\*2

PART 65 OVERLAP

BOX P64 -8.05815 -13.43025 0.0 16.1163 26.8605 164.877528

BOX M17 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M17 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 164.877528

\* Form the row 3 array

PART 66 ARRAY

7 1 1 63 35 19 17 21 35 65

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 5. 7 arrays, the first and last being 3x5 and the remainder 5x5

\* including the two blanket 5x5 groups.

\*

\* Left hand shield array

PART 67 ARRAY

3 5 1 (13)\*2 15 (13)\*2 15 (13)\*9

PART 68 OVERLAP

BOX P67 -8.05815 -13.43025 0.0 16.1163 26.8605 164.877528

BOX M17 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M17 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 164.877528

\*

\* right hand shield array

PART 69 ARRAY

3 5 1 15 (13)\*2 15 (13)\*11

PART 70 OVERLAP

BOX P69 -8.05815 -13.43025 0.0 16.1163 26.8605 164.877528

BOX M17 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M17 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 164.877528

\* Form the row 5 array

PART 71 ARRAY

7 1 1 68 35 23 17 25 35 70

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Arrays of the Superlattice groups

\* Row 2

PART 72 ARRAY

5 1 1 45 35 27 35 47

\*

\* Row 6

PART 73 ARRAY

5 1 1 49 35 29 35 51

\*

\* Insert special element at the core centre

\*

\* Plate 74, the Pu metal plate at the core centre

PART 74 NEST

BOX M15 -2.3355 -2.3355 0.0457 4.671 4.671 0.236

BOX M2 -2.5335 -2.5185 0.0 5.067 5.067 0.3274

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.3274

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.3274

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.3274

\*

\* Plate 75, the UO2 plate

PART 75 NEST

BOX M16 -2.4285 -2.4285 0.03665 4.857 4.857 0.558

BOX M4 -2.5335 -2.5335 0.0 5.067 5.067 0.6313

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.6313

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.6313

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.6313

\*

\* Special cell at the core centre

\*

PART 76 ARRAY

1 1 7 3 75 4 74 3 75 3

\* Special element at core centre

\*

\* Neighbouring cell at the core centre

\*

PART 77 ARRAY

1 1 7 3 75 3 74 4 75 3

\* Special element at core centre

\*

\* The Core Element (half height)(bottom cell 2 reflected at Z=0)

PART 78 ARRAY

1 1 26 11 10 9 8 6 (5)\*3 (76 77)\*5 (5)\*3

7 8 9 10 11

\*

\* Group of elements including the special element at the centre

\* Groups of 5x5 elements surrounded by the superlattice gap

\* Core group including the special element

\*

PART 79 ARRAY

5 5 1 (78)\*25

\*

PART 80 OVERLAP

BOX P79 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M17 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M17 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Middle line, Row 4

PART 81 ARRAY

7 1 1 41 31 17 80 17 33 43

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Cluster of superlattice groups in a circle of shield material

PART 82 CLUSTER

BOX P61 -40.6905 67.8175 0.0 81.381 16.3828 164.877528

BOX P73 -67.8175 40.6905 0.0 135.635 27.127 164.877528

BOX P71 -84.2003 13.5635 0.0 168.4006 27.127 164.877528

BOX P81 -94.9445 -13.5635 0.0 189.889 27.127 164.877528

BOX P66 -84.2003 -40.6905 0.0 168.4006 27.127 164.877528

BOX P72 -67.8175 -67.8175 0.0 135.635 27.127 164.877528

BOX P56 -40.6905 -84.2003 0.0 81.381 16.3828 164.877528

ZROD M14 0.0 0.0 0.0 96.6 168.0

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Albedo for free boundaries at side top and bottom

\*

ALBEDO 0.0 0.0 0.0

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

BEGIN CONTROL DATA

STAGES -50 2400 5000 STDV 0.0001

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

BEGIN SOURCE GEOMETRY

ZONEMAT

ALL / MATERIAL 1

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN ACTION TALLIES

NONORM

END

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

## A1.2. Assembly 24. The voided plate geometry core. Model A

\* MONK9A Input Listing for Assembly 24B,

\* Assembly 24 is the Voided Plate Geometry Version of the Cadenza cores.

\* Symmetry about the mid-plane

\* Reactor structure: elements arranged on a square grid

\* The 269 Core Elements contain Core Cells and an Axial Region Cell,

\* enclosed in a mild steel sheath and reflected in the midplane.

\* The standard plates have a width of 5.067 cm.

\* The Element sheath has an inner width 5.102 cm, outer width 5.2544 cm.

\* The elements occupy a lattice area of 5.3721 cm square.

\* Groups of 5x5 elements form the superlattice

\* with a space between them

\* The 332 Radial Blanket Elements contain 10 U3 blocks and a MST3 block

\* enclosed in a mild steel sheath with reflection in the midplane.

\* The radial shielding elements consist of the Steel bar MST9F10

\* which is about 3 00 cm high.

\* These are represented explicitly within an outer radius and also

\* homogenised (over the overall average lattice area) to fill the

\* remaining space in the outer cylinder (pitch 5.4254 cm)

\* Elements are grouped in square arrays containing 5x5 = 25 elements

\* and the Assembly is built from these.

\* A more regular array can be achieved by adding an exta ring of

\* elements to make the radius 95.9 cm

\* There is a gap between these groups of elements of 0.2667 cm

\* There are 9 types of 5x5 arrays, plus rotations (or reflections)

\* of some of these.

\* Core Element structure:

\* The element consists of combinations of the following cells:

\* Core Cell PART 1, Core Cell PART 2 , is an inversion of PART 1,

\* Core Cell PART 3, which is the same as PART 1

\* but with the 40%Steel plate omitted,

\* and the Upper Axial Region Cell, PART4.

\* This is reflected in the mid-plane.

\* Structure of Core Cell 1, PART 1, 7 plates. Cell height 3.748082 cm.

\* Enclosed in mild steel sheath.

\* Outer area of all plates is 5.067 cm x 5.067 cm

\* From the top down:

\* Sodium (0.613694 cm thick, core 0.541 cm x 4.963 cm square)

\* UO2 (0.6313 cm thick, core 0.558 cm x 4.857 cm square)

\* Sodium (0.613694 cm thick,)

\* Pu Metal (0.3274 cm thick, core 0.236 cm x 4.671cm x 4.671 cm)

\* 40%Steel (0.317 cm thick, void core 0.317 cm x 3.925 cm square)

\* UO2 (0.6313 cm thick)

\* Sodium (0.613694 cm thick)

\* Structure of Core Cell 2 PART 2. The inverse of PART 1

\* Structure of Core Cell PART 3. PART 1 without the 40%Steel plate.

\* Cell height 3.431082 cm.

\* Structure of the Axial Region cell. Enclosed in mild steel sheath.

\* Cell height From the top:

\* MST3 Block (7.60628 cm thick)

\* U3 Block (7.6225 cm thick,)

\* U2 region (10 plates, total thickness 12.723 cm )

\* U8 region (31 plates, total thickness 9.827 cm)

\* Structure of the Radial Blanket element.

\* Height of the reflected half height element

\* MST3 Block (7.60628 cm thick)

\* U3 Block composition (height above mid-plane to match the core

\* element blanket height of 74.83248 cm)

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* material 1 - Plutonium metal plate core

\* material 2 - Plutonium metal clad

\* material 3 - UO2 plate core

\* material 4 - UO2 plate clad

\* material 5 - Sodium plate core

\* material 6 - Sodium plate clad

\* material 7 - 40%Steel

\* material 8 - U8 natural uranium region

\* material 9 - U2 natural uranium region

\* material 10 - U3 natural uranium block

\* material 11 - MST3 Steel block

\* material 12 - Mild steel sheath

\* material 13 - Steel bar MST9F10 at actual density (width 5.08 cm)

\* material 14 - Steel bar averaged over the mean spacing of 5.4254 cm

\* material 15 - Sodium dummy plate type STNAVR4 (ring)

\* material 16 - Sodium dummy plate type STNAVS4 (ring)

\* material 17 - Sodium dummy plate type STNAV4 (uniform)

\* material 18 - Grid plate material

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

COLUMNS 1 132

BEGIN MATERIAL SPECIFICATION

NUMBER DENSITY

MATERIAL 1

U238 6.8782E-07 PU238 3.0461E-05 PU239 2.8920E-02

PU240 6.9095E-03 PU241 7.3960E-04 PU242 1.8699E-04

AM241 4.5718E-04

H1 1.2764E-04 C 4.2260E-04 N 2.4215E-05 O16 8.8450E-05

AL 2.2973E-05 SI 1.4158E-05 CR 3.5989E-06 MN 1.4902E-06

FE 1.6335E-05 NI 8.5688E-06 GA 2.0166E-03

MATERIAL 2

H1 1.3760E-05 C 1.1393E-04 SI 3.6607E-04 P 1.3731E-05

CR 9.4011E-03 MN 8.5931E-04 FE 3.5542E-02 NI 4.1646E-03

CU 1.6613E-02

MATERIAL 3

H1 3.1773E-05 C 1.1808E-05 O16 4.6008E-02 AL 3.3911E-06

SI 2.2967E-05 MN 8.3273E-08 FE 1.3107E-06 NI 1.2472E-06

MO 3.3379E-07 U235 1.6544E-04 U238 2.2837E-02

MATERIAL 4

H1 1.9035E-05 C 1.2831E-04 SI 6.4475E-04 P 3.5078E-04

S 3.6041E-05 CR 1.3819E-02 MN 8.5559E-04 FE 4.8306E-02

NI 8.4258E-03

MATERIAL 5

H1 1.3900E-05 O16 5.6492E-06 NA 2.3225E-02 CA 3.6083E-06

FE 1.6184E-07

MATERIAL 6

H1 2.1631E-05 C 2.9290E-04 SI 6.0867E-04 P 3.2795E-05

S 3.3219E-05 CR 1.4759E-02 MN 1.3570E-03 FE 5.5054E-02

NI 7.0982E-03 NB 3.1147E-04

MATERIAL 7

H1 1.8355E-05 C 8.7794E-05 AL 1.1862E-04 SI 7.9703E-04

P 4.0018E-05 S 1.4422E-05 TI 2.4806E-04 CR 1.5908E-02

MN 1.4972E-03 FE 5.5367E-02 NI 8.7976E-03 CU 5.0365E-05

NB 4.9781E-06 MO 8.0988E-05

MATERIAL 8

H1 4.4048E-05 C 4.9283E-04 SI 2.1076E-04 FE 1.0599E-04

U235 3.3369E-04 U238 4.6021E-02

MATERIAL 9

H1 4.3899E-05 C 4.6047E-04 SI 1.9692E-04 FE 9.9032E-05

U235 3.3962E-04 U238 4.6785E-02

MATERIAL 10

H1 4.4574E-05 C 4.7140E-04 SI 2.0160E-04 FE 1.0138E-04

U235 3.4209E-04 U238 4.7156E-02

MATERIAL 11

H1 2.5700E-05 C 5.1066E-04 AL 1.3989E-04 TI 3.9416E-05

CR 2.7222E-05 MN 3.2634E-04 FE 8.3806E-02 NI 4.8234E-05

CU 4.4548E-05 MO 9.8355E-06

MATERIAL 12

H1 7.5712E-05 C 2.3825E-04 AL 1.9798E-05 CR 3.6690E-06

MN 2.5697E-04 FE 7.7524E-02 NI 1.4302E-05 CU 2.2216E-05

MATERIAL 13

H1 4.6306E-05 C 6.8972E-04 SI 3.1158E-04 P 4.2944E-05

S 3.7110E-05 MN 7.1275E-04 FE 8.1432E-02

MATERIAL 14

H1 4.0597E-05 C 6.0468E-04 SI 2.7317E-04 P 3.7649E-05

S 3.2535E-05 MN 6.2488E-04 FE 7.1392E-02

\* sodium dummy plates

MATERIAL 15

H1 2.4073E-05 C 2.7547E-04 SI 7.5592E-04 P 4.5399E-05

S 1.2036E-05 CR 1.6594E-02 MN 1.1688E-03 FE 5.9245E-02

NI 9.9342E-03 NB 4.0746E-04

MATERIAL 16

H1 2.4073E-05 C 2.5251E-04 SI 7.4610E-04 P 1.7803E-05

S 1.7195E-05 CR 1.6248E-02 MN 1.5006E-03 FE 5.9881E-02

NI 9.4005E-03 NB 3.7393E-04

MATERIAL 17

H1 3.3245E-06 C 3.3477E-05 SI 1.2169E-04 P 4.9764E-06

S 2.5076E-06 CR 2.4643E-03 MN 1.9518E-04 FE 8.0717E-03

NI 1.2195E-03 NB 5.2657E-05

MATERIAL 18

H1 4.6306E-05 C 6.8972E-04 SI 3.1158E-04 P 4.2944E-05

S 3.7110E-05 MN 7.1275E-04 FE 8.1432E-02

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN MATERIAL GEOMETRY

\*

\* Plate 1, the Pu metal plate

PART 1 NEST

BOX M1 -2.3355 -2.3355 0.0457 4.671 4.671 0.236

BOX M2 -2.5335 -2.5185 0.0 5.067 5.067 0.3274

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.3274

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.3274

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.3274

\*

\* Plate 2, the UO2 plate

PART 2 NEST

BOX M3 -2.4285 -2.4285 0.03665 4.857 4.857 0.558

BOX M4 -2.5335 -2.5335 0.0 5.067 5.067 0.6313

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.6313

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.6313

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.6313

\*

\* Plate 3, the sodium dummy plate type STNAVR4 (ring shape)

PART 3 NEST

ZROD M0 0.0 0.0 0.0 2.3 0.616

ZROD M15 0.0 0.0 0.0 2.5335 0.616

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.616

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.616

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.616

\*

\* Plate 4, the 40% steel plate

PART 4 NEST

BOX M0 -1.9625 -1.9625 0.0 3.925 3.925 0.317

BOX M7 -2.5335 -2.5335 0.0 5.067 5.067 0.317

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.317

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.317

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.317

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Alternative dummy plates

\* Plate 5, the sodium dummy plate type STNAVS4 (ring shape)

PART 5 NEST

ZROD M0 0.0 0.0 0.0 2.3 0.616

ZROD M16 0.0 0.0 0.0 2.5335 0.616

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.616

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.616

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.616

\* Plate 6, the sodium dummy plate type STNAV4 (uniform)

PART 6 NEST

BOX M17 -2.5335 -2.5335 0.0 5.067 5.067 0.616

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.616

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.616

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.616

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Core cells for the type X element

\* Core Cell 1 (element type X)

PART 7 ARRAY

1 1 7 3 2 4 1 3 2 3

\* Core Cell 2 (element type X)

PART 8 ARRAY

1 1 7 3 2 3 1 4 2 3

\*

\* Core Cell 3 (element type X)

PART 9 ARRAY

1 1 6 3 2 1 3 2 3

\*

\* Core cells for the type Y element

\* Core Cell 1 (element type Y)

PART 10 ARRAY

1 1 7 5 2 4 1 5 2 5

\* Core Cell 2 (element type Y)

PART 11 ARRAY

1 1 7 5 2 5 1 4 2 5

\*

\* Core Cell 3 (element type Y)

PART 12 ARRAY

1 1 6 5 2 1 5 2 5

\*

\* Core cells for the type Z element

\* Core Cell 1 (element type Z)

PART 13 ARRAY

1 1 7 6 2 4 1 6 2 6

\* Core Cell 2 (element type Z)

PART 14 ARRAY

1 1 7 6 2 6 1 4 2 6

\*

\* Core Cell 3 (element type Z)

PART 15 ARRAY

1 1 6 6 2 1 6 2 6

\*

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Axial blanket U8 section

PART 16 NEST

BOX M8 -2.5335 -2.5335 0.0 5.067 5.067 9.827

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 9.827

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 9.827

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 9.827

\*

\* Axial blanket U2 section

PART 17 NEST

BOX M9 -2.5335 -2.5335 0.0 5.067 5.067 12.723

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 12.723

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 12.723

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 12.723

\*

\* Axial blanket U3 section

PART 18 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 7.6225

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.6225

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.6225

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.6225

\*

\* Axial reflector MST3 section

PART 19 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 7.60628

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.60628

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.60628

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.60628

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Radial blanket U3 section (over half core height)

PART 20 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 74.83248

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 74.83248

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 74.83248

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 74.83248

\*

\* Axial reflector MST3 section above the radial reflector

PART 21 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 7.6893

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.6893

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.6893

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.6893

\*

\* Steel reflector bars (over half core height)

PART 22 NEST

BOX M13 -2.54 -2.54 0.0 5.08 5.08 82.52178

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 82.52178

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* The Core Element X (half height)(bottom cell 2 reflected at Z=0)

PART 23 ARRAY

1 1 16 (8 7)\*5 8 9 16 17 18 19

\*

\* The Core Element Y (half height)(bottom cell 2 reflected at Z=0)

PART 24 ARRAY

1 1 16 (11 10)\*5 11 12 16 17 18 19

\*

\* The Core Element Z (half height)(bottom cell 2 reflected at Z=0)

PART 25 ARRAY

1 1 16 (14 13)\*5 14 15 16 17 18 19

\*

\*The Radial Blanket element (half height)(Cell 8 reflected at Z = 0)

PART 26 ARRAY

1 1 2 20 21

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Groups of 5x5 elements surrounded by the superlattice gap

\* Core centre group (Row 4 centre)

PART 27 ARRAY

5 5 1 (23)\*25

\*

PART 28 OVERLAP

BOX P27 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Core bottom left corner group (Row 3 left)

PART 29 ARRAY

5 5 1 (26)\*3 (25)\*2 26 (25)\*2 (24)\*2 26 25 (24)\*3 25 (24)\*4

25 (24)\*3 23

\*

PART 30 OVERLAP

BOX P29 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Core bottom centre group (Row 3 centre)

PART 31 ARRAY

5 5 1 (24)\*15 (23)\*10

\*

PART 32 OVERLAP

BOX P31 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Core bottom right group (Row 3 right)

PART 33 ARRAY

5 5 1 (25)\*2 (26)\*3 (24)\*2 (25)\*2 26 (24)\*3 25 26 (24)\*4 25

23 (24)\*4

\*

PART 34 OVERLAP

BOX P33 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Core left centre group (Row 4 left)

PART 35 ARRAY

5 5 1 (24)\*3 (23)\*2 (24)\*3 (23)\*2 (24)\*3 (23)\*2 (24)\*3 (23)\*2

(24)\*3 (23)\*2

\*

PART 36 OVERLAP

BOX P35 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Core right centre group (Row 4 right)

PART 37 ARRAY

5 5 1 23 (24)\*4 23 (24)\*4 23 (24)\*4 23 (24)\*4 23 (24)\*4

\*

PART 38 OVERLAP

BOX P37 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Core top left corner group (Row 5 left)

PART 39 ARRAY

5 5 1 25 (24)\*3 23 25 (24)\*3 23 26 25 (24)\*3 26 (25)\*2 (24)\*2

(26)\*3 (25)\*2

\*

PART 40 OVERLAP

BOX P39 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Core top centre group (Row 5 centre)

PART 41 ARRAY

5 5 1 (23)\*2 24 (23)\*2 (23)\*2 24 (23)\*2 (24)\*2 23 (24)\*2

(24)\*2 23 (24)\*2 (24)\*5

\*

PART 42 OVERLAP

BOX P41 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Core top right group (Row 5 right)

PART 43 ARRAY

5 5 1 23 (24)\*3 25 (24)\*4 25 (24)\*3 25 26 (24)\*2 (25)\*2 26

(25)\*2 (26)\*3

\*

PART 44 OVERLAP

BOX P43 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Row 2 three groups containing core elements

\*left group

PART 45 ARRAY

5 5 1 (26)\*24 25

\*

PART 46 OVERLAP

BOX P45 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Centre group

PART 47 ARRAY

5 5 1 (26)\*20 (25)\*5

\*

PART 48 OVERLAP

BOX P47 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Right group (Also the row 3 right hand blanket group)

PART 49 ARRAY

5 5 1 (26)\*20 25 (26)\*4

\*

PART 50 OVERLAP

BOX P49 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Row 5 blanket group (Core left group) Also the Row 6 left-hand group

PART 51 ARRAY

5 5 1 (26)\*4 25 (26)\*20

\*

PART 52 OVERLAP

BOX P51 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Row 5 centre group

PART 53 ARRAY

5 5 1 (25)\*5 (26)\*20

\*

PART 54 OVERLAP

BOX P53 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Row 5 right hand group group

PART 55 ARRAY

5 5 1 25 (26)\*24

\*

PART 56 OVERLAP

BOX P55 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Row 4 left hand blanket group

PART 57 ARRAY

5 5 1 (26)\*4 25 (26)\*4 25 (26)\*4 25 (26)\*4 25 (26)\*4 25

\*

PART 58 OVERLAP

BOX P57 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Row 4 right hand blanket group

PART 59 ARRAY

5 5 1 25 (26)\*4 25 (26)\*4 25 (26)\*4 25 (26)\*4 25 (26)\*4

\*

PART 60 OVERLAP

BOX P59 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Blanket element group

PART 61 ARRAY

5 5 1 (26)\*25

\*

PART 62 OVERLAP

BOX P61 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* top and bottom groups have Y=3

\*

\* Row 1, the lowest set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 63 ARRAY

5 3 1 (22)\*13 (26)\*2

PART 64 OVERLAP

BOX P63 -13.43025 -8.05815 0.0 26.8605 16.1163 82.52178

BOX M18 -13.5635 -8.1914 50.2 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 82.52178

\*

\* Row 1 Shield centre bottom group

PART 65 ARRAY

5 3 1 (22)\*10 (26)\*5

\*

PART 66 OVERLAP

BOX P65 -13.43025 -8.05815 0.0 26.8605 16.1163 82.52178

BOX M18 -13.5635 -8.1914 50.2 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 82.52178

\*

\* Row 1 Right side

PART 67 ARRAY

5 3 1 (22)\*10 (26)\*2 (22)\*3

PART 68 OVERLAP

BOX P67 -13.43025 -8.05815 0.0 26.8605 16.1163 82.52178

BOX M18 -13.5635 -8.1914 50.2 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 82.52178

\* combine these arrays to form the row 1 array

PART 69 ARRAY

3 1 1 64 66 68

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 7, the top set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Row 7 Left side

PART 70 ARRAY

5 3 1 (22)\*3 (26)\*2 (22)\*10

PART 71 OVERLAP

BOX P70 -13.43025 -8.05815 0.0 26.8605 16.1163 82.52178

BOX M18 -13.5635 -8.1914 50.2 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 82.52178

\*

\* Row 7 Shield centre group

PART 72 ARRAY

5 3 1 (26)\*5 (22)\*10

\*

PART 73 OVERLAP

BOX P72 -13.43025 -8.05815 0.0 26.8605 16.1163 82.52178

BOX M18 -13.5635 -8.1914 50.2 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 82.52178

\* Right side

PART 74 ARRAY

5 3 1 (26)\*2 (22)\*13

PART 75 OVERLAP

BOX P74 -13.43025 -8.05815 0.0 26.8605 16.1163 82.52178

BOX M18 -13.5635 -8.1914 50.2 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 82.52178

\* combine these arrays to form the row 7 array

PART 76 ARRAY

3 1 1 71 73 75

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\*Row 2 Shield corner sections

\* Bottom left group

PART 77 ARRAY

5 5 1 (22)\*9 26 (22)\*3 (26)\*2 (22)\*2 (26)\*3 22 (26)\*4

\*

PART 78 OVERLAP

BOX P77 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Row 2 Bottom right group

PART 79 ARRAY

5 5 1 (22)\*5 26 (22)\*4 (26)\*2 (22)\*3 (26)\*3 (22)\*2 (26)\*4 22

\*

PART 80 OVERLAP

BOX P79 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* combine the arrays to form the row 2 array

PART 81 ARRAY

5 1 1 78 46 48 50 80

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 6 Top left group

PART 82 ARRAY

5 5 1 22 (26)\*4 (22)\*2 (26)\*3 (22)\*3 (26)\*2 (22)\*4 26 (22)\*5

\*

PART 83 OVERLAP

BOX P82 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Row 6 top right group

PART 84 ARRAY

5 5 1 (26)\*4 22 (26)\*3 (22)\*2 (26)\*2 (22)\*3 26 (22)\*9

\*

PART 85 OVERLAP

BOX P84 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* combine the arrays to form the row 6 array

PART 86 ARRAY

5 1 1 83 52 54 56 85

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 3, 7 groups, the two end groups being 3x5 arrays

\* Left hand array

PART 87 ARRAY

3 5 1 (22)\*11 26 (22)\*2 26

PART 88 OVERLAP

BOX P87 -8.05815 -13.43025 0.0 16.1163 26.8605 82.52178

BOX M18 -8.1914 -13.5635 50.2 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 82.52178

\* right hand array

PART 89 ARRAY

3 5 1 (22)\*9 26 (22)\*2 26 (22)\*2

PART 90 OVERLAP

BOX P89 -8.05815 -13.43025 0.0 16.1163 26.8605 82.52178

BOX M18 -8.1914 -13.5635 50.2 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 82.52178

\* Form the row 3 array

PART 91 ARRAY

7 1 1 88 62 30 32 34 50 90

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 5. 7 arrays, the first and last being 3x5 and the remainder 5x5

\* including the two blanket 5x5 groups.

\*

\* Left hand shield array

PART 92 ARRAY

3 5 1 (22)\*2 26 (22)\*2 26 (22)\*9

PART 93 OVERLAP

BOX P92 -8.05815 -13.43025 0.0 16.1163 26.8605 82.52178

BOX M18 -8.1914 -13.5635 50.2 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 82.52178

\*

\* right hand shield array

PART 94 ARRAY

3 5 1 26 (22)\*2 26 (22)\*11

PART 95 OVERLAP

BOX P94 -8.05815 -13.43025 0.0 16.1163 26.8605 82.52178

BOX M18 -8.1914 -13.5635 50.2 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 82.52178

\*

\* Form the row 5 array

PART 96 ARRAY

7 1 1 93 52 40 42 44 62 95

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 4 Shield left group

\*

PART 97 ARRAY

5 5 1 (22)\*4 26 (22)\*4 26 (22)\*4 26 (22)\*4 26 (22)\*4 26

\*

PART 98 OVERLAP

BOX P97 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

\* Row 4 Shield right group

PART 99 ARRAY

5 5 1 26 (22)\*4 26 (22)\*4 26 (22)\*4 26 (22)\*4 26 (22)\*4

\*

PART 100 OVERLAP

BOX P99 -13.43025 -13.43025 0.0 26.8605 26.8605 82.52178

BOX M18 -13.5635 -13.5635 50.2 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 82.52178

\*

PART 101 ARRAY

7 1 1 98 58 36 28 38 60 100

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Cluster of superlattice groups in a circle of shield material

PART 102 CLUSTER

BOX P76 -40.6905 67.8175 0.0 81.381 16.3828 82.52178

BOX P86 -67.8175 40.6905 0.0 135.635 27.127 82.52178

BOX P96 -84.2003 13.5635 0.0 168.4006 27.127 82.52178

BOX P101 -94.9445 -13.5635 0.0 189.889 27.127 82.52178

BOX P91 -84.2003 -40.6905 0.0 168.4006 27.127 82.52178

BOX P81 -67.8175 -67.8175 0.0 135.635 27.127 82.52178

BOX P69 -40.6905 -84.2003 0.0 81.381 16.3828 82.52178

ZROD M14 0.0 0.0 0.0 96.6 84.0

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Albedo for free boundaries at side and top and reflection at bottom

\*

ALBEDO 0.0 0.0 1.0

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN CONTROL DATA

STAGES -50 3000 5000 STDV 0.0001

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN SOURCE GEOMETRY

ZONEMAT

ALL / MATERIAL 1

END

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

## A1.3. Assembly 23. The sodium filled pin geometry core. Model A.

### \* MONK9A Input Listing for Assembly 23, Model A.

\* Assembly 23 is the Pin Geometry Version of the Cadenza cores.

\* it also includes an outer ring of plate geometry elements

\* Reactor structure: elements arranged on a square grid

\* The Pin Elements in the core contain 3 minicalandria and an Axial

\* Region Cell, enclosed in a mild steel sheath.

\* The plate elements contain 24 cells, the plates having width 5.067 cm.

\* The Element sheath has an inner width 5.102 cm, outer width 5.2544 cm.

\* The elements occupy a lattice area of 5.3721 cm square.

\* Groups of 5x5 elements form the superlattice

\* with a space between them

\* The Radial Blanket Elements contain 10 U3 blocks and a MST3 block

\* enclosed in a mild steel sheath with reflection in the midplane.

\* The radial shielding elements consist of the Steel bar MST9F10

\* which is about 300 cm high.

\* These are represented explicitly within an outer radius and also

\* homogenised (over the overall average lattice area) to fill the

\* remaining space in the outer cylinder (pitch 5.4254 cm)

\* Elements are grouped in square arrays containing 5x5 = 25 elements

\* plus edge groups with 3x5 elements. The Assembly is built from these.

\* There is a gap between these groups of elements of 0.2667 cm

\* Core Plate Geometry Element structure:

\* The plate element consists of combinations of the following:

\* Core Cell PART 1, Core Cell PART 2, an inversion of PART 1,

\* Core Cell PART 3, which is the same as PART 1

\* but with the 40%Steel plate omitted, and the inversion of

\* this cell which forms PART 4

\* the Axial Region Cell is PART5.

\* Structure of Core Plate Cell 1, PART 1, 7 plates.

\* Cell height 3.748082 cm. Enclosed in mild steel sheath.

\* Outer area of all plates is 5.067 cm x 5.067 cm

\* From the top down:

\* Sodium (0.613694 cm thick, core 0.541 cm x 4.963 cm square)

\* UO2 (0.6313 cm thick, core 0.558 cm x 4.857 cm square)

\* Sodium (0.613694 cm thick,)

\* Pu Metal (0.3274 cm thick, core 0.236 cm x 4.671cm x 4.671 cm)

\* 40%Steel (0.317 cm thick, void core 0.317 cm x 3.925 cm square)

\* UO2 (0.6313 cm thick)

\* Sodium (0.613694 cm thick)

\* Structure of Core Plate Cell 2 PART 2. The inverse of PART 1

\* Structure of Core Plate Cell PART 3. PART 1 without 40%Steel plate.

\* Cell height 3.431082 cm.

\* Structure of the Axial Region cell. Enclosed in mild steel sheath.

\* Cell height From the top:

\* MST3 Block (7.60628 cm thick)

\* U3 Block (7.6225 cm thick,)

\* U2 region (10 plates, total thickness 12.723 cm )

\* U8 region (31 plates, total thickness 9.827 cm)

\* Structure of the Radial Blanket element.

\* Height of the reflected half height element

\* MST3 Block (7.60628 cm thick)

\* U3 Block composition (height above mid-plane to match the core

\* element blanket height of 74.83248 cm)

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* material 1 - Plutonium metal plate core

\* material 2 - Plutonium metal clad

\* material 3 - UO2 plate core

\* material 4 - UO2 plate clad

\* material 5 - Sodium plate core

\* material 6 - Sodium plate clad

\* material 7 - 40%Steel

\* material 8 - U8 natural uranium region

\* material 9 - U2 natural uranium region

\* material 10 - U3 natural uranium block

\* material 11 - MST3 Steel block

\* material 12 - Mild steel sheath

\* material 13 - Steel bar MST9F10 at actual density (width 5.08 cm)

\* material 14 - Steel bar averaged over the mean spacing of 5.4254 cm

\* material 15 - Pin fuel A

\* material 16 - Pin fuel B

\* material 17 - Pin fuel C

\* material 18 - Pin fuel D

\* material 19 - Pin fuel E

\* material 20 - Pin fuel F

\* material 21 - Pin fuel UPINC

\* material 22 - Pin can A

\* material 23 - Pin can B

\* material 24 - Pin can C

\* material 25 - Pin can D

\* material 26 - Pin can E

\* material 27 - Pin can F

\* material 28 - Pin can UPINC

\* material 29 - Tube

\* material 30 - Calandria end regions

\* material 31 - Calandria Walls Type NACLI

\* material 32 - Calandria Walls Type NACLIIS

\* material 33 - Calandria Walls Type NACLIII

\* material 34 - Calandria Walls Type NACLIV

\* material 35 - Calandria Walls Type NACLV

\* material 36 - Calandria Sodium Type NACLI

\* material 37 - Calandria Sodium Type NACLIIS

\* material 38 - Calandria Sodium Type NACLIII

\* material 39 - Calandria Sodium Type NACLIV

\* material 40 - Calandria Sodium Type NACLV

\* material 41 - Superlattice grid

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

COLUMNS 1 132

BEGIN MATERIAL SPECIFICATION

NUMBER DENSITY

MATERIAL 1

U238 6.8782E-07 PU238 3.0461E-05 PU239 2.8920E-02

PU240 6.9095E-03 PU241 7.3960E-04 PU242 1.8699E-04

AM241 4.5718E-04

H1 1.2764E-04 C 4.2260E-04 N 2.4215E-05 O16 8.8450E-05

AL 2.2973E-05 SI 1.4158E-05 CR 3.5989E-06 MN 1.4902E-06

FE 1.6335E-05 NI 8.5688E-06 GA 2.0166E-03

MATERIAL 2

H1 1.3760E-05 C 1.1393E-04 SI 3.6607E-04 P 1.3731E-05

CR 9.4011E-03 MN 8.5931E-04 FE 3.5542E-02 NI 4.1646E-03

CU 1.6613E-02

MATERIAL 3

H1 3.1773E-05 C 1.1808E-05 O16 4.6008E-02 AL 3.3911E-06

SI 2.2967E-05 MN 8.3273E-08 FE 1.3107E-06 NI 1.2472E-06

MO 3.3379E-07 U235 1.6544E-04 U238 2.2837E-02

MATERIAL 4

H1 1.9035E-05 C 1.2831E-04 SI 6.4475E-04 P 3.5078E-04

S 3.6041E-05 CR 1.3819E-02 MN 8.5559E-04 FE 4.8306E-02

NI 8.4258E-03

MATERIAL 5

H1 1.3900E-05 O16 5.6492E-06 NA 2.3225E-02 CA 3.6083E-06

FE 1.6184E-07

MATERIAL 6

H1 2.1631E-05 C 2.9290E-04 SI 6.0867E-04 P 3.2795E-05

S 3.3219E-05 CR 1.4759E-02 MN 1.3570E-03 FE 5.5054E-02

NI 7.0982E-03 NB 3.1147E-04

MATERIAL 7

H1 1.8355E-05 C 8.7794E-05 AL 1.1862E-04 SI 7.9703E-04

P 4.0018E-05 S 1.4422E-05 TI 2.4806E-04 CR 1.5908E-02

MN 1.4972E-03 FE 5.5367E-02 NI 8.7976E-03 CU 5.0365E-05

NB 4.9781E-06 MO 8.0988E-05

MATERIAL 8

H1 4.4048E-05 C 4.9283E-04 SI 2.1076E-04 FE 1.0599E-04

U235 3.3369E-04 U238 4.6021E-02

MATERIAL 9

H1 4.3899E-05 C 4.6047E-04 SI 1.9692E-04 FE 9.9032E-05

U235 3.3962E-04 U238 4.6785E-02

MATERIAL 10

H1 4.4574E-05 C 4.7140E-04 SI 2.0160E-04 FE 1.0138E-04

U235 3.4209E-04 U238 4.7156E-02

MATERIAL 11

H1 2.5700E-05 C 5.1066E-04 AL 1.3989E-04 TI 3.9416E-05

CR 2.7222E-05 MN 3.2634E-04 FE 8.3806E-02 NI 4.8234E-05

CU 4.4548E-05 MO 9.8355E-06

MATERIAL 12

H1 7.5712E-05 C 2.3825E-04 AL 1.9798E-05 CR 3.6690E-06

MN 2.5697E-04 FE 7.7524E-02 NI 1.4302E-05 CU 2.2216E-05

MATERIAL 13

H1 4.6306E-05 C 6.8972E-04 SI 3.1158E-04 P 4.2944E-05

S 3.7110E-05 MN 7.1275E-04 FE 8.1432E-02

MATERIAL 14

H1 4.0597E-05 C 6.0468E-04 SI 2.7317E-04 P 3.7649E-05

S 3.2535E-05 MN 6.2488E-04 FE 7.1392E-02

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Pin fuel A, B, C, D, E, F and U

MATERIAL 15

U234 1.3805E-06 U235 1.4114E-04 U236 7.9324E-07 U238 1.9379E-02

PU238 3.7786E-06 PU239 2.9689E-03 PU240 6.7253E-04 PU241 7.0350E-05

PU242 1.7488E-05 AM241 4.7854E-05

H1 3.2784E-05 O16 4.6606E-02 AL 1.1702E-05 CA 7.8782E-06 FE 5.6537E-06

MATERIAL 16

U234 1.3177E-06 U235 1.3457E-04 U236 7.4658E-07 U238 1.8472E-02

PU238 5.8915E-06 PU239 3.7341E-03 PU240 9.5200E-04 PU241 1.1199E-04

PU242 2.7984E-05 AM241 5.5789E-05

H1 3.2784E-05 O16 4.6993E-02 SI 9.0199E-06 NI 5.4424E-06

MATERIAL 17

U234 1.2863E-06 U235 1.2997E-04 U236 7.3103E-07 U238 1.7843E-02

PU238 6.9094E-06 PU239 4.4708E-03 PU240 1.0602E-03 PU241 1.1598E-04

PU242 3.0047E-05 AM241 5.7784E-05

H1 3.2784E-05 O16 4.7434E-02 AL 1.9730E-05 SI 7.9741E-06

FE 7.6916E-06 NI 1.0947E-05

MATERIAL 18

U234 1.4118E-06 U235 1.4266E-04 U236 7.9324E-07 U238 1.9584E-02

PU238 4.7348E-06 PU239 3.0189E-03 PU240 7.5441E-04 PU241 8.8443E-05

PU242 2.0961E-05 AM241 4.0742E-05

H1 3.2784E-05 O16 4.7314E-02 AL 1.8914E-05 SI 2.5099E-05

CA 1.5940E-05 FE 6.9027E-06 NI 1.4138E-05

MATERIAL 19

U234 1.1295E-06 U235 1.1465E-04 U236 6.3771E-07 U238 1.5739E-02

PU238 9.4851E-06 PU239 6.0438E-03 PU240 1.5103E-03 PU241 1.7707E-04

PU242 4.1953E-05 AM241 8.1559E-05

H1 3.2784E-05 O16 4.7299E-02 AL 9.5250E-06 SI 4.5753E-05

CA 3.2062E-05 FE 1.0321E-05

MATERIAL 20

U234 1.1452E-06 U235 1.1526E-04 U236 6.3771E-07 U238 1.5824E-02

PU238 9.5005E-06 PU239 6.0112E-03 PU240 1.5285E-03 PU241 1.9723E-04

PU242 4.4380E-05 AM241 6.8035E-05

H1 3.2784E-05 O16 4.7482E-02 AL 1.4287E-05 CA 6.7514E-05

CR 4.9427E-06 FE 1.1505E-05 NI 2.1895E-06

\* UO2 fuel pin

MATERIAL 21

U235 1.7604E-04 U238 2.3580E-02

H1 3.2784E-05 C 3.2095E-05 O16 4.7501E-02 AL 2.3812E-05

SI 4.0001E-05 CA 1.2825E-05 FE 1.1176E-06

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Fuel pin cans

MATERIAL 22

H1 2.6710E-05 C 1.3288E-04 SI 8.5585E-04 P 3.7870E-05 S 2.4585E-05

CR 1.8218E-02 MN 1.5646E-03 FE 5.9675E-02 NI 8.9153E-03

MATERIAL 23

H1 2.2895E-05 C 2.3695E-04 SI 1.1571E-03 P 4.1596E-05 S 2.2786E-05

CR 1.4981E-02 MN 1.5751E-03 FE 5.3171E-02 NI 8.8137E-03

NB 2.9391E-04

MATERIAL 24

H1 2.6710E-05 C 1.3609E-04 SI 8.3531E-04 P 3.6008E-05 S 2.4585E-05

CR 1.7856E-02 MN 1.5331E-03 FE 5.8512E-02 NI 8.7515E-03

MATERIAL 25

H1 2.4802E-05 C 2.0172E-04 AL 6.4142E-06 SI 8.9693E-04 P 3.4145E-05

S 8.9942E-06 TI 2.8916E-05 CR 1.5910E-02 MN 1.1586E-03 FE 5.5753E-02

CO 4.2418E-06 NI 7.6341E-03 CU 6.0522E-06 MO 2.2047E-06

MATERIAL 26

H1 2.4802E-05 C 7.3646E-05 AL 6.4142E-06 SI 1.0476E-03 P 1.3658E-05

S 1.7389E-05 TI 2.8916E-05 CR 1.6102E-02 MN 9.8006E-04 FE 5.6794E-02

CO 4.2418E-06 NI 8.0503E-03 CU 6.0522E-06 MO 2.1446E-05

MATERIAL 27

H1 2.4802E-05 C 7.2045E-05 AL 4.2762E-06 SI 1.0544E-03 P 1.3658E-05

S 1.7989E-05 TI 2.1687E-05 CR 1.6284E-02 MN 9.8357E-04 FE 5.7354E-02

CO 3.2629E-06 NI 8.1453E-03 CU 4.5391E-06 MO 2.1246E-05

MATERIAL 28

H1 2.6710E-05 C 1.3288E-04 SI 8.5585E-04 P 3.7870E-05

S 2.4585E-05 CR 1.8255E-02 MN 1.5681E-03 FE 5.9792E-02

NI 8.9349E-03

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Composition of calandria tubes

MATERIAL 29

SI 1.0632E-03 CR 1.6787E-02 MN 1.3588E-03 FE 6.0762E-02

NI 7.4360E-03

\* Composition of Calandria end plate regions

MATERIAL 30

SI 5.5206E-04 CR 1.0016E-02 MN 7.7198E-04 FE 3.5578E-02

NI 4.4601E-03

\* Compositions of Calandria outer walls

MATERIAL 31

H1 3.9844E-05 C 2.8167E-04 SI 6.0229E-04 P 7.3471E-05 S 3.6808E-05

CR 1.4995E-02 MN 1.2214E-03 FE 4.8911E-02 NI 7.2440E-03

MATERIAL 32

H1 3.8637E-05 C 6.5351E-04 SI 9.7623E-04 P 4.7540E-05 S 3.3014E-05

TI 2.4400E-04 CR 1.4380E-02 MN 1.1060E-03 FE 4.7118E-02 CO 1.1151E-05

NI 7.4526E-03 CU 1.0341E-05 MO 3.4248E-06

MATERIAL 33

H1 3.9844E-05 C 1.5948E-04 SI 7.7474E-04 P 5.2334E-05 S 2.4551E-05

CR 1.4132E-02 MN 8.3089E-04 FE 5.0764E-02 NI 7.6658E-03 MO 2.4862E-05

MATERIAL 34

H1 3.7430E-05 C 3.5158E-04 SI 8.2197E-04 P 6.2274E-05 S 1.6431E-05

CR 1.3563E-02 MN 1.0026E-03 FE 4.7151E-02 NI 6.4549E-03 MO 8.8791E-06

MATERIAL 35

H1 3.8637E-05 C 2.4762E-04 SI 9.5110E-04 P 4.5654E-05 S 2.3793E-05

CR 1.3837E-02 MN 8.6191E-04 FE 4.8404E-02 NI 6.8530E-03 MO 2.4862E-05

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Sodium compositions

MATERIAL 36

H1 5.5075E-06 O16 6.4605E-06 NA 2.4129E-02 CA 1.1080E-06 FE 3.0847E-07

MATERIAL 37

H1 1.1205E-05 O16 1.0767E-06 NA 2.4379E-02 CA 9.5521E-08

MATERIAL 38

H1 7.5966E-06 O16 3.5892E-06 NA 2.3888E-02 K 3.4270E-07 CA 6.6865E-07

MATERIAL 39

H1 7.5966E-06 O16 3.5892E-06 NA 2.4037E-02 K 3.4270E-07 CA 6.6865E-07

MATERIAL 40

H1 7.5966E-06 O16 3.5892E-06 NA 2.3829E-02 K 3.4270E-07 CA 6.6865E-07

\* Superlattice grid

MATERIAL 41

H1 4.6306E-05 C 6.8972E-04 SI 3.1158E-04 P 4.2944E-05

S 3.7110E-05 MN 7.1275E-04 FE 8.1432E-02

END

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

BEGIN MATERIAL GEOMETRY

\*

\* Plate 1, the Pu metal plate

PART 1 NEST

BOX M1 -2.3355 -2.3355 0.0457 4.671 4.671 0.236

BOX M2 -2.5335 -2.5335 0.0 5.067 5.067 0.3274

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.3274

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.3274

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.3274

\*

\* Plate 2, the UO2 plate

PART 2 NEST

BOX M3 -2.4285 -2.4285 0.03665 4.857 4.857 0.558

BOX M4 -2.5335 -2.5335 0.0 5.067 5.067 0.6313

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.6313

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.6313

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.6313

\*

\* Plate 3, the sodium plate

PART 3 NEST

BOX M5 -2.4815 -2.4815 0.036347 4.963 4.963 0.541

BOX M6 -2.5335 -2.5335 0.0 5.067 5.067 0.613694

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.613694

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.613694

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.613694

\*

\* Plate 4, the 40% steel plate

PART 4 NEST

BOX M0 -1.9625 -1.9625 0.0 3.925 3.925 0.317

BOX M7 -2.5335 -2.5335 0.0 5.067 5.067 0.317

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.317

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.317

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.317

\*

\* Core Cell 1

PART 5 ARRAY

1 1 7 3 2 4 1 3 2 3

\* Core Cell 2, the reflection of cell 1

PART 6 ARRAY

1 1 7 3 2 3 1 4 2 3

\*

\* Core Cell 3 This is Cell 1 minus Plate 4

PART 7 ARRAY

1 1 6 3 2 1 3 2 3

\*Core Cell 4 the reflection of cell 3, Cell 2 minus Plate 4

PART 8 ARRAY

1 1 6 3 2 3 1 2 3

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Axial blanket U8 section

PART 9 NEST

BOX M8 -2.5335 -2.5335 0.0 5.067 5.067 9.827

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 9.827

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 9.827

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 9.827

\*

\* Axial blanket U2 section

PART 10 NEST

BOX M9 -2.5335 -2.5335 0.0 5.067 5.067 12.723

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 12.723

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 12.723

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 12.723

\*

\* Axial blanket U3 section

PART 11 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 7.6225

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.6225

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.6225

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.6225

\*

\* Axial reflector MST3 section

PART 12 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 7.60628

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.60628

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.60628

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.60628

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Radial blanket U3 section (over half core height)

PART 13 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 74.83248

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 74.83248

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 74.83248

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 74.83248

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* A whole height model.

\* The axial height of the pin cell core is slightly less than

\* that of the plate cell core, 89.19 cm compared with 89.32 cm.

\* (0.13 cm = 2 \* 0.065 cm)

\* The axial shielding material is extended in the model

\* to cover this distance

\* Axial steel reflector section extended 0.065 cm in length

PART 14 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 7.67128

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.67128

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.67128

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.67128

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* The Core Element (full height)

PART 15 ARRAY

1 1 32 12 11 10 9 8 (5 6)\*11 7 9 10 11 12

\*

\*The Radial Blanket element

PART 16 ARRAY

1 1 4 12 13 13 12

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Specification of the pin cells, A to F and U/C

\* Pin cell A

PART 17 NEST

ZROD M15 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M22 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell B

PART 18 NEST

ZROD M16 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M23 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell C

PART 19 NEST

ZROD M17 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M24 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell D

PART 20 NEST

ZROD M18 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M25 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell E

PART 21 NEST

ZROD M19 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M26 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell F

PART 22 NEST

ZROD M20 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M27 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell U/C

PART 23 NEST

ZROD M21 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M28 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini-calandria

\* Mini calandria 3A,

\* 16 PUPINC in NACLI

\* Pin C in square of sodium

PART 24 NEST

ZROD P19 0.0 0.0 0.0 0.513 29.18

BOX M36 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 25 ARRAY

4 4 1 (24)\*16

\* mini-calandria in the element sheath (M12)

PART 26 NEST

BOX P25 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M36 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M31 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3B,

\* 11 PUPINB and 5 PUPINF in NACLI

\* Pin B in square of sodium

PART 27 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M36 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 28 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M36 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 29 ARRAY

4 4 1 27 27 28 27 27 27 27 28 28 27 28 27 27 28 27 27

\* mini-calandria in the element sheath (M12)

PART 30 NEST

BOX P29 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M36 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M31 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3H,

\* 11 PUPINB and 5 PUPINF in NACLV

\* Pin B in square of NACLV sodium

PART 31 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M40 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 32 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M40 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 33 ARRAY

4 4 1 31 31 32 31 31 31 31 32 32 31 32 31 31 32 31 31

\* mini-calandria in the element sheath (M12)

PART 34 NEST

BOX P33 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M40 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M35 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3L,

\* 11 PUPINB and 5 PUPINF in NACLIV

\* Pin B in square of NACLIV sodium

PART 35 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 36 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 37 ARRAY

4 4 1 35 35 36 35 35 35 35 36 36 35 36 35 35 36 35 35

\* mini-calandria in the element sheath (M12)

PART 38 NEST

BOX P37 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M39 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M34 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3C,

\* 8 PUPINA and 8 PUPINE in NACLIII

\* Pin A in square of NACLIII sodium

PART 39 NEST

ZROD P17 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin E in square of sodium

PART 40 NEST

ZROD P21 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 41 ARRAY

4 4 1 39 40 39 40 40 39 40 39 39 40 39 40 40 39 40 39

\* mini-calandria in the element sheath (M12)

PART 42 NEST

BOX P41 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M38 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M33 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3D,

\* 8 PUPIND and 8 PUPINF in NACLIII

\* Pin D in square of NACLIII sodium

PART 43 NEST

ZROD P20 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 44 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 45 ARRAY

4 4 1 43 44 43 44 44 43 44 43 43 44 43 44 44 43 44 43

\* mini-calandria in the element sheath (M12)

PART 46 NEST

BOX P45 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M38 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M33 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3E,

\* 8 PUPIND and 8 PUPINF in NACLIIS

\* Pin D in square of NACLIIS sodium

PART 47 NEST

ZROD P20 0.0 0.0 0.0 0.513 29.18

BOX M37 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 48 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M37 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 49 ARRAY

4 4 1 47 48 47 48 48 47 48 47 47 48 47 48 48 47 48 47

\* mini-calandria in the element sheath (M12)

PART 50 NEST

BOX P49 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M37 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M32 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3J,

\* 12 PUPINE and 4 UO2PINC in NACLIV

\* Pin E in square of NACLIV sodium

PART 51 NEST

ZROD P21 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 52 NEST

ZROD P23 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 53 ARRAY

4 4 1 (51)\*3 52 51 52 (51)\*5 52 51 52 (51)\*2

\* mini-calandria in the element sheath (M12)

PART 54 NEST

BOX P53 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M39 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M34 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* form the elements 3A to 3L

\* Element 3A

PART 55 ARRAY

1 1 11 14 11 10 9 (26)\*3 9 10 11 14

\* Element 3B

PART 56 ARRAY

1 1 11 14 11 10 9 (30)\*3 9 10 11 14

\* Element 3C

PART 57 ARRAY

1 1 11 14 11 10 9 (42)\*3 9 10 11 14

\* Element 3D

PART 58 ARRAY

1 1 11 14 11 10 9 (46)\*3 9 10 11 14

\* Element 3E

PART 59 ARRAY

1 1 11 14 11 10 9 (50)\*3 9 10 11 14

\* Element 3H

PART 60 ARRAY

1 1 11 14 11 10 9 (34)\*3 9 10 11 14

\* Element 3J

PART 61 ARRAY

1 1 11 14 11 10 9 (54)\*3 9 10 11 14

\* Element 3L

PART 62 ARRAY

1 1 11 14 11 10 9 (38)\*3 9 10 11 14

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Steel reflector bars

PART 63 NEST

BOX M13 -2.54 -2.54 0.0 5.08 5.08 164.877528

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 164.877528

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* assemble the arrays of elements

\*

\* Groups of 5x5 elements surrounded by the superlattice gap

\* With groups of 5x3 in rows 1 and 7 and 3x5 in rows 3 and 5

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 1, the lowest set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 64 ARRAY

5 3 1 (63)\*13 (16)\*2

PART 65 OVERLAP

BOX P64 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M41 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M41 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* Centre

PART 66 ARRAY

5 3 1 (63)\* 10 (16)\*5

PART 67 OVERLAP

BOX P66 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M41 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M41 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* Right side

PART 68 ARRAY

5 3 1 (63)\*10 (16)\*2 (63)\*3

PART 69 OVERLAP

BOX P68 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M41 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M41 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* combine these arrays to form the row 1 array

PART 70 ARRAY

3 1 1 65 67 69

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* A 5x5 array of blanket elements

PART 71 ARRAY

5 5 1 (16)\*25

\*

PART 72 OVERLAP

BOX P71 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 2. 5 arrays of 5x5 elements, two being PART 72

\* Left hand array

PART 73 ARRAY

5 5 1 (63)\*9 16 (63)\*3 (16)\*2 (63)\*2 (16)\*3 63 (16)\*4

\*

PART 74 OVERLAP

BOX P73 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Middle array

PART 75 ARRAY

5 5 1 (16)\*20 (15)\*5

\*

PART 76 OVERLAP

BOX P75 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Right hand array

PART 77 ARRAY

5 5 1 (63)\*5 16 (63)\*4 (16)\*2 (63)\*3 (16)\*3 (63)\*2 (16)\*4 63

\*

PART 78 OVERLAP

BOX P77 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Form row 2 array

PART 79 ARRAY

5 1 1 74 72 76 72 78

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 3, 7 groups, the two end groups being 3x5 arrays

\* Left hand array

PART 80 ARRAY

3 5 1 (63)\*11 16 (63)\*2 16

PART 81 OVERLAP

BOX P80 -8.05815 -13.43025 0.0 16.1163 26.8605 164.877528

BOX M41 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M41 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 164.877528

\* Core lower left hand array

PART 82 ARRAY

5 5 1 (16)\*3 (15)\*2 16 (15)\*2 (60)\*2 16 15 55 58 60

15 (58)\*2 57 59 15 (58)\*2 57 59

\*

PART 83 OVERLAP

BOX P82 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Core lower middle array

PART 84 ARRAY

5 5 1 (62)\*5 (56)\*10 (57)\*10

\*

PART 85 OVERLAP

BOX P84 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Core lower right hand array

PART 86 ARRAY

5 5 1 (15)\*2 (16)\*3 (60)\*2 (15)\*2 16 60 58 55 15 16

59 57 58 59 15 59 57 58 59 15

\*

PART 87 OVERLAP

BOX P86 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* right hand array

PART 88 ARRAY

3 5 1 (63)\*9 16 (63)\*2 16 (63)\*2

PART 89 OVERLAP

BOX P88 -8.05815 -13.43025 0.0 16.1163 26.8605 164.877528

BOX M41 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M41 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 164.877528

\* Form the row 3 array

PART 90 ARRAY

7 1 1 81 72 83 85 87 72 89

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 4 (the middle row) 7 groups of 5x5 elements

\* Left hand shield group

PART 91 ARRAY

5 5 1 (63)\*4 16 (63)\*4 16 (63)\*4 16 (63)\*4 16 (63)\*4 16

\*

PART 92 OVERLAP

BOX P91 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Left hand blanket group

PART 93 ARRAY

5 5 1 (16)\*4 15 (16)\*4 15 (16)\*4 15 (16)\*4 15 (16)\*4 15

\*

PART 94 OVERLAP

BOX P93 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Left hand core group

PART 95 ARRAY

5 5 1 55 61 58 (59)\*2 55 (58)\*2 (59)\*2 56 (59)\*4

55 58 55 (59)\*2 55 61 55 (59)\*2

\*

PART 96 OVERLAP

BOX P95 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Centre core group

PART 97 ARRAY

5 5 1 (57)\*25

\*

PART 98 OVERLAP

BOX P97 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Right hand core group

PART 99 ARRAY

5 5 1 (59)\*2 58 61 55 (59)\*2 (58)\*2 55 (59)\*4 56

(59)\*2 55 58 55 (59)\*2 55 61 55

\*

PART 100 OVERLAP

BOX P99 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Right hand blanket group

PART 101 ARRAY

5 5 1 15 (16)\*4 15 (16)\*4 15 (16)\*4 15 (16)\*4 15 (16)\*4

\*

PART 102 OVERLAP

BOX P101 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Right hand shield group

PART 103 ARRAY

5 5 1 16 (63)\*4 16 (63)\*4 16 (63)\*4 16 (63)\*4 16 (63)\*4

\*

PART 104 OVERLAP

BOX P103 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Form the row 4 array

PART 105 ARRAY

7 1 1 92 94 96 98 100 102 104

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 5. 7 arrays, the first and last being 3x5 and the remainder 5x5

\* including the two blanket 5x5 groups.

\*

\* Left hand shield array

PART 106 ARRAY

3 5 1 (63)\*2 16 (63)\*2 16 (63)\*9

PART 107 OVERLAP

BOX P106 -8.05815 -13.43025 0.0 16.1163 26.8605 164.877528

BOX M41 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M41 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 164.877528

\* Core upper left hand array

PART 108 ARRAY

5 5 1 15 (58)\*2 57 59 15 56 58 57 59 16 15 55 58 58

16 (15)\*2 (60)\*2 (16)\*3 (15)\*2

\*

PART 109 OVERLAP

BOX P108 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Core upper middle array

PART 110 ARRAY

5 5 1 (57)\*10 (56)\*10 (62)\*5

\*

PART 111 OVERLAP

BOX P110 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Core upper right hand array

PART 112 ARRAY

5 5 1 59 57 58 58 15 59 57 58 56 15 58 58 55 15

16 (60)\*2 (15)\*2 16 (15)\*2 (16)\*3

\*

PART 113 OVERLAP

BOX P112 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* right hand shield array

PART 114 ARRAY

3 5 1 16 (63)\*2 16 (63)\*2 (63)\*9

PART 115 OVERLAP

BOX P114 -8.05815 -13.43025 0.0 16.1163 26.8605 164.877528

BOX M41 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M41 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 164.877528

\* Form the row 5 array

PART 116 ARRAY

7 1 1 107 72 109 111 113 72 115

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 6 arrays 5 groups of 5x5, one being PART 72

\*

\* Left hand array

PART 117 ARRAY

5 5 1 63 (16)\*4 (63)\*2 (16)\*3 (63)\*3 (16)\*2 (63)\*4 16 (63)\*5

\*

PART 118 OVERLAP

BOX P117 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Middle array

PART 119 ARRAY

5 5 1 (15)\*5 (16)\*20

\*

PART 120 OVERLAP

BOX P119 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\*

\* Right middle array

PART 121 ARRAY

5 5 1 15 (16)\*24

\*

PART 122 OVERLAP

BOX P121 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Right hand array

PART 123 ARRAY

5 5 1 (16)\*4 63 (16)\*3 (63)\*2 (16)\*2 (63)\*3 16 (63)\*9

\*

PART 124 OVERLAP

BOX P123 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Form row 6 array

PART 125 ARRAY

5 1 1 118 72 120 122 124

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 7, the top set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 126 ARRAY

5 3 1 (63)\*3 (16)\*2 (63)\*10

PART 127 OVERLAP

BOX P126 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M41 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M41 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* Centre

PART 128 ARRAY

5 3 1 (16)\*5 (63)\* 10

PART 129 OVERLAP

BOX P128 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M41 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M41 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* Right side

PART 130 ARRAY

5 3 1 (16)\*2 (63)\*13

PART 131 OVERLAP

BOX P130 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M41 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M41 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* combine these arrays to form the row 7 array

PART 132 ARRAY

3 1 1 127 129 131

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Cluster of superlattice groups in a circle of shield material

PART 133 CLUSTER

BOX P132 -40.6905 67.8175 0.0 81.381 16.3828 164.877528

BOX P125 -67.8175 40.6905 0.0 135.635 27.127 164.877528

BOX P116 -84.2003 13.5635 0.0 168.4006 27.127 164.877528

BOX P105 -94.9445 -13.5635 0.0 189.889 27.127 164.877528

BOX P90 -84.2003 -40.6905 0.0 168.4006 27.127 164.877528

BOX P79 -67.8175 -67.8175 0.0 135.635 27.127 164.877528

BOX P70 -40.6905 -84.2003 0.0 81.381 16.3828 164.877528

ZROD M14 0.0 0.0 -1.56 96.6 168.0

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Albedo for free boundaries at side and top and bottom

\*

ALBEDO 0.0 0.0 0.0

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN CONTROL DATA

STAGES -50 3000 3000 STDV 0.0001

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN SOURCE GEOMETRY

ZONEMAT

ALL / MATERIAL 15

END

## A1.4. Assembly 25. The sodium voided pin geometry core, Model A.

### \* MONK9A Input Listing for Assembly 25, Model A

\* Assembly 25 is the sodium voided Pin Geometry Version of the Cadenza cores.

\* it also includes an extra outer ring of plate geometry elements

\* Reactor structure: elements arranged on a square grid

\* The Pin Elements in the core contain 3 minicalandria and an Axial

\* Region Cell, enclosed in a mild steel sheath.

\* The plate elements contain 24 cells, the plates having width 5.067 cm.

\* The Element sheath has an inner width 5.102 cm, outer width 5.2544 cm.

\* The elements occupy a lattice area of 5.3721 cm square.

\* Groups of 5x5 elements form the superlattice (mean pitch 5.4254)

\* with a space between them

\* The Radial Blanket Elements contain 10 U3 blocks and a MST3 block

\* enclosed in a mild steel sheath with reflection in the midplane.

\* The radial shielding elements consist of the Steel bar MST9F10

\* which is about 300 cm high.

\* These are represented explicitly within an outer radius and also

\* homogenised (over the overall average lattice area) to fill the

\* remaining space in the outer cylinder ( mean pitch 5.4254 cm)

\* Elements are grouped in square arrays containing 5x5 = 25 elements

\* plus edge groups with 3x5 elements. The Assembly is built from these.

\* There is a gap between these groups of elements of 0.2667 cm

\* Core Plate Geometry Element structure:

\* The plate element consists of combinations of the following:

\* Core Cell PART 1, Core Cell PART 2, an inversion of PART 1,

\* Core Cell PART 3, which is the same as PART 1

\* but with the 40%Steel plate omitted, and the inversion of

\* this cell which forms PART 4

\* the Axial Region Cell is PART5.

\* Structure of Core Plate Cell 1, PART 1, 7 plates.

\* Cell height 3.748082 cm. Enclosed in mild steel sheath.

\* Outer area of all plates is 5.067 cm x 5.067 cm

\* From the top down:

\* Sodium (0.613694 cm thick, core 0.541 cm x 4.963 cm square)

\* UO2 (0.6313 cm thick, core 0.558 cm x 4.857 cm square)

\* Sodium (0.613694 cm thick,)

\* Pu Metal (0.3274 cm thick, core 0.236 cm x 4.671cm x 4.671 cm)

\* 40%Steel (0.317 cm thick, void core 0.317 cm x 3.925 cm square)

\* UO2 (0.6313 cm thick)

\* Sodium (0.613694 cm thick)

\* Structure of Core Plate Cell 2 PART 2. The inverse of PART 1

\* Structure of Core Plate Cell PART 3. PART 1 without 40%Steel plate.

\* Cell height 3.431082 cm.

\* Structure of the Axial Region cell. Enclosed in mild steel sheath.

\* Cell height From the top:

\* MST3 Block (7.60628 cm thick)

\* U3 Block (7.6225 cm thick,)

\* U2 region (10 plates, total thickness 12.723 cm )

\* U8 region (31 plates, total thickness 9.827 cm)

\* Structure of the Radial Blanket element.

\* Height of the reflected half height element

\* MST3 Block (7.60628 cm thick)

\* U3 Block composition (height above mid-plane to match the core

\* element blanket height of 74.83248 cm)

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* material 1 - Plutonium metal plate core

\* material 2 - Plutonium metal clad

\* material 3 - UO2 plate core

\* material 4 - UO2 plate clad

\* material 5 - Sodium dummy, type Y (STNAVS4 ring)

\* material 6 - Sodium dummy type Z (STNAV4 uniform, eggbox)

\* material 7 - 40%Steel

\* material 8 - U8 natural uranium region

\* material 9 - U2 natural uranium region

\* material 10 - U3 natural uranium block

\* material 11 - MST3 Steel block

\* material 12 - Smeared Mild steel sheath

\* material 13 - Steel bar MST9F10 at actual density (width 5.08 cm)

\* material 14 - Steel bar averaged over the mean spacing of 5.4254 cm

\* material 15 - Pin fuel A

\* material 16 - Pin fuel B

\* material 17 - Pin fuel C

\* material 18 - Pin fuel D

\* material 19 - Pin fuel E

\* material 20 - Pin fuel F

\* material 21 - Pin fuel UPINC

\* material 22 - Pin can A

\* material 23 - Pin can B

\* material 24 - Pin can C

\* material 25 - Pin can D

\* material 26 - Pin can E

\* material 27 - Pin can F

\* material 28 - Pin can UPINC

\* material 29 - Tube

\* material 30 - Calandria end regions

\* material 31 - Calandria Walls Type NACLI

\* material 32 - Calandria Walls Type NACLIIS

\* material 33 - Calandria Walls Type NACLIII

\* material 34 - Calandria Walls Type NACLIV

\* material 35 - Calandria Walls Type NACLV

\* material 36 - Grid material

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

COLUMNS 1 132

BEGIN MATERIAL SPECIFICATION

NUMBER DENSITY

MATERIAL 1

U238 6.8782E-07 PU238 3.0461E-05 PU239 2.8920E-02

PU240 6.9095E-03 PU241 7.3960E-04 PU242 1.8699E-04

AM241 4.5718E-04

H1 1.2764E-04 C 4.2260E-04 N 2.4215E-05 O16 8.8450E-05

AL 2.2973E-05 SI 1.4158E-05 CR 3.5989E-06 MN 1.4902E-06

FE 1.6335E-05 NI 8.5688E-06 GA 2.0166E-03

MATERIAL 2

H1 1.3760E-05 C 1.1393E-04 SI 3.6607E-04 P 1.3731E-05

CR 9.4011E-03 MN 8.5931E-04 FE 3.5542E-02 NI 4.1646E-03

CU 1.6613E-02

MATERIAL 3

H1 3.1773E-05 C 1.1808E-05 O16 4.6008E-02 AL 3.3911E-06

SI 2.2967E-05 MN 8.3273E-08 FE 1.3107E-06 NI 1.2472E-06

MO 3.3379E-07 U235 1.6544E-04 U238 2.2837E-02

MATERIAL 4

H1 1.9035E-05 C 1.2831E-04 SI 6.4475E-04 P 3.5078E-04

S 3.6041E-05 CR 1.3819E-02 MN 8.5559E-04 FE 4.8306E-02

NI 8.4258E-03

MATERIAL 5

H1 2.4073E-05 C 2.5251E-04 SI 7.4610E-04 P 1.7803E-05

S 1.7195E-05 CR 1.6248E-02 MN 1.5006E-03 FE 5.9881E-02

NI 9.4005E-03 NB 3.7393E-04

MATERIAL 6

H1 3.3245E-06 C 3.3477E-05 SI 1.2169E-04 P 4.9764E-06

S 2.5076E-06 CR 2.4643E-03 MN 1.9518E-04 FE 8.0717E-03

NI 1.2195E-03 NB 5.2657E-05

MATERIAL 7

H1 1.8355E-05 C 8.7794E-05 AL 1.1862E-04 SI 7.9703E-04

P 4.0018E-05 S 1.4422E-05 TI 2.4806E-04 CR 1.5908E-02

MN 1.4972E-03 FE 5.5367E-02 NI 8.7976E-03 CU 5.0365E-05

NB 4.9781E-06 MO 8.0988E-05

MATERIAL 8

H1 4.4048E-05 C 4.9283E-04 SI 2.1076E-04 FE 1.0599E-04

U235 3.3369E-04 U238 4.6021E-02

MATERIAL 9

H1 4.3899E-05 C 4.6047E-04 SI 1.9692E-04 FE 9.9032E-05

U235 3.3962E-04 U238 4.6785E-02

MATERIAL 10

H1 4.4574E-05 C 4.7140E-04 SI 2.0160E-04 FE 1.0138E-04

U235 3.4209E-04 U238 4.7156E-02

MATERIAL 11

H1 2.5700E-05 C 5.1066E-04 AL 1.3989E-04 TI 3.9416E-05

CR 2.7222E-05 MN 3.2634E-04 FE 8.3806E-02 NI 4.8234E-05

CU 4.4548E-05 MO 9.8355E-06

MATERIAL 12

H1 3.7519E-05 C 1.1807E-04 AL 9.8110E-06 CR 1.8182E-06

MN 1.2734E-04 FE 3.8417E-02 NI 7.0874E-06 CU 1.1009E-05

MATERIAL 13

H1 4.6306E-05 C 6.8972E-04 SI 3.1158E-04 P 4.2944E-05

S 3.7110E-05 MN 7.1275E-04 FE 8.1432E-02

MATERIAL 14

H1 4.0597E-05 C 6.0468E-04 SI 2.7317E-04 P 3.7649E-05

S 3.2535E-05 MN 6.2488E-04 FE 7.1392E-02

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Pin fuel A, B, C, D, E, F and U

MATERIAL 15

U234 1.3805E-06 U235 1.4114E-04 U236 7.9324E-07 U238 1.9379E-02

PU238 3.7786E-06 PU239 2.9689E-03 PU240 6.7253E-04 PU241 7.0350E-05

PU242 1.7488E-05 AM241 4.7854E-05

H1 3.2784E-05 O16 4.6606E-02 AL 1.1702E-05 CA 7.8782E-06 FE 5.6537E-06

MATERIAL 16

U234 1.3177E-06 U235 1.3457E-04 U236 7.4658E-07 U238 1.8472E-02

PU238 5.8915E-06 PU239 3.7341E-03 PU240 9.5200E-04 PU241 1.1199E-04

PU242 2.7984E-05 AM241 5.5789E-05

H1 3.2784E-05 O16 4.6993E-02 SI 9.0199E-06 NI 5.4424E-06

MATERIAL 17

U234 1.2863E-06 U235 1.2997E-04 U236 7.3103E-07 U238 1.7843E-02

PU238 6.9094E-06 PU239 4.4708E-03 PU240 1.0602E-03 PU241 1.1598E-04

PU242 3.0047E-05 AM241 5.7784E-05

H1 3.2784E-05 O16 4.7434E-02 AL 1.9730E-05 SI 7.9741E-06

FE 7.6916E-06 NI 1.0947E-05

MATERIAL 18

U234 1.4118E-06 U235 1.4266E-04 U236 7.9324E-07 U238 1.9584E-02

PU238 4.7348E-06 PU239 3.0189E-03 PU240 7.5441E-04 PU241 8.8443E-05

PU242 2.0961E-05 AM241 4.0742E-05

H1 3.2784E-05 O16 4.7314E-02 AL 1.8914E-05 SI 2.5099E-05

CA 1.5940E-05 FE 6.9027E-06 NI 1.4138E-05

MATERIAL 19

U234 1.1295E-06 U235 1.1465E-04 U236 6.3771E-07 U238 1.5739E-02

PU238 9.4851E-06 PU239 6.0438E-03 PU240 1.5103E-03 PU241 1.7707E-04

PU242 4.1953E-05 AM241 8.1559E-05

H1 3.2784E-05 O16 4.7299E-02 AL 9.5250E-06 SI 4.5753E-05

CA 3.2062E-05 FE 1.0321E-05

MATERIAL 20

U234 1.1452E-06 U235 1.1526E-04 U236 6.3771E-07 U238 1.5824E-02

PU238 9.5005E-06 PU239 6.0112E-03 PU240 1.5285E-03 PU241 1.9723E-04

PU242 4.4380E-05 AM241 6.8035E-05

H1 3.2784E-05 O16 4.7482E-02 AL 1.4287E-05 CA 6.7514E-05

CR 4.9427E-06 FE 1.1505E-05 NI 2.1895E-06

\* UO2 fuel pin

MATERIAL 21

U235 1.7604E-04 U238 2.3580E-02

H1 3.2784E-05 C 3.2095E-05 O16 4.7501E-02 AL 2.3812E-05

SI 4.0001E-05 CA 1.2825E-05 FE 1.1176E-06

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Fuel pin cans

MATERIAL 22

H1 2.6710E-05 C 1.3288E-04 SI 8.5585E-04 P 3.7870E-05 S 2.4585E-05

CR 1.8218E-02 MN 1.5646E-03 FE 5.9675E-02 NI 8.9153E-03

MATERIAL 23

H1 2.2895E-05 C 2.3695E-04 SI 1.1571E-03 P 4.1596E-05 S 2.2786E-05

CR 1.4981E-02 MN 1.5751E-03 FE 5.3171E-02 NI 8.8137E-03

NB 2.9391E-04

MATERIAL 24

H1 2.6710E-05 C 1.3609E-04 SI 8.3531E-04 P 3.6008E-05 S 2.4585E-05

CR 1.7856E-02 MN 1.5331E-03 FE 5.8512E-02 NI 8.7515E-03

MATERIAL 25

H1 2.4802E-05 C 2.0172E-04 AL 6.4142E-06 SI 8.9693E-04 P 3.4145E-05

S 8.9942E-06 TI 2.8916E-05 CR 1.5910E-02 MN 1.1586E-03 FE 5.5753E-02

CO 4.2418E-06 NI 7.6341E-03 CU 6.0522E-06 MO 2.2047E-06

MATERIAL 26

H1 2.4802E-05 C 7.3646E-05 AL 6.4142E-06 SI 1.0476E-03 P 1.3658E-05

S 1.7389E-05 TI 2.8916E-05 CR 1.6102E-02 MN 9.8006E-04 FE 5.6794E-02

CO 4.2418E-06 NI 8.0503E-03 CU 6.0522E-06 MO 2.1446E-05

MATERIAL 27

H1 2.4802E-05 C 7.2045E-05 AL 4.2762E-06 SI 1.0544E-03 P 1.3658E-05

S 1.7989E-05 TI 2.1687E-05 CR 1.6284E-02 MN 9.8357E-04 FE 5.7354E-02

CO 3.2629E-06 NI 8.1453E-03 CU 4.5391E-06 MO 2.1246E-05

MATERIAL 28

H1 2.6710E-05 C 1.3288E-04 SI 8.5585E-04 P 3.7870E-05

S 2.4585E-05 CR 1.8255E-02 MN 1.5681E-03 FE 5.9792E-02

NI 8.9349E-03

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Composition of calandria tubes

MATERIAL 29

SI 1.0632E-03 CR 1.6787E-02 MN 1.3588E-03 FE 6.0762E-02

NI 7.4360E-03

\* Composition of Calandria end plate regions

MATERIAL 30

SI 5.5206E-04 CR 1.0016E-02 MN 7.7198E-04 FE 3.5578E-02

NI 4.4601E-03

\* Compositions of Calandria outer walls

MATERIAL 31

H1 3.9844E-05 C 2.8167E-04 SI 6.0229E-04 P 7.3471E-05 S 3.6808E-05

CR 1.4995E-02 MN 1.2214E-03 FE 4.8911E-02 NI 7.2440E-03

MATERIAL 32

H1 3.8637E-05 C 6.5351E-04 SI 9.7623E-04 P 4.7540E-05 S 3.3014E-05

TI 2.4400E-04 CR 1.4380E-02 MN 1.1060E-03 FE 4.7118E-02 CO 1.1151E-05

NI 7.4526E-03 CU 1.0341E-05 MO 3.4248E-06

MATERIAL 33

H1 3.9844E-05 C 1.5948E-04 SI 7.7474E-04 P 5.2334E-05 S 2.4551E-05

CR 1.4132E-02 MN 8.3089E-04 FE 5.0764E-02 NI 7.6658E-03 MO 2.4862E-05

MATERIAL 34

H1 3.7430E-05 C 3.5158E-04 SI 8.2197E-04 P 6.2274E-05 S 1.6431E-05

CR 1.3563E-02 MN 1.0026E-03 FE 4.7151E-02 NI 6.4549E-03 MO 8.8791E-06

MATERIAL 35

H1 3.8637E-05 C 2.4762E-04 SI 9.5110E-04 P 4.5654E-05 S 2.3793E-05

CR 1.3837E-02 MN 8.6191E-04 FE 4.8404E-02 NI 6.8530E-03 MO 2.4862E-05

MATERIAL 36

H1 4.6306E-05 C 6.8972E-04 SI 3.1158E-04 P 4.2944E-05

S 3.7110E-05 MN 7.1275E-04 FE 8.1432E-02

END

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

BEGIN MATERIAL GEOMETRY

\*

\* Plate 1, the Pu metal plate

PART 1 NEST

BOX M1 -2.3355 -2.3355 0.0457 4.671 4.671 0.236

BOX M2 -2.5335 -2.5335 0.0 5.067 5.067 0.3274

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 0.3274

\*

\* Plate 2, the UO2 plate

PART 2 NEST

BOX M3 -2.4285 -2.4285 0.03665 4.857 4.857 0.558

BOX M4 -2.5335 -2.5335 0.0 5.067 5.067 0.6313

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 0.6313

\*

\* Plate 3, the sodium dummy plate type Z, STNAV4 (uniform)

PART 3 NEST

BOX M6 -2.5335 -2.5335 0.0 5.067 5.067 0.616

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 0.616

\*

\* Plate 4, the 40% steel plate

PART 4 NEST

BOX M0 -1.9625 -1.9625 0.0 3.925 3.925 0.317

BOX M7 -2.5335 -2.5335 0.0 5.067 5.067 0.317

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 0.317

\*

\* Core Cell 1Z

PART 5 ARRAY

1 1 7 3 2 4 1 3 2 3

\* Core Cell 2Z, the reflection of cell 1

PART 6 ARRAY

1 1 7 3 2 3 1 4 2 3

\*

\* Core Cell 3Z This is Cell 1 minus Plate 4

PART 7 ARRAY

1 1 6 3 2 1 3 2 3

\*Core Cell 4Z the reflection of cell 3, Cell 2 minus Plate 4

PART 8 ARRAY

1 1 6 3 2 3 1 2 3

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Axial blanket U8 section

PART 9 NEST

BOX M8 -2.5335 -2.5335 0.0 5.067 5.067 9.827

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 9.827

\*

\* Axial blanket U2 section

PART 10 NEST

BOX M9 -2.5335 -2.5335 0.0 5.067 5.067 12.723

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 12.723

\*

\* Axial blanket U3 section

PART 11 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 7.6225

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 7.6225

\*

\* Axial reflector MST3 section

PART 12 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 7.60628

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 7.60628

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Radial blanket U3 section (over half core height)

\* (height to match the core elements)

PART 13 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 76.225

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 76.225

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* A whole height model.

\* The axial height of the pin cell elements is slightly less than

\* that of the plate cell elements, 89.19 cm compared with 89.486 cm.

\* (0.296 cm = 2 \* 0.148 cm)

\*

\* The axial shielding material in the minicalandria elements

\* is extended in the model to cover this distance

\* Axial steel reflector section extended 0.148 cm in length

PART 14 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 7.75428

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 7.75428

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* The Core Element type Z (full height)

PART 15 ARRAY

1 1 32 12 11 10 9 8 (5 6)\*11 7 9 10 11 12

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Axial steel reflector section above the radial blanket reduced

\* in length to match the core elements

PART 16 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 6.29678

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 6.29678

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Specification of the pin cells, A to F and U/C

\* Pin cell A

PART 17 NEST

ZROD M15 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M22 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell B

PART 18 NEST

ZROD M16 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M23 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell C

PART 19 NEST

ZROD M17 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M24 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell D

PART 20 NEST

ZROD M18 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M25 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell E

PART 21 NEST

ZROD M19 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M26 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell F

PART 22 NEST

ZROD M20 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M27 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell U/C

PART 23 NEST

ZROD M21 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M28 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini-calandria

\* Mini calandria 3A,

\* 16 PUPINC in void square

\* Pin C in square of void

PART 24 NEST

ZROD P19 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in calandria inner region

PART 25 ARRAY

4 4 1 (24)\*16

\* mini-calandria in the element sheath (M12)

PART 26 NEST

BOX P25 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M31 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3B,

\* 11 PUPINB and 5 PUPINF in void

\* Pin B in square void region

PART 27 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 28 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in void inner calandria region

PART 29 ARRAY

4 4 1 27 27 28 27 27 27 27 28 28 27 28 27 27 28 27 27

\* mini-calandria in the element sheath (M12)

PART 30 NEST

BOX P29 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M31 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3H,

\* 11 PUPINB and 5 PUPINF

\* Pin B in square

PART 31 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square

PART 32 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins

PART 33 ARRAY

4 4 1 31 31 32 31 31 31 31 32 32 31 32 31 31 32 31 31

\* mini-calandria in the element sheath (M12)

PART 34 NEST

BOX P33 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M35 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3L,

\* 11 PUPINB and 5 PUPINF

\* Pin B in void square

PART 35 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in void square

PART 36 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins

PART 37 ARRAY

4 4 1 35 35 36 35 35 35 35 36 36 35 36 35 35 36 35 35

\* mini-calandria in the element sheath (M12)

PART 38 NEST

BOX P37 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M34 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3C,

\* 8 PUPINA and 8 PUPINE

\* Pin A in void square

PART 39 NEST

ZROD P17 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin E in void square

PART 40 NEST

ZROD P21 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins

PART 41 ARRAY

4 4 1 39 40 39 40 40 39 40 39 39 40 39 40 40 39 40 39

\* mini-calandria in the element sheath (M12)

PART 42 NEST

BOX P41 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M33 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3D,

\* 8 PUPIND and 8 PUPINF in NACLIII

\* Pin D in void square

PART 43 NEST

ZROD P20 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in void square

PART 44 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 45 ARRAY

4 4 1 43 44 43 44 44 43 44 43 43 44 43 44 44 43 44 43

\* mini-calandria in the element sheath (M12)

PART 46 NEST

BOX P45 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M33 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3E,

\* 8 PUPIND and 8 PUPINF

\* Pin D in void square

PART 47 NEST

ZROD P20 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 48 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins

PART 49 ARRAY

4 4 1 47 48 47 48 48 47 48 47 47 48 47 48 48 47 48 47

\* mini-calandria in the element sheath (M12)

PART 50 NEST

BOX P49 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M32 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3J,

\* 12 PUPINE and 4 UO2PINC

\* Pin E in void square

PART 51 NEST

ZROD P21 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in void square

PART 52 NEST

ZROD P23 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins

PART 53 ARRAY

4 4 1 (51)\*3 52 51 52 (51)\*5 52 51 52 (51)\*2

\* mini-calandria in the element sheath (M12)

PART 54 NEST

BOX P53 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M34 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* form the pin fuelled elements 3A to 3L

\* Element 3A

PART 55 ARRAY

1 1 11 14 11 10 9 (26)\*3 9 10 11 14

\* Element 3B

PART 56 ARRAY

1 1 11 14 11 10 9 (30)\*3 9 10 11 14

\* Element 3C

PART 57 ARRAY

1 1 11 14 11 10 9 (42)\*3 9 10 11 14

\* Element 3D

PART 58 ARRAY

1 1 11 14 11 10 9 (46)\*3 9 10 11 14

\* Element 3E

PART 59 ARRAY

1 1 11 14 11 10 9 (50)\*3 9 10 11 14

\* Element 3H

PART 60 ARRAY

1 1 11 14 11 10 9 (34)\*3 9 10 11 14

\* Element 3J

PART 61 ARRAY

1 1 11 14 11 10 9 (54)\*3 9 10 11 14

\* Element 3L

PART 62 ARRAY

1 1 11 14 11 10 9 (38)\*3 9 10 11 14

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Steel reflector bars

\* (height adjusted to match the height of the core plate elements)

PART 63 NEST

BOX M13 -2.54 -2.54 0.0 5.08 5.08 165.04356

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 165.04356

\*

\*

\*The Radial Blanket element

PART 64 ARRAY

1 1 4 16 13 13 16

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Plate 3Y, the sodium dummy plate type Y, STNAVS4 (ring)

PART 65 NEST

ZROD M0 0.0 0.0 0.0 2.3 0.616

ZROD M5 0.0 0.0 0.0 2.5335 0.616

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 0.616

\*

\*

\* Core Cell 1Y

PART 66 ARRAY

1 1 7 65 2 4 1 65 2 65

\* Core Cell 2Y, the reflection of cell 1

PART 67 ARRAY

1 1 7 65 2 65 1 4 2 65

\*

\* Core Cell 3Y This is Cell 1Y minus Plate 4

PART 68 ARRAY

1 1 6 65 2 1 65 2 65

\*Core Cell 4Y the reflection of cell 3Y, Cell 2Y minus Plate 4

PART 69 ARRAY

1 1 6 65 2 65 1 2 65

\*

\* The Core Element type Y (full height)

PART 70 ARRAY

1 1 32 12 11 10 9 69 (66 67)\*11 68 9 10 11 12

\*

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* assemble the arrays of elements

\*

\* Groups of 5x5 elements surrounded by the superlattice gap

\* With groups of 5x3 in rows 1 and 7 and 3x5 in rows 3 and 5

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 1, the lowest set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 71 ARRAY

5 3 1 (63)\*13 (64)\*2

PART 72 OVERLAP

BOX P71 -13.43025 -8.05815 0.0 26.8605 16.1163 165.04356

BOX M36 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M36 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 165.04356

\* Centre

PART 73 ARRAY

5 3 1 (63)\*10 (64)\*5

PART 74 OVERLAP

BOX P73 -13.43025 -8.05815 0.0 26.8605 16.1163 165.04356

BOX M36 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M36 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 165.04356

\* Right side

PART 75 ARRAY

5 3 1 (63)\*10 (64)\*2 (63)\*3

PART 76 OVERLAP

BOX P75 -13.43025 -8.05815 0.0 26.8605 16.1163 165.04356

BOX M36 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M36 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 165.04356

\* combine these arrays to form the row 1 array

PART 77 ARRAY

3 1 1 72 74 76

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 7, the top set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 78 ARRAY

5 3 1 (63)\*3 (64)\*2 (63)\*10

PART 79 OVERLAP

BOX P78 -13.43025 -8.05815 0.0 26.8605 16.1163 165.04356

BOX M36 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M36 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 165.04356

\* Centre

PART 80 ARRAY

5 3 1 (64)\*5 (63)\*10

PART 81 OVERLAP

BOX P80 -13.43025 -8.05815 0.0 26.8605 16.1163 165.04356

BOX M36 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M36 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 165.04356

\* Right side

PART 82 ARRAY

5 3 1 (64)\*2 (63)\*13

PART 83 OVERLAP

BOX P82 -13.43025 -8.05815 0.0 26.8605 16.1163 165.04356

BOX M36 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M36 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 165.04356

\* combine these arrays to form the row 7 array

PART 84 ARRAY

3 1 1 79 81 83

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 2. 5 arrays of 5x5 elements

\* Left hand array

PART 85 ARRAY

5 5 1 (63)\*9 64 (63)\*3 (64)\*2 (63)\*2 (64)\*3 63 (64)\*4

\*

PART 86 OVERLAP

BOX P85 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Middle left blanket elements plus Z (15)

PART 87 ARRAY

5 5 1 (64)\*24 15

\*

PART 88 OVERLAP

BOX P87 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\*

\* Middle array blanket elements plus five Z

PART 89 ARRAY

5 5 1 (64)\*20 (15)\*5

\*

PART 90 OVERLAP

BOX P89 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Middle right blanket elements plus one Z

PART 91 ARRAY

5 5 1 (64)\*20 15 (64)\*4

\*

PART 92 OVERLAP

BOX P91 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\*

\* Right hand array

PART 93 ARRAY

5 5 1 (63)\*5 64 (63)\*4 (64)\*2 (63)\*3 (64)\*3 (63)\*2 (64)\*4 63

\*

PART 94 OVERLAP

BOX P93 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Form row 2 array

PART 95 ARRAY

5 1 1 86 88 90 92 94

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 6 arrays 5 groups of 5x5,

\*

\* Left hand array

PART 96 ARRAY

5 5 1 63 (64)\*4 (63)\*2 (64)\*3 (63)\*3 (64)\*2 (63)\*4 64 (63)\*5

\*

PART 97 OVERLAP

BOX P96 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Middle left array (one Z element, 15)

PART 98 ARRAY

5 5 1 (64)\*4 15 (64)\*20

\*

PART 99 OVERLAP

BOX P98 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Middle array (five Z elements)

PART 100 ARRAY

5 5 1 (15)\*5 (64)\*20

\*

PART 101 OVERLAP

BOX P100 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Middle right array (one Z element)

PART 102 ARRAY

5 5 1 15 (64)\*24

\*

PART 103 OVERLAP

BOX P102 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Right hand array

PART 104 ARRAY

5 5 1 (64)\*4 63 (64)\*3 (63)\*2 (64)\*2 (63)\*3 64 (63)\*9

\*

PART 105 OVERLAP

BOX P104 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Form row 6 array

PART 106 ARRAY

5 1 1 97 99 101 103 105

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 3, 7 groups, the two end groups being 3x5 arrays of shield

\* elements plus two blanket elements

\* and the intermediate groups contain blanket elements plus one or two

\* core plate elements (Y or Z)

\* Left hand array

PART 107 ARRAY

3 5 1 (63)\*11 64 (63)\*2 64

PART 108 OVERLAP

BOX P107 -8.05815 -13.43025 0.0 16.1163 26.8605 165.04356

BOX M36 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M36 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 165.04356

\*

\* left hand blanket array plus one Y element

PART 109 ARRAY

5 5 1 (64)\*24 70

PART 110 OVERLAP

BOX P109 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Core lower left hand array (additional Y and Z elements

\* compared with the flooded core)

PART 111 ARRAY

5 5 1 (64)\*2 70 (15)\*2 64 15 70 (60)\*2 (70)\*2 55 58 60

15 (58)\*2 57 59 15 (58)\*2 57 59

\*

PART 112 OVERLAP

BOX P111 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Core lower middle array

PART 113 ARRAY

5 5 1 (62)\*5 (56)\*10 (57)\*10

\*

PART 114 OVERLAP

BOX P113 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Core lower right hand array

PART 115 ARRAY

5 5 1 (15)\*2 70 (64)\*2 (60)\*2 70 15 64 60 58 55 (70)\*2

59 57 58 59 15 59 57 58 59 70

\*

PART 116 OVERLAP

BOX P115 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* right hand blanket array plus one Y and one Z element

PART 117 ARRAY

5 5 1 (64)\*15 15 (64)\*4 70 (64)\*4

PART 118 OVERLAP

BOX P117 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* right hand array

PART 119 ARRAY

3 5 1 (63)\*9 64 (63)\*2 64 (63)\*2

PART 120 OVERLAP

BOX P119 -8.05815 -13.43025 0.0 16.1163 26.8605 165.04356

BOX M36 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M36 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 165.04356

\* Form the row 3 array

PART 121 ARRAY

7 1 1 108 110 112 114 116 118 120

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 5. 7 arrays, the first and last being 3x5 and the remainder 5x5

\* including the two blanket 5x5 groups.

\*

\* Left hand shield array

PART 122 ARRAY

3 5 1 (63)\*2 64 (63)\*2 64 (63)\*9

PART 123 OVERLAP

BOX P122 -8.05815 -13.43025 0.0 16.1163 26.8605 165.04356

BOX M36 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M36 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 165.04356

\*

\* left hand blanket array plus one Y and one Z element

PART 124 ARRAY

5 5 1 (64)\*4 70 (64)\*4 15 (64)\*15

PART 125 OVERLAP

BOX P124 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Core upper left hand array

PART 126 ARRAY

5 5 1 15 (58)\*2 57 59 15 56 58 57 59 (70)\*2 55 58 58

64 15 70 (60)\*2 (64)\*2 70 (15)\*2

\*

PART 127 OVERLAP

BOX P126 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Core upper middle array

PART 128 ARRAY

5 5 1 (57)\*10 (56)\*10 (62)\*5

\*

PART 129 OVERLAP

BOX P128 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Core upper right hand array

PART 130 ARRAY

5 5 1 59 57 58 58 15 59 57 58 56 15 58 58 55 (70)\*2

(60)\*2 70 15 64 (15)\*2 70 (64)\*2

\*

PART 131 OVERLAP

BOX P130 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* right hand blanket array plus one Y element

PART 132 ARRAY

5 5 1 70 (64)\*24

PART 133 OVERLAP

BOX P132 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* right hand shield array

PART 134 ARRAY

3 5 1 64 (63)\*2 64 (63)\*11

PART 135 OVERLAP

BOX P134 -8.05815 -13.43025 0.0 16.1163 26.8605 165.04356

BOX M36 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M36 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 165.04356

\* Form the row 5 array

PART 136 ARRAY

7 1 1 123 125 127 129 131 133 135

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 4 (the middle row) 7 groups of 5x5 elements

\* Left hand shield group

PART 137 ARRAY

5 5 1 (63)\*4 64 (63)\*4 64 (63)\*4 64 (63)\*4 64 (63)\*4 64

\*

PART 138 OVERLAP

BOX P137 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Left hand centre blanket group

PART 139 ARRAY

5 5 1 (64)\*4 70 (64)\*4 15 (64)\*4 15 (64)\*4 15 (64)\*4 70

\*

PART 140 OVERLAP

BOX P139 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Left hand centre core group

PART 141 ARRAY

5 5 1 55 61 58 (59)\*2 55 (58)\*2 (59)\*2 56 (59)\*4

55 58 55 (59)\*2 55 61 55 (59)\*2

\*

PART 142 OVERLAP

BOX P141 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Centre core group

PART 143 ARRAY

5 5 1 (57)\*25

\*

PART 144 OVERLAP

BOX P143 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Right hand centre core group

PART 145 ARRAY

5 5 1 (59)\*2 58 61 55 (59)\*2 (58)\*2 55 (59)\*4 56

(59)\*2 55 58 55 (59)\*2 55 61 55

\*

PART 146 OVERLAP

BOX P145 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Right hand central row blanket group (two Y and three Z)

PART 147 ARRAY

5 5 1 70 (64)\*4 15 (64)\*4 15 (64)\*4 15 (64)\*4 70 (64)\*4

\*

PART 148 OVERLAP

BOX P147 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Right hand shield group

PART 149 ARRAY

5 5 1 64 (63)\*4 64 (63)\*4 64 (63)\*4 64 (63)\*4 64 (63)\*4

\*

PART 150 OVERLAP

BOX P149 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M36 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M36 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Form the row 4 array

PART 151 ARRAY

7 1 1 138 140 142 144 146 148 150

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Cluster of superlattice groups in a circle of shield material

PART 152 CLUSTER

BOX P84 -40.6905 67.8175 0.0 81.381 16.3828 165.04356

BOX P106 -67.8175 40.6905 0.0 135.635 27.127 165.04356

BOX P136 -84.2003 13.5635 0.0 168.4006 27.127 165.04356

BOX P151 -94.9445 -13.5635 0.0 189.889 27.127 165.04356

BOX P121 -84.2003 -40.6905 0.0 168.4006 27.127 165.04356

BOX P95 -67.8175 -67.8175 0.0 135.635 27.127 165.04356

BOX P77 -40.6905 -84.2003 0.0 81.381 16.3828 165.04356

ZROD M14 0.0 0.0 -1.56 96.6 168.0

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Albedo for free boundaries at side and top and bottom

\*

ALBEDO 0.0 0.0 0.0

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN CONTROL DATA

STAGES -50 3000 2000 STDV 0.0001

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN SOURCE GEOMETRY

ZONEMAT

ALL / MATERIAL 15

END

## A1.5. Assembly 23 with the central region of plate elements. Model A

### \* MONK9A Input Listing for Assembly 23 with the central plate region.

\* Assembly 23 is the Pin Geometry Version of the Cadenza cores.

\* it also includes an outer ring of plate geometry elements

\* Reactor structure: elements arranged on a square grid

\* The Pin Elements in the core contain 3 minicalandria and an Axial

\* Region Cell, enclosed in a mild steel sheath.

\* The plate elements contain 24 cells, the plates having width 5.067 cm.

\* The Element sheath has an inner width 5.102 cm, outer width 5.2544 cm.

\* The elements occupy a lattice area of 5.3721 cm square.

\* Groups of 5x5 elements form the superlattice

\* with a space between them

\* The Radial Blanket Elements contain 10 U3 blocks and a MST3 block

\* enclosed in a mild steel sheath with reflection in the midplane.

\* The radial shielding elements consist of the Steel bar MST9F10

\* which is about 300 cm high.

\* These are represented explicitly within an outer radius and also

\* homogenised (over the overall average lattice area) to fill the

\* remaining space in the outer cylinder (pitch 5.4254 cm)

\* Elements are grouped in square arrays containing 5x5 = 25 elements

\* plus edge groups with 3x5 elements. The Assembly is built from these.

\* There is a gap between these groups of elements of 0.2667 cm

\* Core Plate Geometry Element structure:

\* The plate element consists of combinations of the following:

\* Core Cell PART 1, Core Cell PART 2, an inversion of PART 1,

\* Core Cell PART 3, which is the same as PART 1

\* but with the 40%Steel plate omitted, and the inversion of

\* this cell which forms PART 4

\* the Axial Region Cell is PART5.

\* Structure of Core Plate Cell 1, PART 1, 7 plates.

\* Cell height 3.748082 cm. Enclosed in mild steel sheath.

\* Outer area of all plates is 5.067 cm x 5.067 cm

\* From the top down:

\* Sodium (0.613694 cm thick, core 0.541 cm x 4.963 cm square)

\* UO2 (0.6313 cm thick, core 0.558 cm x 4.857 cm square)

\* Sodium (0.613694 cm thick,)

\* Pu Metal (0.3274 cm thick, core 0.236 cm x 4.671cm x 4.671 cm)

\* 40%Steel (0.317 cm thick, void core 0.317 cm x 3.925 cm square)

\* UO2 (0.6313 cm thick)

\* Sodium (0.613694 cm thick)

\* Structure of Core Plate Cell 2 PART 2. The inverse of PART 1

\* Structure of Core Plate Cell PART 3. PART 1 without 40%Steel plate.

\* Cell height 3.431082 cm.

\* Structure of the Axial Region cell. Enclosed in mild steel sheath.

\* Cell height From the top:

\* MST3 Block (7.60628 cm thick)

\* U3 Block (7.6225 cm thick,)

\* U2 region (10 plates, total thickness 12.723 cm )

\* U8 region (31 plates, total thickness 9.827 cm)

\* Structure of the Radial Blanket element.

\* Height of the reflected half height element

\* MST3 Block (7.60628 cm thick)

\* U3 Block composition (height above mid-plane to match the core

\* element blanket height of 74.83248 cm)

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* material 1 - Plutonium metal plate core

\* material 2 - Plutonium metal clad

\* material 3 - UO2 plate core

\* material 4 - UO2 plate clad

\* material 5 - Sodium plate core

\* material 6 - Sodium plate clad

\* material 7 - 40%Steel

\* material 8 - U8 natural uranium region

\* material 9 - U2 natural uranium region

\* material 10 - U3 natural uranium block

\* material 11 - MST3 Steel block

\* material 12 - Mild steel sheath

\* material 13 - Steel bar MST9F10 at actual density (width 5.08 cm)

\* material 14 - Steel bar averaged over the mean spacing of 5.4254 cm

\* material 15 - Pin fuel A

\* material 16 - Pin fuel B

\* material 17 - Pin fuel C

\* material 18 - Pin fuel D

\* material 19 - Pin fuel E

\* material 20 - Pin fuel F

\* material 21 - Pin fuel UPINC

\* material 22 - Pin can A

\* material 23 - Pin can B

\* material 24 - Pin can C

\* material 25 - Pin can D

\* material 26 - Pin can E

\* material 27 - Pin can F

\* material 28 - Pin can UPINC

\* material 29 - Tube

\* material 30 - Calandria end regions

\* material 31 - Calandria Walls Type NACLI

\* material 32 - Calandria Walls Type NACLIIS

\* material 33 - Calandria Walls Type NACLIII

\* material 34 - Calandria Walls Type NACLIV

\* material 35 - Calandria Walls Type NACLV

\* material 36 - Calandria Sodium Type NACLI

\* material 37 - Calandria Sodium Type NACLIIS

\* material 38 - Calandria Sodium Type NACLIII

\* material 39 - Calandria Sodium Type NACLIV

\* material 40 - Calandria Sodium Type NACLV

\* material 41 - Superlattice grid

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

COLUMNS 1 132

BEGIN MATERIAL SPECIFICATION

NUMBER DENSITY

MATERIAL 1

U238 6.8782E-07 PU238 3.0461E-05 PU239 2.8920E-02

PU240 6.9095E-03 PU241 7.3960E-04 PU242 1.8699E-04

AM241 4.5718E-04

H1 1.2764E-04 C 4.2260E-04 N 2.4215E-05 O16 8.8450E-05

AL 2.2973E-05 SI 1.4158E-05 CR 3.5989E-06 MN 1.4902E-06

FE 1.6335E-05 NI 8.5688E-06 GA 2.0166E-03

MATERIAL 2

H1 1.3760E-05 C 1.1393E-04 SI 3.6607E-04 P 1.3731E-05

CR 9.4011E-03 MN 8.5931E-04 FE 3.5542E-02 NI 4.1646E-03

CU 1.6613E-02

MATERIAL 3

H1 3.1773E-05 C 1.1808E-05 O16 4.6008E-02 AL 3.3911E-06

SI 2.2967E-05 MN 8.3273E-08 FE 1.3107E-06 NI 1.2472E-06

MO 3.3379E-07 U235 1.6544E-04 U238 2.2837E-02

MATERIAL 4

H1 1.9035E-05 C 1.2831E-04 SI 6.4475E-04 P 3.5078E-04

S 3.6041E-05 CR 1.3819E-02 MN 8.5559E-04 FE 4.8306E-02

NI 8.4258E-03

MATERIAL 5

H1 1.3900E-05 O16 5.6492E-06 NA 2.3225E-02 CA 3.6083E-06

FE 1.6184E-07

MATERIAL 6

H1 2.1631E-05 C 2.9290E-04 SI 6.0867E-04 P 3.2795E-05

S 3.3219E-05 CR 1.4759E-02 MN 1.3570E-03 FE 5.5054E-02

NI 7.0982E-03 NB 3.1147E-04

MATERIAL 7

H1 1.8355E-05 C 8.7794E-05 AL 1.1862E-04 SI 7.9703E-04

P 4.0018E-05 S 1.4422E-05 TI 2.4806E-04 CR 1.5908E-02

MN 1.4972E-03 FE 5.5367E-02 NI 8.7976E-03 CU 5.0365E-05

NB 4.9781E-06 MO 8.0988E-05

MATERIAL 8

H1 4.4048E-05 C 4.9283E-04 SI 2.1076E-04 FE 1.0599E-04

U235 3.3369E-04 U238 4.6021E-02

MATERIAL 9

H1 4.3899E-05 C 4.6047E-04 SI 1.9692E-04 FE 9.9032E-05

U235 3.3962E-04 U238 4.6785E-02

MATERIAL 10

H1 4.4574E-05 C 4.7140E-04 SI 2.0160E-04 FE 1.0138E-04

U235 3.4209E-04 U238 4.7156E-02

MATERIAL 11

H1 2.5700E-05 C 5.1066E-04 AL 1.3989E-04 TI 3.9416E-05

CR 2.7222E-05 MN 3.2634E-04 FE 8.3806E-02 NI 4.8234E-05

CU 4.4548E-05 MO 9.8355E-06

MATERIAL 12

H1 7.5712E-05 C 2.3825E-04 AL 1.9798E-05 CR 3.6690E-06

MN 2.5697E-04 FE 7.7524E-02 NI 1.4302E-05 CU 2.2216E-05

MATERIAL 13

H1 4.6306E-05 C 6.8972E-04 SI 3.1158E-04 P 4.2944E-05

S 3.7110E-05 MN 7.1275E-04 FE 8.1432E-02

MATERIAL 14

H1 4.0597E-05 C 6.0468E-04 SI 2.7317E-04 P 3.7649E-05

S 3.2535E-05 MN 6.2488E-04 FE 7.1392E-02

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Pin fuel A, B, C, D, E, F and U

MATERIAL 15

U234 1.3805E-06 U235 1.4114E-04 U236 7.9324E-07 U238 1.9379E-02

PU238 3.7786E-06 PU239 2.9689E-03 PU240 6.7253E-04 PU241 7.0350E-05

PU242 1.7488E-05 AM241 4.7854E-05

H1 3.2784E-05 O16 4.6606E-02 AL 1.1702E-05 CA 7.8782E-06 FE 5.6537E-06

MATERIAL 16

U234 1.3177E-06 U235 1.3457E-04 U236 7.4658E-07 U238 1.8472E-02

PU238 5.8915E-06 PU239 3.7341E-03 PU240 9.5200E-04 PU241 1.1199E-04

PU242 2.7984E-05 AM241 5.5789E-05

H1 3.2784E-05 O16 4.6993E-02 SI 9.0199E-06 NI 5.4424E-06

MATERIAL 17

U234 1.2863E-06 U235 1.2997E-04 U236 7.3103E-07 U238 1.7843E-02

PU238 6.9094E-06 PU239 4.4708E-03 PU240 1.0602E-03 PU241 1.1598E-04

PU242 3.0047E-05 AM241 5.7784E-05

H1 3.2784E-05 O16 4.7434E-02 AL 1.9730E-05 SI 7.9741E-06

FE 7.6916E-06 NI 1.0947E-05

MATERIAL 18

U234 1.4118E-06 U235 1.4266E-04 U236 7.9324E-07 U238 1.9584E-02

PU238 4.7348E-06 PU239 3.0189E-03 PU240 7.5441E-04 PU241 8.8443E-05

PU242 2.0961E-05 AM241 4.0742E-05

H1 3.2784E-05 O16 4.7314E-02 AL 1.8914E-05 SI 2.5099E-05

CA 1.5940E-05 FE 6.9027E-06 NI 1.4138E-05

MATERIAL 19

U234 1.1295E-06 U235 1.1465E-04 U236 6.3771E-07 U238 1.5739E-02

PU238 9.4851E-06 PU239 6.0438E-03 PU240 1.5103E-03 PU241 1.7707E-04

PU242 4.1953E-05 AM241 8.1559E-05

H1 3.2784E-05 O16 4.7299E-02 AL 9.5250E-06 SI 4.5753E-05

CA 3.2062E-05 FE 1.0321E-05

MATERIAL 20

U234 1.1452E-06 U235 1.1526E-04 U236 6.3771E-07 U238 1.5824E-02

PU238 9.5005E-06 PU239 6.0112E-03 PU240 1.5285E-03 PU241 1.9723E-04

PU242 4.4380E-05 AM241 6.8035E-05

H1 3.2784E-05 O16 4.7482E-02 AL 1.4287E-05 CA 6.7514E-05

CR 4.9427E-06 FE 1.1505E-05 NI 2.1895E-06

\* UO2 fuel pin

MATERIAL 21

U235 1.7604E-04 U238 2.3580E-02

H1 3.2784E-05 C 3.2095E-05 O16 4.7501E-02 AL 2.3812E-05

SI 4.0001E-05 CA 1.2825E-05 FE 1.1176E-06

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Fuel pin cans

MATERIAL 22

H1 2.6710E-05 C 1.3288E-04 SI 8.5585E-04 P 3.7870E-05 S 2.4585E-05

CR 1.8218E-02 MN 1.5646E-03 FE 5.9675E-02 NI 8.9153E-03

MATERIAL 23

H1 2.2895E-05 C 2.3695E-04 SI 1.1571E-03 P 4.1596E-05 S 2.2786E-05

CR 1.4981E-02 MN 1.5751E-03 FE 5.3171E-02 NI 8.8137E-03

NB 2.9391E-04

MATERIAL 24

H1 2.6710E-05 C 1.3609E-04 SI 8.3531E-04 P 3.6008E-05 S 2.4585E-05

CR 1.7856E-02 MN 1.5331E-03 FE 5.8512E-02 NI 8.7515E-03

MATERIAL 25

H1 2.4802E-05 C 2.0172E-04 AL 6.4142E-06 SI 8.9693E-04 P 3.4145E-05

S 8.9942E-06 TI 2.8916E-05 CR 1.5910E-02 MN 1.1586E-03 FE 5.5753E-02

CO 4.2418E-06 NI 7.6341E-03 CU 6.0522E-06 MO 2.2047E-06

MATERIAL 26

H1 2.4802E-05 C 7.3646E-05 AL 6.4142E-06 SI 1.0476E-03 P 1.3658E-05

S 1.7389E-05 TI 2.8916E-05 CR 1.6102E-02 MN 9.8006E-04 FE 5.6794E-02

CO 4.2418E-06 NI 8.0503E-03 CU 6.0522E-06 MO 2.1446E-05

MATERIAL 27

H1 2.4802E-05 C 7.2045E-05 AL 4.2762E-06 SI 1.0544E-03 P 1.3658E-05

S 1.7989E-05 TI 2.1687E-05 CR 1.6284E-02 MN 9.8357E-04 FE 5.7354E-02

CO 3.2629E-06 NI 8.1453E-03 CU 4.5391E-06 MO 2.1246E-05

MATERIAL 28

H1 2.6710E-05 C 1.3288E-04 SI 8.5585E-04 P 3.7870E-05

S 2.4585E-05 CR 1.8255E-02 MN 1.5681E-03 FE 5.9792E-02

NI 8.9349E-03

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Composition of calandria tubes

MATERIAL 29

SI 1.0632E-03 CR 1.6787E-02 MN 1.3588E-03 FE 6.0762E-02

NI 7.4360E-03

\* Composition of Calandria end plate regions

MATERIAL 30

SI 5.5206E-04 CR 1.0016E-02 MN 7.7198E-04 FE 3.5578E-02

NI 4.4601E-03

\* Compositions of Calandria outer walls

MATERIAL 31

H1 3.9844E-05 C 2.8167E-04 SI 6.0229E-04 P 7.3471E-05 S 3.6808E-05

CR 1.4995E-02 MN 1.2214E-03 FE 4.8911E-02 NI 7.2440E-03

MATERIAL 32

H1 3.8637E-05 C 6.5351E-04 SI 9.7623E-04 P 4.7540E-05 S 3.3014E-05

TI 2.4400E-04 CR 1.4380E-02 MN 1.1060E-03 FE 4.7118E-02 CO 1.1151E-05

NI 7.4526E-03 CU 1.0341E-05 MO 3.4248E-06

MATERIAL 33

H1 3.9844E-05 C 1.5948E-04 SI 7.7474E-04 P 5.2334E-05 S 2.4551E-05

CR 1.4132E-02 MN 8.3089E-04 FE 5.0764E-02 NI 7.6658E-03 MO 2.4862E-05

MATERIAL 34

H1 3.7430E-05 C 3.5158E-04 SI 8.2197E-04 P 6.2274E-05 S 1.6431E-05

CR 1.3563E-02 MN 1.0026E-03 FE 4.7151E-02 NI 6.4549E-03 MO 8.8791E-06

MATERIAL 35

H1 3.8637E-05 C 2.4762E-04 SI 9.5110E-04 P 4.5654E-05 S 2.3793E-05

CR 1.3837E-02 MN 8.6191E-04 FE 4.8404E-02 NI 6.8530E-03 MO 2.4862E-05

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Sodium compositions

MATERIAL 36

H1 5.5075E-06 O16 6.4605E-06 NA 2.4129E-02 CA 1.1080E-06 FE 3.0847E-07

MATERIAL 37

H1 1.1205E-05 O16 1.0767E-06 NA 2.4379E-02 CA 9.5521E-08

MATERIAL 38

H1 7.5966E-06 O16 3.5892E-06 NA 2.3888E-02 K 3.4270E-07 CA 6.6865E-07

MATERIAL 39

H1 7.5966E-06 O16 3.5892E-06 NA 2.4037E-02 K 3.4270E-07 CA 6.6865E-07

MATERIAL 40

H1 7.5966E-06 O16 3.5892E-06 NA 2.3829E-02 K 3.4270E-07 CA 6.6865E-07

\* Superlattice grid

MATERIAL 41

H1 4.6306E-05 C 6.8972E-04 SI 3.1158E-04 P 4.2944E-05

S 3.7110E-05 MN 7.1275E-04 FE 8.1432E-02

END

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

BEGIN MATERIAL GEOMETRY

\*

\* Plate 1, the Pu metal plate

PART 1 NEST

BOX M1 -2.3355 -2.3355 0.0457 4.671 4.671 0.236

BOX M2 -2.5335 -2.5335 0.0 5.067 5.067 0.3274

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.3274

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.3274

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.3274

\*

\* Plate 2, the UO2 plate

PART 2 NEST

BOX M3 -2.4285 -2.4285 0.03665 4.857 4.857 0.558

BOX M4 -2.5335 -2.5335 0.0 5.067 5.067 0.6313

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.6313

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.6313

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.6313

\*

\* Plate 3, the sodium plate

PART 3 NEST

BOX M5 -2.4815 -2.4815 0.036347 4.963 4.963 0.541

BOX M6 -2.5335 -2.5335 0.0 5.067 5.067 0.613694

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.613694

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.613694

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.613694

\*

\* Plate 4, the 40% steel plate

PART 4 NEST

BOX M0 -1.9625 -1.9625 0.0 3.925 3.925 0.317

BOX M7 -2.5335 -2.5335 0.0 5.067 5.067 0.317

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.317

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.317

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.317

\*

\* Core Cell 1

PART 5 ARRAY

1 1 7 3 2 4 1 3 2 3

\* Core Cell 2, the reflection of cell 1

PART 6 ARRAY

1 1 7 3 2 3 1 4 2 3

\*

\* Core Cell 3 This is Cell 1 minus Plate 4

PART 7 ARRAY

1 1 6 3 2 1 3 2 3

\*Core Cell 4 the reflection of cell 3, Cell 2 minus Plate 4

PART 8 ARRAY

1 1 6 3 2 3 1 2 3

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Axial blanket U8 section

PART 9 NEST

BOX M8 -2.5335 -2.5335 0.0 5.067 5.067 9.827

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 9.827

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 9.827

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 9.827

\*

\* Axial blanket U2 section

PART 10 NEST

BOX M9 -2.5335 -2.5335 0.0 5.067 5.067 12.723

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 12.723

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 12.723

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 12.723

\*

\* Axial blanket U3 section

PART 11 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 7.6225

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.6225

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.6225

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.6225

\*

\* Axial reflector MST3 section

PART 12 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 7.60628

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.60628

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.60628

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.60628

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Radial blanket U3 section (over half core height)

PART 13 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 74.83248

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 74.83248

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 74.83248

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 74.83248

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* A whole height model.

\* The axial height of the pin cell core is slightly less than

\* that of the plate cell core, 89.19 cm compared with 89.32 cm.

\* (0.13 cm = 2 \* 0.065 cm)

\* The axial shielding material is extended in the model

\* to cover this distance

\* Axial steel reflector section extended 0.065 cm in length

PART 14 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 7.67128

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.67128

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.67128

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.67128

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* The Core Element (full height)

PART 15 ARRAY

1 1 32 12 11 10 9 8 (5 6)\*11 7 9 10 11 12

\*

\*The Radial Blanket element

PART 16 ARRAY

1 1 4 12 13 13 12

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Specification of the pin cells, A to F and U/C

\* Pin cell A

PART 17 NEST

ZROD M15 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M22 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell B

PART 18 NEST

ZROD M16 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M23 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell C

PART 19 NEST

ZROD M17 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M24 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell D

PART 20 NEST

ZROD M18 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M25 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell E

PART 21 NEST

ZROD M19 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M26 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell F

PART 22 NEST

ZROD M20 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M27 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell U/C

PART 23 NEST

ZROD M21 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M28 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini-calandria

\* Mini calandria 3A,

\* 16 PUPINC in NACLI

\* Pin C in square of sodium

PART 24 NEST

ZROD P19 0.0 0.0 0.0 0.513 29.18

BOX M36 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 25 ARRAY

4 4 1 (24)\*16

\* mini-calandria in the element sheath (M12)

PART 26 NEST

BOX P25 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M36 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M31 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3B,

\* 11 PUPINB and 5 PUPINF in NACLI

\* Pin B in square of sodium

PART 27 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M36 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 28 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M36 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 29 ARRAY

4 4 1 27 27 28 27 27 27 27 28 28 27 28 27 27 28 27 27

\* mini-calandria in the element sheath (M12)

PART 30 NEST

BOX P29 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M36 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M31 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3H,

\* 11 PUPINB and 5 PUPINF in NACLV

\* Pin B in square of NACLV sodium

PART 31 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M40 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 32 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M40 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 33 ARRAY

4 4 1 31 31 32 31 31 31 31 32 32 31 32 31 31 32 31 31

\* mini-calandria in the element sheath (M12)

PART 34 NEST

BOX P33 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M40 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M35 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3L,

\* 11 PUPINB and 5 PUPINF in NACLIV

\* Pin B in square of NACLIV sodium

PART 35 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 36 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 37 ARRAY

4 4 1 35 35 36 35 35 35 35 36 36 35 36 35 35 36 35 35

\* mini-calandria in the element sheath (M12)

PART 38 NEST

BOX P37 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M39 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M34 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3C,

\* 8 PUPINA and 8 PUPINE in NACLIII

\* Pin A in square of NACLIII sodium

PART 39 NEST

ZROD P17 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin E in square of sodium

PART 40 NEST

ZROD P21 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 41 ARRAY

4 4 1 39 40 39 40 40 39 40 39 39 40 39 40 40 39 40 39

\* mini-calandria in the element sheath (M12)

PART 42 NEST

BOX P41 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M38 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M33 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3D,

\* 8 PUPIND and 8 PUPINF in NACLIII

\* Pin D in square of NACLIII sodium

PART 43 NEST

ZROD P20 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 44 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 45 ARRAY

4 4 1 43 44 43 44 44 43 44 43 43 44 43 44 44 43 44 43

\* mini-calandria in the element sheath (M12)

PART 46 NEST

BOX P45 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M38 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M33 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3E,

\* 8 PUPIND and 8 PUPINF in NACLIIS

\* Pin D in square of NACLIIS sodium

PART 47 NEST

ZROD P20 0.0 0.0 0.0 0.513 29.18

BOX M37 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 48 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M37 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 49 ARRAY

4 4 1 47 48 47 48 48 47 48 47 47 48 47 48 48 47 48 47

\* mini-calandria in the element sheath (M12)

PART 50 NEST

BOX P49 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M37 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M32 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3J,

\* 12 PUPINE and 4 UO2PINC in NACLIV

\* Pin E in square of NACLIV sodium

PART 51 NEST

ZROD P21 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 52 NEST

ZROD P23 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 53 ARRAY

4 4 1 (51)\*3 52 51 52 (51)\*5 52 51 52 (51)\*2

\* mini-calandria in the element sheath (M12)

PART 54 NEST

BOX P53 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M39 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M34 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* form the elements 3A to 3L

\* Element 3A

PART 55 ARRAY

1 1 11 14 11 10 9 (26)\*3 9 10 11 14

\* Element 3B

PART 56 ARRAY

1 1 11 14 11 10 9 (30)\*3 9 10 11 14

\* Element 3C

PART 57 ARRAY

1 1 11 14 11 10 9 (42)\*3 9 10 11 14

\* Element 3D

PART 58 ARRAY

1 1 11 14 11 10 9 (46)\*3 9 10 11 14

\* Element 3E

PART 59 ARRAY

1 1 11 14 11 10 9 (50)\*3 9 10 11 14

\* Element 3H

PART 60 ARRAY

1 1 11 14 11 10 9 (34)\*3 9 10 11 14

\* Element 3J

PART 61 ARRAY

1 1 11 14 11 10 9 (54)\*3 9 10 11 14

\* Element 3L

PART 62 ARRAY

1 1 11 14 11 10 9 (38)\*3 9 10 11 14

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Steel reflector bars

PART 63 NEST

BOX M13 -2.54 -2.54 0.0 5.08 5.08 164.877528

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 164.877528

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* assemble the arrays of elements

\*

\* Groups of 5x5 elements surrounded by the superlattice gap

\* With groups of 5x3 in rows 1 and 7 and 3x5 in rows 3 and 5

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 1, the lowest set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 64 ARRAY

5 3 1 (63)\*13 (16)\*2

PART 65 OVERLAP

BOX P64 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M41 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M41 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* Centre

PART 66 ARRAY

5 3 1 (63)\* 10 (16)\*5

PART 67 OVERLAP

BOX P66 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M41 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M41 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* Right side

PART 68 ARRAY

5 3 1 (63)\*10 (16)\*2 (63)\*3

PART 69 OVERLAP

BOX P68 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M41 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M41 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* combine these arrays to form the row 1 array

PART 70 ARRAY

3 1 1 65 67 69

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* A 5x5 array of blanket elements

PART 71 ARRAY

5 5 1 (16)\*25

\*

PART 72 OVERLAP

BOX P71 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 2. 5 arrays of 5x5 elements, two being PART 72

\* Left hand array

PART 73 ARRAY

5 5 1 (63)\*9 16 (63)\*3 (16)\*2 (63)\*2 (16)\*3 63 (16)\*4

\*

PART 74 OVERLAP

BOX P73 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Middle array

PART 75 ARRAY

5 5 1 (16)\*20 (15)\*5

\*

PART 76 OVERLAP

BOX P75 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Right hand array

PART 77 ARRAY

5 5 1 (63)\*5 16 (63)\*4 (16)\*2 (63)\*3 (16)\*3 (63)\*2 (16)\*4 63

\*

PART 78 OVERLAP

BOX P77 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Form row 2 array

PART 79 ARRAY

5 1 1 74 72 76 72 78

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 3, 7 groups, the two end groups being 3x5 arrays

\* Left hand array

PART 80 ARRAY

3 5 1 (63)\*11 16 (63)\*2 16

PART 81 OVERLAP

BOX P80 -8.05815 -13.43025 0.0 16.1163 26.8605 164.877528

BOX M41 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M41 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 164.877528

\* Core lower left hand array

PART 82 ARRAY

5 5 1 (16)\*3 (15)\*2 16 (15)\*2 (60)\*2 16 15 55 58 60

15 (58)\*2 57 59 15 (58)\*2 57 59

\*

PART 83 OVERLAP

BOX P82 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Core lower middle array

PART 84 ARRAY

5 5 1 (62)\*5 (56)\*10 (57)\*5 (15)\*5

\*

PART 85 OVERLAP

BOX P84 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Core lower right hand array

PART 86 ARRAY

5 5 1 (15)\*2 (16)\*3 (60)\*2 (15)\*2 16 60 58 55 15 16

59 57 58 59 15 59 57 58 59 15

\*

PART 87 OVERLAP

BOX P86 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* right hand array

PART 88 ARRAY

3 5 1 (63)\*9 16 (63)\*2 16 (63)\*2

PART 89 OVERLAP

BOX P88 -8.05815 -13.43025 0.0 16.1163 26.8605 164.877528

BOX M41 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M41 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 164.877528

\* Form the row 3 array

PART 90 ARRAY

7 1 1 81 72 83 85 87 72 89

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 4 (the middle row) 7 groups of 5x5 elements

\* Left hand shield group

PART 91 ARRAY

5 5 1 (63)\*4 16 (63)\*4 16 (63)\*4 16 (63)\*4 16 (63)\*4 16

\*

PART 92 OVERLAP

BOX P91 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Left hand blanket group

PART 93 ARRAY

5 5 1 (16)\*4 15 (16)\*4 15 (16)\*4 15 (16)\*4 15 (16)\*4 15

\*

PART 94 OVERLAP

BOX P93 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Left hand core group

PART 95 ARRAY

5 5 1 55 61 58 59 15 55 (58)\*2 59 15 56 (59)\*3 15

55 58 55 59 15 55 61 55 59 15

\*

PART 96 OVERLAP

BOX P95 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Centre core group of plate elements

PART 97 ARRAY

5 5 1 (15)\*25

\*

PART 98 OVERLAP

BOX P97 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Right hand core group

PART 99 ARRAY

5 5 1 15 59 58 61 55 15 59 (58)\*2 55 15 (59)\*3 56

15 59 55 58 55 15 59 55 61 55

\*

PART 100 OVERLAP

BOX P99 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Right hand blanket group

PART 101 ARRAY

5 5 1 15 (16)\*4 15 (16)\*4 15 (16)\*4 15 (16)\*4 15 (16)\*4

\*

PART 102 OVERLAP

BOX P101 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Right hand shield group

PART 103 ARRAY

5 5 1 16 (63)\*4 16 (63)\*4 16 (63)\*4 16 (63)\*4 16 (63)\*4

\*

PART 104 OVERLAP

BOX P103 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Form the row 4 array

PART 105 ARRAY

7 1 1 92 94 96 98 100 102 104

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 5. 7 arrays, the first and last being 3x5 and the remainder 5x5

\* including the two blanket 5x5 groups.

\*

\* Left hand shield array

PART 106 ARRAY

3 5 1 (63)\*2 16 (63)\*2 16 (63)\*9

PART 107 OVERLAP

BOX P106 -8.05815 -13.43025 0.0 16.1163 26.8605 164.877528

BOX M41 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M41 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 164.877528

\* Core upper left hand array

PART 108 ARRAY

5 5 1 15 (58)\*2 57 59 15 56 58 57 59 16 15 55 58 58

16 (15)\*2 (60)\*2 (16)\*3 (15)\*2

\*

PART 109 OVERLAP

BOX P108 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Core upper middle array

PART 110 ARRAY

5 5 1 (15)\*5 (57)\*5 (56)\*10 (62)\*5

\*

PART 111 OVERLAP

BOX P110 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Core upper right hand array

PART 112 ARRAY

5 5 1 59 57 58 58 15 59 57 58 56 15 58 58 55 15

16 (60)\*2 (15)\*2 16 (15)\*2 (16)\*3

\*

PART 113 OVERLAP

BOX P112 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* right hand shield array

PART 114 ARRAY

3 5 1 16 (63)\*2 16 (63)\*2 (63)\*9

PART 115 OVERLAP

BOX P114 -8.05815 -13.43025 0.0 16.1163 26.8605 164.877528

BOX M41 -8.1914 -13.5635 1.83876 16.3828 27.127 30.4

BOX M41 -8.1914 -13.5635 132.63876 16.3828 27.127 30.4

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 164.877528

\* Form the row 5 array

PART 116 ARRAY

7 1 1 107 72 109 111 113 72 115

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 6 arrays 5 groups of 5x5, one being PART 72

\*

\* Left hand array

PART 117 ARRAY

5 5 1 63 (16)\*4 (63)\*2 (16)\*3 (63)\*3 (16)\*2 (63)\*4 16 (63)\*5

\*

PART 118 OVERLAP

BOX P117 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\* Middle array

PART 119 ARRAY

5 5 1 (15)\*5 (16)\*20

\*

PART 120 OVERLAP

BOX P119 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\*

\* Right middle array

PART 121 ARRAY

5 5 1 15 (16)\*24

\*

PART 122 OVERLAP

BOX P121 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Right hand array

PART 123 ARRAY

5 5 1 (16)\*4 63 (16)\*3 (63)\*2 (16)\*2 (63)\*3 16 (63)\*9

\*

PART 124 OVERLAP

BOX P123 -13.43025 -13.43025 0.0 26.8605 26.8605 164.877528

BOX M41 -13.5635 -13.5635 1.83876 27.127 27.127 30.4

BOX M41 -13.5635 -13.5635 132.63876 27.127 27.127 30.4

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 164.877528

\*

\* Form row 6 array

PART 125 ARRAY

5 1 1 118 72 120 122 124

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 7, the top set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 126 ARRAY

5 3 1 (63)\*3 (16)\*2 (63)\*10

PART 127 OVERLAP

BOX P126 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M41 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M41 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* Centre

PART 128 ARRAY

5 3 1 (16)\*5 (63)\* 10

PART 129 OVERLAP

BOX P128 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M41 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M41 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* Right side

PART 130 ARRAY

5 3 1 (16)\*2 (63)\*13

PART 131 OVERLAP

BOX P130 -13.43025 -8.05815 0.0 26.8605 16.1163 164.877528

BOX M41 -13.5635 -8.1914 1.83876 27.127 16.3828 30.4

BOX M41 -13.5635 -8.1914 132.63876 27.127 16.3828 30.4

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 164.877528

\* combine these arrays to form the row 7 array

PART 132 ARRAY

3 1 1 127 129 131

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Cluster of superlattice groups in a circle of shield material

PART 133 CLUSTER

BOX P132 -40.6905 67.8175 0.0 81.381 16.3828 164.877528

BOX P125 -67.8175 40.6905 0.0 135.635 27.127 164.877528

BOX P116 -84.2003 13.5635 0.0 168.4006 27.127 164.877528

BOX P105 -94.9445 -13.5635 0.0 189.889 27.127 164.877528

BOX P90 -84.2003 -40.6905 0.0 168.4006 27.127 164.877528

BOX P79 -67.8175 -67.8175 0.0 135.635 27.127 164.877528

BOX P70 -40.6905 -84.2003 0.0 81.381 16.3828 164.877528

ZROD M14 0.0 0.0 -1.56 96.6 168.0

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Albedo for free boundaries at side and top and bottom

\*

ALBEDO 0.0 0.0 0.0

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN CONTROL DATA

STAGES -50 3000 3000 STDV 0.0001

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN SOURCE GEOMETRY

ZONEMAT

ALL / MATERIAL 15

END

## A1.6. Assembly 25 with the central region of 69 plate elements. Model A representation but without the grid plates.

### \* MONK9A Input Listing for Assembly 23 with the central plate region.

\* There are 45 plate elements at the core centre

\* and those at the core boundary have been replaced by pin elements.

\* There are also fewer core elements

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* material 1 - Plutonium metal plate core

\* material 2 - Plutonium metal clad

\* material 3 - UO2 plate core

\* material 4 - UO2 plate clad

\* material 5 - Sodium dummy, type Y (STNAVS4 ring)

\* material 6 - Sodium dummy type Z (STNAV4 uniform, honeycomb)

\* material 7 - 40%Steel

\* material 8 - U8 natural uranium region

\* material 9 - U2 natural uranium region

\* material 10 - U3 natural uranium block

\* material 11 - MST3 Steel block

\* material 12 - Mild steel sheath

\* material 13 - Steel bar MST9F10 at actual density (width 5.08 cm)

\* material 14 - Steel bar averaged over the mean spacing of 5.4254 cm

\* material 15 - Pin fuel A

\* material 16 - Pin fuel B

\* material 17 - Pin fuel C

\* material 18 - Pin fuel D

\* material 19 - Pin fuel E

\* material 20 - Pin fuel F

\* material 21 - Pin fuel UPINC

\* material 22 - Pin can A

\* material 23 - Pin can B

\* material 24 - Pin can C

\* material 25 - Pin can D

\* material 26 - Pin can E

\* material 27 - Pin can F

\* material 28 - Pin can UPINC

\* material 29 - Tube

\* material 30 - Calandria end regions

\* material 31 - Calandria Walls Type NACLI

\* material 32 - Calandria Walls Type NACLIIS

\* material 33 - Calandria Walls Type NACLIII

\* material 34 - Calandria Walls Type NACLIV

\* material 35 - Calandria Walls Type NACLV

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

COLUMNS 1 132

BEGIN MATERIAL SPECIFICATION

NUMBER DENSITY

MATERIAL 1

U238 6.8782E-07 PU238 3.0461E-05 PU239 2.8920E-02

PU240 6.9095E-03 PU241 7.3960E-04 PU242 1.8699E-04

AM241 4.5718E-04

H1 1.2764E-04 C 4.2260E-04 N 2.4215E-05 O16 8.8450E-05

AL 2.2973E-05 SI 1.4158E-05 CR 3.5989E-06 MN 1.4902E-06

FE 1.6335E-05 NI 8.5688E-06 GA 2.0166E-03

MATERIAL 2

H1 1.3760E-05 C 1.1393E-04 SI 3.6607E-04 P 1.3731E-05

CR 9.4011E-03 MN 8.5931E-04 FE 3.5542E-02 NI 4.1646E-03

CU 1.6613E-02

MATERIAL 3

H1 3.1773E-05 C 1.1808E-05 O16 4.6008E-02 AL 3.3911E-06

SI 2.2967E-05 MN 8.3273E-08 FE 1.3107E-06 NI 1.2472E-06

MO 3.3379E-07 U235 1.6544E-04 U238 2.2837E-02

MATERIAL 4

H1 1.9035E-05 C 1.2831E-04 SI 6.4475E-04 P 3.5078E-04

S 3.6041E-05 CR 1.3819E-02 MN 8.5559E-04 FE 4.8306E-02

NI 8.4258E-03

MATERIAL 5

H1 2.4073E-05 C 2.5251E-04 SI 7.4610E-04 P 1.7803E-05

S 1.7195E-05 CR 1.6248E-02 MN 1.5006E-03 FE 5.9881E-02

NI 9.4005E-03 NB 3.7393E-04

MATERIAL 6

H1 3.3245E-06 C 3.3477E-05 SI 1.2169E-04 P 4.9764E-06

S 2.5076E-06 CR 2.4643E-03 MN 1.9518E-04 FE 8.0717E-03

NI 1.2195E-03 NB 5.2657E-05

MATERIAL 7

H1 1.8355E-05 C 8.7794E-05 AL 1.1862E-04 SI 7.9703E-04

P 4.0018E-05 S 1.4422E-05 TI 2.4806E-04 CR 1.5908E-02

MN 1.4972E-03 FE 5.5367E-02 NI 8.7976E-03 CU 5.0365E-05

NB 4.9781E-06 MO 8.0988E-05

MATERIAL 8

H1 4.4048E-05 C 4.9283E-04 SI 2.1076E-04 FE 1.0599E-04

U235 3.3369E-04 U238 4.6021E-02

MATERIAL 9

H1 4.3899E-05 C 4.6047E-04 SI 1.9692E-04 FE 9.9032E-05

U235 3.3962E-04 U238 4.6785E-02

MATERIAL 10

H1 4.4574E-05 C 4.7140E-04 SI 2.0160E-04 FE 1.0138E-04

U235 3.4209E-04 U238 4.7156E-02

MATERIAL 11

H1 2.5700E-05 C 5.1066E-04 AL 1.3989E-04 TI 3.9416E-05

CR 2.7222E-05 MN 3.2634E-04 FE 8.3806E-02 NI 4.8234E-05

CU 4.4548E-05 MO 9.8355E-06

MATERIAL 12

H1 7.5712E-05 C 2.3825E-04 AL 1.9798E-05 CR 3.6690E-06

MN 2.5697E-04 FE 7.7524E-02 NI 1.4302E-05 CU 2.2216E-05

MATERIAL 13

H1 4.6306E-05 C 6.8972E-04 SI 3.1158E-04 P 4.2944E-05

S 3.7110E-05 MN 7.1275E-04 FE 8.1432E-02

MATERIAL 14

H1 4.0597E-05 C 6.0468E-04 SI 2.7317E-04 P 3.7649E-05

S 3.2535E-05 MN 6.2488E-04 FE 7.1392E-02

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Pin fuel A, B, C, D, E, F and U

MATERIAL 15

U234 1.3805E-06 U235 1.4114E-04 U236 7.9324E-07 U238 1.9379E-02

PU238 3.7786E-06 PU239 2.9689E-03 PU240 6.7253E-04 PU241 7.0350E-05

PU242 1.7488E-05 AM241 4.7854E-05

H1 3.2784E-05 O16 4.6606E-02 AL 1.1702E-05 CA 7.8782E-06 FE 5.6537E-06

MATERIAL 16

U234 1.3177E-06 U235 1.3457E-04 U236 7.4658E-07 U238 1.8472E-02

PU238 5.8915E-06 PU239 3.7341E-03 PU240 9.5200E-04 PU241 1.1199E-04

PU242 2.7984E-05 AM241 5.5789E-05

H1 3.2784E-05 O16 4.6993E-02 SI 9.0199E-06 NI 5.4424E-06

MATERIAL 17

U234 1.2863E-06 U235 1.2997E-04 U236 7.3103E-07 U238 1.7843E-02

PU238 6.9094E-06 PU239 4.4708E-03 PU240 1.0602E-03 PU241 1.1598E-04

PU242 3.0047E-05 AM241 5.7784E-05

H1 3.2784E-05 O16 4.7434E-02 AL 1.9730E-05 SI 7.9741E-06

FE 7.6916E-06 NI 1.0947E-05

MATERIAL 18

U234 1.4118E-06 U235 1.4266E-04 U236 7.9324E-07 U238 1.9584E-02

PU238 4.7348E-06 PU239 3.0189E-03 PU240 7.5441E-04 PU241 8.8443E-05

PU242 2.0961E-05 AM241 4.0742E-05

H1 3.2784E-05 O16 4.7314E-02 AL 1.8914E-05 SI 2.5099E-05

CA 1.5940E-05 FE 6.9027E-06 NI 1.4138E-05

MATERIAL 19

U234 1.1295E-06 U235 1.1465E-04 U236 6.3771E-07 U238 1.5739E-02

PU238 9.4851E-06 PU239 6.0438E-03 PU240 1.5103E-03 PU241 1.7707E-04

PU242 4.1953E-05 AM241 8.1559E-05

H1 3.2784E-05 O16 4.7299E-02 AL 9.5250E-06 SI 4.5753E-05

CA 3.2062E-05 FE 1.0321E-05

MATERIAL 20

U234 1.1452E-06 U235 1.1526E-04 U236 6.3771E-07 U238 1.5824E-02

PU238 9.5005E-06 PU239 6.0112E-03 PU240 1.5285E-03 PU241 1.9723E-04

PU242 4.4380E-05 AM241 6.8035E-05

H1 3.2784E-05 O16 4.7482E-02 AL 1.4287E-05 CA 6.7514E-05

CR 4.9427E-06 FE 1.1505E-05 NI 2.1895E-06

\* UO2 fuel pin

MATERIAL 21

U235 1.7604E-04 U238 2.3580E-02

H1 3.2784E-05 C 3.2095E-05 O16 4.7501E-02 AL 2.3812E-05

SI 4.0001E-05 CA 1.2825E-05 FE 1.1176E-06

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Fuel pin cans

MATERIAL 22

H1 2.6710E-05 C 1.3288E-04 SI 8.5585E-04 P 3.7870E-05 S 2.4585E-05

CR 1.8218E-02 MN 1.5646E-03 FE 5.9675E-02 NI 8.9153E-03

MATERIAL 23

H1 2.2895E-05 C 2.3695E-04 SI 1.1571E-03 P 4.1596E-05 S 2.2786E-05

CR 1.4981E-02 MN 1.5751E-03 FE 5.3171E-02 NI 8.8137E-03

NB 2.9391E-04

MATERIAL 24

H1 2.6710E-05 C 1.3609E-04 SI 8.3531E-04 P 3.6008E-05 S 2.4585E-05

CR 1.7856E-02 MN 1.5331E-03 FE 5.8512E-02 NI 8.7515E-03

MATERIAL 25

H1 2.4802E-05 C 2.0172E-04 AL 6.4142E-06 SI 8.9693E-04 P 3.4145E-05

S 8.9942E-06 TI 2.8916E-05 CR 1.5910E-02 MN 1.1586E-03 FE 5.5753E-02

CO 4.2418E-06 NI 7.6341E-03 CU 6.0522E-06 MO 2.2047E-06

MATERIAL 26

H1 2.4802E-05 C 7.3646E-05 AL 6.4142E-06 SI 1.0476E-03 P 1.3658E-05

S 1.7389E-05 TI 2.8916E-05 CR 1.6102E-02 MN 9.8006E-04 FE 5.6794E-02

CO 4.2418E-06 NI 8.0503E-03 CU 6.0522E-06 MO 2.1446E-05

MATERIAL 27

H1 2.4802E-05 C 7.2045E-05 AL 4.2762E-06 SI 1.0544E-03 P 1.3658E-05

S 1.7989E-05 TI 2.1687E-05 CR 1.6284E-02 MN 9.8357E-04 FE 5.7354E-02

CO 3.2629E-06 NI 8.1453E-03 CU 4.5391E-06 MO 2.1246E-05

MATERIAL 28

H1 2.6710E-05 C 1.3288E-04 SI 8.5585E-04 P 3.7870E-05

S 2.4585E-05 CR 1.8255E-02 MN 1.5681E-03 FE 5.9792E-02

NI 8.9349E-03

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Composition of calandria tubes

MATERIAL 29

SI 1.0632E-03 CR 1.6787E-02 MN 1.3588E-03 FE 6.0762E-02

NI 7.4360E-03

\* Composition of Calandria end plate regions

MATERIAL 30

SI 5.5206E-04 CR 1.0016E-02 MN 7.7198E-04 FE 3.5578E-02

NI 4.4601E-03

\* Compositions of Calandria outer walls

MATERIAL 31

H1 3.9844E-05 C 2.8167E-04 SI 6.0229E-04 P 7.3471E-05 S 3.6808E-05

CR 1.4995E-02 MN 1.2214E-03 FE 4.8911E-02 NI 7.2440E-03

MATERIAL 32

H1 3.8637E-05 C 6.5351E-04 SI 9.7623E-04 P 4.7540E-05 S 3.3014E-05

TI 2.4400E-04 CR 1.4380E-02 MN 1.1060E-03 FE 4.7118E-02 CO 1.1151E-05

NI 7.4526E-03 CU 1.0341E-05 MO 3.4248E-06

MATERIAL 33

H1 3.9844E-05 C 1.5948E-04 SI 7.7474E-04 P 5.2334E-05 S 2.4551E-05

CR 1.4132E-02 MN 8.3089E-04 FE 5.0764E-02 NI 7.6658E-03 MO 2.4862E-05

MATERIAL 34

H1 3.7430E-05 C 3.5158E-04 SI 8.2197E-04 P 6.2274E-05 S 1.6431E-05

CR 1.3563E-02 MN 1.0026E-03 FE 4.7151E-02 NI 6.4549E-03 MO 8.8791E-06

MATERIAL 35

H1 3.8637E-05 C 2.4762E-04 SI 9.5110E-04 P 4.5654E-05 S 2.3793E-05

CR 1.3837E-02 MN 8.6191E-04 FE 4.8404E-02 NI 6.8530E-03 MO 2.4862E-05

END

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

BEGIN MATERIAL GEOMETRY

\*

\* Plate 1, the Pu metal plate

PART 1 NEST

BOX M1 -2.3355 -2.3355 0.0457 4.671 4.671 0.236

BOX M2 -2.5335 -2.5335 0.0 5.067 5.067 0.3274

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.3274

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.3274

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.3274

\*

\* Plate 2, the UO2 plate

PART 2 NEST

BOX M3 -2.4285 -2.4285 0.03665 4.857 4.857 0.558

BOX M4 -2.5335 -2.5335 0.0 5.067 5.067 0.6313

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.6313

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.6313

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.6313

\*

\* Plate 3, the sodium dummy plate type Z, STNAV4 (uniform)

PART 3 NEST

BOX M6 -2.5335 -2.5335 0.0 5.067 5.067 0.616

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.616

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.616

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.616

\*

\* Plate 4, the 40% steel plate

PART 4 NEST

BOX M0 -1.9625 -1.9625 0.0 3.925 3.925 0.317

BOX M7 -2.5335 -2.5335 0.0 5.067 5.067 0.317

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.317

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.317

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.317

\*

\* Core Cell 1Z

PART 5 ARRAY

1 1 7 3 2 4 1 3 2 3

\* Core Cell 2Z, the reflection of cell 1

PART 6 ARRAY

1 1 7 3 2 3 1 4 2 3

\*

\* Core Cell 3Z This is Cell 1 minus Plate 4

PART 7 ARRAY

1 1 6 3 2 1 3 2 3

\*Core Cell 4Z the reflection of cell 3, Cell 2 minus Plate 4

PART 8 ARRAY

1 1 6 3 2 3 1 2 3

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Axial blanket U8 section

PART 9 NEST

BOX M8 -2.5335 -2.5335 0.0 5.067 5.067 9.827

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 9.827

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 9.827

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 9.827

\*

\* Axial blanket U2 section

PART 10 NEST

BOX M9 -2.5335 -2.5335 0.0 5.067 5.067 12.723

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 12.723

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 12.723

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 12.723

\*

\* Axial blanket U3 section

PART 11 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 7.6225

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.6225

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.6225

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.6225

\*

\* Axial reflector MST3 section

PART 12 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 7.60628

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.60628

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.60628

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.60628

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Radial blanket U3 section (over half core height)

\* (height to match the core elements)

PART 13 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 76.225

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 76.225

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 76.225

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 76.225

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* A whole height model.

\* The axial height of the pin cell elements is slightly less than

\* that of the plate cell elements, 89.19 cm compared with 89.486 cm.

\* (0.296 cm = 2 \* 0.148 cm)

\*

\* The axial shielding material in the minicalandria elements

\* is extended in the model to cover this distance

\* Axial steel reflector section extended 0.148 cm in length

PART 14 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 7.75428

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 7.75428

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 7.75428

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 7.75428

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* The Core Element type Z (full height)

PART 15 ARRAY

1 1 32 12 11 10 9 8 (5 6)\*11 7 9 10 11 12

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Axial steel reflector section above the radial blanket reduced

\* in length to match the core elements

PART 16 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 6.29678

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 6.29678

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 6.29678

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 6.29678

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Specification of the pin cells, A to F and U/C

\* Pin cell A

PART 17 NEST

ZROD M15 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M22 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell B

PART 18 NEST

ZROD M16 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M23 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell C

PART 19 NEST

ZROD M17 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M24 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell D

PART 20 NEST

ZROD M18 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M25 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell E

PART 21 NEST

ZROD M19 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M26 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell F

PART 22 NEST

ZROD M20 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M27 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell U/C

PART 23 NEST

ZROD M21 0.0 0.0 0.0 0.423 29.18

ZROD M0 0.0 0.0 0.0 0.4305 29.18

ZROD M28 0.0 0.0 0.0 0.4685 29.18

ZROD M0 0.0 0.0 0.0 0.488 29.18

ZROD M29 0.0 0.0 0.0 0.513 29.18

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini-calandria

\* Mini calandria 3A,

\* 16 PUPINC in void square

\* Pin C in square of void

PART 24 NEST

ZROD P19 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in calandria inner region

PART 25 ARRAY

4 4 1 (24)\*16

\* mini-calandria in the element sheath (M12)

PART 26 NEST

BOX P25 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M31 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3B,

\* 11 PUPINB and 5 PUPINF in void

\* Pin B in square void region

PART 27 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 28 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in void inner calandria region

PART 29 ARRAY

4 4 1 27 27 28 27 27 27 27 28 28 27 28 27 27 28 27 27

\* mini-calandria in the element sheath (M12)

PART 30 NEST

BOX P29 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M31 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3H,

\* 11 PUPINB and 5 PUPINF

\* Pin B in square

PART 31 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square

PART 32 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins

PART 33 ARRAY

4 4 1 31 31 32 31 31 31 31 32 32 31 32 31 31 32 31 31

\* mini-calandria in the element sheath (M12)

PART 34 NEST

BOX P33 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M35 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3L,

\* 11 PUPINB and 5 PUPINF

\* Pin B in void square

PART 35 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in void square

PART 36 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins

PART 37 ARRAY

4 4 1 35 35 36 35 35 35 35 36 36 35 36 35 35 36 35 35

\* mini-calandria in the element sheath (M12)

PART 38 NEST

BOX P37 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M34 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3C,

\* 8 PUPINA and 8 PUPINE

\* Pin A in void square

PART 39 NEST

ZROD P17 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin E in void square

PART 40 NEST

ZROD P21 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins

PART 41 ARRAY

4 4 1 39 40 39 40 40 39 40 39 39 40 39 40 40 39 40 39

\* mini-calandria in the element sheath (M12)

PART 42 NEST

BOX P41 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M33 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3D,

\* 8 PUPIND and 8 PUPINF in NACLIII

\* Pin D in void square

PART 43 NEST

ZROD P20 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in void square

PART 44 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 45 ARRAY

4 4 1 43 44 43 44 44 43 44 43 43 44 43 44 44 43 44 43

\* mini-calandria in the element sheath (M12)

PART 46 NEST

BOX P45 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M33 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3E,

\* 8 PUPIND and 8 PUPINF

\* Pin D in void square

PART 47 NEST

ZROD P20 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 48 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins

PART 49 ARRAY

4 4 1 47 48 47 48 48 47 48 47 47 48 47 48 48 47 48 47

\* mini-calandria in the element sheath (M12)

PART 50 NEST

BOX P49 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M32 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3J,

\* 12 PUPINE and 4 UO2PINC

\* Pin E in void square

PART 51 NEST

ZROD P21 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in void square

PART 52 NEST

ZROD P23 0.0 0.0 0.0 0.513 29.18

BOX M0 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins

PART 53 ARRAY

4 4 1 (51)\*3 52 51 52 (51)\*5 52 51 52 (51)\*2

\* mini-calandria in the element sheath (M12)

PART 54 NEST

BOX P53 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M0 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M34 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 29.73

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 29.73

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* form the pin fuelled elements 3A to 3L

\* Element 3A

PART 55 ARRAY

1 1 11 14 11 10 9 (26)\*3 9 10 11 14

\* Element 3B

PART 56 ARRAY

1 1 11 14 11 10 9 (30)\*3 9 10 11 14

\* Element 3C

PART 57 ARRAY

1 1 11 14 11 10 9 (42)\*3 9 10 11 14

\* Element 3D

PART 58 ARRAY

1 1 11 14 11 10 9 (46)\*3 9 10 11 14

\* Element 3E

PART 59 ARRAY

1 1 11 14 11 10 9 (50)\*3 9 10 11 14

\* Element 3H

PART 60 ARRAY

1 1 11 14 11 10 9 (34)\*3 9 10 11 14

\* Element 3J

PART 61 ARRAY

1 1 11 14 11 10 9 (54)\*3 9 10 11 14

\* Element 3L

PART 62 ARRAY

1 1 11 14 11 10 9 (38)\*3 9 10 11 14

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Steel reflector bars

\* (height adjusted to match the height of the core plate elements)

PART 63 NEST

BOX M13 -2.54 -2.54 0.0 5.08 5.08 165.04356

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 165.04356

\*

\*

\*The Radial Blanket element

PART 64 ARRAY

1 1 4 16 13 13 16

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Plate 3Y, the sodium dummy plate type Y, STNAVS4 (ring)

PART 65 NEST

ZROD M0 0.0 0.0 0.0 2.3 0.616

ZROD M5 0.0 0.0 0.0 2.5335 0.616

BOX M0 -2.5510 -2.5510 0.0 5.102 5.102 0.616

BOX M12 -2.6272 -2.6272 0.0 5.2544 5.2544 0.616

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 0.616

\*

\*

\* Core Cell 1Y

PART 66 ARRAY

1 1 7 65 2 4 1 65 2 65

\* Core Cell 2Y, the reflection of cell 1

PART 67 ARRAY

1 1 7 65 2 65 1 4 2 65

\*

\* Core Cell 3Y This is Cell 1Y minus Plate 4

PART 68 ARRAY

1 1 6 65 2 1 65 2 65

\*Core Cell 4Y the reflection of cell 3Y, Cell 2Y minus Plate 4

PART 69 ARRAY

1 1 6 65 2 65 1 2 65

\*

\* The Core Element type Y (full height)

PART 70 ARRAY

1 1 32 12 11 10 9 69 (66 67)\*11 68 9 10 11 12

\*

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* assemble the arrays of elements

\*

\* Groups of 5x5 elements surrounded by the superlattice gap

\* With groups of 5x3 in rows 1 and 7 and 3x5 in rows 3 and 5

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 1, the lowest set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 71 ARRAY

5 3 1 (63)\*13 (64)\*2

PART 72 NEST

BOX P71 -13.43025 -8.05815 0.0 26.8605 16.1163 165.04356

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 165.04356

\* Centre

PART 73 ARRAY

5 3 1 (63)\*10 (64)\*5

PART 74 NEST

BOX P73 -13.43025 -8.05815 0.0 26.8605 16.1163 165.04356

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 165.04356

\* Right side

PART 75 ARRAY

5 3 1 (63)\*10 (64)\*2 (63)\*3

PART 76 NEST

BOX P75 -13.43025 -8.05815 0.0 26.8605 16.1163 165.04356

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 165.04356

\* combine these arrays to form the row 1 array

PART 77 ARRAY

3 1 1 72 74 76

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 7, the top set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 78 ARRAY

5 3 1 (63)\*3 (64)\*2 (63)\*10

PART 79 NEST

BOX P78 -13.43025 -8.05815 0.0 26.8605 16.1163 165.04356

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 165.04356

\* Centre

PART 80 ARRAY

5 3 1 (64)\*5 (63)\*10

PART 81 NEST

BOX P80 -13.43025 -8.05815 0.0 26.8605 16.1163 165.04356

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 165.04356

\* Right side

PART 82 ARRAY

5 3 1 (64)\*2 (63)\*13

PART 83 NEST

BOX P82 -13.43025 -8.05815 0.0 26.8605 16.1163 165.04356

BOX M0 -13.5635 -8.1914 0.0 27.127 16.3828 165.04356

\* combine these arrays to form the row 7 array

PART 84 ARRAY

3 1 1 79 81 83

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 2. 5 arrays of 5x5 elements

\* Left hand array

PART 85 ARRAY

5 5 1 (63)\*9 64 (63)\*3 (64)\*2 (63)\*2 (64)\*3 63 (64)\*4

\*

PART 86 NEST

BOX P85 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Middle left blanket elements

PART 87 ARRAY

5 5 1 (64)\*25

\*

PART 88 NEST

BOX P87 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\*

\* Middle array blanket elements plus five 3C3

PART 89 ARRAY

5 5 1 (64)\*20 (57)\*5

\*

PART 90 NEST

BOX P89 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Middle right blanket elements plus one (301)

PART 91 ARRAY

5 5 1 (64)\*20 59 (64)\*4

\*

PART 92 NEST

BOX P91 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\*

\* Right hand array

PART 93 ARRAY

5 5 1 (63)\*5 64 (63)\*4 (64)\*2 (63)\*3 (64)\*3 (63)\*2 (64)\*4 63

\*

PART 94 NEST

BOX P93 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Form row 2 array

PART 95 ARRAY

5 1 1 86 88 90 92 94

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 6 arrays 5 groups of 5x5,

\*

\* Left hand array

PART 96 ARRAY

5 5 1 63 (64)\*4 (63)\*2 (64)\*3 (63)\*3 (64)\*2 (63)\*4 64 (63)\*5

\*

PART 97 NEST

BOX P96 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Middle left array (one 387 element, 56)

PART 98 ARRAY

5 5 1 (64)\*4 56 (64)\*20

\*

PART 99 NEST

BOX P98 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Middle array (4 3C3 and one 387 element)

PART 100 ARRAY

5 5 1 (57)\*4 56 (64)\*20

\*

PART 101 NEST

BOX P100 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Middle right array

PART 102 ARRAY

5 5 1 (64)\*25

\*

PART 103 NEST

BOX P102 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Right hand array

PART 104 ARRAY

5 5 1 (64)\*4 63 (64)\*3 (63)\*2 (64)\*2 (63)\*3 64 (63)\*9

\*

PART 105 NEST

BOX P104 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Form row 6 array

PART 106 ARRAY

5 1 1 97 99 101 103 105

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 3, 7 groups, the two end groups being 3x5 arrays of shield

\* elements plus two blanket elements

\*

\* Left hand array

PART 107 ARRAY

3 5 1 (63)\*11 64 (63)\*2 64

PART 108 NEST

BOX P107 -8.05815 -13.43025 0.0 16.1163 26.8605 165.04356

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 165.04356

\*

\* left hand blanket array

PART 109 ARRAY

5 5 1 (64)\*25

PART 110 NEST

BOX P109 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Core lower left hand array (additional Y and Z elements

\* compared with the flooded core)

PART 111 ARRAY

5 5 1 (64)\*2 59 (57)\*2 64 57 59 (60)\*2 (57)\*2 55 58 60

57 (58)\*2 57 59 57 (58)\*2 57 70

\*

PART 112 NEST

BOX P111 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Core lower middle array

PART 113 ARRAY

5 5 1 (62)\*5 (56)\*10 15 70 (15)\*3 15 70 (15)\*3

\*

PART 114 NEST

BOX P113 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Core lower right hand array

PART 115 ARRAY

5 5 1 (57)\*2 58 (64)\*2 (60)\*2 58 57 64 60 58 55 (57)\*2

59 57 58 59 57 15 57 58 59 57

\*

PART 116 NEST

BOX P115 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* right hand blanket array

PART 117 ARRAY

5 5 1 (64)\*25

PART 118 NEST

BOX P117 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* right hand array

PART 119 ARRAY

3 5 1 (63)\*9 64 (63)\*2 64 (63)\*2

PART 120 NEST

BOX P119 -8.05815 -13.43025 0.0 16.1163 26.8605 165.04356

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 165.04356

\* Form the row 3 array

PART 121 ARRAY

7 1 1 108 110 112 114 116 118 120

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 5. 7 arrays, the first and last being 3x5 and the remainder 5x5

\* including the two blanket 5x5 groups.

\*

\* Left hand shield array

PART 122 ARRAY

3 5 1 (63)\*2 64 (63)\*2 64 (63)\*9

PART 123 NEST

BOX P122 -8.05815 -13.43025 0.0 16.1163 26.8605 165.04356

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 165.04356

\*

\* left hand blanket array

PART 124 ARRAY

5 5 1 (64)\*25

PART 125 NEST

BOX P124 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Core upper left hand array

PART 126 ARRAY

5 5 1 57 (58)\*2 57 15 57 56 58 57 59 (57)\*2 55 58 58

64 57 58 (60)\*2 (64)\*2 58 (57)\*2

\*

PART 127 NEST

BOX P126 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Core upper middle array

PART 128 ARRAY

5 5 1 (15)\*3 70 15 (15)\*3 70 15 (56)\*10 (62)\*5

\*

PART 129 NEST

BOX P128 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Core upper right hand array

PART 130 ARRAY

5 5 1 15 57 58 58 57 59 57 58 56 57

58 58 55 (59)\*2 (60)\*2 58 57 64 (57)\*3 (64)\*2

\*

PART 131 NEST

BOX P130 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* right hand blanket array

PART 132 ARRAY

5 5 1 (64)\*25

PART 133 NEST

BOX P132 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* right hand shield array

PART 134 ARRAY

3 5 1 64 (63)\*2 64 (63)\*11

PART 135 NEST

BOX P134 -8.05815 -13.43025 0.0 16.1163 26.8605 165.04356

BOX M0 -8.1914 -13.5635 0.0 16.3828 27.127 165.04356

\* Form the row 5 array

PART 136 ARRAY

7 1 1 123 125 127 129 131 133 135

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 4 (the middle row) 7 groups of 5x5 elements

\* Left hand shield group

PART 137 ARRAY

5 5 1 (63)\*4 64 (63)\*4 64 (63)\*4 64 (63)\*4 64 (63)\*4 64

\*

PART 138 NEST

BOX P137 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Left hand centre blanket group

PART 139 ARRAY

5 5 1 (64)\*4 57 (64)\*4 57 (64)\*4 57 (64)\*4 57 (64)\*4 57

\*

PART 140 NEST

BOX P139 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Left hand centre core group

PART 141 ARRAY

5 5 1 55 61 58 (15)\*2 55 (58)\*2 (70)\*2 56 (59)\*2 (70)\*2

55 58 55 (15)\*2 55 61 55 (15)\*2

\*

PART 142 NEST

BOX P141 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Centre core group

PART 143 ARRAY

5 5 1 (70)\*4 15 (70)\*10 15 (70)\*9

\*

PART 144 NEST

BOX P143 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Right hand centre core group

PART 145 ARRAY

5 5 1 70 15 58 61 55 (15)\*2 (58)\*2 55 70 15 (59)\*2 56

(15)\*2 55 58 55 (15)\*2 55 61 55

\*

PART 146 NEST

BOX P145 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Right hand central row blanket group

PART 147 ARRAY

5 5 1 57 (64)\*4 57 (64)\*4 57 (64)\*4 57 (64)\*4 57 (64)\*4

\*

PART 148 NEST

BOX P147 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Right hand shield group

PART 149 ARRAY

5 5 1 64 (63)\*4 64 (63)\*4 64 (63)\*4 64 (63)\*4 64 (63)\*4

\*

PART 150 NEST

BOX P149 -13.43025 -13.43025 0.0 26.8605 26.8605 165.04356

BOX M0 -13.5635 -13.5635 0.0 27.127 27.127 165.04356

\*

\* Form the row 4 array

PART 151 ARRAY

7 1 1 138 140 142 144 146 148 150

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Cluster of superlattice groups in a circle of shield material

PART 152 CLUSTER

BOX P84 -40.6905 67.8175 0.0 81.381 16.3828 165.04356

BOX P106 -67.8175 40.6905 0.0 135.635 27.127 165.04356

BOX P136 -84.2003 13.5635 0.0 168.4006 27.127 165.04356

BOX P151 -94.9445 -13.5635 0.0 189.889 27.127 165.04356

BOX P121 -84.2003 -40.6905 0.0 168.4006 27.127 165.04356

BOX P95 -67.8175 -67.8175 0.0 135.635 27.127 165.04356

BOX P77 -40.6905 -84.2003 0.0 81.381 16.3828 165.04356

ZROD M14 0.0 0.0 -1.56 96.6 168.0

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Albedo for free boundaries at side and top and bottom

\*

ALBEDO 0.0 0.0 0.0

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN CONTROL DATA

STAGES -50 2000 2000 STDV 0.0001

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN SOURCE GEOMETRY

ZONEMAT

ALL / MATERIAL 1

END

### A1.7.Simplified MONK Models

### \* MONK8B Input Listing for Assembly 22B, Model B

\* Simplified treatment of the sheath and neighbouring void regions

\* Modified material 12

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

MATERIAL 12

H1 3.7519E-05 C 1.1807E-04 AL 9.8110E-06 CR 1.8182E-06

MN 1.2734E-04 FE 3.8417E-02 NI 7.0874E-06 CU 1.1009E-05 \*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN MATERIAL GEOMETRY

\*

\* Plate 1, the Pu metal plate

PART 1 NEST

BOX M1 -2.3355 -2.3355 0.0457 4.671 4.671 0.236

BOX M2 -2.5335 -2.5185 0.0 5.067 5.067 0.3274

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 0.3274

\*

\* Plate 2, the UO2 plate

PART 2 NEST

BOX M3 -2.4285 -2.4285 0.03665 4.857 4.857 0.558

BOX M4 -2.5335 -2.5335 0.0 5.067 5.067 0.6313

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 0.6313

\*

\* Plate 3, the sodium plate

PART 3 NEST

BOX M5 -2.4815 -2.4815 0.036347 4.963 4.963 0.541

BOX M6 -2.5335 -2.5335 0.0 5.067 5.067 0.613694

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 0.613694

\*

\* Plate 4, the 40% steel plate

PART 4 NEST

BOX M0 -1.9625 -1.9625 0.0 3.925 3.925 0.317

BOX M7 -2.5335 -2.5335 0.0 5.067 5.067 0.317

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 0.317

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Core Cell 1

PART 5 ARRAY

1 1 7 3 2 4 1 3 2 3

\* Core Cell 2

PART 6 ARRAY

1 1 7 3 2 3 1 4 2 3

\*

\* Core Cell 3

PART 7 ARRAY

1 1 6 3 2 1 3 2 3

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Axial blanket U8 section

PART 8 NEST

BOX M8 -2.5335 -2.5335 0.0 5.067 5.067 9.827

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 9.827

\*

\* Axial blanket U2 section

PART 9 NEST

BOX M9 -2.5335 -2.5335 0.0 5.067 5.067 12.723

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 12.723

\*

\* Axial blanket U3 section

PART 10 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 7.6225

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 7.6225

\*

\* Axial reflector MST3 section

PART 11 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 7.60628

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 7.60628

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Radial blanket U3 section (over half core height)

PART 12 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 74.83248

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 74.83248

\*

\* Steel reflector bars (over half core height)

PART 13 NEST

BOX M13 -2.54 -2.54 0.0 5.08 5.08 82.438764

BOX M0 -2.68605 -2.68605 0.0 5.3721 5.3721 82.438764

\*

### \* MONK9A Input Listing for Assembly 22B Model C,

\* The lattice pitch is changed to 5.4254 cm and the sheath homogenised

\* Material 12 is changed

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

MATERIAL 12

H1 3.1777E-05 C 9.9996E-05 AL 8.3095E-06 CR 1.5399E-06

MN 1.0785E-04 FE 3.2538E-02 NI 6.0027E-06 CU 9.3243E-06

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN MATERIAL GEOMETRY

\*

\* Plate 1, the Pu metal plate

PART 1 NEST

BOX M1 -2.3355 -2.3355 0.0457 4.671 4.671 0.236

BOX M2 -2.5335 -2.5185 0.0 5.067 5.067 0.3274

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 0.3274

\*

\* Plate 2, the UO2 plate

PART 2 NEST

BOX M3 -2.4285 -2.4285 0.03665 4.857 4.857 0.558

BOX M4 -2.5335 -2.5335 0.0 5.067 5.067 0.6313

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 0.6313

\*

\* Plate 3, the sodium plate

PART 3 NEST

BOX M5 -2.4815 -2.4815 0.036347 4.963 4.963 0.541

BOX M6 -2.5335 -2.5335 0.0 5.067 5.067 0.613694

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 0.613694

\*

\* Plate 4, the 40% steel plate

PART 4 NEST

BOX M0 -1.9625 -1.9625 0.0 3.925 3.925 0.317

BOX M7 -2.5335 -2.5335 0.0 5.067 5.067 0.317

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 0.317

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Core Cell 1

PART 5 ARRAY

1 1 7 3 2 4 1 3 2 3

\* Core Cell 2

PART 6 ARRAY

1 1 7 3 2 3 1 4 2 3

\*

\* Core Cell 3

PART 7 ARRAY

1 1 6 3 2 1 3 2 3

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Axial blanket U8 section

PART 8 NEST

BOX M8 -2.5335 -2.5335 0.0 5.067 5.067 9.827

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 9.827

\*

\* Axial blanket U2 section

PART 9 NEST

BOX M9 -2.5335 -2.5335 0.0 5.067 5.067 12.723

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 12.723

\*

\* Axial blanket U3 section

PART 10 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 7.6225

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 7.6225

\*

\* Axial reflector MST3 section

PART 11 NEST

BOX M11 -2.5335 -2.5335 0.0 5.067 5.067 7.60628

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 7.60628

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Radial blanket U3 section (over half core height)

PART 12 NEST

BOX M10 -2.5335 -2.5335 0.0 5.067 5.067 74.83248

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 74.83248

\*

\* Steel reflector bars (over half core height)

PART 13 NEST

BOX M13 -2.54 -2.54 0.0 5.08 5.08 82.438764

BOX M0 -2.7127 -2.7127 0.0 5.4254 5.4254 82.438764

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* The Core Element (half height)(bottom cell 2 reflected at Z=0)

PART 14 ARRAY

1 1 16 (6 5)\*5 6 7 8 9 10 11

\*

\*The Radial Blanket element (half height)(Cell 8 reflected at Z = 0)

PART 15 ARRAY

1 1 2 12 11

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Insert special element at the core centre

\*

\* Plate 16, the Pu metal plate at the core centre

PART 16 NEST

BOX M15 -2.3355 -2.3355 0.0457 4.671 4.671 0.236

BOX M2 -2.5335 -2.5185 0.0 5.067 5.067 0.3274

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 0.3274

\*

\* Plate 17, the UO2 plate

PART 17 NEST

BOX M16 -2.4285 -2.4285 0.03665 4.857 4.857 0.558

BOX M4 -2.5335 -2.5335 0.0 5.067 5.067 0.6313

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 0.6313

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Special cell at the core centre

\*

PART 18 ARRAY

1 1 7 3 17 4 16 3 17 3

\* Special element at core centre

\*

\* Neighbouring cell at the core centre

\*

PART 19 ARRAY

1 1 7 3 17 3 16 4 17 3

\*

\* The Special Core Element (half height)(bottom cell 2 reflected at Z=0)

PART 20 ARRAY

1 1 16 (19 18)\*2 (6 5)\*3 6 7 8 9 10 11

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Groups of 5x5 elements forming a superlattice group

\* Core group

PART 21 ARRAY

5 5 1 (14)\*25

\*

\* Core bottom left corner group

PART 22 ARRAY

5 5 1 (15)\*3 (14)\*2 15 (14)\*4 15 (14)\*14

\*

\* Core bottom right group

PART 23 ARRAY

5 5 1 (14)\*2 (15)\*3 (14)\*3 (15)\*2 (14)\*4 15 (14)\*10

\*

\* Core top left corner group

PART 24 ARRAY

5 5 1 (14)\*10 15 (14)\*4 (15)\*2 (14)\*3 (15)\*3 (14)\*2

\*

\* Core top right group

PART 25 ARRAY

5 5 1 (14)\*14 15 (14)\*4 15 (14)\*2 (15)\*3

\*

\* Core bottom group

PART 26 ARRAY

5 5 1 (15)\*21 (14)\*3 15

\*

\* Core top group

PART 27 ARRAY

5 5 1 15 (14)\*3 (15)\*21

\*

\* Core left group

PART 28 ARRAY

5 5 1 (15)\*9 14 (15)\*4 14 (15)\*4 14 (15)\*5

\*

\* Core right group

PART 29 ARRAY

5 5 1 (15)\*5 14 (15)\*4 14 (15)\*4 14 (15)\*9

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Blanket element group

PART 30 ARRAY

5 5 1 (15)\*25

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* top and bottom groups have Y=3

\* Shield bottom group

PART 31 ARRAY

5 3 1 (13)\*10 (15)\*5

\*

\* Shield top group

PART 32 ARRAY

5 3 1 (15)\*5 (13)\*10

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Shield left group

PART 33 ARRAY

5 5 1 (13)\*4 15 (13)\*4 15 (13)\*4 15 (13)\*4 15 (13)\*4 15

\*

\* Shield right group

PART 34 ARRAY

5 5 1 15 (13)\*4 15 (13)\*4 15 (13)\*4 15 (13)\*4 15 (13)\*4

\*

\*Shield corner sections

\* Bottom left group

PART 35 ARRAY

5 5 1 (13)\*9 15 (13)\*3 (15)\*2 (13)\*2 (15)\*3 13 (15)\*4

\*

\* Bottom right group

PART 36 ARRAY

5 5 1 (13)\*5 15 (13)\*4 (15)\*2 (13)\*3 (15)\*3 (13)\*2 (15)\*4 13

\*

\* Top left group

PART 37 ARRAY

5 5 1 13 (15)\*4 (13)\*2 (15)\*3 (13)\*3 (15)\*2 (13)\*4 15 (13)\*5

\*

\* top right group

PART 38 ARRAY

5 5 1 (15)\*4 13 (15)\*3 (13)\*2 (15)\*2 (13)\*3 15 (13)\*9

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 1, the lowest set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 39 ARRAY

5 3 1 (13)\*13 (15)\*2

\*

\* Centre is Part 31

\* Right side

PART 40 ARRAY

5 3 1 (13)\*10 (15)\*2 (13)\*3

\*

\* combine these arrays to form the row 1 array

PART 41 ARRAY

3 1 1 39 31 40

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Row 7, the top set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 42 ARRAY

5 3 1 (13)\*3 (15)\*2 (13)\*10

\*

\* Centre is Part 32

\* Right side

PART 43 ARRAY

5 3 1 (15)\*2 (13)\*13

\*

\* combine these arrays to form the row 7 array

PART 44 ARRAY

3 1 1 42 32 43

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 3, 7 groups, the two end groups being 3x5 arrays

\* Left hand array

PART 45 ARRAY

3 5 1 (13)\*11 15 (13)\*2 15

\*

\* right hand array

PART 46 ARRAY

3 5 1 (13)\*9 15 (13)\*2 15 (13)\*2

\*

\* Form the row 3 array

PART 47 ARRAY

7 1 1 45 30 22 21 23 30 46

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 5. 7 arrays, the first and last being 3x5 and the remainder 5x5

\* including the two blanket 5x5 groups.

\*

\* Left hand shield array

PART 48 ARRAY

3 5 1 (13)\*2 15 (13)\*2 15 (13)\*9

\*

\* right hand shield array

PART 49 ARRAY

3 5 1 15 (13)\*2 15 (13)\*11

\*

\* Form the row 5 array

PART 50 ARRAY

7 1 1 48 30 24 21 25 30 49

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\* Arrays of the Superlattice groups

\* Row 2

PART 51 ARRAY

5 1 1 35 30 26 30 36

\*

\* Row 6

PART 52 ARRAY

5 1 1 37 30 27 30 38

\*

\* Group of elements including the special element at the centre

\* Groups of 5x5 elements surrounded by the superlattice gap

\* Core group including the special element

\*

PART 53 ARRAY

5 5 1 (20)\*25

\*

\* Middle line, Row 4

PART 54 ARRAY

7 1 1 33 28 21 53 21 29 34

\*

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Cluster of superlattice groups in a circle of shield material

PART 55 CLUSTER

BOX P44 -40.6905 67.8175 0.0 81.381 16.2762 82.438764

BOX P52 -67.8175 40.6905 0.0 135.635 27.127 82.438764

BOX P50 -84.0937 13.5635 0.0 168.1874 27.127 82.438764

BOX P54 -94.9445 -13.5635 0.0 189.889 27.127 82.438764

BOX P47 -84.0937 -40.6905 0.0 168.1874 27.127 82.438764

BOX P51 -67.8175 -67.8175 0.0 135.635 27.127 82.438764

BOX P41 -40.6905 -84.0937 0.0 81.381 16.2762 82.438764

ZROD M14 0.0 0.0 0.0 96.6 84.0

\*

**\* MONK9A Input Listing for Assembly 22B, Model D**

\* As model C with the blanket and shield regions homogenised

\* Materials 8, 9, 10, 11 and 12 revised

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* material 8 - U8 natural uranium region

\* material 9 - U2 natural uranium region

\* material 10 - U3 natural uranium block

\* material 11 - MST3 Steel block

\* material 12 - Mild steel sheath averaged over the superlattice space

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

MATERIAL 8

H1 4.2481E-05 C 4.4265E-04 AL 1.0616E-06 SI 1.8383E-04

CR 1.9673E-07 MN 1.3779E-05 FE 4.2493E-03 NI 7.6688E-07

CU 1.1912E-06

U235 2.9106E-04 U238 4.0142E-02

MATERIAL 9

H1 4.2351E-05 C 4.1442E-04 AL 1.0616E-06 SI 1.7176E-04

CR 1.9673E-07 MN 1.3779E-05 FE 4.2433E-03 NI 7.6688E-07

CU 1.1912E-06

U235 2.9623E-04 U238 4.0808E-02

MATERIAL 10

H1 4.2939E-05 C 4.2396E-04 AL 1.0616E-06 SI 1.7584E-04

CR 1.9673E-07 MN 1.3779E-05 FE 4.2453E-03 NI 7.6688E-07

CU 1.1912E-06

U235 2.9839E-04 U238 4.1132E-02

MATERIAL 11

H1 2.6476E-05 C 4.5820E-04 AL 1.2308E-04 TI 3.4380E-05

CR 2.3941E-05 MN 2.9843E-04 FE 7.7256E-02 NI 4.2839E-05

CU 4.0048E-05 MO 8.5790E-06

MATERIAL 12

H1 3.1777E-05 C 9.9996E-05 AL 8.3095E-06 CR 1.5399E-06

MN 1.0785E-04 FE 3.2538E-02 NI 6.0027E-06 CU 9.3243E-06

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN MATERIAL GEOMETRY

\*

\* Axial blanket U8 section

PART 8 NEST

BOX M8 -2.7127 -2.7127 0.0 5.4254 5.4254 9.827

\*

\* Axial blanket U2 section

PART 9 NEST

BOX M9 -2.7127 -2.7127 0.0 5.4254 5.4254 12.723

\*

\* Axial blanket U3 section

PART 10 NEST

BOX M10 -2.7127 -2.7127 0.0 5.4254 5.4254 7.6225

\*

\* Axial reflector MST3 section

PART 11 NEST

BOX M11 -2.7127 -2.7127 0.0 5.4254 5.4254 7.60628

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Radial blanket U3 section (over half core height)

PART 12 NEST

BOX M10 -2.7127 -2.7127 0.0 5.4254 5.4254 74.83248

\*

\* Steel reflector bars (over half core height)

PART 13 NEST

BOX M14 -2.7127 -2.7127 0.0 5.4254 5.4254 82.438764

**\* MONK8B Input Listing for Assembly 22B, Model E homogenisation**

\* As Model D but with the canning and sheath material homogenised

\* Revised materials 2, 4, 6, 7 New materials 12, 13 and 14

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* material 1 - Plutonium metal plate core

\* material 2 - Plutonium metal plate can

\* material 3 - UO2 plate core

\* material 4 - UO2 plate can

\* material 5 - Sodium plate core

\* material 6 - Sodium plate can

\* material 7 - 40%Steel region

\* material 8 - U8 natural uranium region

\* material 9 - U2 natural uranium region

\* material 10 - U3 natural uranium block

\* material 11 - MST3 Steel block

\* material 12 - Plutonium plate edge region

\* material 13 - UO2 plate edge region

\* material 14 - Sodium plate edge region

\* material 15 - Plutonium metal plate core at reactor core centre

\* material 16 - UO2 plate core at reactor core centre

\* material 17 - Steel bar averaged over the mean spacing of 5.4254 cm

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

COLUMNS 1 132

BEGIN MATERIAL SPECIFICATION

NUMBER DENSITY

MATERIAL 1

U238 6.8782E-07 PU238 3.0461E-05 PU239 2.8920E-02

PU240 6.9095E-03 PU241 7.3960E-04 PU242 1.8699E-04

AM241 4.5718E-04

H1 1.2764E-04 C 4.2260E-04 N 2.4215E-05 O16 8.8450E-05

AL 2.2973E-05 SI 1.4158E-05 CR 3.5989E-06 MN 1.4902E-06

FE 1.6335E-05 NI 8.5688E-06 GA 2.0166E-03

MATERIAL 2

H1 1.3760E-05 C 1.1393E-04 SI 3.6607E-04 P 1.3731E-05

CR 9.4011E-03 MN 8.5931E-04 FE 3.5542E-02 NI 4.1646E-03

CU 1.6613E-02

MATERIAL 3

H1 3.1773E-05 C 1.1808E-05 O16 4.6008E-02 AL 3.3911E-06

SI 2.2967E-05 MN 8.3273E-08 FE 1.3107E-06 NI 1.2472E-06

MO 3.3379E-07 U235 1.6544E-04 U238 2.2837E-02

MATERIAL 4

H1 1.9035E-05 C 1.2831E-04 SI 6.4475E-04 P 3.5078E-04

S 3.6041E-05 CR 1.3819E-02 MN 8.5559E-04 FE 4.8306E-02

NI 8.4258E-03

MATERIAL 5

H1 1.3900E-05 O16 5.6492E-06 NA 2.3225E-02 CA 3.6083E-06

FE 1.6184E-07

MATERIAL 6

H1 2.1631E-05 C 2.9290E-04 SI 6.0867E-04 P 3.2795E-05

S 3.3219E-05 CR 1.4759E-02 MN 1.3570E-03 FE 5.5054E-02

NI 7.0982E-03 NB 3.1147E-04

MATERIAL 7

H1 2.1952E-05 C 9.1064E-05 AL 8.9052E-05 SI 5.8340E-04

P 2.9292E-05 S 1.0556E-05 TI 1.8157E-04 CR 1.1644E-02

MN 1.1248E-03 FE 4.9247E-02 NI 6.4410E-03 CU 3.9365E-05

NB 3.6597E-06 MO 5.9280E-05

MATERIAL 8

H1 4.2481E-05 C 4.4265E-04 AL 1.0616E-06 SI 1.8383E-04

CR 1.9673E-07 MN 1.3779E-05 FE 4.2493E-03 NI 7.6688E-07

CU 1.1912E-06

U235 2.9106E-04 U238 4.0142E-02

MATERIAL 9

H1 4.2351E-05 C 4.1442E-04 AL 1.0616E-06 SI 1.7176E-04

CR 1.9673E-07 MN 1.3779E-05 FE 4.2433E-03 NI 7.6688E-07

CU 1.1912E-06

U235 2.9623E-04 U238 4.0808E-02

MATERIAL 10

H1 4.2939E-05 C 4.2396E-04 AL 1.0616E-06 SI 1.7584E-04

CR 1.9673E-07 MN 1.3779E-05 FE 4.2453E-03 NI 7.6688E-07

CU 1.1912E-06

U235 2.9839E-04 U238 4.1132E-02

MATERIAL 11

H1 2.6476E-05 C 4.5820E-04 AL 1.2308E-04 TI 3.4380E-05

CR 2.3941E-05 MN 2.9843E-04 FE 7.7256E-02 NI 4.2839E-05

CU 4.0048E-05 MO 8.5790E-06

MATERIAL 12

H1 2.2655E-05 C 1.0705E-04 AL 4.1025E-06 SI 1.8534E-04

P 6.9518E-06 CR 4.7604E-03 MN 4.8831E-04 FE 3.4059E-02

NI 2.1114E-03 CU 8.4155E-03

MATERIAL 13

H1 2.7234E-05 C 1.1009E-04 AL 5.3465E-06 SI 2.2990E-04

P 1.2508E-04 S 1.2851E-05 CR 4.9286E-03 MN 3.7448E-04

FE 3.8160E-02 NI 3.0083E-03 CU 5.9995E-06

MATERIAL 14

H1 2.9574E-05 C 1.4189E-04 AL 6.5050E-06 SI 1.3218E-04

P 7.1216E-06 S 7.2136E-06 CR 3.2062E-03 MN 3.7911E-04

FE 3.7427E-02 NI 1.5461E-03 CU 7.2995E-06 NB 6.7637E-05

MATERIAL 15

U238 6.8782E-07 PU238 3.0461E-05 PU239 2.8920E-02

PU240 6.9095E-03 PU241 7.3960E-04 PU242 1.8699E-04

AM241 4.5718E-04

H1 1.2764E-04 C 4.2260E-04 N 2.4215E-05 O16 8.8450E-05

AL 2.2973E-05 SI 1.4158E-05 CR 3.5989E-06 MN 1.4902E-06

FE 1.6335E-05 NI 8.5688E-06 GA 2.0166E-03

MATERIAL 16

H1 3.1773E-05 C 1.1808E-05 O16 4.6008E-02 AL 3.3911E-06

SI 2.2967E-05 MN 8.3273E-08 FE 1.3107E-06 NI 1.2472E-06

MO 3.3379E-07 U235 1.6544E-04 U238 2.2837E-02

MATERIAL 17

H1 4.0597E-05 C 6.0468E-04 SI 2.7317E-04 P 3.7649E-05

S 3.2535E-05 MN 6.2488E-04 FE 7.1392E-02

END

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

BEGIN MATERIAL GEOMETRY

\*

\* Plate 1, the Pu metal plate

PART 1 NEST

BOX M1 -2.3355 -2.3355 0.0457 4.671 4.671 0.236

BOX M2 -2.3355 -2.3355 0.0 4.671 4.671 0.3274

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 0.3274

\*

\* Plate 2, the UO2 plate

PART 2 NEST

BOX M3 -2.4285 -2.4285 0.03665 4.857 4.857 0.558

BOX M4 -2.4285 -2.4285 0.0 4.857 4.857 0.6313

BOX M13 -2.7127 -2.7127 0.0 5.4254 5.4254 0.6313

\*

\* Plate 3, the sodium plate

PART 3 NEST

BOX M5 -2.4815 -2.4815 0.036347 4.963 4.963 0.541

BOX M6 -2.4815 -2.4815 0.0 4.963 4.963 0.613694

BOX M14 -2.7127 -2.7127 0.0 5.4254 5.4254 0.613694

\*

\* Plate 4, the 40% steel plate

PART 4 NEST

BOX M0 -1.9625 -1.9625 0.0 3.925 3.925 0.317

BOX M7 -2.7127 -2.7127 0.0 5.4254 5.4254 0.317

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Insert special element at the core centre

\*

\* Plate 16, the Pu metal plate at the core centre

PART 16 NEST

BOX M15 -2.3355 -2.3355 0.0457 4.671 4.671 0.236

BOX M2 -2.3355 -2.3355 0.0 4.671 4.671 0.3274

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 0.3274

\*

\* Plate 17, the UO2 plate

PART 17 NEST

BOX M16 -2.4285 -2.4285 0.03665 4.857 4.857 0.558

BOX M4 -2.4285 -2.4285 0.0 4.857 4.857 0.6313

BOX M13 -2.7127 -2.7127 0.0 5.4254 5.4254 0.6313

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

**\* MONK9A Input Listing for Assembly 23 homogenised sheath region Mat 12**

\* Material 12 is changed and the void regions by the sheath removed

\* Plate cells, blanket and shield as for 22 Model B

\* Minicalandria as follows:

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini-calandria

\* Mini calandria 3A,

\* 16 PUPINC in NACLI

\* Pin C in square of sodium

PART 24 NEST

ZROD P19 0.0 0.0 0.0 0.513 29.18

BOX M36 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 25 ARRAY

4 4 1 (24)\*16

\* mini-calandria in the element sheath (M12)

PART 26 NEST

BOX P25 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M36 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M31 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3B,

\* 11 PUPINB and 5 PUPINF in NACLI

\* Pin B in square of sodium

PART 27 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M36 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 28 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M36 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 29 ARRAY

4 4 1 27 27 28 27 27 27 27 28 28 27 28 27 27 28 27 27

\* mini-calandria in the element sheath (M12)

PART 30 NEST

BOX P29 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M36 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M31 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3H,

\* 11 PUPINB and 5 PUPINF in NACLV

\* Pin B in square of NACLV sodium

PART 31 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M40 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 32 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M40 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 33 ARRAY

4 4 1 31 31 32 31 31 31 31 32 32 31 32 31 31 32 31 31

\* mini-calandria in the element sheath (M12)

PART 34 NEST

BOX P33 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M40 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M35 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3L,

\* 11 PUPINB and 5 PUPINF in NACLIV

\* Pin B in square of NACLIV sodium

PART 35 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 36 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 37 ARRAY

4 4 1 35 35 36 35 35 35 35 36 36 35 36 35 35 36 35 35

\* mini-calandria in the element sheath (M12)

PART 38 NEST

BOX P37 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M39 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M34 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3C,

\* 8 PUPINA and 8 PUPINE in NACLIII

\* Pin A in square of NACLIII sodium

PART 39 NEST

ZROD P17 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin E in square of sodium

PART 40 NEST

ZROD P21 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 41 ARRAY

4 4 1 39 40 39 40 40 39 40 39 39 40 39 40 40 39 40 39

\* mini-calandria in the element sheath (M12)

PART 42 NEST

BOX P41 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M38 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M33 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3D,

\* 8 PUPIND and 8 PUPINF in NACLIII

\* Pin D in square of NACLIII sodium

PART 43 NEST

ZROD P20 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 44 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 45 ARRAY

4 4 1 43 44 43 44 44 43 44 43 43 44 43 44 44 43 44 43

\* mini-calandria in the element sheath (M12)

PART 46 NEST

BOX P45 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M38 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M33 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3E,

\* 8 PUPIND and 8 PUPINF in NACLIIS

\* Pin D in square of NACLIIS sodium

PART 47 NEST

ZROD P20 0.0 0.0 0.0 0.513 29.18

BOX M37 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 48 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M37 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 49 ARRAY

4 4 1 47 48 47 48 48 47 48 47 47 48 47 48 48 47 48 47

\* mini-calandria in the element sheath (M12)

PART 50 NEST

BOX P49 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M37 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M32 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3J,

\* 12 PUPINE and 4 UO2PINC in NACLIV

\* Pin E in square of NACLIV sodium

PART 51 NEST

ZROD P21 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 52 NEST

ZROD P23 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 53 ARRAY

4 4 1 (51)\*3 52 51 52 (51)\*5 52 51 52 (51)\*2

\* mini-calandria in the element sheath (M12)

PART 54 NEST

BOX P53 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M39 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M34 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.68605 -2.68605 0.0 5.3721 5.3721 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

**\* MONK9A Input Listing for Assembly 23 regular lattice pitch 5.4254cm**

\* Assembly 23 is the Pin Geometry Version of the Cadenza cores.

\* it also includes an outer ring of plate geometry elements

\* Reactor structure: elements arranged on a square grid

\* The Pin Elements in the core contain 3 minicalandria and an Axial

\* Region Cell, enclosed in a mild steel sheath.

\* The plate elements contain 24 cells, the plates having width 5.067cm

\* The Element sheath has an inner width 5.102 cm, outer width 5.2544cm

\* The elements occupy a lattice area of 5.3721 cm square.

\* Groups of 5x5 elements form the superlattice

\* with a space between them

\* The Radial Blanket Elements contain 10 U3 blocks and a MST3 block

\* enclosed in a mild steel sheath with reflection in the midplane.

\* The radial shielding elements consist of the Steel bar MST9F10

\* which is about 300 cm high.

\* These are represented explicitly within an outer radius and also

\* homogenised (over the overall average lattice area) to fill the

\* remaining space in the outer cylinder (pitch 5.4254 cm)

\* Elements are grouped in square arrays containing 5x5 = 25 elements

\* plus edge groups with 3x5 elements. The Assembly is built from these

\* There is a gap between these groups of elements of 0.2667 cm

\* Core Plate Geometry Element structure:

\* The plate element consists of combinations of the following:

\* Core Cell PART 1, Core Cell PART 2, an inversion of PART 1,

\* Core Cell PART 3, which is the same as PART 1

\* but with the 40%Steel plate omitted, and the inversion of

\* this cell which forms PART 4

\* the Axial Region Cell is PART5.

\* Structure of Core Plate Cell 1, PART 1, 7 plates.

\* Cell height 3.748082 cm. Enclosed in mild steel sheath.

\* Outer area of all plates is 5.067 cm x 5.067 cm

\* From the top down:

\* Sodium (0.613694 cm thick, core 0.541 cm x 4.963 cm square)

\* UO2 (0.6313 cm thick, core 0.558 cm x 4.857 cm square)

\* Sodium (0.613694 cm thick,)

\* Pu Metal (0.3274 cm thick, core 0.236 cm x 4.671cm x 4.671 cm)

\* 40%Steel (0.317 cm thick, void core 0.317 cm x 3.925 cm square)

\* UO2 (0.6313 cm thick)

\* Sodium (0.613694 cm thick)

\* Structure of Core Plate Cell 2 PART 2. The inverse of PART 1

\* Structure of Core Plate Cell PART 3. PART 1 without 40%Steel plate.

\* Cell height 3.431082 cm.

\* Structure of the Axial Region cell. Enclosed in mild steel sheath.

\* Cell height From the top:

\* MST3 Block (7.60628 cm thick)

\* U3 Block (7.6225 cm thick,)

\* U2 region (10 plates, total thickness 12.723 cm )

\* U8 region (31 plates, total thickness 9.827 cm)

\* Structure of the Radial Blanket element.

\* Height of the reflected half height element

\* MST3 Block (7.60628 cm thick)

\* U3 Block composition (height above mid-plane to match the core

\* element blanket height of 74.83248 cm)

MATERIAL 12

H1 3.1777E-05 C 9.9996E-05 AL 8.3095E-06 CR 1.5399E-06

MN 1.0785E-04 FE 3.2538E-02 NI 6.0027E-06 CU 9.3243E-06

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini-calandria

\* Mini calandria 3A,

\* 16 PUPINC in NACLI

\* Pin C in square of sodium

PART 24 NEST

ZROD P19 0.0 0.0 0.0 0.513 29.18

BOX M36 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 25 ARRAY

4 4 1 (24)\*16

\* mini-calandria in the element sheath (M12)

PART 26 NEST

BOX P25 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M36 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M31 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3B,

\* 11 PUPINB and 5 PUPINF in NACLI

\* Pin B in square of sodium

PART 27 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M36 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 28 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M36 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 29 ARRAY

4 4 1 27 27 28 27 27 27 27 28 28 27 28 27 27 28 27 27

\* mini-calandria in the element sheath (M12)

PART 30 NEST

BOX P29 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M36 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M31 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3H,

\* 11 PUPINB and 5 PUPINF in NACLV

\* Pin B in square of NACLV sodium

PART 31 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M40 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 32 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M40 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 33 ARRAY

4 4 1 31 31 32 31 31 31 31 32 32 31 32 31 31 32 31 31

\* mini-calandria in the element sheath (M12)

PART 34 NEST

BOX P33 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M40 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M35 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3L,

\* 11 PUPINB and 5 PUPINF in NACLIV

\* Pin B in square of NACLIV sodium

PART 35 NEST

ZROD P18 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 36 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 37 ARRAY

4 4 1 35 35 36 35 35 35 35 36 36 35 36 35 35 36 35 35

\* mini-calandria in the element sheath (M12)

PART 38 NEST

BOX P37 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M39 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M34 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3C,

\* 8 PUPINA and 8 PUPINE in NACLIII

\* Pin A in square of NACLIII sodium

PART 39 NEST

ZROD P17 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin E in square of sodium

PART 40 NEST

ZROD P21 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 41 ARRAY

4 4 1 39 40 39 40 40 39 40 39 39 40 39 40 40 39 40 39

\* mini-calandria in the element sheath (M12)

PART 42 NEST

BOX P41 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M38 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M33 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3D,

\* 8 PUPIND and 8 PUPINF in NACLIII

\* Pin D in square of NACLIII sodium

PART 43 NEST

ZROD P20 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 44 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M38 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 45 ARRAY

4 4 1 43 44 43 44 44 43 44 43 43 44 43 44 44 43 44 43

\* mini-calandria in the element sheath (M12)

PART 46 NEST

BOX P45 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M38 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M33 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3E,

\* 8 PUPIND and 8 PUPINF in NACLIIS

\* Pin D in square of NACLIIS sodium

PART 47 NEST

ZROD P20 0.0 0.0 0.0 0.513 29.18

BOX M37 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 48 NEST

ZROD P22 0.0 0.0 0.0 0.513 29.18

BOX M37 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 49 ARRAY

4 4 1 47 48 47 48 48 47 48 47 47 48 47 48 48 47 48 47

\* mini-calandria in the element sheath (M12)

PART 50 NEST

BOX P49 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M37 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M32 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini calandria 3J,

\* 12 PUPINE and 4 UO2PINC in NACLIV

\* Pin E in square of NACLIV sodium

PART 51 NEST

ZROD P21 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* Pin F in square of sodium

PART 52 NEST

ZROD P23 0.0 0.0 0.0 0.513 29.18

BOX M39 -0.595 -0.595 0.0 1.19 1.19 29.18

\* array of pins in sodium

PART 53 ARRAY

4 4 1 (51)\*3 52 51 52 (51)\*5 52 51 52 (51)\*2

\* mini-calandria in the element sheath (M12)

PART 54 NEST

BOX P53 -2.38 -2.38 0.44 4.76 4.76 29.18

BOX M39 -2.45 -2.45 0.44 4.9 4.9 29.18

BOX M30 -2.45 -2.45 0.0 4.9 4.9 29.73

BOX M34 -2.5335 -2.5335 0.0 5.067 5.067 29.73

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 29.73

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* form the elements 3A to 3L

\* Element 3A

PART 55 ARRAY

1 1 11 14 11 10 9 (26)\*3 9 10 11 14

\* Element 3B

PART 56 ARRAY

1 1 11 14 11 10 9 (30)\*3 9 10 11 14

\* Element 3C

PART 57 ARRAY

1 1 11 14 11 10 9 (42)\*3 9 10 11 14

\* Element 3D

PART 58 ARRAY

1 1 11 14 11 10 9 (46)\*3 9 10 11 14

\* Element 3E

PART 59 ARRAY

1 1 11 14 11 10 9 (50)\*3 9 10 11 14

\* Element 3H

PART 60 ARRAY

1 1 11 14 11 10 9 (34)\*3 9 10 11 14

\* Element 3J

PART 61 ARRAY

1 1 11 14 11 10 9 (54)\*3 9 10 11 14

\* Element 3L

PART 62 ARRAY

1 1 11 14 11 10 9 (38)\*3 9 10 11 14

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Steel reflector bars

PART 63 NEST

BOX M13 -2.54 -2.54 0.0 5.08 5.08 164.877528

BOX M0 -2.7127 -2.7127 0.0 5.4254 5.4254 164.877528

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* assemble the arrays of elements

\*

\* Groups of 5x5 elements surrounded by the superlattice gap

\* With groups of 5x3 in rows 1 and 7 and 3x5 in rows 3 and 5

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 1, the lowest set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 64 ARRAY

5 3 1 (63)\*13 (16)\*2

\* Centre

PART 65 ARRAY

5 3 1 (63)\* 10 (16)\*5

\* Right side

PART 66 ARRAY

5 3 1 (63)\*10 (16)\*2 (63)\*3

\* combine these arrays to form the row 1 array

PART 67 ARRAY

3 1 1 64 65 66

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* A 5x5 array of blanket elements

PART 68 ARRAY

5 5 1 (16)\*25

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 2. 5 arrays of 5x5 elements, two being PART 68

\* Left hand array

PART 69 ARRAY

5 5 1 (63)\*9 16 (63)\*3 (16)\*2 (63)\*2 (16)\*3 63 (16)\*4

\*

\* Middle array

PART 70 ARRAY

5 5 1 (16)\*20 (15)\*5

\*

\* Right hand array

PART 71 ARRAY

5 5 1 (63)\*5 16 (63)\*4 (16)\*2 (63)\*3 (16)\*3 (63)\*2 (16)\*4 63

\*

\* Form row 2 array

PART 72 ARRAY

5 1 1 69 68 70 68 71

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 3, 7 groups, the two end groups being 3x5 arrays

\* Left hand array

PART 73 ARRAY

3 5 1 (63)\*11 16 (63)\*2 16

\* Core lower left hand array

PART 74 ARRAY

5 5 1 (16)\*3 (15)\*2 16 (15)\*2 (60)\*2 16 15 55 58 60

15 (58)\*2 57 59 15 (58)\*2 57 59

\*

\* Core lower middle array

PART 75 ARRAY

5 5 1 (62)\*5 (56)\*10 (57)\*10

\*

\* Core lower right hand array

PART 76 ARRAY

5 5 1 (15)\*2 (16)\*3 (60)\*2 (15)\*2 16 60 58 55 15 16

59 57 58 59 15 59 57 58 59 15

\*

\* right hand array

PART 77 ARRAY

3 5 1 (63)\*9 16 (63)\*2 16 (63)\*2

\* Form the row 3 array

PART 78 ARRAY

7 1 1 73 68 74 75 76 68 77

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 4 (the middle row) 7 groups of 5x5 elements

\* Left hand shield group

PART 79 ARRAY

5 5 1 (63)\*4 16 (63)\*4 16 (63)\*4 16 (63)\*4 16 (63)\*4 16

\*

\* Left hand blanket group

PART 80 ARRAY

5 5 1 (16)\*4 15 (16)\*4 15 (16)\*4 15 (16)\*4 15 (16)\*4 15

\*

\* Left hand core group

PART 81 ARRAY

5 5 1 55 61 58 (59)\*2 55 (58)\*2 (59)\*2 56 (59)\*4

55 58 55 (59)\*2 55 61 55 (59)\*2

\*

\* Centre core group

PART 82 ARRAY

5 5 1 (57)\*25

\*

\* Right hand core group

PART 83 ARRAY

5 5 1 (59)\*2 58 61 55 (59)\*2 (58)\*2 55 (59)\*4 56

(59)\*2 55 58 55 (59)\*2 55 61 55

\*

\* Right hand blanket group

PART 84 ARRAY

5 5 1 15 (16)\*4 15 (16)\*4 15 (16)\*4 15 (16)\*4 15 (16)\*4

\*

\* Right hand shield group

PART 85 ARRAY

5 5 1 16 (63)\*4 16 (63)\*4 16 (63)\*4 16 (63)\*4 16 (63)\*4

\*

\* Form the row 4 array

PART 86 ARRAY

7 1 1 79 80 81 82 83 84 85

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 5. 7 arrays, the first and last being 3x5 and the remainder 5x5

\* including the two blanket 5x5 groups.

\*

\* Left hand shield array

PART 87 ARRAY

3 5 1 (63)\*2 16 (63)\*2 16 (63)\*9

\* Core upper left hand array

PART 88 ARRAY

5 5 1 15 (58)\*2 57 59 15 56 58 57 59 16 15 55 58 58

16 (15)\*2 (60)\*2 (16)\*3 (15)\*2

\*

\* Core upper middle array

PART 89 ARRAY

5 5 1 (57)\*10 (56)\*10 (62)\*5

\*

\* Core upper right hand array

PART 90 ARRAY

5 5 1 59 57 58 58 15 59 57 58 56 15 58 58 55 15

16 (60)\*2 (15)\*2 16 (15)\*2 (16)\*3

\*

\* right hand shield array

PART 91 ARRAY

3 5 1 16 (63)\*2 16 (63)\*2 (63)\*9

\*

\* Form the row 5 array

PART 92 ARRAY

7 1 1 87 68 88 89 90 68 91

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 6 arrays 5 groups of 5x5, one being PART 68

\*

\* Left hand array

PART 93 ARRAY

5 5 1 63 (16)\*4 (63)\*2 (16)\*3 (63)\*3 (16)\*2 (63)\*4 16 (63)\*5

\*

\* Middle array

PART 94 ARRAY

5 5 1 (15)\*5 (16)\*20

\*

\* Right middle array

PART 95 ARRAY

5 5 1 15 (16)\*24

\*

\* Right hand array

PART 96 ARRAY

5 5 1 (16)\*4 63 (16)\*3 (63)\*2 (16)\*2 (63)\*3 16 (63)\*9

\*

\* Form row 6 array

PART 97 ARRAY

5 1 1 93 68 94 95 96

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Row 7, the top set of groups of size 5x3 (5 along the x axis)

\* 3 arrays

\* Left side

PART 98 ARRAY

5 3 1 (63)\*3 (16)\*2 (63)\*10

\*

\* Centre

PART 99 ARRAY

5 3 1 (16)\*5 (63)\* 10

\*

\* Right side

PART 100 ARRAY

5 3 1 (16)\*2 (63)\*13

\*

\* combine these arrays to form the row 7 array

PART 101 ARRAY

3 1 1 98 99 100

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Cluster of superlattice groups in a circle of shield material

PART 102 CLUSTER

BOX P101 -40.6905 67.8175 0.0 81.381 16.2762 164.877528

BOX P97 -67.8175 40.6905 0.0 135.635 27.127 164.877528

BOX P92 -84.0937 13.5635 0.0 168.1874 27.127 164.877528

BOX P86 -94.9445 -13.5635 0.0 189.889 27.127 164.877528

BOX P78 -84.0937 -40.6905 0.0 168.1874 27.127 164.877528

BOX P72 -67.8175 -67.8175 0.0 135.635 27.127 164.877528

BOX P67 -40.6905 -84.0937 0.0 81.381 16.2762 164.877528

ZROD M14 0.0 0.0 -1.56 96.6 168.0

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

**\* MONK8B Input Listing for Assembly 23 Model E**

\* Uniform lattice with radial homogenisation with the mild steel sheath.

\* combination of sheath and plate canning, sheath and calandria walls

\* fuel pin canning and calandria tubes

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

COLUMNS 1 132

BEGIN MATERIAL SPECIFICATION

NUMBER DENSITY

MATERIAL 1

U238 6.8782E-07 PU238 3.0461E-05 PU239 2.8920E-02

PU240 6.9095E-03 PU241 7.3960E-04 PU242 1.8699E-04

AM241 4.5718E-04

H1 1.2764E-04 C 4.2260E-04 N 2.4215E-05 O16 8.8450E-05

AL 2.2973E-05 SI 1.4158E-05 CR 3.5989E-06 MN 1.4902E-06

FE 1.6335E-05 NI 8.5688E-06 GA 2.0166E-03

MATERIAL 2

H1 1.3760E-05 C 1.1393E-04 SI 3.6607E-04 P 1.3731E-05

CR 9.4011E-03 MN 8.5931E-04 FE 3.5542E-02 NI 4.1646E-03

CU 1.6613E-02

MATERIAL 3

H1 3.1773E-05 C 1.1808E-05 O16 4.6008E-02 AL 3.3911E-06

SI 2.2967E-05 MN 8.3273E-08 FE 1.3107E-06 NI 1.2472E-06

MO 3.3379E-07 U235 1.6544E-04 U238 2.2837E-02

MATERIAL 4

H1 1.9035E-05 C 1.2831E-04 SI 6.4475E-04 P 3.5078E-04

S 3.6041E-05 CR 1.3819E-02 MN 8.5559E-04 FE 4.8306E-02

NI 8.4258E-03

MATERIAL 5

H1 1.3900E-05 O16 5.6492E-06 NA 2.3225E-02 CA 3.6083E-06

FE 1.6184E-07

MATERIAL 6

H1 2.1631E-05 C 2.9290E-04 SI 6.0867E-04 P 3.2795E-05

S 3.3219E-05 CR 1.4759E-02 MN 1.3570E-03 FE 5.5054E-02

NI 7.0982E-03 NB 3.1147E-04

MATERIAL 7

H1 2.1952E-05 C 9.1064E-05 AL 8.9052E-05 SI 5.8340E-04

P 2.9292E-05 S 1.0556E-05 TI 1.8157E-04 CR 1.1644E-02

MN 1.1248E-03 FE 4.9247E-02 NI 6.4410E-03 CU 3.9365E-05

NB 3.6597E-06 MO 5.9280E-05

MATERIAL 8

H1 4.2481E-05 C 4.4265E-04 AL 1.0616E-06 SI 1.8383E-04

CR 1.9673E-07 MN 1.3779E-05 FE 4.2493E-03 NI 7.6688E-07

CU 1.1912E-06

U235 2.9106E-04 U238 4.0142E-02

MATERIAL 9

H1 4.2351E-05 C 4.1442E-04 AL 1.0616E-06 SI 1.7176E-04

CR 1.9673E-07 MN 1.3779E-05 FE 4.2433E-03 NI 7.6688E-07

CU 1.1912E-06

U235 2.9623E-04 U238 4.0808E-02

MATERIAL 10

H1 4.2939E-05 C 4.2396E-04 AL 1.0616E-06 SI 1.7584E-04

CR 1.9673E-07 MN 1.3779E-05 FE 4.2453E-03 NI 7.6688E-07

CU 1.1912E-06

U235 2.9839E-04 U238 4.1132E-02

MATERIAL 11

H1 2.6476E-05 C 4.5820E-04 AL 1.2308E-04 TI 3.4380E-05

CR 2.3941E-05 MN 2.9843E-04 FE 7.7256E-02 NI 4.2839E-05

CU 4.0048E-05 MO 8.5790E-06

MATERIAL 12

H1 2.2655E-05 C 1.0705E-04 AL 4.1025E-06 SI 1.8534E-04

P 6.9518E-06 CR 4.7604E-03 MN 4.8831E-04 FE 3.4059E-02

NI 2.1114E-03 CU 8.4155E-03

MATERIAL 13

H1 2.7234E-05 C 1.1009E-04 AL 5.3465E-06 SI 2.2990E-04

P 1.2508E-04 S 1.2851E-05 CR 4.9286E-03 MN 3.7448E-04

FE 3.8160E-02 NI 3.0083E-03 CU 5.9995E-06

MATERIAL 14

H1 4.0597E-05 C 6.0468E-04 SI 2.7317E-04 P 3.7649E-05

S 3.2535E-05 MN 6.2488E-04 FE 7.1392E-02

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Fuel pin cans homogenised with the calandria tubes

MATERIAL 22

H1 1.0832E-05 C 5.3887E-05 SI 6.6291E-04 P 1.5357E-05

S 9.9700E-06 CR 1.2375E-02 MN 1.0382E-03 FE 4.2250E-02

NI 5.8244E-03

MATERIAL 23

H1 9.2847E-06 C 9.6091E-05 SI 7.8508E-04 P 1.6869E-05

S 9.2404E-06 CR 1.1062E-02 MN 1.0424E-03 FE 3.9613E-02

NI 5.7832E-03 NB 1.1919E-04

MATERIAL 24

H1 1.0832E-05 C 5.5189E-05 SI 6.5458E-04 P 1.4602E-05

S 9.9700E-06 CR 1.2228E-02 MN 1.0254E-03 FE 4.1778E-02

NI 5.7580E-03

MATERIAL 25

H1 1.0058E-05 C 8.1804E-05 AL 2.6012E-06 SI 6.7957E-04

P 1.3847E-05 S 3.6474E-06 TI 1.1726E-05 CR 1.1439E-02

MN 8.7351E-04 FE 4.0660E-02 CO 1.7202E-06 NI 5.3049E-03

CU 2.4544E-06 MO 8.9408E-07

MATERIAL 26

H1 1.0058E-05 C 2.9866E-05 AL 2.6012E-06 SI 7.4068E-04

P 5.5388E-06 S 7.0518E-06 TI 1.1726E-05 CR 1.1517E-02

MN 8.0111E-04 FE 4.1082E-02 CO 1.7202E-06 NI 5.4737E-03

CU 2.4544E-06 MO 8.6970E-06

MATERIAL 27

H1 1.0058E-05 C 2.9217E-05 AL 1.7341E-06 SI 7.4343E-04

P 5.5388E-06 S 7.2951E-06 TI 8.7948E-06 CR 1.1591E-02

MN 8.0253E-04 FE 4.1309E-02 CO 1.3232E-06 NI 5.5122E-03

CU 1.8407E-06 MO 8.6159E-06

MATERIAL 28

H1 1.0832E-05 C 5.3887E-05 SI 6.6291E-04 P 1.5357E-05

S 9.9700E-06 CR 1.2390E-02 MN 1.0396E-03 FE 4.2298E-02

NI 5.8324E-03

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Composition of calandria tubes

MATERIAL 29

SI 1.0632E-03 CR 1.6787E-02 MN 1.3588E-03 FE 6.0762E-02

NI 7.4360E-03

\* Composition of Calandria end plate regions

MATERIAL 30

SI 5.5206E-04 CR 1.0016E-02 MN 7.7198E-04 FE 3.5578E-02

NI 4.4601E-03

\* Compositions of Calandria outer walls homogenised with the sheath

MATERIAL 31

H1 3.4252E-05 C 1.5574E-04 AL 5.7600E-06 SI 1.8479E-04

P 2.2542E-05 S 1.1293E-05 CR 4.6018E-03 MN 4.4951E-04

FE 3.7562E-02 NI 2.2268E-03 CU 6.4634E-06

MATERIAL 32

H1 3.3882E-05 C 2.6983E-04 AL 5.7600E-06 SI 2.9953E-04

P 1.4586E-05 S 1.0129E-05 TI 7.4864E-05 CR 4.4131E-03

MN 4.1410E-04 FE 3.7011E-02 CO 3.4213E-06 NI 2.2908E-03

CU 9.6362E-06 MO 1.0508E-06

MATERIAL 33

H1 3.4252E-05 C 1.1825E-04 AL 5.7600E-06 SI 2.3771E-04

P 1.6057E-05 S 7.5327E-06 CR 4.3370E-03 MN 3.2969E-04

FE 3.8130E-02 NI 2.3562E-03 CU 6.4634E-06 MO 7.6282E-06

MATERIAL 34

H1 3.3511E-05 C 1.7719E-04 AL 5.7600E-06 SI 2.5220E-04

P 1.9107E-05 S 5.0414E-06 CR 4.1625E-03 MN 3.8238E-04

FE 3.7022E-02 NI 1.9847E-03 CU 6.4634E-06 MO 2.7243E-06

MATERIAL 35

H1 3.3882E-05 C 1.5014E-04 AL 5.7600E-06 SI 1.9756E-04

P 2.1036E-05 S 5.2742E-06 CR 4.2444E-03 MN 3.7217E-04

FE 3.7713E-02 NI 2.2296E-03 CU 6.4634E-06 MO 2.7243E-06

\*

BEGIN MATERIAL GEOMETRY

\*

\* Plate 1, the Pu metal plate

PART 1 NEST

BOX M1 -2.3355 -2.3355 0.0457 4.671 4.671 0.236

BOX M2 -2.3355 -2.3355 0.0 4.671 4.671 0.3274

BOX M12 -2.7127 -2.7127 0.0 5.4254 5.4254 0.3274

\*

\* Plate 2, the UO2 plate

PART 2 NEST

BOX M3 -2.4285 -2.4285 0.03665 4.857 4.857 0.558

BOX M4 -2.4285 -2.4285 0.0 4.857 4.857 0.6313

BOX M13 -2.7127 -2.7127 0.0 5.4254 5.4254 0.6313

\*

\* Plate 3, the sodium plate

PART 3 NEST

BOX M5 -2.4815 -2.4815 0.036347 4.963 4.963 0.541

BOX M6 -2.4815 -2.4815 0.0 4.963 4.963 0.613694

BOX M41 -2.7127 -2.7127 0.0 5.4254 5.4254 0.613694

\*

\* Plate 4, the 40% steel plate

PART 4 NEST

BOX M0 -1.9625 -1.9625 0.0 3.925 3.925 0.317

BOX M7 -2.7127 -2.7127 0.0 5.4254 5.4254 0.317

\*

\* Core Cell 1

PART 5 ARRAY

1 1 7 3 2 4 1 3 2 3

\* Core Cell 2, the reflection of cell 1

PART 6 ARRAY

1 1 7 3 2 3 1 4 2 3

\*

\* Core Cell 3 This is Cell 1 minus Plate 4

PART 7 ARRAY

1 1 6 3 2 1 3 2 3

\*Core Cell 4 the reflection of cell 3, Cell 2 minus Plate 4

PART 8 ARRAY

1 1 6 3 2 3 1 2 3

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Axial blanket U8 section

PART 9 NEST

BOX M8 -2.7127 -2.7127 0.0 5.4254 5.4254 9.827

\*

\* Axial blanket U2 section

PART 10 NEST

BOX M9 -2.7127 -2.7127 0.0 5.4254 5.4254 12.723

\*

\* Axial blanket U3 section

PART 11 NEST

BOX M10 -2.7127 -2.7127 0.0 5.4254 5.4254 7.6225

\*

\* Axial reflector MST3 section

PART 12 NEST

BOX M11 -2.7127 -2.7127 0.0 5.4254 5.4254 7.60628

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Radial blanket U3 section (over half core height)

PART 13 NEST

BOX M10 -2.7127 -2.7127 0.0 5.4254 5.4254 74.83248

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* A whole height model.

\* The axial height of the pin cell core is slightly less than

\* that of the plate cell core, 89.19 cm compared with 89.32 cm.

\* (0.13 cm = 2 \* 0.065 cm)

\* The axial shielding material is extended in the model nce.

\* to cover this dista

\* Axial steel reflector section extended 0.065 cm in length

PART 14 NEST

BOX M11 -2.7127 -2.7127 0.0 5.4254 5.4254 7.67128

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* The Core Element (full height)

PART 15 ARRAY

1 1 32 12 11 10 9 8 (5 6)\*11 7 9 10 11 12

\*

\*The Radial Blanket element

PART 16 ARRAY

1 1 4 12 13 13 12

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Specification of the pin cells, A to F and U/C

\* Pin cell A

PART 17 NEST

ZROD M15 0.0 0.0 0.0 0.423 29.18

ZROD M22 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell B

PART 18 NEST

ZROD M16 0.0 0.0 0.0 0.423 29.18

ZROD M23 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell C

PART 19 NEST

ZROD M17 0.0 0.0 0.0 0.423 29.18

ZROD M24 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell D

PART 20 NEST

ZROD M18 0.0 0.0 0.0 0.423 29.18

ZROD M25 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell E

PART 21 NEST

ZROD M19 0.0 0.0 0.0 0.423 29.18

ZROD M26 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell F

PART 22 NEST

ZROD M20 0.0 0.0 0.0 0.423 29.18

ZROD M27 0.0 0.0 0.0 0.513 29.18

\*

\* Pin cell U/C

PART 23 NEST

ZROD M21 0.0 0.0 0.0 0.423 29.18

ZROD M28 0.0 0.0 0.0 0.513 29.18

\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* Mini-calandria

## A.2 Input data for the KENO5a+CONSYST+ABBN-93 System Calculations

made by Anatoly Tsiboulia and Mikhail Semenov**.**

=cons9901

TASK:

MULTIC= 1

NOUT = 2

IHT = 4

IHS = 77

NG = 299

IPRIB = 0

idelta= 1

NMOM = 5

IZT = 16

NRZT = 13

INZ = 28

NAME=

'PU38' 'PU39' 'PU40' 'PU41' 'PU42' 'AM41' 'GA'

'U235' 'U238NR'

'NA'

'H+H(FREE)' 'C' 'N' 'O' 'AL' 'SI' 'CR' 'MN' 'FE' 'NI' 'MO'

'NB' 'TI' 'CU' 'P' 'S' 'CA' 'D-SC'

RO=

\*1 PU

3.0461E-05 2.8920E-02 6.9095E-03 7.3960E-04 1.8699E-04 4.5718E-04 2.0166E-03

0.0000E+00 6.8782E-07 0.0000E+00 1.2764E-04 4.2260E-04 2.4215E-05 8.8450E-05

2.2973E-05 1.4158E-05 3.5989E-06 1.4902E-06 1.6335E-05 8.5688E-06 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*2 CAN

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 1.3760E-05 1.1393E-04 0.0000E+00 0.0000E+00

0.0000E+00 3.6607E-04 9.4011E-03 8.5931E-04 3.5542E-02 4.1646E-03 0.0000E+00

0.0000E+00 0.0000E+00 1.6613E-02 1.3731E-05 0.0000E+00 0.0000E+00 0.0000E+00

\*3 UO2

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

1.6585E-04 2.2894E-02 0.0000E+00 3.1852E-05 1.1837E-05 0.0000E+00 4.6122E-02

3.3995E-06 2.3024E-05 0.0000E+00 8.3479E-08 1.3139E-06 1.2503E-06 3.3462E-07

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*4 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 1.8834E-05 1.2695E-04 0.0000E+00 0.0000E+00

0.0000E+00 6.3794E-04 1.3673E-02 8.4655E-04 4.7796E-02 8.3368E-03 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 3.4708E-04 3.5660E-05 0.0000E+00 0.0000E+00

\*5 na

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 2.3225E-02 1.3900E-05 0.0000E+00 0.0000E+00 5.6492E-06

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.6184E-07 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 3.6083E-06 0.0000E+00

\*6 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 2.1631E-05 2.9290E-04 0.0000E+00 0.0000E+00

0.0000E+00 6.0867E-04 1.4759E-02 1.3570E-03 5.5054E-02 7.0982E-03 0.0000E+00

3.1147E-04 0.0000E+00 0.0000E+00 3.2795E-05 3.3219E-05 0.0000E+00 0.0000E+00

\*7 ss

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 1.8355E-05 8.7794E-05 0.0000E+00 0.0000E+00

1.1862E-04 7.9703E-04 1.5908E-02 1.4972E-03 5.5367E-02 8.7976E-03 8.0988E-05

5.0000E-06 2.4806E-04 5.0365E-05 4.0018E-05 1.4422E-05 0.0000E+00 0.0000E+00

\*8 sheath

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 7.5712E-05 2.3825E-04 0.0000E+00 0.0000E+00

1.9798E-05 0.0000E+00 3.6690E-06 2.5697E-04 7.7524E-02 1.4302E-05 0.0000E+00

0.0000E+00 0.0000E+00 2.2216E-05 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*9 U8

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

3.3369E-04 4.6021E-02 0.0000E+00 4.4048E-05 4.9283E-04 0.0000E+00 0.0000E+00

0.0000E+00 2.1076E-04 0.0000E+00 0.0000E+00 1.0599E-04 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*10 U2

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

3.3962E-04 4.6785E-02 0.0000E+00 4.3899E-05 4.6047E-04 0.0000E+00 0.0000E+00

0.0000E+00 1.9692E-04 0.0000E+00 0.0000E+00 9.9032E-05 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*11 U3

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

3.4209E-04 4.7156E-02 0.0000E+00 4.4574E-05 4.7140E-04 0.0000E+00 0.0000E+00

0.0000E+00 2.0160E-04 0.0000E+00 0.0000E+00 1.0138E-04 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*12 mst3

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 2.5700E-05 5.1066E-04 0.0000E+00 0.0000E+00

1.3989E-04 0.0000E+00 2.7222E-05 3.2634E-04 8.3806E-02 4.8234E-05 9.8355E-06

0.0000E+00 3.9416E-05 4.4548E-05 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*13 mst9f10

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 4.6306E-05 6.8972E-04 0.0000E+00 0.0000E+00

0.0000E+00 3.1158E-04 0.0000E+00 7.1275E-04 8.1432E-02 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 4.2944E-05 3.7110E-05 0.0000E+00 0.0000E+00

\*14 HOMO

1.4500E-06 1.3767E-03 3.2891E-04 3.5207E-05 8.9013E-06 2.1763E-05 9.5996E-05

4.0267E-05 5.5585E-03 8.5835E-03 2.6584E-05 6.9062E-05 1.1527E-06 1.1204E-02

6.5715E-06 1.1860E-04 2.5351E-03 2.2472E-04 1.3408E-02 1.3445E-03 2.5185E-06

2.1148E-05 7.4651E-06 5.0291E-04 2.3577E-05 4.7025E-06 1.3336E-06 0.0000E+00

\*\*\*\*\*\*\*\*\* D-SC

\*15 PU

3.0461E-05 2.8920E-02 6.9095E-03 7.3960E-04 1.8699E-04 4.5718E-04 2.0166E-03

0.0000E+00 6.8782E-07 0.0000E+00 1.2764E-04 4.2260E-04 2.4215E-05 8.8450E-05

2.2973E-05 1.4158E-05 3.5989E-06 1.4902E-06 1.6335E-05 8.5688E-06 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 2.3327E+00

\*16 UO2

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

1.6585E-04 2.2894E-02 0.0000E+00 3.1852E-05 1.1837E-05 0.0000E+00 4.6122E-02

3.3995E-06 2.3024E-05 0.0000E+00 8.3479E-08 1.3139E-06 1.2503E-06 3.3462E-07

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.1022E+00

ICOR =

15 14 16 14 14 14 14 14

9 10 11 12 13

14 15 16

NAMSUB='U238NR' 'PU39'

NGSUB=10 11 12 13 14 15 16 17 18 19 20 21 22 23

END

end

=subgran

end

=lava

-1$$ 2500000

0$$ 71 72 18 19

1$$ 13 755 4 91 845 61 0 -1 1 t

2$$ 11I1000 13000

3$$ F5

4$$ 11I100 1300

5$$ 1 1452 27 1018

7\*\*

2.00000E+07 1.86181E+07 1.73316E+07 1.61341E+07 1.50192E+07

1.39818E+07 1.30158E+07 1.21165E+07 1.12793E+07 1.05000E+07

9.69341E+06 8.94878E+06 8.26136E+06 7.62674E+06 7.04086E+06

6.50000E+06 5.99475E+06 5.52877E+06 5.09902E+06 4.70267E+06

4.33713E+06 4.00000E+06 3.69862E+06 3.41995E+06 3.16228E+06

2.92402E+06 2.70371E+06 2.50000E+06 2.32522E+06 2.16265E+06

2.01146E+06 1.87083E+06 1.74003E+06 1.61838E+06 1.50524E+06

1.40000E+06 1.30541E+06 1.21722E+06 1.13498E+06 1.05830E+06

9.86800E+05 9.20131E+05 8.57965E+05 8.00000E+05 7.40700E+05

6.85795E+05 6.34960E+05 5.87894E+05 5.44316E+05 5.03968E+05

4.66612E+05 4.32024E+05 4.00000E+05 3.70350E+05 3.42898E+05

3.17480E+05 2.93947E+05 2.72158E+05 2.51984E+05 2.33306E+05

2.16012E+05 2.00000E+05 1.91435E+05 1.85175E+05 1.77154E+05

1.71449E+05 1.63937E+05 1.58740E+05 1.51708E+05 1.46973E+05

1.40390E+05 1.36079E+05 1.29916E+05 1.25992E+05 1.20222E+05

1.16653E+05 1.11251E+05 1.08006E+05 1.02951E+05 1.00000E+05

9.60586E+04 9.38042E+04 9.00741E+04 8.79923E+04 8.44625E+04

8.25404E+04 7.92005E+04 7.74264E+04 7.42663E+04 7.26292E+04

6.96395E+04 6.81292E+04 6.53014E+04 6.39081E+04 6.12343E+04

5.99484E+04 5.74205E+04 5.62341E+04 5.38442E+04 5.27500E+04

5.04907E+04 4.94817E+04 4.73460E+04 4.64159E+04 4.52365E+04

4.43972E+04 4.38990E+04 4.35400E+04 4.24188E+04 4.16320E+04

4.11705E+04 4.08424E+04 3.97762E+04 3.90389E+04 3.86114E+04

3.83119E+04 3.72981E+04 3.66074E+04 3.62115E+04 3.59381E+04

3.49744E+04 3.43274E+04 3.39609E+04 3.37115E+04 3.27956E+04

3.21894E+04 3.18504E+04 3.16227E+04 3.07523E+04 3.01846E+04

2.98710E+04 2.96635E+04 2.88362E+04 2.83046E+04 2.80147E+04

2.78256E+04 2.70395E+04 2.65418E+04 2.62738E+04 2.61015E+04

2.53546E+04 2.48887E+04 2.46412E+04 2.44843E+04 2.37747E+04

2.33386E+04 2.31100E+04 2.29673E+04 2.22931E+04 2.18850E+04

2.16741E+04 2.15443E+04 2.09038E+04 2.05218E+04 2.03274E+04

2.02095E+04 1.96011E+04 1.92437E+04 1.90644E+04 1.89573E+04

1.83795E+04 1.80451E+04 1.78800E+04 1.77828E+04 1.72340E+04

1.69213E+04 1.67692E+04 1.66810E+04 1.61599E+04 1.58674E+04

1.57274E+04 1.56475E+04 1.51527E+04 1.48791E+04 1.47504E+04

1.46780E+04 1.42082E+04 1.39524E+04 1.38342E+04 1.37686E+04

1.33225E+04 1.30834E+04 1.29748E+04 1.29155E+04 1.24919E+04

1.22685E+04 1.21688E+04 1.21153E+04 1.17131E+04 1.15044E+04

1.14130E+04 1.13646E+04 1.09828E+04 1.07879E+04 1.07041E+04

1.06605E+04 1.02980E+04 1.01159E+04 1.00393E+04 1.00000E+04

9.65597E+03 9.48588E+03 9.41580E+03 9.38042E+03 9.05389E+03

8.89508E+03 8.83104E+03 8.79923E+03 8.48930E+03 8.34103E+03

8.28260E+03 8.25404E+03 7.95994E+03 7.82153E+03 7.76826E+03

7.74264E+03 7.46356E+03 7.33439E+03 7.28588E+03 7.26292E+03

6.99809E+03 6.87754E+03 6.83345E+03 6.81292E+03 6.56175E+03

6.44928E+03 6.40918E+03 6.39081E+03 6.15266E+03 6.04776E+03

6.01129E+03 5.99484E+03 5.76907E+03 5.67124E+03 5.63811E+03

5.62341E+03 5.40937E+03 5.31816E+03 5.28811E+03 5.27500E+03

5.07209E+03 4.98706E+03 4.95985E+03 4.94817E+03 4.75585E+03

4.67660E+03 4.65199E+03 4.64159E+03 4.45930E+03 4.38545E+03

4.36323E+03 4.35400E+03 4.18123E+03 4.11242E+03 4.09241E+03

4.08424E+03 3.92049E+03 3.85639E+03 3.83841E+03 3.83119E+03

3.67600E+03 3.61629E+03 3.60018E+03 3.59381E+03 3.44677E+03

3.39115E+03 3.37674E+03 3.37114E+03 3.23181E+03 3.18002E+03

3.16718E+03 3.16227E+03 3.03025E+03 2.98204E+03 2.97063E+03

2.96635E+03 2.84126E+03 2.79638E+03 2.78628E+03 2.78256E+03

2.66404E+03 2.62228E+03 2.61338E+03 2.61015E+03 2.49787E+03

2.45903E+03 2.45121E+03 2.44843E+03 2.34207E+03 2.30593E+03

2.29911E+03 2.29673E+03 2.19597E+03 2.16237E+03 2.15646E+03

2.15443E+03 2.08156E+03 2.05753E+03 2.03423E+03 2.02643E+03

2.02233E+03 2.02095E+03 1.94867E+03 1.92530E+03 1.91246E+03

1.90823E+03 1.90091E+03 1.89850E+03 1.89642E+03 1.89573E+03

1.82083E+03 1.79713E+03 1.78450E+03 1.78042E+03 1.77880E+03

1.77828E+03 1.71599E+03 1.69659E+03 1.68085E+03 1.67586E+03

1.67210E+03 1.67091E+03 1.66878E+03 1.66810E+03 1.62473E+03

1.61140E+03 1.58045E+03 1.57089E+03 1.56621E+03 1.56475E+03

1.50398E+03 1.48581E+03 1.47431E+03 1.47080E+03 1.46850E+03

1.46780E+03 1.41805E+03 1.40341E+03 1.38536E+03 1.37998E+03

1.37758E+03 1.37686E+03 1.31491E+03 1.29719E+03 1.29283E+03

1.29155E+03 1.24774E+03 1.23536E+03 1.21853E+03 1.21371E+03

1.21202E+03 1.21153E+03 1.17775E+03 1.16836E+03 1.14755E+03

1.14173E+03 1.13762E+03 1.13646E+03 1.10141E+03 1.09189E+03

1.07319E+03 1.06806E+03 1.06649E+03 1.06605E+03 1.02376E+03

1.01259E+03 1.00357E+03 1.00114E+03 1.00024E+03 1.00000E+03

9.66236E+02 9.57470E+02 9.49570E+02 9.47485E+02 9.42407E+02

9.41065E+02 9.38675E+02 9.38042E+02 8.99406E+02 8.89639E+02

8.83723E+02 8.82194E+02 8.80390E+02 8.79923E+02 8.46636E+02

8.38387E+02 8.30030E+02 8.27921E+02 8.25913E+02 8.25404E+02

7.89300E+02 7.80584E+02 7.76423E+02 7.75394E+02 7.74492E+02

7.74269E+02 7.37010E+02 7.28241E+02 7.26676E+02 7.26296E+02

6.95229E+02 6.88058E+02 6.84227E+02 6.83321E+02 6.81684E+02

6.81296E+02 6.51912E+02 6.45279E+02 6.41161E+02 6.40210E+02

6.39296E+02 6.39085E+02 6.11590E+02 6.05519E+02 6.01580E+02

6.00689E+02 5.99710E+02 5.99488E+02 5.75586E+02 5.70412E+02

5.65542E+02 5.64467E+02 5.62730E+02 5.62345E+02 5.36729E+02

5.31326E+02 5.29011E+02 5.28509E+02 5.27682E+02 5.27503E+02

5.03701E+02 4.98792E+02 4.96329E+02 4.95808E+02 4.94993E+02

4.94820E+02 4.70155E+02 4.65202E+02 4.64340E+02 4.64162E+02

4.40985E+02 4.36438E+02 4.35577E+02 4.35403E+02 4.17034E+02

4.13497E+02 4.10542E+02 4.09960E+02 4.08679E+02 4.08426E+02

3.89954E+02 3.86488E+02 3.84318E+02 3.83901E+02 3.83247E+02

3.83121E+02 3.63761E+02 3.60231E+02 3.59518E+02 3.59384E+02

3.46541E+02 3.44235E+02 3.40010E+02 3.39241E+02 3.38106E+02

3.37898E+02 3.37238E+02 3.37117E+02 3.19313E+02 3.16230E+02

3.07376E+02 3.02104E+02 2.97359E+02 2.97025E+02 2.96822E+02

2.96637E+02 2.82831E+02 2.80486E+02 2.79215E+02 2.78994E+02

2.78367E+02 2.78258E+02 2.70318E+02 2.65502E+02 2.63863E+02

2.62708E+02 2.61994E+02 2.61748E+02 2.61349E+02 2.61102E+02

2.61017E+02 2.47008E+02 2.44845E+02 2.37617E+02 2.34994E+02

2.32422E+02 2.31245E+02 2.30811E+02 2.30381E+02 2.29975E+02

2.29824E+02 2.29675E+02 2.19156E+02 2.15445E+02 2.10258E+02

2.09166E+02 2.04427E+02 2.03428E+02 2.02821E+02 2.02692E+02

2.02201E+02 2.02096E+02 1.97202E+02 1.93488E+02 1.91406E+02

1.90813E+02 1.90355E+02 1.90094E+02 1.89860E+02 1.89678E+02

1.89575E+02 1.82295E+02 1.79185E+02 1.78715E+02 1.78509E+02

1.78209E+02 1.78077E+02 1.77905E+02 1.77829E+02 1.71468E+02

1.68053E+02 1.66811E+02 1.58152E+02 1.57088E+02 1.56545E+02

1.56476E+02 1.48817E+02 1.46781E+02 1.39817E+02 1.38221E+02

1.37789E+02 1.37687E+02 1.33160E+02 1.29901E+02 1.29156E+02

1.24352E+02 1.22028E+02 1.21154E+02 1.19058E+02 1.17703E+02

1.17309E+02 1.16008E+02 1.15163E+02 1.14916E+02 1.14504E+02

1.14234E+02 1.14155E+02 1.13880E+02 1.13700E+02 1.13647E+02

1.08936E+02 1.07009E+02 1.06606E+02 1.04367E+02 1.02788E+02

1.02221E+02 1.01371E+02 1.00765E+02 1.00546E+02 1.00270E+02

1.00072E+02 1.00001E+02 9.49147E+01 9.38048E+01 9.00591E+01

8.84578E+01 8.79928E+01 8.53864E+01 8.29607E+01 8.25409E+01

8.00020E+01 7.87116E+01 7.81267E+01 7.78241E+01 7.75626E+01

7.74269E+01 7.48414E+01 7.31916E+01 7.26296E+01 6.81296E+01

6.64990E+01 6.57970E+01 6.55235E+01 6.47774E+01 6.44532E+01

6.43264E+01 6.40667E+01 6.39533E+01 6.39089E+01 6.16780E+01

5.99492E+01 5.77630E+01 5.69789E+01 5.62349E+01 5.43365E+01

5.31530E+01 5.27507E+01 5.12878E+01 5.00051E+01 4.94823E+01

4.71930E+01 4.64165E+01 4.39677E+01 4.35406E+01 4.15092E+01

4.08429E+01 3.86248E+01 3.83124E+01 3.71495E+01 3.62881E+01

3.59386E+01 3.40190E+01 3.37119E+01 3.20656E+01 3.16232E+01

2.96639E+01 2.78259E+01 2.70538E+01 2.63962E+01 2.61019E+01

2.44847E+01 2.33182E+01 2.29676E+01 2.24015E+01 2.18633E+01

2.15446E+01 2.10496E+01 2.09018E+01 2.05679E+01 2.04677E+01

2.02695E+01 2.02098E+01 1.89576E+01 1.81519E+01 1.78913E+01

1.77830E+01 1.69505E+01 1.66812E+01 1.60901E+01 1.56477E+01

1.48289E+01 1.46782E+01 1.37687E+01 1.29157E+01 1.22858E+01

1.21154E+01 1.17726E+01 1.15521E+01 1.13648E+01 1.09868E+01

1.06606E+01 1.02388E+01 1.00001E+01 9.62837E+00 9.38054E+00

8.79934E+00 8.46274E+00 8.25415E+00 8.07648E+00 7.90335E+00

7.74274E+00 7.49870E+00 7.33772E+00 7.26301E+00 6.81301E+00

6.64826E+00 6.50284E+00 6.39089E+00 5.99492E+00 5.62349E+00

5.27506E+00 4.94823E+00 4.64165E+00 4.35406E+00 4.08429E+00

3.83124E+00 3.59386E+00 3.37119E+00 3.16232E+00 2.96639E+00

2.78259E+00 2.61019E+00 2.44847E+00 2.29676E+00 2.15446E+00

2.02098E+00 1.89576E+00 1.77830E+00 1.66812E+00 1.56477E+00

1.46782E+00 1.37687E+00 1.29157E+00 1.21154E+00 1.13648E+00

1.06606E+00 1.00001E+00 9.38054E-01 8.79934E-01 8.25415E-01

7.74274E-01 7.26301E-01 6.81301E-01 6.39089E-01 5.99492E-01

5.62348E-01 5.27506E-01 4.94823E-01 4.64165E-01 4.35406E-01

4.08429E-01 3.83124E-01 3.59386E-01 3.37119E-01 3.16232E-01

2.96639E-01 2.78259E-01 2.61019E-01 2.44847E-01 2.29676E-01

2.15446E-01 1.89576E-01 1.66812E-01 1.46782E-01 1.29157E-01

1.13647E-01 1.00001E-01 8.25415E-02 6.81301E-02 5.62348E-02

4.64165E-02 3.83124E-02 3.16232E-02 2.61019E-02 2.15446E-02

1.77830E-02 1.46782E-02 1.21155E-02 1.00001E-02 6.81301E-03

4.64164E-03 3.16231E-03 2.15446E-03 1.00001E-03 1.00001E-04

1.00001E-05

9$$ F0 t

end

#sc\_bin

72

75

end

#kenova

zebra 22-b

read param

tme=1000

lib=75

lng=25000000

nb8=70000

gen=2020

npg=10000

nsk=20

run=yes

plt=no

end param

read mixt

sct=3

eps=1.

mix=1 100 1.

mix=2 200 1.

mix=3 300 1.

mix=4 400 1.

mix=5 500 1.

mix=6 600 1.

mix=7 700 1.

mix=8 800 1.

mix=9 900 1.

mix=10 1000 1.

mix=11 1100 1.

mix=12 1200 1.

mix=13 1300 1.

end mixt

read geometry

unit 1

com='core'

array 111 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 111

com='pu'

cuboid 1 1 4p2.3355 0.28170 0.0457

cuboid 2 1 4p2.5335 0.32740 0

unit 112

com='uo2'

cuboid 3 1 4p2.4255 0.59465 0.03665

cuboid 4 1 4p2.5335 0.63130 0

unit 113

com='na'

cuboid 5 1 4p2.4815 0.577347 0.036347

cuboid 6 1 4p2.5335 0.613694 0

unit 114

com='ss'

cuboid 0 1 4p1.9625 0.31700 0

cuboid 7 1 4p2.5335 0.31700 0

unit 211

com='u8'

cuboid 9 1 4p2.5335 9.82700 0

unit 212

com='u2'

cuboid 10 1 4p2.5335 12.72300 0

unit 213

com='u3'

cuboid 11 1 4p2.5335 7.62250 0

unit 311

com='mst3'

cuboid 12 1 4p2.5335 7.60628 0

unit 511

com='air'

cuboid 0 1 4p2.5335 1.392516 0

unit 2

com='u3-radial'

cuboid 12 1 4p2.5335 7.60628 0

cuboid 11 1 4p2.5335 160.05628 0

cuboid 12 1 4p2.5335 167.66256 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 3

com='mst9f10'

cuboid 13 1 4p2.54000 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 4

com='empty tube'

cuboid 0 1 4p2.55100 167.66256 0

cuboid 8 1 4p2.62720 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 11

com='2'

array 11 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 12

com='2'

array 12 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 13

com='2'

array 13 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 14

com='2'

array 14 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 15

com='2'

array 15 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 16

com='2'

array 16 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 17

com='2'

array 17 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 21

com='2'

array 21 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 22

com='2'

array 22 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 23

com='2'

array 23 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 24

com='2'

array 24 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 25

com='2'

array 25 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 26

com='2'

array 26 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 27

com='2'

array 27 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 31

com='2'

array 31 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 32

com='2'

array 32 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 33

com='2'

array 33 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 34

com='2'

array 34 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 35

com='2'

array 35 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 36

com='2'

array 36 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 37

com='2'

array 37 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 41

com='2'

array 41 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 42

com='2'

array 42 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 43

com='2'

array 43 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 44

com='2'

array 44 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 45

com='2'

array 45 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 46

com='2'

array 46 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 47

com='2'

array 47 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 51

com='2'

array 51 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 52

com='2'

array 52 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 53

com='2'

array 53 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 54

com='2'

array 54 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 55

com='2'

array 55 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 56

com='2'

array 56 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 57

com='2'

array 57 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 61

com='2'

array 61 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 62

com='2'

array 62 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 63

com='2'

array 63 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 64

com='2'

array 64 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 65

com='2'

array 65 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 66

com='2'

array 66 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 67

com='2'

array 67 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 71

com='2'

array 71 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 72

com='2'

array 72 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 73

com='2'

array 73 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 74

com='2'

array 74 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 75

com='2'

array 75 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 76

com='2'

array 76 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 77

com='2'

array 77 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

global unit 100

com='reactor'

array 100 3\*0

end geometry

read array

ara=111 nux=1 nuy=1 nuz=176

fill

511 311 213 212 211

113 112 113 111 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 111 113 112 113

211 212 213 311 511

end fill

ara=11 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=12 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 3 3

4 4 3 3 3

end fill

ara=13 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 3 3

3 3 3 3 3

3 3 3 3 3

3 3 3 2 2

end fill

ara=14 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

2 2 2 2 2

end fill

ara=15 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

3 3 4 4 4

3 3 3 3 3

3 3 3 3 3

2 2 3 3 3

end fill

ara=16 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

3 3 4 4 4

3 3 3 4 4

end fill

ara=17 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=21 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 3

4 4 4 3 3

4 4 4 3 3

end fill

ara=22 nux=5 nuy=5 nuz=1

fill

4 3 3 3 3

3 3 3 3 2

3 3 3 2 2

3 3 2 2 2

3 2 2 2 2

end fill

ara=23 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=24 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 1 1 1 2

end fill

ara=25 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=26 nux=5 nuy=5 nuz=1

fill

3 3 3 3 4

2 3 3 3 3

2 2 3 3 3

2 2 2 3 3

2 2 2 2 3

end fill

ara=27 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

3 4 4 4 4

3 3 4 4 4

3 3 4 4 4

end fill

ara=31 nux=5 nuy=5 nuz=1

fill

4 4 3 3 3

4 4 3 3 3

4 4 3 3 3

4 3 3 3 2

4 3 3 3 2

end fill

ara=32 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=33 nux=5 nuy=5 nuz=1

fill

2 2 2 1 1

2 2 1 1 1

2 1 1 1 1

1 1 1 1 1

1 1 1 1 1

end fill

ara=34 nux=5 nuy=5 nuz=1

fill

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

end fill

ara=35 nux=5 nuy=5 nuz=1

fill

1 1 2 2 2

1 1 1 1 2

1 1 1 1 2

1 1 1 1 1

1 1 1 1 1

end fill

ara=36 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=37 nux=5 nuy=5 nuz=1

fill

3 3 3 4 4

3 3 3 4 4

3 3 3 4 4

2 3 3 3 4

2 3 3 3 4

end fill

ara=41 nux=5 nuy=5 nuz=1

fill

4 3 3 3 2

4 3 3 3 2

4 3 3 3 2

4 3 3 3 2

4 3 3 3 2

end fill

ara=42 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 1

2 2 2 2 1

2 2 2 2 1

2 2 2 2 2

end fill

ara=43 nux=5 nuy=5 nuz=1

fill

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

end fill

ara=44 nux=5 nuy=5 nuz=1

fill

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

end fill

ara=45 nux=5 nuy=5 nuz=1

fill

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

end fill

ara=46 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

1 2 2 2 2

1 2 2 2 2

1 2 2 2 2

2 2 2 2 2

end fill

ara=47 nux=5 nuy=5 nuz=1

fill

2 3 3 3 4

2 3 3 3 4

2 3 3 3 4

2 3 3 3 4

2 3 3 3 4

end fill

ara=51 nux=5 nuy=5 nuz=1

fill

4 3 3 3 2

4 3 3 3 2

4 4 3 3 3

4 4 3 3 3

4 4 3 3 3

end fill

ara=52 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=53 nux=5 nuy=5 nuz=1

fill

1 1 1 1 1

1 1 1 1 1

2 1 1 1 1

2 1 1 1 1

2 2 2 1 1

end fill

ara=54 nux=5 nuy=5 nuz=1

fill

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

end fill

ara=55 nux=5 nuy=5 nuz=1

fill

1 1 1 1 1

1 1 1 1 1

1 1 1 1 2

1 1 1 2 2

1 1 2 2 2

end fill

ara=56 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=57 nux=5 nuy=5 nuz=1

fill

2 3 3 3 4

2 3 3 3 4

3 3 3 4 4

3 3 3 4 4

3 3 3 4 4

end fill

ara=61 nux=5 nuy=5 nuz=1

fill

4 4 4 3 3

4 4 4 3 3

4 4 4 4 3

4 4 4 4 4

4 4 4 4 4

end fill

ara=62 nux=5 nuy=5 nuz=1

fill

3 2 2 2 2

3 3 2 2 2

3 3 3 2 2

3 3 3 3 2

4 3 3 3 3

end fill

ara=63 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=64 nux=5 nuy=5 nuz=1

fill

2 1 1 1 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=65 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=66 nux=5 nuy=5 nuz=1

fill

2 2 2 2 3

2 2 2 3 3

2 2 3 3 3

2 3 3 3 3

3 3 3 3 4

end fill

ara=67 nux=5 nuy=5 nuz=1

fill

3 3 4 4 4

3 3 4 4 4

3 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=71 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=72 nux=5 nuy=5 nuz=1

fill

4 4 3 3 3

4 4 4 3 3

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=73 nux=5 nuy=5 nuz=1

fill

3 3 3 2 2

3 3 3 3 3

3 3 3 3 3

4 4 4 3 3

4 4 4 4 4

end fill

ara=74 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

4 4 4 4 4

end fill

ara=75 nux=5 nuy=5 nuz=1

fill

2 2 3 3 3

3 3 3 3 3

3 3 3 3 3

3 3 4 4 4

4 4 4 4 4

end fill

ara=76 nux=5 nuy=5 nuz=1

fill

3 3 3 4 4

3 3 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=77 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=100 nux=7 nuy=7 nuz=1

fill

11 12 13 14 15 16 17

21 22 23 24 25 26 27

31 32 33 34 35 36 37

41 42 43 44 45 46 47

51 52 53 54 55 56 57

61 62 63 64 65 66 67

71 72 73 74 75 76 77

end fill

end array

read plot

ttl='simple plot 1'

pic=mix

xul= 0 yul= 190 zul= 100

xlr= 190 ylr= 0 zlr= 100

uax=1.0 vdn=-1.0

nax=1200

lpi=10

scr=yes end

ttl='simple plot 4'

pic=mix

xul= 0 yul= 95 zul= 168

xlr= 190 ylr= 95 zlr= 0

uax=1.0 wdn=-1.0

nax=800

scr=yes end

end plot

end data

end

=cons9901

TASK:

MULTIC= 1

NOUT = 2

IHT = 4

IHS = 77

NG = 299

IPRIB = 0

idelta= 1

NMOM = 5

IZT = 50

NRZT = 39

INZ = 32

NAME=

'U234' 'U235' 'U236' 'U238NR' 'PU38' 'PU39' 'PU40' 'PU41' 'PU42' 'AM41'

'O' 'NA' 'FE' 'CR' 'NI' 'MN' 'MO' 'TI' 'NB' 'CU' 'AL' 'SI' 'CA' 'C'

'P' 'S' 'H+H(FREE)' 'CO' 'K' 'N' 'GA' 'D-SC'

RO=

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*PLATES

\*1 PU

0.0000E+00 0.0000E+00 0.0000E+00 6.8782E-07 3.0461E-05 2.8920E-02 6.9095E-03

7.3960E-04 1.8699E-04 4.5718E-04 8.8450E-05 0.0000E+00 1.6335E-05 3.5989E-06

8.5688E-06 1.4902E-06 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 2.2973E-05

1.4158E-05 0.0000E+00 4.2260E-04 0.0000E+00 0.0000E+00 1.2764E-04 0.0000E+00

0.0000E+00 2.4215E-05 2.0166E-03 0.0000E+00

\*2 CAN

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 3.5542E-02 9.4011E-03

4.1646E-03 8.5931E-04 0.0000E+00 0.0000E+00 0.0000E+00 1.6613E-02 0.0000E+00

3.6607E-04 0.0000E+00 1.1393E-04 1.3731E-05 0.0000E+00 1.3760E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*3 UO2

0.0000E+00 1.6585E-04 0.0000E+00 2.2894E-02 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 4.6122E-02 0.0000E+00 1.3139E-06 0.0000E+00

1.2503E-06 8.3479E-08 3.3462E-07 0.0000E+00 0.0000E+00 0.0000E+00 3.3995E-06

2.3024E-05 0.0000E+00 1.1837E-05 0.0000E+00 0.0000E+00 3.1852E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*4 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 4.7796E-02 1.3673E-02

8.3368E-03 8.4655E-04 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

6.3794E-04 0.0000E+00 1.2695E-04 3.4708E-04 3.5660E-05 1.8834E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*5 na

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 5.6492E-06 2.3225E-02 1.6184E-07 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 3.6083E-06 0.0000E+00 0.0000E+00 0.0000E+00 1.3900E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*6 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 5.5054E-02 1.4759E-02

7.0982E-03 1.3570E-03 0.0000E+00 0.0000E+00 3.1147E-04 0.0000E+00 0.0000E+00

6.0867E-04 0.0000E+00 2.9290E-04 3.2795E-05 3.3219E-05 2.1631E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*7 ss

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 5.5367E-02 1.5908E-02

8.7976E-03 1.4972E-03 8.0988E-05 2.4806E-04 5.0000E-06 5.0365E-05 1.1862E-04

7.9703E-04 0.0000E+00 8.7794E-05 4.0018E-05 1.4422E-05 1.8355E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*8 sheath

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 7.7524E-02 3.6690E-06

1.4302E-05 2.5697E-04 0.0000E+00 0.0000E+00 0.0000E+00 2.2216E-05 1.9798E-05

0.0000E+00 0.0000E+00 2.3825E-04 0.0000E+00 0.0000E+00 7.5712E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*9 U8

0.0000E+00 3.3369E-04 0.0000E+00 4.6021E-02 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.0599E-04 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

2.1076E-04 0.0000E+00 4.9283E-04 0.0000E+00 0.0000E+00 4.4048E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*10 U2

0.0000E+00 3.3962E-04 0.0000E+00 4.6785E-02 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 9.9032E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

1.9692E-04 0.0000E+00 4.6047E-04 0.0000E+00 0.0000E+00 4.3899E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*11 U3

0.0000E+00 3.4209E-04 0.0000E+00 4.7156E-02 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.0138E-04 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

2.0160E-04 0.0000E+00 4.7140E-04 0.0000E+00 0.0000E+00 4.4574E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*12 mst3

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 8.3806E-02 2.7222E-05

4.8234E-05 3.2634E-04 9.8355E-06 3.9416E-05 0.0000E+00 4.4548E-05 1.3989E-04

0.0000E+00 0.0000E+00 5.1066E-04 0.0000E+00 0.0000E+00 2.5700E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*13 mst9f10

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 8.1432E-02 0.0000E+00

0.0000E+00 7.1275E-04 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

3.1158E-04 0.0000E+00 6.8972E-04 4.2944E-05 3.7110E-05 4.6306E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* PINS

\*14 PUPINA

1.3805E-06 1.4114E-04 7.9324E-07 1.9379E-02 3.7786E-06 2.9689E-03 6.7253E-04

7.0350E-05 1.7488E-05 4.7854E-05 4.6606E-02 0.0000E+00 5.6537E-06 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.1702E-05

0.0000E+00 7.8782E-06 0.0000E+00 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*15 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 5.9675E-02 1.8218E-02

8.9153E-03 1.5646E-03 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

8.5585E-04 0.0000E+00 1.3288E-04 3.7870E-05 2.4585E-05 2.6710E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*16 PUPINB

1.3177E-06 1.3457E-04 7.4658E-07 1.8472E-02 5.8915E-06 3.7341E-03 9.5200E-04

1.1199E-04 2.7984E-05 5.5789E-05 4.6993E-02 0.0000E+00 0.0000E+00 0.0000E+00

5.4424E-06 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

9.0199E-06 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*17 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 5.3171E-02 1.4981E-02

8.8137E-03 1.5751E-03 0.0000E+00 0.0000E+00 2.9391E-04 0.0000E+00 0.0000E+00

1.1571E-03 0.0000E+00 2.3695E-04 4.1596E-05 2.2786E-05 2.2895E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*18 PUPINC

1.2863E-06 1.2997E-04 7.3103E-07 1.7843E-02 6.9094E-06 4.4708E-03 1.0602E-03

1.1598E-04 3.0047E-05 5.7784E-05 4.7434E-02 0.0000E+00 7.6916E-06 0.0000E+00

1.0947E-05 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.9730E-05

7.9741E-06 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*19 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 5.8512E-02 1.7856E-02

8.7515E-03 1.5331E-03 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

8.3531E-04 0.0000E+00 1.3609E-04 3.6008E-05 2.4585E-05 2.6710E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*20 PUPIND

1.4118E-06 1.4266E-04 7.9324E-07 1.9584E-02 4.7348E-06 3.0189E-03 7.5441E-04

8.8443E-05 2.0961E-05 4.0742E-05 4.7314E-02 0.0000E+00 6.9027E-06 0.0000E+00

1.4138E-05 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.8914E-05

2.5099E-05 1.5940E-05 0.0000E+00 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*21 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 5.5753E-02 1.5910E-02

7.6341E-03 1.1586E-03 2.2047E-06 2.8916E-05 0.0000E+00 6.0522E-06 6.4142E-06

8.9693E-04 0.0000E+00 2.0172E-04 3.4145E-05 8.9942E-06 2.4802E-05 4.2418E-06

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*22 PUPINE

1.1295E-06 1.1465E-04 6.3771E-07 1.5739E-02 9.4851E-06 6.0438E-03 1.5103E-03

1.7707E-04 4.1953E-05 8.1559E-05 4.7299E-02 0.0000E+00 1.0321E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 9.5250E-06

4.5753E-05 3.2062E-05 0.0000E+00 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*23 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 5.6794E-02 1.6102E-02

8.0503E-03 9.8006E-04 2.1446E-05 2.8916E-05 0.0000E+00 6.0522E-06 6.4142E-06

1.0476E-03 0.0000E+00 7.3646E-05 1.3658E-05 1.7389E-05 2.4802E-05 4.2418E-06

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*24 PUPINF

1.1452E-06 1.1526E-04 6.3771E-07 1.5824E-02 9.5005E-06 6.0112E-03 1.5285E-03

1.9723E-04 4.4380E-05 6.8035E-05 4.7482E-02 0.0000E+00 1.1505E-05 4.9427E-06

2.1895E-06 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.4287E-05

0.0000E+00 6.7514E-05 0.0000E+00 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*25 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 5.7354E-02 1.6284E-02

8.1453E-03 9.8357E-04 2.1246E-05 2.1687E-05 0.0000E+00 4.5391E-06 4.2762E-06

1.0544E-03 0.0000E+00 7.2045E-05 1.3658E-05 1.7989E-05 2.4802E-05 3.2629E-06

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*26 UO2PINC

9.7268E-07 1.7084E-04 0.0000E+00 2.3588E-02 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 4.7501E-02 0.0000E+00 1.1176E-06 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 2.3812E-05

4.0001E-05 1.2825E-05 3.2095E-05 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*27 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 5.9792E-02 1.8255E-02

8.9349E-03 1.5681E-03 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

8.5585E-04 0.0000E+00 1.3288E-04 3.7870E-05 2.4585E-05 2.6710E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* WALLS

\*28 NACLI

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 4.8911E-02 1.4995E-02

7.2440E-03 1.2214E-03 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

6.0229E-04 0.0000E+00 2.8167E-04 7.3471E-05 3.6808E-05 3.9844E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*29 NACLIIS

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 4.7118E-02 1.4380E-02

7.4526E-03 1.1060E-03 3.4248E-06 2.4400E-04 0.0000E+00 1.0341E-05 0.0000E+00

9.7623E-04 0.0000E+00 6.5351E-04 4.7540E-05 3.3014E-05 3.8637E-05 1.1151E-05

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*30 NACLIII

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 5.0764E-02 1.4132E-02

7.6658E-03 8.3089E-04 2.4862E-05 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

7.7474E-04 0.0000E+00 1.5948E-04 5.2334E-05 2.4551E-05 3.9844E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*31 NACLIV

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 4.7151E-02 1.3563E-02

6.4549E-03 1.0026E-03 8.8791E-06 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

8.2197E-04 0.0000E+00 3.5158E-04 6.2274E-05 1.6431E-05 3.7430E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*32 NACLV

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 4.9404E-02 1.3830E-02

7.2532E-03 9.6934E-04 8.8791E-06 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

6.4389E-04 0.0000E+00 2.6343E-04 6.8560E-05 1.7190E-05 3.8637E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*NA

\*33 NACLI

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 6.4605E-06 2.4129E-02 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 1.1080E-06 0.0000E+00 0.0000E+00 0.0000E+00 5.5075E-06 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*34 NACLIIS

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 1.0767E-06 2.4379E-02 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 9.5521E-08 0.0000E+00 0.0000E+00 0.0000E+00 1.1205E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*35 NACLIII

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 3.5892E-06 2.3888E-02 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 6.6865E-07 0.0000E+00 0.0000E+00 0.0000E+00 7.5966E-06 0.0000E+00

3.4270E-07 0.0000E+00 0.0000E+00 0.0000E+00

\*36 NACLIV

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 3.5892E-06 2.4037E-02 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 6.6865E-07 0.0000E+00 0.0000E+00 0.0000E+00 7.5966E-06 0.0000E+00

3.4270E-07 0.0000E+00 0.0000E+00 0.0000E+00

\*37 NACLV

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 3.5892E-06 2.3829E-02 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 6.6865E-07 0.0000E+00 0.0000E+00 0.0000E+00 7.5966E-06 0.0000E+00

3.4270E-07 0.0000E+00 0.0000E+00 0.0000E+00

\*38 TUBES

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 6.0762E-02 1.6787E-02

7.4360E-03 1.3588E-03 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

1.0632E-03 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*39 PLATES

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 3.5578E-02 1.0016E-02

4.4601E-03 7.7198E-04 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

5.5206E-04 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*40 HOMO PLATE

0.0000E+00 4.0267E-05 0.0000E+00 5.5585E-03 1.4500E-06 1.3767E-03 3.2891E-04

3.5207E-05 8.9013E-06 2.1763E-05 1.1204E-02 8.5835E-03 1.3408E-02 2.5351E-03

1.3445E-03 2.2472E-04 2.5185E-06 7.4651E-06 2.1148E-05 5.0291E-04 6.5715E-06

1.1860E-04 1.3336E-06 6.9062E-05 2.3577E-05 4.7025E-06 2.6584E-05 0.0000E+00

0.0000E+00 1.1527E-06 9.5996E-05 0.0000E+00

\*41 HOMO PIN

3.9345E-07 3.9755E-05 2.2361E-07 5.4578E-03 2.1135E-06 1.3675E-03 3.2429E-04

3.5476E-05 9.1908E-06 1.7675E-05 1.4512E-02 8.8477E-03 1.3627E-02 2.7802E-03

1.3198E-03 2.4404E-04 0.0000E+00 0.0000E+00 0.0000E+00 1.2150E-06 7.1178E-06

1.3994E-04 4.0628E-07 3.7223E-05 6.3404E-06 3.5587E-06 2.0046E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*\*\*\*\*\*\*\*\* D-SC

\*42 PU

0.0000E+00 0.0000E+00 0.0000E+00 6.8782E-07 3.0461E-05 2.8920E-02 6.9095E-03

7.3960E-04 1.8699E-04 4.5718E-04 8.8450E-05 0.0000E+00 1.6335E-05 3.5989E-06

8.5688E-06 1.4902E-06 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 2.2973E-05

1.4158E-05 0.0000E+00 4.2260E-04 0.0000E+00 0.0000E+00 1.2764E-04 0.0000E+00

0.0000E+00 2.4215E-05 2.0166E-03 2.3327E+00

\*43 UO2

0.0000E+00 1.6585E-04 0.0000E+00 2.2894E-02 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 4.6122E-02 0.0000E+00 1.3139E-06 0.0000E+00

1.2503E-06 8.3479E-08 3.3462E-07 0.0000E+00 0.0000E+00 0.0000E+00 3.3995E-06

2.3024E-05 0.0000E+00 1.1837E-05 0.0000E+00 0.0000E+00 3.1852E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 1.1022E+00

\*44 PUPINA

1.3805E-06 1.4114E-04 7.9324E-07 1.9379E-02 3.7786E-06 2.9689E-03 6.7253E-04

7.0350E-05 1.7488E-05 4.7854E-05 4.6606E-02 0.0000E+00 5.6537E-06 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.1702E-05

0.0000E+00 7.8782E-06 0.0000E+00 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.8460E+00

\*45 PUPINB

1.3177E-06 1.3457E-04 7.4658E-07 1.8472E-02 5.8915E-06 3.7341E-03 9.5200E-04

1.1199E-04 2.7984E-05 5.5789E-05 4.6993E-02 0.0000E+00 0.0000E+00 0.0000E+00

5.4424E-06 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

9.0199E-06 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.8460E+00

\*46 PUPINC

1.2863E-06 1.2997E-04 7.3103E-07 1.7843E-02 6.9094E-06 4.4708E-03 1.0602E-03

1.1598E-04 3.0047E-05 5.7784E-05 4.7434E-02 0.0000E+00 7.6916E-06 0.0000E+00

1.0947E-05 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.9730E-05

7.9741E-06 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.8460E+00

\*47 PUPIND

1.4118E-06 1.4266E-04 7.9324E-07 1.9584E-02 4.7348E-06 3.0189E-03 7.5441E-04

8.8443E-05 2.0961E-05 4.0742E-05 4.7314E-02 0.0000E+00 6.9027E-06 0.0000E+00

1.4138E-05 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.8914E-05

2.5099E-05 1.5940E-05 0.0000E+00 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.8460E+00

\*48 PUPINE

1.1295E-06 1.1465E-04 6.3771E-07 1.5739E-02 9.4851E-06 6.0438E-03 1.5103E-03

1.7707E-04 4.1953E-05 8.1559E-05 4.7299E-02 0.0000E+00 1.0321E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 9.5250E-06

4.5753E-05 3.2062E-05 0.0000E+00 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.8460E+00

\*49 PUPINF

1.1452E-06 1.1526E-04 6.3771E-07 1.5824E-02 9.5005E-06 6.0112E-03 1.5285E-03

1.9723E-04 4.4380E-05 6.8035E-05 4.7482E-02 0.0000E+00 1.1505E-05 4.9427E-06

2.1895E-06 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.4287E-05

0.0000E+00 6.7514E-05 0.0000E+00 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.8460E+00

\*50 UO2PINC

9.7268E-07 1.7084E-04 0.0000E+00 2.3588E-02 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 4.7501E-02 0.0000E+00 1.1176E-06 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 2.3812E-05

4.0001E-05 1.2825E-05 3.2095E-05 0.0000E+00 0.0000E+00 3.2784E-05 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.8460E+00

ICOR =

42 40 43 40 40 40 40 40

9 10 11 12 13

44 41 45 41 46 41 47 41 48 41 49 41 50 41

5\*41 5\*41 41 41

40 41 42 43 44 45 46 47 48 49 50

NAMSUB='U238NR' 'PU39'

NGSUB=10 11 12 13 14 15 16 17 18 19 20 21 22 23

END

end

=subgran

end

=lava

-1$$ 2500000

0$$ 71 72 18 19

1$$ 39 755 4 91 845 61 0 -1 1 t

2$$ 37I1000 39000

3$$ F5

4$$ 37I100 3900

5$$ 1 1452 27 1018

7\*\*

2.00000E+07 1.86181E+07 1.73316E+07 1.61341E+07 1.50192E+07

1.39818E+07 1.30158E+07 1.21165E+07 1.12793E+07 1.05000E+07

9.69341E+06 8.94878E+06 8.26136E+06 7.62674E+06 7.04086E+06

6.50000E+06 5.99475E+06 5.52877E+06 5.09902E+06 4.70267E+06

4.33713E+06 4.00000E+06 3.69862E+06 3.41995E+06 3.16228E+06

2.92402E+06 2.70371E+06 2.50000E+06 2.32522E+06 2.16265E+06

2.01146E+06 1.87083E+06 1.74003E+06 1.61838E+06 1.50524E+06

1.40000E+06 1.30541E+06 1.21722E+06 1.13498E+06 1.05830E+06

9.86800E+05 9.20131E+05 8.57965E+05 8.00000E+05 7.40700E+05

6.85795E+05 6.34960E+05 5.87894E+05 5.44316E+05 5.03968E+05

4.66612E+05 4.32024E+05 4.00000E+05 3.70350E+05 3.42898E+05

3.17480E+05 2.93947E+05 2.72158E+05 2.51984E+05 2.33306E+05

2.16012E+05 2.00000E+05 1.91435E+05 1.85175E+05 1.77154E+05

1.71449E+05 1.63937E+05 1.58740E+05 1.51708E+05 1.46973E+05

1.40390E+05 1.36079E+05 1.29916E+05 1.25992E+05 1.20222E+05

1.16653E+05 1.11251E+05 1.08006E+05 1.02951E+05 1.00000E+05

9.60586E+04 9.38042E+04 9.00741E+04 8.79923E+04 8.44625E+04

8.25404E+04 7.92005E+04 7.74264E+04 7.42663E+04 7.26292E+04

6.96395E+04 6.81292E+04 6.53014E+04 6.39081E+04 6.12343E+04

5.99484E+04 5.74205E+04 5.62341E+04 5.38442E+04 5.27500E+04

5.04907E+04 4.94817E+04 4.73460E+04 4.64159E+04 4.52365E+04

4.43972E+04 4.38990E+04 4.35400E+04 4.24188E+04 4.16320E+04

4.11705E+04 4.08424E+04 3.97762E+04 3.90389E+04 3.86114E+04

3.83119E+04 3.72981E+04 3.66074E+04 3.62115E+04 3.59381E+04

3.49744E+04 3.43274E+04 3.39609E+04 3.37115E+04 3.27956E+04

3.21894E+04 3.18504E+04 3.16227E+04 3.07523E+04 3.01846E+04

2.98710E+04 2.96635E+04 2.88362E+04 2.83046E+04 2.80147E+04

2.78256E+04 2.70395E+04 2.65418E+04 2.62738E+04 2.61015E+04

2.53546E+04 2.48887E+04 2.46412E+04 2.44843E+04 2.37747E+04

2.33386E+04 2.31100E+04 2.29673E+04 2.22931E+04 2.18850E+04

2.16741E+04 2.15443E+04 2.09038E+04 2.05218E+04 2.03274E+04

2.02095E+04 1.96011E+04 1.92437E+04 1.90644E+04 1.89573E+04

1.83795E+04 1.80451E+04 1.78800E+04 1.77828E+04 1.72340E+04

1.69213E+04 1.67692E+04 1.66810E+04 1.61599E+04 1.58674E+04

1.57274E+04 1.56475E+04 1.51527E+04 1.48791E+04 1.47504E+04

1.46780E+04 1.42082E+04 1.39524E+04 1.38342E+04 1.37686E+04

1.33225E+04 1.30834E+04 1.29748E+04 1.29155E+04 1.24919E+04

1.22685E+04 1.21688E+04 1.21153E+04 1.17131E+04 1.15044E+04

1.14130E+04 1.13646E+04 1.09828E+04 1.07879E+04 1.07041E+04

1.06605E+04 1.02980E+04 1.01159E+04 1.00393E+04 1.00000E+04

9.65597E+03 9.48588E+03 9.41580E+03 9.38042E+03 9.05389E+03

8.89508E+03 8.83104E+03 8.79923E+03 8.48930E+03 8.34103E+03

8.28260E+03 8.25404E+03 7.95994E+03 7.82153E+03 7.76826E+03

7.74264E+03 7.46356E+03 7.33439E+03 7.28588E+03 7.26292E+03

6.99809E+03 6.87754E+03 6.83345E+03 6.81292E+03 6.56175E+03

6.44928E+03 6.40918E+03 6.39081E+03 6.15266E+03 6.04776E+03

6.01129E+03 5.99484E+03 5.76907E+03 5.67124E+03 5.63811E+03

5.62341E+03 5.40937E+03 5.31816E+03 5.28811E+03 5.27500E+03

5.07209E+03 4.98706E+03 4.95985E+03 4.94817E+03 4.75585E+03

4.67660E+03 4.65199E+03 4.64159E+03 4.45930E+03 4.38545E+03

4.36323E+03 4.35400E+03 4.18123E+03 4.11242E+03 4.09241E+03

4.08424E+03 3.92049E+03 3.85639E+03 3.83841E+03 3.83119E+03

3.67600E+03 3.61629E+03 3.60018E+03 3.59381E+03 3.44677E+03

3.39115E+03 3.37674E+03 3.37114E+03 3.23181E+03 3.18002E+03

3.16718E+03 3.16227E+03 3.03025E+03 2.98204E+03 2.97063E+03

2.96635E+03 2.84126E+03 2.79638E+03 2.78628E+03 2.78256E+03

2.66404E+03 2.62228E+03 2.61338E+03 2.61015E+03 2.49787E+03

2.45903E+03 2.45121E+03 2.44843E+03 2.34207E+03 2.30593E+03

2.29911E+03 2.29673E+03 2.19597E+03 2.16237E+03 2.15646E+03

2.15443E+03 2.08156E+03 2.05753E+03 2.03423E+03 2.02643E+03

2.02233E+03 2.02095E+03 1.94867E+03 1.92530E+03 1.91246E+03

1.90823E+03 1.90091E+03 1.89850E+03 1.89642E+03 1.89573E+03

1.82083E+03 1.79713E+03 1.78450E+03 1.78042E+03 1.77880E+03

1.77828E+03 1.71599E+03 1.69659E+03 1.68085E+03 1.67586E+03

1.67210E+03 1.67091E+03 1.66878E+03 1.66810E+03 1.62473E+03

1.61140E+03 1.58045E+03 1.57089E+03 1.56621E+03 1.56475E+03

1.50398E+03 1.48581E+03 1.47431E+03 1.47080E+03 1.46850E+03

1.46780E+03 1.41805E+03 1.40341E+03 1.38536E+03 1.37998E+03

1.37758E+03 1.37686E+03 1.31491E+03 1.29719E+03 1.29283E+03

1.29155E+03 1.24774E+03 1.23536E+03 1.21853E+03 1.21371E+03

1.21202E+03 1.21153E+03 1.17775E+03 1.16836E+03 1.14755E+03

1.14173E+03 1.13762E+03 1.13646E+03 1.10141E+03 1.09189E+03

1.07319E+03 1.06806E+03 1.06649E+03 1.06605E+03 1.02376E+03

1.01259E+03 1.00357E+03 1.00114E+03 1.00024E+03 1.00000E+03

9.66236E+02 9.57470E+02 9.49570E+02 9.47485E+02 9.42407E+02

9.41065E+02 9.38675E+02 9.38042E+02 8.99406E+02 8.89639E+02

8.83723E+02 8.82194E+02 8.80390E+02 8.79923E+02 8.46636E+02

8.38387E+02 8.30030E+02 8.27921E+02 8.25913E+02 8.25404E+02

7.89300E+02 7.80584E+02 7.76423E+02 7.75394E+02 7.74492E+02

7.74269E+02 7.37010E+02 7.28241E+02 7.26676E+02 7.26296E+02

6.95229E+02 6.88058E+02 6.84227E+02 6.83321E+02 6.81684E+02

6.81296E+02 6.51912E+02 6.45279E+02 6.41161E+02 6.40210E+02

6.39296E+02 6.39085E+02 6.11590E+02 6.05519E+02 6.01580E+02

6.00689E+02 5.99710E+02 5.99488E+02 5.75586E+02 5.70412E+02

5.65542E+02 5.64467E+02 5.62730E+02 5.62345E+02 5.36729E+02

5.31326E+02 5.29011E+02 5.28509E+02 5.27682E+02 5.27503E+02

5.03701E+02 4.98792E+02 4.96329E+02 4.95808E+02 4.94993E+02

4.94820E+02 4.70155E+02 4.65202E+02 4.64340E+02 4.64162E+02

4.40985E+02 4.36438E+02 4.35577E+02 4.35403E+02 4.17034E+02

4.13497E+02 4.10542E+02 4.09960E+02 4.08679E+02 4.08426E+02

3.89954E+02 3.86488E+02 3.84318E+02 3.83901E+02 3.83247E+02

3.83121E+02 3.63761E+02 3.60231E+02 3.59518E+02 3.59384E+02

3.46541E+02 3.44235E+02 3.40010E+02 3.39241E+02 3.38106E+02

3.37898E+02 3.37238E+02 3.37117E+02 3.19313E+02 3.16230E+02

3.07376E+02 3.02104E+02 2.97359E+02 2.97025E+02 2.96822E+02

2.96637E+02 2.82831E+02 2.80486E+02 2.79215E+02 2.78994E+02

2.78367E+02 2.78258E+02 2.70318E+02 2.65502E+02 2.63863E+02

2.62708E+02 2.61994E+02 2.61748E+02 2.61349E+02 2.61102E+02

2.61017E+02 2.47008E+02 2.44845E+02 2.37617E+02 2.34994E+02

2.32422E+02 2.31245E+02 2.30811E+02 2.30381E+02 2.29975E+02

2.29824E+02 2.29675E+02 2.19156E+02 2.15445E+02 2.10258E+02

2.09166E+02 2.04427E+02 2.03428E+02 2.02821E+02 2.02692E+02

2.02201E+02 2.02096E+02 1.97202E+02 1.93488E+02 1.91406E+02

1.90813E+02 1.90355E+02 1.90094E+02 1.89860E+02 1.89678E+02

1.89575E+02 1.82295E+02 1.79185E+02 1.78715E+02 1.78509E+02

1.78209E+02 1.78077E+02 1.77905E+02 1.77829E+02 1.71468E+02

1.68053E+02 1.66811E+02 1.58152E+02 1.57088E+02 1.56545E+02

1.56476E+02 1.48817E+02 1.46781E+02 1.39817E+02 1.38221E+02

1.37789E+02 1.37687E+02 1.33160E+02 1.29901E+02 1.29156E+02

1.24352E+02 1.22028E+02 1.21154E+02 1.19058E+02 1.17703E+02

1.17309E+02 1.16008E+02 1.15163E+02 1.14916E+02 1.14504E+02

1.14234E+02 1.14155E+02 1.13880E+02 1.13700E+02 1.13647E+02

1.08936E+02 1.07009E+02 1.06606E+02 1.04367E+02 1.02788E+02

1.02221E+02 1.01371E+02 1.00765E+02 1.00546E+02 1.00270E+02

1.00072E+02 1.00001E+02 9.49147E+01 9.38048E+01 9.00591E+01

8.84578E+01 8.79928E+01 8.53864E+01 8.29607E+01 8.25409E+01

8.00020E+01 7.87116E+01 7.81267E+01 7.78241E+01 7.75626E+01

7.74269E+01 7.48414E+01 7.31916E+01 7.26296E+01 6.81296E+01

6.64990E+01 6.57970E+01 6.55235E+01 6.47774E+01 6.44532E+01

6.43264E+01 6.40667E+01 6.39533E+01 6.39089E+01 6.16780E+01

5.99492E+01 5.77630E+01 5.69789E+01 5.62349E+01 5.43365E+01

5.31530E+01 5.27507E+01 5.12878E+01 5.00051E+01 4.94823E+01

4.71930E+01 4.64165E+01 4.39677E+01 4.35406E+01 4.15092E+01

4.08429E+01 3.86248E+01 3.83124E+01 3.71495E+01 3.62881E+01

3.59386E+01 3.40190E+01 3.37119E+01 3.20656E+01 3.16232E+01

2.96639E+01 2.78259E+01 2.70538E+01 2.63962E+01 2.61019E+01

2.44847E+01 2.33182E+01 2.29676E+01 2.24015E+01 2.18633E+01

2.15446E+01 2.10496E+01 2.09018E+01 2.05679E+01 2.04677E+01

2.02695E+01 2.02098E+01 1.89576E+01 1.81519E+01 1.78913E+01

1.77830E+01 1.69505E+01 1.66812E+01 1.60901E+01 1.56477E+01

1.48289E+01 1.46782E+01 1.37687E+01 1.29157E+01 1.22858E+01

1.21154E+01 1.17726E+01 1.15521E+01 1.13648E+01 1.09868E+01

1.06606E+01 1.02388E+01 1.00001E+01 9.62837E+00 9.38054E+00

8.79934E+00 8.46274E+00 8.25415E+00 8.07648E+00 7.90335E+00

7.74274E+00 7.49870E+00 7.33772E+00 7.26301E+00 6.81301E+00

6.64826E+00 6.50284E+00 6.39089E+00 5.99492E+00 5.62349E+00

5.27506E+00 4.94823E+00 4.64165E+00 4.35406E+00 4.08429E+00

3.83124E+00 3.59386E+00 3.37119E+00 3.16232E+00 2.96639E+00

2.78259E+00 2.61019E+00 2.44847E+00 2.29676E+00 2.15446E+00

2.02098E+00 1.89576E+00 1.77830E+00 1.66812E+00 1.56477E+00

1.46782E+00 1.37687E+00 1.29157E+00 1.21154E+00 1.13648E+00

1.06606E+00 1.00001E+00 9.38054E-01 8.79934E-01 8.25415E-01

7.74274E-01 7.26301E-01 6.81301E-01 6.39089E-01 5.99492E-01

5.62348E-01 5.27506E-01 4.94823E-01 4.64165E-01 4.35406E-01

4.08429E-01 3.83124E-01 3.59386E-01 3.37119E-01 3.16232E-01

2.96639E-01 2.78259E-01 2.61019E-01 2.44847E-01 2.29676E-01

2.15446E-01 1.89576E-01 1.66812E-01 1.46782E-01 1.29157E-01

1.13647E-01 1.00001E-01 8.25415E-02 6.81301E-02 5.62348E-02

4.64165E-02 3.83124E-02 3.16232E-02 2.61019E-02 2.15446E-02

1.77830E-02 1.46782E-02 1.21155E-02 1.00001E-02 6.81301E-03

4.64164E-03 3.16231E-03 2.15446E-03 1.00001E-03 1.00001E-04

1.00001E-05

9$$ F0 t

end

#sc\_bin

72

75

end

#kenova

zebra 23

read param

tme=1000

lib=75

lng=70000000

nb8=90000

nl8=2000

gen=2020

npg=10000

nsk=20

run=yes

plt=no

end param

read mixt

sct=3

eps=1.

mix=1 100 1.

mix=2 200 1.

mix=3 300 1.

mix=4 400 1.

mix=5 500 1.

mix=6 600 1.

mix=7 700 1.

mix=8 800 1.

mix=9 900 1.

mix=10 1000 1.

mix=11 1100 1.

mix=12 1200 1.

mix=13 1300 1.

mix=14 1400 1.

mix=15 1500 1.

mix=16 1600 1.

mix=17 1700 1.

mix=18 1800 1.

mix=19 1900 1.

mix=20 2000 1.

mix=21 2100 1.

mix=22 2200 1.

mix=23 2300 1.

mix=24 2400 1.

mix=25 2500 1.

mix=26 2600 1.

mix=27 2700 1.

mix=28 2800 1.

mix=29 2900 1.

mix=30 3000 1.

mix=31 3100 1.

mix=32 3200 1.

mix=33 3300 1.

mix=34 3400 1.

mix=35 3500 1.

mix=36 3600 1.

mix=37 3700 1.

mix=38 3800 1.

mix=39 3900 1.

end mixt

read geometry

unit 1

com='core'

array 111 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 111

com='pu'

cuboid 1 1 4p2.3355 0.28170 0.0457

cuboid 2 1 4p2.5335 0.32740 0

unit 112

com='uo2'

cuboid 3 1 4p2.4255 0.59465 0.03665

cuboid 4 1 4p2.5335 0.63130 0

unit 113

com='na'

cuboid 5 1 4p2.4815 0.577347 0.036347

cuboid 6 1 4p2.5335 0.613694 0

unit 114

com='ss'

cuboid 0 1 4p1.9625 0.31700 0

cuboid 7 1 4p2.5335 0.31700 0

unit 211

com='u8'

cuboid 9 1 4p2.5335 9.82700 0

unit 212

com='u2'

cuboid 10 1 4p2.5335 12.72300 0

unit 213

com='u3'

cuboid 11 1 4p2.5335 7.62250 0

unit 311

com='mst3'

cuboid 12 1 4p2.5335 7.60628 0

unit 511

com='air-PLATE'

cuboid 0 1 4p2.5335 1.392516 0

unit 611

com='air-PIN'

cuboid 0 1 4p2.5335 1.4575 0

unit 2

com='u3-radial'

cuboid 12 1 4p2.5335 7.60628 0

cuboid 11 1 4p2.5335 160.05628 0

cuboid 12 1 4p2.5335 167.66256 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 3

com='mst9f10'

cuboid 13 1 4p2.54000 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 4

com='empty tube'

cuboid 0 1 4p2.55100 167.66256 0

cuboid 8 1 4p2.62720 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 81

com='3A'

array 91 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 82

com='3B'

array 92 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 83

com='3C'

array 93 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 84

com='3D'

array 94 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 85

com='3E'

array 95 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 86

com='3H'

array 96 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 87

com='3J'

array 97 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 88

com='3L'

array 98 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 91

com='CAL-A'

cuboid 33 1 4p2.45 29.62 0.44

'

hole 203 -1.785 -1.785 0.44

hole 203 -0.595 -1.785 0.44

hole 203 0.595 -1.785 0.44

hole 203 1.785 -1.785 0.44

hole 203 -1.785 -0.595 0.44

hole 203 -0.595 -0.595 0.44

hole 203 0.595 -0.595 0.44

hole 203 1.785 -0.595 0.44

hole 203 -1.785 0.595 0.44

hole 203 -0.595 0.595 0.44

hole 203 0.595 0.595 0.44

hole 203 1.785 0.595 0.44

hole 203 -1.785 1.785 0.44

hole 203 -0.595 1.785 0.44

hole 203 0.595 1.785 0.44

hole 203 1.785 1.785 0.44

'

cuboid 39 1 4p2.45 29.73 0

cuboid 28 1 4p2.5335 29.73 0

unit 92

com='CAL-B'

cuboid 33 1 4p2.45 29.62 0.44

'

hole 202 -1.785 -1.785 0.44

hole 202 -0.595 -1.785 0.44

hole 206 0.595 -1.785 0.44

hole 202 1.785 -1.785 0.44

hole 202 -1.785 -0.595 0.44

hole 202 -0.595 -0.595 0.44

hole 202 0.595 -0.595 0.44

hole 206 1.785 -0.595 0.44

hole 206 -1.785 0.595 0.44

hole 202 -0.595 0.595 0.44

hole 206 0.595 0.595 0.44

hole 202 1.785 0.595 0.44

hole 202 -1.785 1.785 0.44

hole 206 -0.595 1.785 0.44

hole 202 0.595 1.785 0.44

hole 202 1.785 1.785 0.44

'

cuboid 39 1 4p2.45 29.73 0

cuboid 28 1 4p2.5335 29.73 0

unit 93

com='CAL-C'

cuboid 35 1 4p2.45 29.62 0.44

'

hole 201 -1.785 -1.785 0.44

hole 205 -0.595 -1.785 0.44

hole 201 0.595 -1.785 0.44

hole 205 1.785 -1.785 0.44

hole 205 -1.785 -0.595 0.44

hole 201 -0.595 -0.595 0.44

hole 205 0.595 -0.595 0.44

hole 201 1.785 -0.595 0.44

hole 201 -1.785 0.595 0.44

hole 205 -0.595 0.595 0.44

hole 201 0.595 0.595 0.44

hole 205 1.785 0.595 0.44

hole 205 -1.785 1.785 0.44

hole 201 -0.595 1.785 0.44

hole 205 0.595 1.785 0.44

hole 201 1.785 1.785 0.44

'

cuboid 39 1 4p2.45 29.73 0

cuboid 30 1 4p2.5335 29.73 0

unit 94

com='CAL-D'

cuboid 35 1 4p2.45 29.62 0.44

'

hole 204 -1.785 -1.785 0.44

hole 206 -0.595 -1.785 0.44

hole 204 0.595 -1.785 0.44

hole 206 1.785 -1.785 0.44

hole 206 -1.785 -0.595 0.44

hole 204 -0.595 -0.595 0.44

hole 206 0.595 -0.595 0.44

hole 204 1.785 -0.595 0.44

hole 204 -1.785 0.595 0.44

hole 206 -0.595 0.595 0.44

hole 204 0.595 0.595 0.44

hole 206 1.785 0.595 0.44

hole 206 -1.785 1.785 0.44

hole 204 -0.595 1.785 0.44

hole 206 0.595 1.785 0.44

hole 204 1.785 1.785 0.44

'

cuboid 39 1 4p2.45 29.73 0

cuboid 30 1 4p2.5335 29.73 0

unit 95

com='CAL-E'

cuboid 34 1 4p2.45 29.62 0.44

'

hole 204 -1.785 -1.785 0.44

hole 206 -0.595 -1.785 0.44

hole 204 0.595 -1.785 0.44

hole 206 1.785 -1.785 0.44

hole 206 -1.785 -0.595 0.44

hole 204 -0.595 -0.595 0.44

hole 206 0.595 -0.595 0.44

hole 204 1.785 -0.595 0.44

hole 204 -1.785 0.595 0.44

hole 206 -0.595 0.595 0.44

hole 204 0.595 0.595 0.44

hole 206 1.785 0.595 0.44

hole 206 -1.785 1.785 0.44

hole 204 -0.595 1.785 0.44

hole 206 0.595 1.785 0.44

hole 204 1.785 1.785 0.44

'

cuboid 39 1 4p2.45 29.73 0

cuboid 29 1 4p2.5335 29.73 0

unit 96

com='CAL-H'

cuboid 37 1 4p2.45 29.62 0.44

'

hole 202 -1.785 -1.785 0.44

hole 202 -0.595 -1.785 0.44

hole 206 0.595 -1.785 0.44

hole 202 1.785 -1.785 0.44

hole 202 -1.785 -0.595 0.44

hole 202 -0.595 -0.595 0.44

hole 202 0.595 -0.595 0.44

hole 206 1.785 -0.595 0.44

hole 206 -1.785 0.595 0.44

hole 202 -0.595 0.595 0.44

hole 206 0.595 0.595 0.44

hole 202 1.785 0.595 0.44

hole 202 -1.785 1.785 0.44

hole 206 -0.595 1.785 0.44

hole 202 0.595 1.785 0.44

hole 202 1.785 1.785 0.44

'

cuboid 39 1 4p2.45 29.73 0

cuboid 32 1 4p2.5335 29.73 0

unit 97

com='CAL-J'

cuboid 36 1 4p2.45 29.62 0.44

'

hole 205 -1.785 -1.785 0.44

hole 205 -0.595 -1.785 0.44

hole 205 0.595 -1.785 0.44

hole 207 1.785 -1.785 0.44

hole 205 -1.785 -0.595 0.44

hole 207 -0.595 -0.595 0.44

hole 205 0.595 -0.595 0.44

hole 205 1.785 -0.595 0.44

hole 205 -1.785 0.595 0.44

hole 205 -0.595 0.595 0.44

hole 205 0.595 0.595 0.44

hole 207 1.785 0.595 0.44

hole 205 -1.785 1.785 0.44

hole 207 -0.595 1.785 0.44

hole 205 0.595 1.785 0.44

hole 205 1.785 1.785 0.44

'

cuboid 39 1 4p2.45 29.73 0

cuboid 31 1 4p2.5335 29.73 0

unit 98

com='CAL-L'

cuboid 36 1 4p2.45 29.62 0.44

'

hole 202 -1.785 -1.785 0.44

hole 202 -0.595 -1.785 0.44

hole 206 0.595 -1.785 0.44

hole 202 1.785 -1.785 0.44

hole 202 -1.785 -0.595 0.44

hole 202 -0.595 -0.595 0.44

hole 202 0.595 -0.595 0.44

hole 206 1.785 -0.595 0.44

hole 206 -1.785 0.595 0.44

hole 202 -0.595 0.595 0.44

hole 206 0.595 0.595 0.44

hole 202 1.785 0.595 0.44

hole 202 -1.785 1.785 0.44

hole 206 -0.595 1.785 0.44

hole 202 0.595 1.785 0.44

hole 202 1.785 1.785 0.44

'

cuboid 39 1 4p2.45 29.73 0

cuboid 31 1 4p2.5335 29.73 0

unit 201

com='PIN-A'

cylinder 14 1 0.4230 29.18 0

cylinder 0 1 0.4305 29.18 0

cylinder 15 1 0.4685 29.18 0

cylinder 0 1 0.4880 29.18 0

cylinder 38 1 0.5130 29.18 0

unit 202

com='PIN-B'

cylinder 16 1 0.4230 29.18 0

cylinder 0 1 0.4305 29.18 0

cylinder 17 1 0.4685 29.18 0

cylinder 0 1 0.4880 29.18 0

cylinder 38 1 0.5130 29.18 0

unit 203

com='PIN-C'

cylinder 18 1 0.4230 29.18 0

cylinder 0 1 0.4305 29.18 0

cylinder 19 1 0.4685 29.18 0

cylinder 0 1 0.4880 29.18 0

cylinder 38 1 0.5130 29.18 0

unit 204

com='PIN-D'

cylinder 20 1 0.4230 29.18 0

cylinder 0 1 0.4305 29.18 0

cylinder 21 1 0.4685 29.18 0

cylinder 0 1 0.4880 29.18 0

cylinder 38 1 0.5130 29.18 0

unit 205

com='PIN-E'

cylinder 22 1 0.4230 29.18 0

cylinder 0 1 0.4305 29.18 0

cylinder 23 1 0.4685 29.18 0

cylinder 0 1 0.4880 29.18 0

cylinder 38 1 0.5130 29.18 0

unit 206

com='PIN-F'

cylinder 24 1 0.4230 29.18 0

cylinder 0 1 0.4305 29.18 0

cylinder 25 1 0.4685 29.18 0

cylinder 0 1 0.4880 29.18 0

cylinder 38 1 0.5130 29.18 0

unit 207

com='PIN-UO2'

cylinder 26 1 0.4230 29.18 0

cylinder 0 1 0.4305 29.18 0

cylinder 27 1 0.4685 29.18 0

cylinder 0 1 0.4880 29.18 0

cylinder 38 1 0.5130 29.18 0

unit 11

com='2'

array 11 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 12

com='2'

array 12 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 13

com='2'

array 13 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 14

com='2'

array 14 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 15

com='2'

array 15 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 16

com='2'

array 16 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 17

com='2'

array 17 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 21

com='2'

array 21 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 22

com='2'

array 22 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 23

com='2'

array 23 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 24

com='2'

array 24 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 25

com='2'

array 25 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 26

com='2'

array 26 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 27

com='2'

array 27 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 31

com='2'

array 31 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 32

com='2'

array 32 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 33

com='2'

array 33 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 34

com='2'

array 34 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 35

com='2'

array 35 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 36

com='2'

array 36 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 37

com='2'

array 37 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 41

com='2'

array 41 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 42

com='2'

array 42 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 43

com='2'

array 43 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 44

com='2'

array 44 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 45

com='2'

array 45 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 46

com='2'

array 46 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 47

com='2'

array 47 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 51

com='2'

array 51 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 52

com='2'

array 52 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 53

com='2'

array 53 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 54

com='2'

array 54 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 55

com='2'

array 55 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 56

com='2'

array 56 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 57

com='2'

array 57 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 61

com='2'

array 61 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 62

com='2'

array 62 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 63

com='2'

array 63 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 64

com='2'

array 64 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 65

com='2'

array 65 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 66

com='2'

array 66 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 67

com='2'

array 67 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 71

com='2'

array 71 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 72

com='2'

array 72 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 73

com='2'

array 73 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 74

com='2'

array 74 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 75

com='2'

array 75 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 76

com='2'

array 76 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 77

com='2'

array 77 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

global unit 100

com='reactor'

array 100 3\*0

end geometry

read array

ara=111 nux=1 nuy=1 nuz=176

fill

511 311 213 212 211

113 112 113 111 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 114 111 113 112 113 113 112 113 111 114 112 113

113 112 111 113 112 113

211 212 213 311 511

end fill

ara=91 nux=1 nuy=1 nuz=13

fill

611 311 213 212 211

91 91 91

211 212 213 311 611

end fill

ara=92 nux=1 nuy=1 nuz=13

fill

611 311 213 212 211

92 92 92

211 212 213 311 611

end fill

ara=93 nux=1 nuy=1 nuz=13

fill

611 311 213 212 211

93 93 93

211 212 213 311 611

end fill

ara=94 nux=1 nuy=1 nuz=13

fill

611 311 213 212 211

94 94 94

211 212 213 311 611

end fill

ara=95 nux=1 nuy=1 nuz=13

fill

611 311 213 212 211

95 95 95

211 212 213 311 611

end fill

ara=96 nux=1 nuy=1 nuz=13

fill

611 311 213 212 211

96 96 96

211 212 213 311 611

end fill

ara=97 nux=1 nuy=1 nuz=13

fill

611 311 213 212 211

97 97 97

211 212 213 311 611

end fill

ara=98 nux=1 nuy=1 nuz=13

fill

611 311 213 212 211

98 98 98

211 212 213 311 611

end fill

ara=11 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=12 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 3 3

4 4 3 3 3

end fill

ara=13 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 3 3

3 3 3 3 3

3 3 3 3 3

3 3 3 2 2

end fill

ara=14 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

2 2 2 2 2

end fill

ara=15 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

3 3 4 4 4

3 3 3 3 3

3 3 3 3 3

2 2 3 3 3

end fill

ara=16 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

3 3 4 4 4

3 3 3 4 4

end fill

ara=17 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=21 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 3

4 4 4 3 3

4 4 4 3 3

end fill

ara=22 nux=5 nuy=5 nuz=1

fill

4 3 3 3 3

3 3 3 3 2

3 3 3 2 2

3 3 2 2 2

3 2 2 2 2

end fill

ara=23 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=24 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

1 1 1 1 1

end fill

ara=25 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=26 nux=5 nuy=5 nuz=1

fill

3 3 3 3 4

2 3 3 3 3

2 2 3 3 3

2 2 2 3 3

2 2 2 2 3

end fill

ara=27 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

3 4 4 4 4

3 3 4 4 4

3 3 4 4 4

end fill

ara=31 nux=5 nuy=5 nuz=1

fill

4 4 3 3 3

4 4 3 3 3

4 4 3 3 3

4 3 3 3 2

4 3 3 3 2

end fill

ara=32 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=33 nux=5 nuy=5 nuz=1

fill

2 2 2 1 1

2 1 1 86 86

2 1 81 84 86

1 84 84 83 85

1 84 84 83 85

end fill

ara=34 nux=5 nuy=5 nuz=1

fill

88 88 88 88 88

82 82 82 82 82

82 82 82 82 82

83 83 83 83 83

83 83 83 83 83

end fill

ara=35 nux=5 nuy=5 nuz=1

fill

1 1 2 2 2

86 86 1 1 2

86 84 81 1 2

85 83 84 85 1

85 83 84 85 1

end fill

ara=36 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=37 nux=5 nuy=5 nuz=1

fill

3 3 3 4 4

3 3 3 4 4

3 3 3 4 4

2 3 3 3 4

2 3 3 3 4

end fill

ara=41 nux=5 nuy=5 nuz=1

fill

4 3 3 3 2

4 3 3 3 2

4 3 3 3 2

4 3 3 3 2

4 3 3 3 2

end fill

ara=42 nux=5 nuy=5 nuz=1

fill

2 2 2 2 1

2 2 2 2 1

2 2 2 2 1

2 2 2 2 1

2 2 2 2 1

end fill

ara=43 nux=5 nuy=5 nuz=1

fill

81 87 84 85 85

81 84 84 85 85

82 85 85 85 85

81 84 81 85 85

81 87 81 85 85

end fill

ara=44 nux=5 nuy=5 nuz=1

fill

83 83 83 83 83

83 83 83 83 83

83 83 83 83 83

83 83 83 83 83

83 83 83 83 83

end fill

ara=45 nux=5 nuy=5 nuz=1

fill

85 85 84 87 81

85 85 84 84 81

85 85 85 85 82

85 85 81 84 81

85 85 81 87 81

end fill

ara=46 nux=5 nuy=5 nuz=1

fill

1 2 2 2 2

1 2 2 2 2

1 2 2 2 2

1 2 2 2 2

1 2 2 2 2

end fill

ara=47 nux=5 nuy=5 nuz=1

fill

2 3 3 3 4

2 3 3 3 4

2 3 3 3 4

2 3 3 3 4

2 3 3 3 4

end fill

ara=51 nux=5 nuy=5 nuz=1

fill

4 3 3 3 2

4 3 3 3 2

4 4 3 3 3

4 4 3 3 3

4 4 3 3 3

end fill

ara=52 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=53 nux=5 nuy=5 nuz=1

fill

1 84 84 83 85

1 82 84 83 85

2 1 81 84 84

2 1 1 86 86

2 2 2 1 1

end fill

ara=54 nux=5 nuy=5 nuz=1

fill

83 83 83 83 83

83 83 83 83 83

82 82 82 82 82

82 82 82 82 82

88 88 88 88 88

end fill

ara=55 nux=5 nuy=5 nuz=1

fill

85 83 84 84 1

85 83 84 82 1

84 84 81 1 2

86 86 1 1 2

1 1 2 2 2

end fill

ara=56 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=57 nux=5 nuy=5 nuz=1

fill

2 3 3 3 4

2 3 3 3 4

3 3 3 4 4

3 3 3 4 4

3 3 3 4 4

end fill

ara=61 nux=5 nuy=5 nuz=1

fill

4 4 4 3 3

4 4 4 3 3

4 4 4 4 3

4 4 4 4 4

4 4 4 4 4

end fill

ara=62 nux=5 nuy=5 nuz=1

fill

3 2 2 2 2

3 3 2 2 2

3 3 3 2 2

3 3 3 3 2

4 3 3 3 3

end fill

ara=63 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=64 nux=5 nuy=5 nuz=1

fill

1 1 1 1 1

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=65 nux=5 nuy=5 nuz=1

fill

1 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=66 nux=5 nuy=5 nuz=1

fill

2 2 2 2 3

2 2 2 3 3

2 2 3 3 3

2 3 3 3 3

3 3 3 3 4

end fill

ara=67 nux=5 nuy=5 nuz=1

fill

3 3 4 4 4

3 3 4 4 4

3 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=71 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=72 nux=5 nuy=5 nuz=1

fill

4 4 3 3 3

4 4 4 3 3

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=73 nux=5 nuy=5 nuz=1

fill

3 3 3 2 2

3 3 3 3 3

3 3 3 3 3

4 4 4 3 3

4 4 4 4 4

end fill

ara=74 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

4 4 4 4 4

end fill

ara=75 nux=5 nuy=5 nuz=1

fill

2 2 3 3 3

3 3 3 3 3

3 3 3 3 3

3 3 4 4 4

4 4 4 4 4

end fill

ara=76 nux=5 nuy=5 nuz=1

fill

3 3 3 4 4

3 3 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=77 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=100 nux=7 nuy=7 nuz=1

fill

11 12 13 14 15 16 17

21 22 23 24 25 26 27

31 32 33 34 35 36 37

41 42 43 44 45 46 47

51 52 53 54 55 56 57

61 62 63 64 65 66 67

71 72 73 74 75 76 77

end fill

end array

read plot

ttl='simple plot 1'

pic=mix

xul= 0 yul= 190 zul= 100.5

xlr= 190 ylr= 0 zlr= 100.5

uax=1.0 vdn=-1.0

nax=1200

lpi=10

scr=yes end

ttl='simple plot 1'

pic=mix

xul= 45 yul= 145 zul= 100.5

xlr= 145 ylr= 45 zlr= 100.5

uax=1.0 vdn=-1.0

nax=1200

lpi=10

scr=yes end

ttl='simple plot 4'

pic=mix

xul= 0 yul= 95.6 zul= 168

xlr= 190 ylr= 95.6 zlr= 0

uax=1.0 wdn=-1.0

nax=800

scr=yes end

end plot

end data

end

=cons9901

TASK:

MULTIC= 1

NOUT = 2

IHT = 4

IHS = 77

NG = 299

IPRIB = 0

idelta= 1

NMOM = 5

IZT = 19

NRZT = 16

INZ = 28

NAME=

'PU38' 'PU39' 'PU40' 'PU41' 'PU42' 'AM41' 'GA'

'U235' 'U238NR'

'NA'

'H+H(FREE)' 'C' 'N' 'O' 'AL' 'SI' 'CR' 'MN' 'FE' 'NI' 'MO'

'NB' 'TI' 'CU' 'P' 'S' 'CA' 'D-SC'

RO=

\*1 PU

3.0461E-05 2.8920E-02 6.9095E-03 7.3960E-04 1.8699E-04 4.5718E-04 2.0166E-03

0.0000E+00 6.8782E-07 0.0000E+00 1.2764E-04 4.2260E-04 2.4215E-05 8.8450E-05

2.2973E-05 1.4158E-05 3.5989E-06 1.4902E-06 1.6335E-05 8.5688E-06 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*2 CAN

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 1.3760E-05 1.1393E-04 0.0000E+00 0.0000E+00

0.0000E+00 3.6607E-04 9.4011E-03 8.5931E-04 3.5542E-02 4.1646E-03 0.0000E+00

0.0000E+00 0.0000E+00 1.6613E-02 1.3731E-05 0.0000E+00 0.0000E+00 0.0000E+00

\*3 UO2

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

1.6585E-04 2.2894E-02 0.0000E+00 3.1852E-05 1.1837E-05 0.0000E+00 4.6122E-02

3.3995E-06 2.3024E-05 0.0000E+00 8.3479E-08 1.3139E-06 1.2503E-06 3.3462E-07

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*4 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 1.8834E-05 1.2695E-04 0.0000E+00 0.0000E+00

0.0000E+00 6.3794E-04 1.3673E-02 8.4655E-04 4.7796E-02 8.3368E-03 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 3.4708E-04 3.5660E-05 0.0000E+00 0.0000E+00

\*5 na

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 2.3225E-02 1.3900E-05 0.0000E+00 0.0000E+00 5.6492E-06

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.6184E-07 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 3.6083E-06 0.0000E+00

\*6 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 2.1631E-05 2.9290E-04 0.0000E+00 0.0000E+00

0.0000E+00 6.0867E-04 1.4759E-02 1.3570E-03 5.5054E-02 7.0982E-03 0.0000E+00

3.1147E-04 0.0000E+00 0.0000E+00 3.2795E-05 3.3219E-05 0.0000E+00 0.0000E+00

\*7 ss

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 1.8355E-05 8.7794E-05 0.0000E+00 0.0000E+00

1.1862E-04 7.9703E-04 1.5908E-02 1.4972E-03 5.5367E-02 8.7976E-03 8.0988E-05

5.0000E-06 2.4806E-04 5.0365E-05 4.0018E-05 1.4422E-05 0.0000E+00 0.0000E+00

\*8 sheath

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 7.5712E-05 2.3825E-04 0.0000E+00 0.0000E+00

1.9798E-05 0.0000E+00 3.6690E-06 2.5697E-04 7.7524E-02 1.4302E-05 0.0000E+00

0.0000E+00 0.0000E+00 2.2216E-05 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*9 U8

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

3.3369E-04 4.6021E-02 0.0000E+00 4.4048E-05 4.9283E-04 0.0000E+00 0.0000E+00

0.0000E+00 2.1076E-04 0.0000E+00 0.0000E+00 1.0599E-04 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*10 U2

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

3.3962E-04 4.6785E-02 0.0000E+00 4.3899E-05 4.6047E-04 0.0000E+00 0.0000E+00

0.0000E+00 1.9692E-04 0.0000E+00 0.0000E+00 9.9032E-05 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*11 U3

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

3.4209E-04 4.7156E-02 0.0000E+00 4.4574E-05 4.7140E-04 0.0000E+00 0.0000E+00

0.0000E+00 2.0160E-04 0.0000E+00 0.0000E+00 1.0138E-04 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*12 mst3

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 2.5700E-05 5.1066E-04 0.0000E+00 0.0000E+00

1.3989E-04 0.0000E+00 2.7222E-05 3.2634E-04 8.3806E-02 4.8234E-05 9.8355E-06

0.0000E+00 3.9416E-05 4.4548E-05 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*13 mst9f10

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 4.6306E-05 6.8972E-04 0.0000E+00 0.0000E+00

0.0000E+00 3.1158E-04 0.0000E+00 7.1275E-04 8.1432E-02 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 4.2944E-05 3.7110E-05 0.0000E+00 0.0000E+00

\*14 stnavr4

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 2.4073E-05 2.7547E-04 0.0000E+00 0.0000E+00

0.0000E+00 7.5592E-04 1.6594E-02 1.1688E-03 5.9245E-02 9.9342E-03 0.0000E+00

4.0746E-04 0.0000E+00 0.0000E+00 4.5399E-05 1.2036E-05 0.0000E+00 0.0000E+00

\*15 stnavs4

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 2.4073E-05 2.5251E-04 0.0000E+00 0.0000E+00

0.0000E+00 7.4610E-04 1.6248E-02 1.5006E-03 5.9881E-02 9.4005E-03 0.0000E+00

3.7393E-04 0.0000E+00 0.0000E+00 1.7803E-05 1.7195E-05 0.0000E+00 0.0000E+00

\*16 stnav4

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 3.3245E-06 3.3477E-05 0.0000E+00 0.0000E+00

0.0000E+00 1.2169E-04 2.4643E-03 1.9518E-04 8.0717E-03 1.2195E-03 0.0000E+00

5.2657E-05 0.0000E+00 0.0000E+00 4.9764E-06 2.5076E-06 0.0000E+00 0.0000E+00

\*17 HOMO

1.4474E-06 1.3741E-03 3.2831E-04 3.5142E-05 8.8849E-06 2.1723E-05 9.5819E-05

4.0193E-05 5.5482E-03 0.0000E+00 2.1415E-05 6.4517E-05 1.1506E-06 1.1182E-02

6.5613E-06 1.2254E-04 2.5197E-03 2.2375E-04 1.3307E-02 1.4328E-03 2.5139E-06

2.2759E-05 7.4514E-06 5.0199E-04 2.2403E-05 3.4982E-06 0.0000E+00 0.0000E+00

\*\*\*\*\*\*\*\*\* D-SC

\*18 PU

3.0461E-05 2.8920E-02 6.9095E-03 7.3960E-04 1.8699E-04 4.5718E-04 2.0166E-03

0.0000E+00 6.8782E-07 0.0000E+00 1.2764E-04 4.2260E-04 2.4215E-05 8.8450E-05

2.2973E-05 1.4158E-05 3.5989E-06 1.4902E-06 1.6335E-05 8.5688E-06 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 2.3327E+00

\*19 UO2

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

1.6585E-04 2.2894E-02 0.0000E+00 3.1852E-05 1.1837E-05 0.0000E+00 4.6122E-02

3.3995E-06 2.3024E-05 0.0000E+00 8.3479E-08 1.3139E-06 1.2503E-06 3.3462E-07

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.1022E+00

ICOR =

18 17 19 17 17 17 17 17

9 10 11 12 13 17 17 17

17 18 19

NAMSUB='U238NR' 'PU39'

NGSUB=10 11 12 13 14 15 16 17 18 19 20 21 22 23

END

end

=subgran

end

=lava

-1$$ 2500000

0$$ 71 72 18 19

1$$ 16 755 4 91 845 61 0 -1 1 t

2$$ 14I1000 16000

3$$ F5

4$$ 14I100 1600

5$$ 1 1452 27 1018

7\*\*

2.00000E+07 1.86181E+07 1.73316E+07 1.61341E+07 1.50192E+07

1.39818E+07 1.30158E+07 1.21165E+07 1.12793E+07 1.05000E+07

9.69341E+06 8.94878E+06 8.26136E+06 7.62674E+06 7.04086E+06

6.50000E+06 5.99475E+06 5.52877E+06 5.09902E+06 4.70267E+06

4.33713E+06 4.00000E+06 3.69862E+06 3.41995E+06 3.16228E+06

2.92402E+06 2.70371E+06 2.50000E+06 2.32522E+06 2.16265E+06

2.01146E+06 1.87083E+06 1.74003E+06 1.61838E+06 1.50524E+06

1.40000E+06 1.30541E+06 1.21722E+06 1.13498E+06 1.05830E+06

9.86800E+05 9.20131E+05 8.57965E+05 8.00000E+05 7.40700E+05

6.85795E+05 6.34960E+05 5.87894E+05 5.44316E+05 5.03968E+05

4.66612E+05 4.32024E+05 4.00000E+05 3.70350E+05 3.42898E+05

3.17480E+05 2.93947E+05 2.72158E+05 2.51984E+05 2.33306E+05

2.16012E+05 2.00000E+05 1.91435E+05 1.85175E+05 1.77154E+05

1.71449E+05 1.63937E+05 1.58740E+05 1.51708E+05 1.46973E+05

1.40390E+05 1.36079E+05 1.29916E+05 1.25992E+05 1.20222E+05

1.16653E+05 1.11251E+05 1.08006E+05 1.02951E+05 1.00000E+05

9.60586E+04 9.38042E+04 9.00741E+04 8.79923E+04 8.44625E+04

8.25404E+04 7.92005E+04 7.74264E+04 7.42663E+04 7.26292E+04

6.96395E+04 6.81292E+04 6.53014E+04 6.39081E+04 6.12343E+04

5.99484E+04 5.74205E+04 5.62341E+04 5.38442E+04 5.27500E+04

5.04907E+04 4.94817E+04 4.73460E+04 4.64159E+04 4.52365E+04

4.43972E+04 4.38990E+04 4.35400E+04 4.24188E+04 4.16320E+04

4.11705E+04 4.08424E+04 3.97762E+04 3.90389E+04 3.86114E+04

3.83119E+04 3.72981E+04 3.66074E+04 3.62115E+04 3.59381E+04

3.49744E+04 3.43274E+04 3.39609E+04 3.37115E+04 3.27956E+04

3.21894E+04 3.18504E+04 3.16227E+04 3.07523E+04 3.01846E+04

2.98710E+04 2.96635E+04 2.88362E+04 2.83046E+04 2.80147E+04

2.78256E+04 2.70395E+04 2.65418E+04 2.62738E+04 2.61015E+04

2.53546E+04 2.48887E+04 2.46412E+04 2.44843E+04 2.37747E+04

2.33386E+04 2.31100E+04 2.29673E+04 2.22931E+04 2.18850E+04

2.16741E+04 2.15443E+04 2.09038E+04 2.05218E+04 2.03274E+04

2.02095E+04 1.96011E+04 1.92437E+04 1.90644E+04 1.89573E+04

1.83795E+04 1.80451E+04 1.78800E+04 1.77828E+04 1.72340E+04

1.69213E+04 1.67692E+04 1.66810E+04 1.61599E+04 1.58674E+04

1.57274E+04 1.56475E+04 1.51527E+04 1.48791E+04 1.47504E+04

1.46780E+04 1.42082E+04 1.39524E+04 1.38342E+04 1.37686E+04

1.33225E+04 1.30834E+04 1.29748E+04 1.29155E+04 1.24919E+04

1.22685E+04 1.21688E+04 1.21153E+04 1.17131E+04 1.15044E+04

1.14130E+04 1.13646E+04 1.09828E+04 1.07879E+04 1.07041E+04

1.06605E+04 1.02980E+04 1.01159E+04 1.00393E+04 1.00000E+04

9.65597E+03 9.48588E+03 9.41580E+03 9.38042E+03 9.05389E+03

8.89508E+03 8.83104E+03 8.79923E+03 8.48930E+03 8.34103E+03

8.28260E+03 8.25404E+03 7.95994E+03 7.82153E+03 7.76826E+03

7.74264E+03 7.46356E+03 7.33439E+03 7.28588E+03 7.26292E+03

6.99809E+03 6.87754E+03 6.83345E+03 6.81292E+03 6.56175E+03

6.44928E+03 6.40918E+03 6.39081E+03 6.15266E+03 6.04776E+03

6.01129E+03 5.99484E+03 5.76907E+03 5.67124E+03 5.63811E+03

5.62341E+03 5.40937E+03 5.31816E+03 5.28811E+03 5.27500E+03

5.07209E+03 4.98706E+03 4.95985E+03 4.94817E+03 4.75585E+03

4.67660E+03 4.65199E+03 4.64159E+03 4.45930E+03 4.38545E+03

4.36323E+03 4.35400E+03 4.18123E+03 4.11242E+03 4.09241E+03

4.08424E+03 3.92049E+03 3.85639E+03 3.83841E+03 3.83119E+03

3.67600E+03 3.61629E+03 3.60018E+03 3.59381E+03 3.44677E+03

3.39115E+03 3.37674E+03 3.37114E+03 3.23181E+03 3.18002E+03

3.16718E+03 3.16227E+03 3.03025E+03 2.98204E+03 2.97063E+03

2.96635E+03 2.84126E+03 2.79638E+03 2.78628E+03 2.78256E+03

2.66404E+03 2.62228E+03 2.61338E+03 2.61015E+03 2.49787E+03

2.45903E+03 2.45121E+03 2.44843E+03 2.34207E+03 2.30593E+03

2.29911E+03 2.29673E+03 2.19597E+03 2.16237E+03 2.15646E+03

2.15443E+03 2.08156E+03 2.05753E+03 2.03423E+03 2.02643E+03

2.02233E+03 2.02095E+03 1.94867E+03 1.92530E+03 1.91246E+03

1.90823E+03 1.90091E+03 1.89850E+03 1.89642E+03 1.89573E+03

1.82083E+03 1.79713E+03 1.78450E+03 1.78042E+03 1.77880E+03

1.77828E+03 1.71599E+03 1.69659E+03 1.68085E+03 1.67586E+03

1.67210E+03 1.67091E+03 1.66878E+03 1.66810E+03 1.62473E+03

1.61140E+03 1.58045E+03 1.57089E+03 1.56621E+03 1.56475E+03

1.50398E+03 1.48581E+03 1.47431E+03 1.47080E+03 1.46850E+03

1.46780E+03 1.41805E+03 1.40341E+03 1.38536E+03 1.37998E+03

1.37758E+03 1.37686E+03 1.31491E+03 1.29719E+03 1.29283E+03

1.29155E+03 1.24774E+03 1.23536E+03 1.21853E+03 1.21371E+03

1.21202E+03 1.21153E+03 1.17775E+03 1.16836E+03 1.14755E+03

1.14173E+03 1.13762E+03 1.13646E+03 1.10141E+03 1.09189E+03

1.07319E+03 1.06806E+03 1.06649E+03 1.06605E+03 1.02376E+03

1.01259E+03 1.00357E+03 1.00114E+03 1.00024E+03 1.00000E+03

9.66236E+02 9.57470E+02 9.49570E+02 9.47485E+02 9.42407E+02

9.41065E+02 9.38675E+02 9.38042E+02 8.99406E+02 8.89639E+02

8.83723E+02 8.82194E+02 8.80390E+02 8.79923E+02 8.46636E+02

8.38387E+02 8.30030E+02 8.27921E+02 8.25913E+02 8.25404E+02

7.89300E+02 7.80584E+02 7.76423E+02 7.75394E+02 7.74492E+02

7.74269E+02 7.37010E+02 7.28241E+02 7.26676E+02 7.26296E+02

6.95229E+02 6.88058E+02 6.84227E+02 6.83321E+02 6.81684E+02

6.81296E+02 6.51912E+02 6.45279E+02 6.41161E+02 6.40210E+02

6.39296E+02 6.39085E+02 6.11590E+02 6.05519E+02 6.01580E+02

6.00689E+02 5.99710E+02 5.99488E+02 5.75586E+02 5.70412E+02

5.65542E+02 5.64467E+02 5.62730E+02 5.62345E+02 5.36729E+02

5.31326E+02 5.29011E+02 5.28509E+02 5.27682E+02 5.27503E+02

5.03701E+02 4.98792E+02 4.96329E+02 4.95808E+02 4.94993E+02

4.94820E+02 4.70155E+02 4.65202E+02 4.64340E+02 4.64162E+02

4.40985E+02 4.36438E+02 4.35577E+02 4.35403E+02 4.17034E+02

4.13497E+02 4.10542E+02 4.09960E+02 4.08679E+02 4.08426E+02

3.89954E+02 3.86488E+02 3.84318E+02 3.83901E+02 3.83247E+02

3.83121E+02 3.63761E+02 3.60231E+02 3.59518E+02 3.59384E+02

3.46541E+02 3.44235E+02 3.40010E+02 3.39241E+02 3.38106E+02

3.37898E+02 3.37238E+02 3.37117E+02 3.19313E+02 3.16230E+02

3.07376E+02 3.02104E+02 2.97359E+02 2.97025E+02 2.96822E+02

2.96637E+02 2.82831E+02 2.80486E+02 2.79215E+02 2.78994E+02

2.78367E+02 2.78258E+02 2.70318E+02 2.65502E+02 2.63863E+02

2.62708E+02 2.61994E+02 2.61748E+02 2.61349E+02 2.61102E+02

2.61017E+02 2.47008E+02 2.44845E+02 2.37617E+02 2.34994E+02

2.32422E+02 2.31245E+02 2.30811E+02 2.30381E+02 2.29975E+02

2.29824E+02 2.29675E+02 2.19156E+02 2.15445E+02 2.10258E+02

2.09166E+02 2.04427E+02 2.03428E+02 2.02821E+02 2.02692E+02

2.02201E+02 2.02096E+02 1.97202E+02 1.93488E+02 1.91406E+02

1.90813E+02 1.90355E+02 1.90094E+02 1.89860E+02 1.89678E+02

1.89575E+02 1.82295E+02 1.79185E+02 1.78715E+02 1.78509E+02

1.78209E+02 1.78077E+02 1.77905E+02 1.77829E+02 1.71468E+02

1.68053E+02 1.66811E+02 1.58152E+02 1.57088E+02 1.56545E+02

1.56476E+02 1.48817E+02 1.46781E+02 1.39817E+02 1.38221E+02

1.37789E+02 1.37687E+02 1.33160E+02 1.29901E+02 1.29156E+02

1.24352E+02 1.22028E+02 1.21154E+02 1.19058E+02 1.17703E+02

1.17309E+02 1.16008E+02 1.15163E+02 1.14916E+02 1.14504E+02

1.14234E+02 1.14155E+02 1.13880E+02 1.13700E+02 1.13647E+02

1.08936E+02 1.07009E+02 1.06606E+02 1.04367E+02 1.02788E+02

1.02221E+02 1.01371E+02 1.00765E+02 1.00546E+02 1.00270E+02

1.00072E+02 1.00001E+02 9.49147E+01 9.38048E+01 9.00591E+01

8.84578E+01 8.79928E+01 8.53864E+01 8.29607E+01 8.25409E+01

8.00020E+01 7.87116E+01 7.81267E+01 7.78241E+01 7.75626E+01

7.74269E+01 7.48414E+01 7.31916E+01 7.26296E+01 6.81296E+01

6.64990E+01 6.57970E+01 6.55235E+01 6.47774E+01 6.44532E+01

6.43264E+01 6.40667E+01 6.39533E+01 6.39089E+01 6.16780E+01

5.99492E+01 5.77630E+01 5.69789E+01 5.62349E+01 5.43365E+01

5.31530E+01 5.27507E+01 5.12878E+01 5.00051E+01 4.94823E+01

4.71930E+01 4.64165E+01 4.39677E+01 4.35406E+01 4.15092E+01

4.08429E+01 3.86248E+01 3.83124E+01 3.71495E+01 3.62881E+01

3.59386E+01 3.40190E+01 3.37119E+01 3.20656E+01 3.16232E+01

2.96639E+01 2.78259E+01 2.70538E+01 2.63962E+01 2.61019E+01

2.44847E+01 2.33182E+01 2.29676E+01 2.24015E+01 2.18633E+01

2.15446E+01 2.10496E+01 2.09018E+01 2.05679E+01 2.04677E+01

2.02695E+01 2.02098E+01 1.89576E+01 1.81519E+01 1.78913E+01

1.77830E+01 1.69505E+01 1.66812E+01 1.60901E+01 1.56477E+01

1.48289E+01 1.46782E+01 1.37687E+01 1.29157E+01 1.22858E+01

1.21154E+01 1.17726E+01 1.15521E+01 1.13648E+01 1.09868E+01

1.06606E+01 1.02388E+01 1.00001E+01 9.62837E+00 9.38054E+00

8.79934E+00 8.46274E+00 8.25415E+00 8.07648E+00 7.90335E+00

7.74274E+00 7.49870E+00 7.33772E+00 7.26301E+00 6.81301E+00

6.64826E+00 6.50284E+00 6.39089E+00 5.99492E+00 5.62349E+00

5.27506E+00 4.94823E+00 4.64165E+00 4.35406E+00 4.08429E+00

3.83124E+00 3.59386E+00 3.37119E+00 3.16232E+00 2.96639E+00

2.78259E+00 2.61019E+00 2.44847E+00 2.29676E+00 2.15446E+00

2.02098E+00 1.89576E+00 1.77830E+00 1.66812E+00 1.56477E+00

1.46782E+00 1.37687E+00 1.29157E+00 1.21154E+00 1.13648E+00

1.06606E+00 1.00001E+00 9.38054E-01 8.79934E-01 8.25415E-01

7.74274E-01 7.26301E-01 6.81301E-01 6.39089E-01 5.99492E-01

5.62348E-01 5.27506E-01 4.94823E-01 4.64165E-01 4.35406E-01

4.08429E-01 3.83124E-01 3.59386E-01 3.37119E-01 3.16232E-01

2.96639E-01 2.78259E-01 2.61019E-01 2.44847E-01 2.29676E-01

2.15446E-01 1.89576E-01 1.66812E-01 1.46782E-01 1.29157E-01

1.13647E-01 1.00001E-01 8.25415E-02 6.81301E-02 5.62348E-02

4.64165E-02 3.83124E-02 3.16232E-02 2.61019E-02 2.15446E-02

1.77830E-02 1.46782E-02 1.21155E-02 1.00001E-02 6.81301E-03

4.64164E-03 3.16231E-03 2.15446E-03 1.00001E-03 1.00001E-04

1.00001E-05

9$$ F0 t

end

#sc\_bin

72

75

end

#kenova

zebra 24b (215)

read param

tme=1000

lib=75

lng=25000000

nb8=70000

gen=2020

npg=10000

nsk=20

run=yes

plt=no

end param

read mixt

sct=3

eps=1.

mix=1 100 1.

mix=2 200 1.

mix=3 300 1.

mix=4 400 1.

mix=5 500 1.

mix=6 600 1.

mix=7 700 1.

mix=8 800 1.

mix=9 900 1.

mix=10 1000 1.

mix=11 1100 1.

mix=12 1200 1.

mix=13 1300 1.

mix=14 1400 1.

mix=15 1500 1.

mix=16 1600 1.

end mixt

read geometry

unit 1

com='core'

array 111 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 111

com='pu'

cuboid 1 1 4p2.3355 0.28170 0.0457

cuboid 2 1 4p2.5335 0.32740 0

unit 112

com='uo2'

cuboid 3 1 4p2.4255 0.59465 0.03665

cuboid 4 1 4p2.5335 0.63130 0

unit 113

com='na'

cuboid 5 1 4p2.4815 0.577347 0.036347

cuboid 6 1 4p2.5335 0.613694 0

unit 114

com='ss'

cuboid 0 1 4p1.9625 0.31700 0

cuboid 7 1 4p2.5335 0.31700 0

unit 115

com='stnavr4'

cylinder 0 1 2.3000 0.61600 0

cylinder 14 1 2.5335 0.61600 0

cuboid 0 1 4p2.5335 0.61600 0

unit 116

com='stnavs4'

cylinder 0 1 2.3000 0.61600 0

cylinder 15 1 2.5335 0.61600 0

cuboid 0 1 4p2.5335 0.61600 0

unit 117

com='stnav4'

cuboid 16 1 4p2.5335 0.61600 0

unit 211

com='u8'

cuboid 9 1 4p2.5335 9.82700 0

unit 212

com='u2'

cuboid 10 1 4p2.5335 12.72300 0

unit 213

com='u3'

cuboid 11 1 4p2.5335 7.62250 0

unit 311

com='mst3'

cuboid 12 1 4p2.5335 7.60628 0

unit 511

com='air'

cuboid 0 1 4p2.5335 1.3095 0

unit 2

com='u3-radial'

cuboid 12 1 4p2.5335 7.60628 0

cuboid 11 1 4p2.5335 160.05628 0

cuboid 12 1 4p2.5335 167.66256 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 3

com='mst9f10'

cuboid 13 1 4p2.54000 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 4

com='empty tube'

cuboid 0 1 4p2.55100 167.66256 0

cuboid 8 1 4p2.62720 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 5

com='core'

array 115 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 6

com='core'

array 116 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 7

com='core'

array 117 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 11

com='2'

array 11 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 12

com='2'

array 12 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 13

com='2'

array 13 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 14

com='2'

array 14 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 15

com='2'

array 15 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 16

com='2'

array 16 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 17

com='2'

array 17 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 21

com='2'

array 21 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 22

com='2'

array 22 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 23

com='2'

array 23 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 24

com='2'

array 24 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 25

com='2'

array 25 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 26

com='2'

array 26 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 27

com='2'

array 27 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 31

com='2'

array 31 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 32

com='2'

array 32 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 33

com='2'

array 33 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 34

com='2'

array 34 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 35

com='2'

array 35 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 36

com='2'

array 36 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 37

com='2'

array 37 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 41

com='2'

array 41 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 42

com='2'

array 42 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 43

com='2'

array 43 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 44

com='2'

array 44 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 45

com='2'

array 45 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 46

com='2'

array 46 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 47

com='2'

array 47 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 51

com='2'

array 51 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 52

com='2'

array 52 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 53

com='2'

array 53 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 54

com='2'

array 54 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 55

com='2'

array 55 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 56

com='2'

array 56 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 57

com='2'

array 57 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 61

com='2'

array 61 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 62

com='2'

array 62 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 63

com='2'

array 63 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 64

com='2'

array 64 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 65

com='2'

array 65 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 66

com='2'

array 66 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 67

com='2'

array 67 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 71

com='2'

array 71 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 72

com='2'

array 72 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 73

com='2'

array 73 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 74

com='2'

array 74 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 75

com='2'

array 75 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 76

com='2'

array 76 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 77

com='2'

array 77 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

global unit 100

com='reactor'

array 100 3\*0

end geometry

read array

ara=115 nux=1 nuy=1 nuz=176

fill

511 311 213 212 211

115 112 115 111 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 111 115 112 115

211 212 213 311 511

end fill

ara=116 nux=1 nuy=1 nuz=176

fill

511 311 213 212 211

116 112 116 111 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 111 116 112 116

211 212 213 311 511

end fill

ara=117 nux=1 nuy=1 nuz=176

fill

511 311 213 212 211

117 112 117 111 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 111 117 112 117

211 212 213 311 511

end fill

ara=11 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=12 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 3 3

4 4 3 3 3

end fill

ara=13 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 3 3

3 3 3 3 3

3 3 3 3 3

3 3 3 2 2

end fill

ara=14 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

2 2 2 2 2

end fill

ara=15 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

3 3 4 4 4

3 3 3 3 3

3 3 3 3 3

2 2 3 3 3

end fill

ara=16 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

3 3 4 4 4

3 3 3 4 4

end fill

ara=17 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=21 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 3

4 4 4 3 3

4 4 4 3 3

end fill

ara=22 nux=5 nuy=5 nuz=1

fill

4 3 3 3 3

3 3 3 3 2

3 3 3 2 2

3 3 2 2 2

3 2 2 2 2

end fill

ara=23 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=24 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 7 7 7 2

end fill

ara=25 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=26 nux=5 nuy=5 nuz=1

fill

3 3 3 3 4

2 3 3 3 3

2 2 3 3 3

2 2 2 3 3

2 2 2 2 3

end fill

ara=27 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

3 4 4 4 4

3 3 4 4 4

3 3 4 4 4

end fill

ara=31 nux=5 nuy=5 nuz=1

fill

4 4 3 3 3

4 4 3 3 3

4 4 3 3 3

4 3 3 3 2

4 3 3 3 2

end fill

ara=32 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=33 nux=5 nuy=5 nuz=1

fill

2 2 2 7 7

2 2 7 6 6

2 7 6 6 6

7 6 6 6 6

7 6 6 6 5

end fill

ara=34 nux=5 nuy=5 nuz=1

fill

6 6 6 6 6

6 6 6 6 6

6 6 6 6 6

5 5 5 5 5

5 5 5 5 5

end fill

ara=35 nux=5 nuy=5 nuz=1

fill

7 7 2 2 2

6 6 7 7 2

6 6 6 7 2

6 6 6 6 7

5 6 6 6 6

end fill

ara=36 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=37 nux=5 nuy=5 nuz=1

fill

3 3 3 4 4

3 3 3 4 4

3 3 3 4 4

2 3 3 3 4

2 3 3 3 4

end fill

ara=41 nux=5 nuy=5 nuz=1

fill

4 3 3 3 2

4 3 3 3 2

4 3 3 3 2

4 3 3 3 2

4 3 3 3 2

end fill

ara=42 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 7

2 2 2 2 7

2 2 2 2 7

2 2 2 2 2

end fill

ara=43 nux=5 nuy=5 nuz=1

fill

6 6 6 5 5

6 6 6 5 5

6 6 6 5 5

6 6 6 5 5

6 6 6 5 5

end fill

ara=44 nux=5 nuy=5 nuz=1

fill

5 5 5 5 5

5 5 5 5 5

5 5 5 5 5

5 5 5 5 5

5 5 5 5 5

end fill

ara=45 nux=5 nuy=5 nuz=1

fill

5 6 6 6 6

5 6 6 6 6

5 6 6 6 6

5 6 6 6 6

5 6 6 6 6

end fill

ara=46 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

7 2 2 2 2

7 2 2 2 2

7 2 2 2 2

2 2 2 2 2

end fill

ara=47 nux=5 nuy=5 nuz=1

fill

2 3 3 3 4

2 3 3 3 4

2 3 3 3 4

2 3 3 3 4

2 3 3 3 4

end fill

ara=51 nux=5 nuy=5 nuz=1

fill

4 3 3 3 2

4 3 3 3 2

4 4 3 3 3

4 4 3 3 3

4 4 3 3 3

end fill

ara=52 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=53 nux=5 nuy=5 nuz=1

fill

7 6 6 6 5

7 6 6 6 6

2 7 6 6 6

2 7 7 6 6

2 2 2 7 7

end fill

ara=54 nux=5 nuy=5 nuz=1

fill

5 5 6 5 5

5 5 6 5 5

6 6 5 6 6

6 6 5 6 6

6 6 6 6 6

end fill

ara=55 nux=5 nuy=5 nuz=1

fill

5 6 6 6 7

6 6 6 6 7

6 6 6 7 2

6 6 7 2 2

7 7 2 2 2

end fill

ara=56 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=57 nux=5 nuy=5 nuz=1

fill

2 3 3 3 4

2 3 3 3 4

3 3 3 4 4

3 3 3 4 4

3 3 3 4 4

end fill

ara=61 nux=5 nuy=5 nuz=1

fill

4 4 4 3 3

4 4 4 3 3

4 4 4 4 3

4 4 4 4 4

4 4 4 4 4

end fill

ara=62 nux=5 nuy=5 nuz=1

fill

3 2 2 2 2

3 3 2 2 2

3 3 3 2 2

3 3 3 3 2

4 3 3 3 3

end fill

ara=63 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=64 nux=5 nuy=5 nuz=1

fill

2 7 7 7 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=65 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=66 nux=5 nuy=5 nuz=1

fill

2 2 2 2 3

2 2 2 3 3

2 2 3 3 3

2 3 3 3 3

3 3 3 3 4

end fill

ara=67 nux=5 nuy=5 nuz=1

fill

3 3 4 4 4

3 3 4 4 4

3 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=71 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=72 nux=5 nuy=5 nuz=1

fill

4 4 3 3 3

4 4 4 3 3

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=73 nux=5 nuy=5 nuz=1

fill

3 3 3 2 2

3 3 3 3 3

3 3 3 3 3

4 4 4 3 3

4 4 4 4 4

end fill

ara=74 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

4 4 4 4 4

end fill

ara=75 nux=5 nuy=5 nuz=1

fill

2 2 3 3 3

3 3 3 3 3

3 3 3 3 3

3 3 4 4 4

4 4 4 4 4

end fill

ara=76 nux=5 nuy=5 nuz=1

fill

3 3 3 4 4

3 3 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=77 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=100 nux=7 nuy=7 nuz=1

fill

11 12 13 14 15 16 17

21 22 23 24 25 26 27

31 32 33 34 35 36 37

41 42 43 44 45 46 47

51 52 53 54 55 56 57

61 62 63 64 65 66 67

71 72 73 74 75 76 77

end fill

end array

read plot

ttl='simple plot 1'

pic=mix

xul= 0 yul= 190 zul= 100

xlr= 190 ylr= 0 zlr= 100

uax=1.0 vdn=-1.0

nax=1200

lpi=10

scr=yes end

ttl='simple plot 4'

pic=mix

xul= 0 yul= 95 zul= 168

xlr= 190 ylr= 95 zlr= 0

uax=1.0 wdn=-1.0

nax=800

scr=yes end

end plot

end data

end

=cons9901

TASK:

MULTIC= 1

NOUT = 2

IHT = 4

IHS = 77

NG = 299

IPRIB = 0

idelta= 1

NMOM = 5

IZT = 19

NRZT = 16

INZ = 28

NAME=

'PU38' 'PU39' 'PU40' 'PU41' 'PU42' 'AM41' 'GA'

'U235' 'U238NR'

'NA'

'H+H(FREE)' 'C' 'N' 'O' 'AL' 'SI' 'CR' 'MN' 'FE' 'NI' 'MO'

'NB' 'TI' 'CU' 'P' 'S' 'CA' 'D-SC'

RO=

\*1 PU

3.0461E-05 2.8920E-02 6.9095E-03 7.3960E-04 1.8699E-04 4.5718E-04 2.0166E-03

0.0000E+00 6.8782E-07 0.0000E+00 1.2764E-04 4.2260E-04 2.4215E-05 8.8450E-05

2.2973E-05 1.4158E-05 3.5989E-06 1.4902E-06 1.6335E-05 8.5688E-06 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*2 CAN

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 1.3760E-05 1.1393E-04 0.0000E+00 0.0000E+00

0.0000E+00 3.6607E-04 9.4011E-03 8.5931E-04 3.5542E-02 4.1646E-03 0.0000E+00

0.0000E+00 0.0000E+00 1.6613E-02 1.3731E-05 0.0000E+00 0.0000E+00 0.0000E+00

\*3 UO2

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

1.6585E-04 2.2894E-02 0.0000E+00 3.1852E-05 1.1837E-05 0.0000E+00 4.6122E-02

3.3995E-06 2.3024E-05 0.0000E+00 8.3479E-08 1.3139E-06 1.2503E-06 3.3462E-07

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*4 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 1.8834E-05 1.2695E-04 0.0000E+00 0.0000E+00

0.0000E+00 6.3794E-04 1.3673E-02 8.4655E-04 4.7796E-02 8.3368E-03 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 3.4708E-04 3.5660E-05 0.0000E+00 0.0000E+00

\*5 na

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 2.3225E-02 1.3900E-05 0.0000E+00 0.0000E+00 5.6492E-06

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.6184E-07 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 3.6083E-06 0.0000E+00

\*6 can

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 2.1631E-05 2.9290E-04 0.0000E+00 0.0000E+00

0.0000E+00 6.0867E-04 1.4759E-02 1.3570E-03 5.5054E-02 7.0982E-03 0.0000E+00

3.1147E-04 0.0000E+00 0.0000E+00 3.2795E-05 3.3219E-05 0.0000E+00 0.0000E+00

\*7 ss

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 1.8355E-05 8.7794E-05 0.0000E+00 0.0000E+00

1.1862E-04 7.9703E-04 1.5908E-02 1.4972E-03 5.5367E-02 8.7976E-03 8.0988E-05

5.0000E-06 2.4806E-04 5.0365E-05 4.0018E-05 1.4422E-05 0.0000E+00 0.0000E+00

\*8 sheath

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 7.5712E-05 2.3825E-04 0.0000E+00 0.0000E+00

1.9798E-05 0.0000E+00 3.6690E-06 2.5697E-04 7.7524E-02 1.4302E-05 0.0000E+00

0.0000E+00 0.0000E+00 2.2216E-05 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*9 U8

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

3.3369E-04 4.6021E-02 0.0000E+00 4.4048E-05 4.9283E-04 0.0000E+00 0.0000E+00

0.0000E+00 2.1076E-04 0.0000E+00 0.0000E+00 1.0599E-04 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*10 U2

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

3.3962E-04 4.6785E-02 0.0000E+00 4.3899E-05 4.6047E-04 0.0000E+00 0.0000E+00

0.0000E+00 1.9692E-04 0.0000E+00 0.0000E+00 9.9032E-05 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*11 U3

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

3.4209E-04 4.7156E-02 0.0000E+00 4.4574E-05 4.7140E-04 0.0000E+00 0.0000E+00

0.0000E+00 2.0160E-04 0.0000E+00 0.0000E+00 1.0138E-04 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*12 mst3

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 2.5700E-05 5.1066E-04 0.0000E+00 0.0000E+00

1.3989E-04 0.0000E+00 2.7222E-05 3.2634E-04 8.3806E-02 4.8234E-05 9.8355E-06

0.0000E+00 3.9416E-05 4.4548E-05 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

\*13 mst9f10

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 4.6306E-05 6.8972E-04 0.0000E+00 0.0000E+00

0.0000E+00 3.1158E-04 0.0000E+00 7.1275E-04 8.1432E-02 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 4.2944E-05 3.7110E-05 0.0000E+00 0.0000E+00

\*14 stnavr4

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 2.4073E-05 2.7547E-04 0.0000E+00 0.0000E+00

0.0000E+00 7.5592E-04 1.6594E-02 1.1688E-03 5.9245E-02 9.9342E-03 0.0000E+00

4.0746E-04 0.0000E+00 0.0000E+00 4.5399E-05 1.2036E-05 0.0000E+00 0.0000E+00

\*15 stnavs4

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 2.4073E-05 2.5251E-04 0.0000E+00 0.0000E+00

0.0000E+00 7.4610E-04 1.6248E-02 1.5006E-03 5.9881E-02 9.4005E-03 0.0000E+00

3.7393E-04 0.0000E+00 0.0000E+00 1.7803E-05 1.7195E-05 0.0000E+00 0.0000E+00

\*16 stnav4

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 3.3245E-06 3.3477E-05 0.0000E+00 0.0000E+00

0.0000E+00 1.2169E-04 2.4643E-03 1.9518E-04 8.0717E-03 1.2195E-03 0.0000E+00

5.2657E-05 0.0000E+00 0.0000E+00 4.9764E-06 2.5076E-06 0.0000E+00 0.0000E+00

\*17 HOMO

1.4474E-06 1.3741E-03 3.2831E-04 3.5142E-05 8.8849E-06 2.1723E-05 9.5819E-05

4.0193E-05 5.5482E-03 0.0000E+00 2.1415E-05 6.4517E-05 1.1506E-06 1.1182E-02

6.5613E-06 1.2254E-04 2.5197E-03 2.2375E-04 1.3307E-02 1.4328E-03 2.5139E-06

2.2759E-05 7.4514E-06 5.0199E-04 2.2403E-05 3.4982E-06 0.0000E+00 0.0000E+00

\*\*\*\*\*\*\*\*\* D-SC

\*18 PU

3.0461E-05 2.8920E-02 6.9095E-03 7.3960E-04 1.8699E-04 4.5718E-04 2.0166E-03

0.0000E+00 6.8782E-07 0.0000E+00 1.2764E-04 4.2260E-04 2.4215E-05 8.8450E-05

2.2973E-05 1.4158E-05 3.5989E-06 1.4902E-06 1.6335E-05 8.5688E-06 0.0000E+00

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 2.3327E+00

\*19 UO2

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

1.6585E-04 2.2894E-02 0.0000E+00 3.1852E-05 1.1837E-05 0.0000E+00 4.6122E-02

3.3995E-06 2.3024E-05 0.0000E+00 8.3479E-08 1.3139E-06 1.2503E-06 3.3462E-07

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 1.1022E+00

ICOR =

18 17 19 17 17 17 17 17

9 10 11 12 13 17 17 17

17 18 19

NAMSUB='U238NR' 'PU39'

NGSUB=10 11 12 13 14 15 16 17 18 19 20 21 22 23

END

end

=subgran

end

=lava

-1$$ 2500000

0$$ 71 72 18 19

1$$ 16 755 4 91 845 61 0 -1 1 t

2$$ 14I1000 16000

3$$ F5

4$$ 14I100 1600

5$$ 1 1452 27 1018

7\*\*

2.00000E+07 1.86181E+07 1.73316E+07 1.61341E+07 1.50192E+07

1.39818E+07 1.30158E+07 1.21165E+07 1.12793E+07 1.05000E+07

9.69341E+06 8.94878E+06 8.26136E+06 7.62674E+06 7.04086E+06

6.50000E+06 5.99475E+06 5.52877E+06 5.09902E+06 4.70267E+06

4.33713E+06 4.00000E+06 3.69862E+06 3.41995E+06 3.16228E+06

2.92402E+06 2.70371E+06 2.50000E+06 2.32522E+06 2.16265E+06

2.01146E+06 1.87083E+06 1.74003E+06 1.61838E+06 1.50524E+06

1.40000E+06 1.30541E+06 1.21722E+06 1.13498E+06 1.05830E+06

9.86800E+05 9.20131E+05 8.57965E+05 8.00000E+05 7.40700E+05

6.85795E+05 6.34960E+05 5.87894E+05 5.44316E+05 5.03968E+05

4.66612E+05 4.32024E+05 4.00000E+05 3.70350E+05 3.42898E+05

3.17480E+05 2.93947E+05 2.72158E+05 2.51984E+05 2.33306E+05

2.16012E+05 2.00000E+05 1.91435E+05 1.85175E+05 1.77154E+05

1.71449E+05 1.63937E+05 1.58740E+05 1.51708E+05 1.46973E+05

1.40390E+05 1.36079E+05 1.29916E+05 1.25992E+05 1.20222E+05

1.16653E+05 1.11251E+05 1.08006E+05 1.02951E+05 1.00000E+05

9.60586E+04 9.38042E+04 9.00741E+04 8.79923E+04 8.44625E+04

8.25404E+04 7.92005E+04 7.74264E+04 7.42663E+04 7.26292E+04

6.96395E+04 6.81292E+04 6.53014E+04 6.39081E+04 6.12343E+04

5.99484E+04 5.74205E+04 5.62341E+04 5.38442E+04 5.27500E+04

5.04907E+04 4.94817E+04 4.73460E+04 4.64159E+04 4.52365E+04

4.43972E+04 4.38990E+04 4.35400E+04 4.24188E+04 4.16320E+04

4.11705E+04 4.08424E+04 3.97762E+04 3.90389E+04 3.86114E+04

3.83119E+04 3.72981E+04 3.66074E+04 3.62115E+04 3.59381E+04

3.49744E+04 3.43274E+04 3.39609E+04 3.37115E+04 3.27956E+04

3.21894E+04 3.18504E+04 3.16227E+04 3.07523E+04 3.01846E+04

2.98710E+04 2.96635E+04 2.88362E+04 2.83046E+04 2.80147E+04

2.78256E+04 2.70395E+04 2.65418E+04 2.62738E+04 2.61015E+04

2.53546E+04 2.48887E+04 2.46412E+04 2.44843E+04 2.37747E+04

2.33386E+04 2.31100E+04 2.29673E+04 2.22931E+04 2.18850E+04

2.16741E+04 2.15443E+04 2.09038E+04 2.05218E+04 2.03274E+04

2.02095E+04 1.96011E+04 1.92437E+04 1.90644E+04 1.89573E+04

1.83795E+04 1.80451E+04 1.78800E+04 1.77828E+04 1.72340E+04

1.69213E+04 1.67692E+04 1.66810E+04 1.61599E+04 1.58674E+04

1.57274E+04 1.56475E+04 1.51527E+04 1.48791E+04 1.47504E+04

1.46780E+04 1.42082E+04 1.39524E+04 1.38342E+04 1.37686E+04

1.33225E+04 1.30834E+04 1.29748E+04 1.29155E+04 1.24919E+04

1.22685E+04 1.21688E+04 1.21153E+04 1.17131E+04 1.15044E+04

1.14130E+04 1.13646E+04 1.09828E+04 1.07879E+04 1.07041E+04

1.06605E+04 1.02980E+04 1.01159E+04 1.00393E+04 1.00000E+04

9.65597E+03 9.48588E+03 9.41580E+03 9.38042E+03 9.05389E+03

8.89508E+03 8.83104E+03 8.79923E+03 8.48930E+03 8.34103E+03

8.28260E+03 8.25404E+03 7.95994E+03 7.82153E+03 7.76826E+03

7.74264E+03 7.46356E+03 7.33439E+03 7.28588E+03 7.26292E+03

6.99809E+03 6.87754E+03 6.83345E+03 6.81292E+03 6.56175E+03

6.44928E+03 6.40918E+03 6.39081E+03 6.15266E+03 6.04776E+03

6.01129E+03 5.99484E+03 5.76907E+03 5.67124E+03 5.63811E+03

5.62341E+03 5.40937E+03 5.31816E+03 5.28811E+03 5.27500E+03

5.07209E+03 4.98706E+03 4.95985E+03 4.94817E+03 4.75585E+03

4.67660E+03 4.65199E+03 4.64159E+03 4.45930E+03 4.38545E+03

4.36323E+03 4.35400E+03 4.18123E+03 4.11242E+03 4.09241E+03

4.08424E+03 3.92049E+03 3.85639E+03 3.83841E+03 3.83119E+03

3.67600E+03 3.61629E+03 3.60018E+03 3.59381E+03 3.44677E+03

3.39115E+03 3.37674E+03 3.37114E+03 3.23181E+03 3.18002E+03

3.16718E+03 3.16227E+03 3.03025E+03 2.98204E+03 2.97063E+03

2.96635E+03 2.84126E+03 2.79638E+03 2.78628E+03 2.78256E+03

2.66404E+03 2.62228E+03 2.61338E+03 2.61015E+03 2.49787E+03

2.45903E+03 2.45121E+03 2.44843E+03 2.34207E+03 2.30593E+03

2.29911E+03 2.29673E+03 2.19597E+03 2.16237E+03 2.15646E+03

2.15443E+03 2.08156E+03 2.05753E+03 2.03423E+03 2.02643E+03

2.02233E+03 2.02095E+03 1.94867E+03 1.92530E+03 1.91246E+03

1.90823E+03 1.90091E+03 1.89850E+03 1.89642E+03 1.89573E+03

1.82083E+03 1.79713E+03 1.78450E+03 1.78042E+03 1.77880E+03

1.77828E+03 1.71599E+03 1.69659E+03 1.68085E+03 1.67586E+03

1.67210E+03 1.67091E+03 1.66878E+03 1.66810E+03 1.62473E+03

1.61140E+03 1.58045E+03 1.57089E+03 1.56621E+03 1.56475E+03

1.50398E+03 1.48581E+03 1.47431E+03 1.47080E+03 1.46850E+03

1.46780E+03 1.41805E+03 1.40341E+03 1.38536E+03 1.37998E+03

1.37758E+03 1.37686E+03 1.31491E+03 1.29719E+03 1.29283E+03

1.29155E+03 1.24774E+03 1.23536E+03 1.21853E+03 1.21371E+03

1.21202E+03 1.21153E+03 1.17775E+03 1.16836E+03 1.14755E+03

1.14173E+03 1.13762E+03 1.13646E+03 1.10141E+03 1.09189E+03

1.07319E+03 1.06806E+03 1.06649E+03 1.06605E+03 1.02376E+03

1.01259E+03 1.00357E+03 1.00114E+03 1.00024E+03 1.00000E+03

9.66236E+02 9.57470E+02 9.49570E+02 9.47485E+02 9.42407E+02

9.41065E+02 9.38675E+02 9.38042E+02 8.99406E+02 8.89639E+02

8.83723E+02 8.82194E+02 8.80390E+02 8.79923E+02 8.46636E+02

8.38387E+02 8.30030E+02 8.27921E+02 8.25913E+02 8.25404E+02

7.89300E+02 7.80584E+02 7.76423E+02 7.75394E+02 7.74492E+02

7.74269E+02 7.37010E+02 7.28241E+02 7.26676E+02 7.26296E+02

6.95229E+02 6.88058E+02 6.84227E+02 6.83321E+02 6.81684E+02

6.81296E+02 6.51912E+02 6.45279E+02 6.41161E+02 6.40210E+02

6.39296E+02 6.39085E+02 6.11590E+02 6.05519E+02 6.01580E+02

6.00689E+02 5.99710E+02 5.99488E+02 5.75586E+02 5.70412E+02

5.65542E+02 5.64467E+02 5.62730E+02 5.62345E+02 5.36729E+02

5.31326E+02 5.29011E+02 5.28509E+02 5.27682E+02 5.27503E+02

5.03701E+02 4.98792E+02 4.96329E+02 4.95808E+02 4.94993E+02

4.94820E+02 4.70155E+02 4.65202E+02 4.64340E+02 4.64162E+02

4.40985E+02 4.36438E+02 4.35577E+02 4.35403E+02 4.17034E+02

4.13497E+02 4.10542E+02 4.09960E+02 4.08679E+02 4.08426E+02

3.89954E+02 3.86488E+02 3.84318E+02 3.83901E+02 3.83247E+02

3.83121E+02 3.63761E+02 3.60231E+02 3.59518E+02 3.59384E+02

3.46541E+02 3.44235E+02 3.40010E+02 3.39241E+02 3.38106E+02

3.37898E+02 3.37238E+02 3.37117E+02 3.19313E+02 3.16230E+02

3.07376E+02 3.02104E+02 2.97359E+02 2.97025E+02 2.96822E+02

2.96637E+02 2.82831E+02 2.80486E+02 2.79215E+02 2.78994E+02

2.78367E+02 2.78258E+02 2.70318E+02 2.65502E+02 2.63863E+02

2.62708E+02 2.61994E+02 2.61748E+02 2.61349E+02 2.61102E+02

2.61017E+02 2.47008E+02 2.44845E+02 2.37617E+02 2.34994E+02

2.32422E+02 2.31245E+02 2.30811E+02 2.30381E+02 2.29975E+02

2.29824E+02 2.29675E+02 2.19156E+02 2.15445E+02 2.10258E+02

2.09166E+02 2.04427E+02 2.03428E+02 2.02821E+02 2.02692E+02

2.02201E+02 2.02096E+02 1.97202E+02 1.93488E+02 1.91406E+02

1.90813E+02 1.90355E+02 1.90094E+02 1.89860E+02 1.89678E+02

1.89575E+02 1.82295E+02 1.79185E+02 1.78715E+02 1.78509E+02

1.78209E+02 1.78077E+02 1.77905E+02 1.77829E+02 1.71468E+02

1.68053E+02 1.66811E+02 1.58152E+02 1.57088E+02 1.56545E+02

1.56476E+02 1.48817E+02 1.46781E+02 1.39817E+02 1.38221E+02

1.37789E+02 1.37687E+02 1.33160E+02 1.29901E+02 1.29156E+02

1.24352E+02 1.22028E+02 1.21154E+02 1.19058E+02 1.17703E+02

1.17309E+02 1.16008E+02 1.15163E+02 1.14916E+02 1.14504E+02

1.14234E+02 1.14155E+02 1.13880E+02 1.13700E+02 1.13647E+02

1.08936E+02 1.07009E+02 1.06606E+02 1.04367E+02 1.02788E+02

1.02221E+02 1.01371E+02 1.00765E+02 1.00546E+02 1.00270E+02

1.00072E+02 1.00001E+02 9.49147E+01 9.38048E+01 9.00591E+01

8.84578E+01 8.79928E+01 8.53864E+01 8.29607E+01 8.25409E+01

8.00020E+01 7.87116E+01 7.81267E+01 7.78241E+01 7.75626E+01

7.74269E+01 7.48414E+01 7.31916E+01 7.26296E+01 6.81296E+01

6.64990E+01 6.57970E+01 6.55235E+01 6.47774E+01 6.44532E+01

6.43264E+01 6.40667E+01 6.39533E+01 6.39089E+01 6.16780E+01

5.99492E+01 5.77630E+01 5.69789E+01 5.62349E+01 5.43365E+01

5.31530E+01 5.27507E+01 5.12878E+01 5.00051E+01 4.94823E+01

4.71930E+01 4.64165E+01 4.39677E+01 4.35406E+01 4.15092E+01

4.08429E+01 3.86248E+01 3.83124E+01 3.71495E+01 3.62881E+01

3.59386E+01 3.40190E+01 3.37119E+01 3.20656E+01 3.16232E+01

2.96639E+01 2.78259E+01 2.70538E+01 2.63962E+01 2.61019E+01

2.44847E+01 2.33182E+01 2.29676E+01 2.24015E+01 2.18633E+01

2.15446E+01 2.10496E+01 2.09018E+01 2.05679E+01 2.04677E+01

2.02695E+01 2.02098E+01 1.89576E+01 1.81519E+01 1.78913E+01

1.77830E+01 1.69505E+01 1.66812E+01 1.60901E+01 1.56477E+01

1.48289E+01 1.46782E+01 1.37687E+01 1.29157E+01 1.22858E+01

1.21154E+01 1.17726E+01 1.15521E+01 1.13648E+01 1.09868E+01

1.06606E+01 1.02388E+01 1.00001E+01 9.62837E+00 9.38054E+00

8.79934E+00 8.46274E+00 8.25415E+00 8.07648E+00 7.90335E+00

7.74274E+00 7.49870E+00 7.33772E+00 7.26301E+00 6.81301E+00

6.64826E+00 6.50284E+00 6.39089E+00 5.99492E+00 5.62349E+00

5.27506E+00 4.94823E+00 4.64165E+00 4.35406E+00 4.08429E+00

3.83124E+00 3.59386E+00 3.37119E+00 3.16232E+00 2.96639E+00

2.78259E+00 2.61019E+00 2.44847E+00 2.29676E+00 2.15446E+00

2.02098E+00 1.89576E+00 1.77830E+00 1.66812E+00 1.56477E+00

1.46782E+00 1.37687E+00 1.29157E+00 1.21154E+00 1.13648E+00

1.06606E+00 1.00001E+00 9.38054E-01 8.79934E-01 8.25415E-01

7.74274E-01 7.26301E-01 6.81301E-01 6.39089E-01 5.99492E-01

5.62348E-01 5.27506E-01 4.94823E-01 4.64165E-01 4.35406E-01

4.08429E-01 3.83124E-01 3.59386E-01 3.37119E-01 3.16232E-01

2.96639E-01 2.78259E-01 2.61019E-01 2.44847E-01 2.29676E-01

2.15446E-01 1.89576E-01 1.66812E-01 1.46782E-01 1.29157E-01

1.13647E-01 1.00001E-01 8.25415E-02 6.81301E-02 5.62348E-02

4.64165E-02 3.83124E-02 3.16232E-02 2.61019E-02 2.15446E-02

1.77830E-02 1.46782E-02 1.21155E-02 1.00001E-02 6.81301E-03

4.64164E-03 3.16231E-03 2.15446E-03 1.00001E-03 1.00001E-04

1.00001E-05

9$$ F0 t

end

#sc\_bin

72

75

end

#kenova

zebra 24b (231)

read param

tme=1000

lib=75

lng=25000000

nb8=70000

gen=2020

npg=10000

nsk=20

run=yes

plt=no

end param

read mixt

sct=3

eps=1.

mix=1 100 1.

mix=2 200 1.

mix=3 300 1.

mix=4 400 1.

mix=5 500 1.

mix=6 600 1.

mix=7 700 1.

mix=8 800 1.

mix=9 900 1.

mix=10 1000 1.

mix=11 1100 1.

mix=12 1200 1.

mix=13 1300 1.

mix=14 1400 1.

mix=15 1500 1.

mix=16 1600 1.

end mixt

read geometry

unit 1

com='core'

array 111 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 111

com='pu'

cuboid 1 1 4p2.3355 0.28170 0.0457

cuboid 2 1 4p2.5335 0.32740 0

unit 112

com='uo2'

cuboid 3 1 4p2.4255 0.59465 0.03665

cuboid 4 1 4p2.5335 0.63130 0

unit 113

com='na'

cuboid 5 1 4p2.4815 0.577347 0.036347

cuboid 6 1 4p2.5335 0.613694 0

unit 114

com='ss'

cuboid 0 1 4p1.9625 0.31700 0

cuboid 7 1 4p2.5335 0.31700 0

unit 115

com='stnavr4'

cylinder 0 1 2.3000 0.61600 0

cylinder 14 1 2.5335 0.61600 0

cuboid 0 1 4p2.5335 0.61600 0

unit 116

com='stnavs4'

cylinder 0 1 2.3000 0.61600 0

cylinder 15 1 2.5335 0.61600 0

cuboid 0 1 4p2.5335 0.61600 0

unit 117

com='stnav4'

cuboid 16 1 4p2.5335 0.61600 0

unit 211

com='u8'

cuboid 9 1 4p2.5335 9.82700 0

unit 212

com='u2'

cuboid 10 1 4p2.5335 12.72300 0

unit 213

com='u3'

cuboid 11 1 4p2.5335 7.62250 0

unit 311

com='mst3'

cuboid 12 1 4p2.5335 7.60628 0

unit 511

com='air'

cuboid 0 1 4p2.5335 1.3095 0

unit 2

com='u3-radial'

cuboid 12 1 4p2.5335 7.60628 0

cuboid 11 1 4p2.5335 160.05628 0

cuboid 12 1 4p2.5335 167.66256 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 3

com='mst9f10'

cuboid 13 1 4p2.54000 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 4

com='empty tube'

cuboid 0 1 4p2.55100 167.66256 0

cuboid 8 1 4p2.62720 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 5

com='core'

array 115 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 6

com='core'

array 116 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 7

com='core'

array 117 -2.5335 -2.5335 0

cuboid 0 1 4p2.5510 167.66256 0

cuboid 8 1 4p2.6272 167.66256 0

cuboid 0 1 4p2.68605 167.66256 0

unit 11

com='2'

array 11 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 12

com='2'

array 12 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 13

com='2'

array 13 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 14

com='2'

array 14 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 15

com='2'

array 15 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 16

com='2'

array 16 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 17

com='2'

array 17 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 21

com='2'

array 21 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 22

com='2'

array 22 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 23

com='2'

array 23 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 24

com='2'

array 24 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 25

com='2'

array 25 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 26

com='2'

array 26 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 27

com='2'

array 27 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 31

com='2'

array 31 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 32

com='2'

array 32 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 33

com='2'

array 33 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 34

com='2'

array 34 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 35

com='2'

array 35 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 36

com='2'

array 36 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 37

com='2'

array 37 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 41

com='2'

array 41 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 42

com='2'

array 42 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 43

com='2'

array 43 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 44

com='2'

array 44 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 45

com='2'

array 45 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 46

com='2'

array 46 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 47

com='2'

array 47 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 51

com='2'

array 51 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 52

com='2'

array 52 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 53

com='2'

array 53 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 54

com='2'

array 54 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 55

com='2'

array 55 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 56

com='2'

array 56 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 57

com='2'

array 57 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 61

com='2'

array 61 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 62

com='2'

array 62 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 63

com='2'

array 63 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 64

com='2'

array 64 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 65

com='2'

array 65 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 66

com='2'

array 66 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 67

com='2'

array 67 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 71

com='2'

array 71 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 72

com='2'

array 72 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 73

com='2'

array 73 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 74

com='2'

array 74 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 75

com='2'

array 75 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 76

com='2'

array 76 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

unit 77

com='2'

array 77 -13.43025 -13.43025 0

cuboid 0 1 4p13.5635 167.66256 0

global unit 100

com='reactor'

array 100 3\*0

end geometry

read array

ara=115 nux=1 nuy=1 nuz=176

fill

511 311 213 212 211

115 112 115 111 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 114 111 115 112 115 115 112 115 111 114 112 115

115 112 111 115 112 115

211 212 213 311 511

end fill

ara=116 nux=1 nuy=1 nuz=176

fill

511 311 213 212 211

116 112 116 111 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 114 111 116 112 116 116 112 116 111 114 112 116

116 112 111 116 112 116

211 212 213 311 511

end fill

ara=117 nux=1 nuy=1 nuz=176

fill

511 311 213 212 211

117 112 117 111 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 114 111 117 112 117 117 112 117 111 114 112 117

117 112 111 117 112 117

211 212 213 311 511

end fill

ara=11 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=12 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 3 3

4 4 3 3 3

end fill

ara=13 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 3 3

3 3 3 3 3

3 3 3 3 3

3 3 3 2 2

end fill

ara=14 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

2 2 2 2 2

end fill

ara=15 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

3 3 4 4 4

3 3 3 3 3

3 3 3 3 3

2 2 3 3 3

end fill

ara=16 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

3 3 4 4 4

3 3 3 4 4

end fill

ara=17 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=21 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 3

4 4 4 3 3

4 4 4 3 3

end fill

ara=22 nux=5 nuy=5 nuz=1

fill

4 3 3 3 3

3 3 3 3 2

3 3 3 2 2

3 3 2 2 2

3 2 2 2 2

end fill

ara=23 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 7

end fill

ara=24 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

7 7 7 7 7

end fill

ara=25 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

7 2 2 2 2

end fill

ara=26 nux=5 nuy=5 nuz=1

fill

3 3 3 3 4

2 3 3 3 3

2 2 3 3 3

2 2 2 3 3

2 2 2 2 3

end fill

ara=27 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

3 4 4 4 4

3 3 4 4 4

3 3 4 4 4

end fill

ara=31 nux=5 nuy=5 nuz=1

fill

4 4 3 3 3

4 4 3 3 3

4 4 3 3 3

4 3 3 3 2

4 3 3 3 2

end fill

ara=32 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=33 nux=5 nuy=5 nuz=1

fill

2 2 2 7 7

2 7 7 6 6

2 7 6 6 6

7 6 6 6 6

7 6 6 6 5

end fill

ara=34 nux=5 nuy=5 nuz=1

fill

6 6 6 6 6

6 6 6 6 6

6 6 6 6 6

5 5 5 5 5

5 5 5 5 5

end fill

ara=35 nux=5 nuy=5 nuz=1

fill

7 7 2 2 2

6 6 7 7 2

6 6 6 7 2

6 6 6 6 7

5 6 6 6 6

end fill

ara=36 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

7 2 2 2 2

end fill

ara=37 nux=5 nuy=5 nuz=1

fill

3 3 3 4 4

3 3 3 4 4

3 3 3 4 4

2 3 3 3 4

2 3 3 3 4

end fill

ara=41 nux=5 nuy=5 nuz=1

fill

4 3 3 3 2

4 3 3 3 2

4 3 3 3 2

4 3 3 3 2

4 3 3 3 2

end fill

ara=42 nux=5 nuy=5 nuz=1

fill

2 2 2 2 7

2 2 2 2 7

2 2 2 2 7

2 2 2 2 7

2 2 2 2 7

end fill

ara=43 nux=5 nuy=5 nuz=1

fill

6 6 6 5 5

6 6 6 5 5

6 6 6 5 5

6 6 6 5 5

6 6 6 5 5

end fill

ara=44 nux=5 nuy=5 nuz=1

fill

5 5 5 5 5

5 5 5 5 5

5 5 5 5 5

5 5 5 5 5

5 5 5 5 5

end fill

ara=45 nux=5 nuy=5 nuz=1

fill

5 6 6 6 6

5 6 6 6 6

5 6 6 6 6

5 6 6 6 6

5 6 6 6 6

end fill

ara=46 nux=5 nuy=5 nuz=1

fill

7 2 2 2 2

7 2 2 2 2

7 2 2 2 2

7 2 2 2 2

7 2 2 2 2

end fill

ara=47 nux=5 nuy=5 nuz=1

fill

2 3 3 3 4

2 3 3 3 4

2 3 3 3 4

2 3 3 3 4

2 3 3 3 4

end fill

ara=51 nux=5 nuy=5 nuz=1

fill

4 3 3 3 2

4 3 3 3 2

4 4 3 3 3

4 4 3 3 3

4 4 3 3 3

end fill

ara=52 nux=5 nuy=5 nuz=1

fill

2 2 2 2 7

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=53 nux=5 nuy=5 nuz=1

fill

7 6 6 6 5

7 6 6 6 6

2 7 6 6 6

2 7 7 6 6

2 2 2 7 7

end fill

ara=54 nux=5 nuy=5 nuz=1

fill

5 5 6 5 5

5 5 6 5 5

6 6 5 6 6

6 6 5 6 6

6 6 6 6 6

end fill

ara=55 nux=5 nuy=5 nuz=1

fill

5 6 6 6 7

6 6 6 6 7

6 6 6 7 2

6 6 7 7 2

7 7 2 2 2

end fill

ara=56 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=57 nux=5 nuy=5 nuz=1

fill

2 3 3 3 4

2 3 3 3 4

3 3 3 4 4

3 3 3 4 4

3 3 3 4 4

end fill

ara=61 nux=5 nuy=5 nuz=1

fill

4 4 4 3 3

4 4 4 3 3

4 4 4 4 3

4 4 4 4 4

4 4 4 4 4

end fill

ara=62 nux=5 nuy=5 nuz=1

fill

3 2 2 2 2

3 3 2 2 2

3 3 3 2 2

3 3 3 3 2

4 3 3 3 3

end fill

ara=63 nux=5 nuy=5 nuz=1

fill

2 2 2 2 7

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=64 nux=5 nuy=5 nuz=1

fill

7 7 7 7 7

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=65 nux=5 nuy=5 nuz=1

fill

7 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

2 2 2 2 2

end fill

ara=66 nux=5 nuy=5 nuz=1

fill

2 2 2 2 3

2 2 2 3 3

2 2 3 3 3

2 3 3 3 3

3 3 3 3 4

end fill

ara=67 nux=5 nuy=5 nuz=1

fill

3 3 4 4 4

3 3 4 4 4

3 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=71 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=72 nux=5 nuy=5 nuz=1

fill

4 4 3 3 3

4 4 4 3 3

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=73 nux=5 nuy=5 nuz=1

fill

3 3 3 2 2

3 3 3 3 3

3 3 3 3 3

4 4 4 3 3

4 4 4 4 4

end fill

ara=74 nux=5 nuy=5 nuz=1

fill

2 2 2 2 2

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

4 4 4 4 4

end fill

ara=75 nux=5 nuy=5 nuz=1

fill

2 2 3 3 3

3 3 3 3 3

3 3 3 3 3

3 3 4 4 4

4 4 4 4 4

end fill

ara=76 nux=5 nuy=5 nuz=1

fill

3 3 3 4 4

3 3 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=77 nux=5 nuy=5 nuz=1

fill

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

4 4 4 4 4

end fill

ara=100 nux=7 nuy=7 nuz=1

fill

11 12 13 14 15 16 17

21 22 23 24 25 26 27

31 32 33 34 35 36 37

41 42 43 44 45 46 47

51 52 53 54 55 56 57

61 62 63 64 65 66 67

71 72 73 74 75 76 77

end fill

end array

read plot

ttl='simple plot 1'

pic=mix

xul= 0 yul= 190 zul= 100

xlr= 190 ylr= 0 zlr= 100

uax=1.0 vdn=-1.0

nax=1200

lpi=10

scr=yes end

ttl='simple plot 4'

pic=mix

xul= 0 yul= 95 zul= 168

xlr= 190 ylr= 95 zlr= 0

uax=1.0 wdn=-1.0

nax=800

scr=yes end

end plot

end data

end

## A.3 The ERANOS RZ model used for sensitivity calculations.

Data used in ERANOS with CARNAVAL-IV nuclear data

Material compositions

MATERIAU\_SIMPLE 'UPUO2C1' COMBUSTIBLE

NOMBRE\_D\_ATOMES

CORPS

'U234' 1.2863E-06

'U235' 1.2997E-04

'U236' 7.3103E-07

'U238' 1.7843E-02

'PU238' 6.9094E-06

'PU239' 4.4708E-03

'PU240' 1.0602E-03

'PU241' 1.1598E-04

'PU242' 3.0047E-05

'AM241' 5.7784E-05

'O' 4.7434E-02

MATERIAU\_SIMPLE 'STEEL' STRUCTURE

NOMBRE\_D\_ATOMES

CORPS

'C' 0.033600E-2

'CR' 1.113600E-2

'FE' 6.209600E-2

'NI' 0.806400E-2

MATERIAU\_SIMPLE 'NA' CALOPORTEUR

NOMBRE\_D\_ATOMES

CORPS

'NA' 2.3225E-02

MATERIAU\_SIMPLE 'AX.BLKT' FERTILE

NOMBRE\_D\_ATOMES

CORPS

'U235' 2.9839E-04

'U238' 4.1132E-02

'FE' 4.2453E-03

'C' 4.2396E-04

'SI' 1.7584E-04

MATERIAU\_SIMPLE 'RAD.BLKT' FERTILE

NOMBRE\_D\_ATOMES

CORPS

'U235' 2.9839E-04

'U238' 4.1132E-02

'FE' 4.2453E-03

'C' 4.2396E-04

'SI' 1.7584E-04

MATERIAU\_SIMPLE 'PL.CORE' STRUCTURE

NOMBRE\_D\_ATOMES

CORPS

'FE' 7.7256E-02

'C' 4.5820E-04

'H' 2.6476E-05

'AL' 1.2308E-04

'MN' 2.9843E-04

MATERIAU\_SIMPLE 'RAD.REFL' STRUCTURE

NOMBRE\_D\_ATOMES

CORPS

'FE' 3.9297E-02

'CR' 8.0171E-03

'NI' 3.8059E-03

'C' 1.0735E-04

'H' 5.7941E-05

'CU' 3.5294E-06

'SI' 4.0353E-04

'MN' 7.0382E-04

MILIEU 'C1'

'UPUO2C1' 30.00 'STEEL' 34.00 'NA' 36.00

MILIEU 'AX.BLKT'

'AX.BLKT' 100.00

MILIEU 'RAD.BLKT'

'RAD.BLKT' 100.00

MILIEU 'GAS PLE.'

'PL.CORE' 100.00

MILIEU 'REFLEC.'

'RAD.REFL' 100.00

;

TEMPERATURE

COMBUSTIBLE 300.

FERTILE 300.

STRUCTURE 300.

CALOPORTEUR 300.

;

FINSI ;

EDITION\_MILIEU (MIL) ;

ARCHIVE 'ARCHERAN' ->EDLCAR

CARNAVAL\_IV FILE ;

CREATION\_BANDE\_CARNAVAL\_A\_PARTIR\_EDL (EDLCAR)

10

;

CREATION\_JSEM\_HETARED

MICRO ->MIC

MACRO ->MAC

MILIEU (MIL)

FICHIER\_HETARED 10

!&F

!&F HETEROGENEITY DATA ARE AVAILABLE ONLY FOR C1

!&F

MILIEU 'C1' HETEROGENE 0.423 0.77229

MILIEU 'AX.BLKT' BUCKLING 0.01542 SOURCE 'C1'

MILIEU 'RAD.BLKT' BUCKLING 0.019038 SOURCE 'C1'

MILIEU 'GAS PLE.' SOURCE 'AX.BLKT'

MILIEU 'REFLEC.' SOURCE 'RAD.BLKT'

SPECTRE\_DE\_FISSION 'C1'

;

/ (EDLCAR) ;

ITERATIONS\_DIFFUSION\_RECTANGULAIRE ->FDIR

METHODE (METH)

COEFFICIENT (COEF)

PARAMETRES\_DE\_CALCUL

ITERATIONS\_EXTERNES

NOMBRE\_MAXIMUM 1

CONVERGENCE\_INTEGRALE 1.0E-5

CONVERGENCE\_PONCTUELLE 1.0E-3

ITERATIONS\_INTERNES

NOMBRE\_MAXIMUM 1

SPECTRE VARIABLE

CALCUL DIRECT

;

EDITION\_FLUX\_RECTANGULAIRE (FDIR) ;

CREATION\_COEUR ->CORE

RESEAU

CENTRE 30

PERIODICITE 'PI/3'

NOMBRE\_DE\_COURONNES 18

COURONNE 'Z1' 1 9

'Z2' 10 15

'Z3' 16 18

PAS\_RESEAU 5.11

CYLINDRISATION

'Z1' 46.00

'Z2' 75.00

'Z3' 90.00

MAILLAGE\_DE\_BASE

OZ 2 30.

3 60.

4 90.

2 120.

4 150.

3 180.

2 210.

OR 20 46.00

6 75.00

4 90.00

ASSEMBLAGE 'TYPE 1' COMBUSTIBLE 271 0.865

MILIEU 'GAS PLE.' 0. 210.

'AX.BLKT' 30. 180.

'C1' 60. 150.

ZONE 'Z1'

SECTION 'C1' 60. 150.

PARCELLE 90. 120.

ASSEMBLAGE 'TYPE 2' FERTILE 1 0.

MILIEU 'GAS PLE.' 0. 210.

'RAD.BLKT' 30. 180.

ZONE 'Z2'

SECTION 'RAD.BLKT' 30. 180.

PARCELLE 90. 120.

ASSEMBLAGE 'TYPE 3' STRUCTURE 1 0.

MILIEU 'REFLEC.' 0. 210.

ZONE 'Z3'

;

CREATION\_GEOMETRIE\_RZ ->GEOMRZ

COEUR (CORE)

MILIEU (MIL)

CONFIGURATION

ZONE 'Z1' 'TYPE 1'

ZONE 'Z2' 'TYPE 2'

ZONE 'Z3' 'TYPE 3'

LIMITE

RSUP VIDE

ZINF VIDE

ZSUP VIDE

;

EDITION\_GEOMETRIE\_RECTANGULAIRE (GEOMRZ) ;

COEFFICIENTS\_DIFFUSION\_RECTANGULAIRE\_2D ->COEF

GEOMETRIE (GEOMRZ)

MACRO (MAC)

MAILLAGE 1 1

;

METHODE\_RESOLUTION\_DIFFUSION ->METH

COEFFICIENT (COEF)

PLANE

GROUPE 1 21 DIRECTIONS\_ALTERNEES CALCUL

!&F

!&F SIM PERFORMS BETTER IN THE LOW ENERGY RANGE

!&F

GROUPE 22 25 SIM

;

ITERATIONS\_DIFFUSION\_RECTANGULAIRE ->FDIRRZ

METHODE (METH)

COEFFICIENT (COEF)

PARAMETRES\_DE\_CALCUL

ITERATIONS\_EXTERNES

NOMBRE\_MAXIMUM 40

CONVERGENCE\_INTEGRALE 1.0E-5

CONVERGENCE\_PONCTUELLE 1.0E-3

ITERATIONS\_INTERNES

NOMBRE\_MAXIMUM 6

SPECTRE VARIABLE

CALCUL DIRECT

;

## A4. MCNP – JEFF-3.1 Input Decks

### A4.1 MCNP-JEFF-3.1 Zebra22 Model A

Zebra Assembly 22 reference model including Void gaps between elements

c JEFF-3.1

c

c ------- Elements of the assembly ----------------------------------

c

c --- Core Element

c Lower padding

111 16 3.279692E-02 -8 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Lower Reflector

112 14 8.4932E-02 8 -9 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Lower section of the NatU Blanket

113 15 4.8317E-02 9 -41 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

114 9 4.7925E-02 41 -42 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

115 8 4.7208E-02 42 -10 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c

c Fuelled section

c

c Lowest core Cell, Cell 12

c

c Na plate core

122 5 2.324832E-02 502 -503 109 -110 111 -112 u=5 imp:n=1 TMP=2.5301E-08

C Na plate can

123 6 7.9429E-02 10 -504 21 -22 23 -24 &

(-109:110:-111:112:-502:503) u=5 imp:n=1 TMP=2.5301E-08

c

c UO2 core

127 3 6.9083E-02 505 -506 105 -106 107 -108 u=5 imp:n=1 TMP=2.5301E-08

c UO2 plate can

128 4 7.2463E-02 504 -507 21 -22 23 -24 &

(-105:106:-107:108:-505:506) u=5 imp:n=1 TMP=2.5301E-08

c

c Na plate core

132 5 2.324832E-02 508 -509 109 -110 111 -112 u=5 imp:n=1 TMP=2.5301E-08

C Na plate can

133 6 7.9429E-02 507 -510 21 -22 23 -24 &

(-109:110:-111:112:-508:509) u=5 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

135 1 3.9991E-02 101 -102 103 -104 511 -512 u=5 imp:n=1 TMP=2.5301E-08

C Pu canning

136 2 6.6997E-02 510 -513 21 -22 23 -24 &

(-101:102:-103:104:-511:512) u=5 imp:n=1 TMP=2.5301E-08

c

c UO2 core

139 3 6.9083E-02 514 -515 105 -106 107 -108 u=5 imp:n=1 TMP=2.5301E-08

c UO2 plate can

140 4 7.2463E-02 513 -516 21 -22 23 -24 &

(-105:106:-107:108:-514:515) u=5 imp:n=1 TMP=2.5301E-08

c

c Na plate core

142 5 2.324832E-02 517 -518 109 -110 111 -112 u=5 imp:n=1 TMP=2.5301E-08

C Na plate can

143 6 7.9429E-02 516 -43 21 -22 23 -24 &

(-109:110:-111:112:-517:518) u=5 imp:n=1 TMP=2.5301E-08

c

c Insert the 22 central region core cells

c

151 0 43 -44 21 -22 23 -24 fill=3 (0 0 71.209862) u=5 imp:n=1

c

152 0 44 -45 21 -22 23 -24 fill=4 (0 0 74.957944) u=5 imp:n=1

c

c

153 0 45 -46 21 -22 23 -24 fill=3 (0 0 78.706026) u=5 imp:n=1

c

154 0 46 -47 21 -22 23 -24 fill=4 (0 0 82.454108) u=5 imp:n=1

c

c

155 0 47 -48 21 -22 23 -24 fill=3 (0 0 86.202190) u=5 imp:n=1

c

156 0 48 -49 21 -22 23 -24 fill=4 (0 0 89.950272) u=5 imp:n=1

c

c

157 0 49 -50 21 -22 23 -24 fill=3 (0 0 93.698354) u=5 imp:n=1

c

158 0 50 -51 21 -22 23 -24 fill=4 (0 0 97.446436) u=5 imp:n=1

c

c

159 0 51 -52 21 -22 23 -24 fill=3 (0 0 101.194518) u=5 imp:n=1

c

160 0 52 -53 21 -22 23 -24 fill=4 (0 0 104.942600) u=5 imp:n=1

c

c

161 0 53 -54 21 -22 23 -24 fill=3 (0 0 108.690682) u=5 imp:n=1

c

162 0 54 -55 21 -22 23 -24 fill=4 (0 0 112.438764) u=5 imp:n=1

c

c

163 0 55 -56 21 -22 23 -24 fill=3 (0 0 116.186846) u=5 imp:n=1

c

164 0 56 -57 21 -22 23 -24 fill=4 (0 0 119.934928) u=5 imp:n=1

c

c

165 0 57 -58 21 -22 23 -24 fill=3 (0 0 123.683010) u=5 imp:n=1

c

166 0 58 -59 21 -22 23 -24 fill=4 (0 0 127.431092) u=5 imp:n=1

c

c

167 0 59 -60 21 -22 23 -24 fill=3 (0 0 131.179174) u=5 imp:n=1

c

168 0 60 -61 21 -22 23 -24 fill=4 (0 0 134.927256) u=5 imp:n=1

c

c

169 0 61 -62 21 -22 23 -24 fill=3 (0 0 138.675338) u=5 imp:n=1

c

170 0 62 -63 21 -22 23 -24 fill=4 (0 0 142.423420) u=5 imp:n=1

c

c

171 0 63 -64 21 -22 23 -24 fill=3 (0 0 146.171502) u=5 imp:n=1

c

172 0 64 -65 21 -22 23 -24 fill=4 (0 0 149.919584) u=5 imp:n=1

c

c

c The top core cell, Cell 2

c

c Na plate core

1002 5 2.324832E-02 402 -403 109 -110 111 -112 u=5 imp:n=1 TMP=2.5301E-08

C Na plate can

1003 6 7.9429E-02 65 -404 21 -22 23 -24 &

(-109:110:-111:112:-402:403) u=5 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1007 3 6.9083E-02 405 -406 105 -106 107 -108 u=5 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1008 4 7.2463E-02 404 -407 21 -22 23 -24 &

(-105:106:-107:108:-405:406) u=5 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

1012 1 3.9991E-02 101 -102 103 -104 408 -409 u=5 imp:n=1 &

TMP=2.5301E-08

C Pu canning

1013 2 6.6997E-02 407 -410 21 -22 23 -24 &

(-101:102:-103:104:-408:409) u=5 imp:n=1 TMP=2.5301E-08

c

c Na plate core

1022 5 2.324832E-02 411 -412 109 -110 111 -112 u=5 imp:n=1 TMP=2.5301E-08

C Na plate can

1023 6 7.9429E-02 410 -413 21 -22 23 -24 &

(-109:110:-111:112:-411:412) u=5 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1027 3 6.9083E-02 414 -415 105 -106 107 -108 u=5 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1028 4 7.2463E-02 413 -416 21 -22 23 -24 &

(-105:106:-107:108:-414:415) u=5 imp:n=1 TMP=2.5301E-08

c

c Na plate core

1032 5 2.324832E-02 417 -418 109 -110 111 -112 u=5 imp:n=1 TMP=2.5301E-08

C Na plate can

1033 6 7.9429E-02 416 -11 21 -22 23 -24 &

(-109:110:-111:112:-417:418) u=5 imp:n=1 TMP=2.5301E-08

c

c

c Upper Axial blanket.

c

1171 8 4.7208E-02 11 -67 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

1172 9 4.7925E-02 67 -68 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

1173 15 4.8317E-02 68 -12 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c

c Upper Reflector

1176 14 8.4932E-02 12 -13 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Upper padding

1177 16 3.279692E-02 13 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Wrapper region

c 1198 17 3.87228E-02 1 -2 3 -4 (-21:22:-23:24) u=5 imp:n=1

c TMP=2.5301E-08

c gap between plates and wrapper

1191 0 32 -33 34 -35 (-21:22:-23:24) u=5 imp:n=1

c Wrapper

1192 17 7.81552E-02 36 -37 38 -39 (-32:33:-34:35) u=5 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

1193 0 1 -2 3 -4 (-36:37:-38:39) u=5 imp:n=1

c

c --- Radial Blanket Elements

c

c Lower padding

1211 like 111 but u=6 imp:n=1 TMP=2.5301E-08

c Lower Reflector

1212 like 112 but u=6 imp:n=1 TMP=2.5301E-08

c Radial blanket

1214 15 4.8317E-02 9 -12 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Upper reflector

1216 like 1176 but u=6 imp:n=1 TMP=2.5301E-08

c Upper padding

1217 like 1177 but u=6 imp:n=1 TMP=2.5301E-08

c Wrapper region

1257 like 1191 but u=6 imp:n=1

1258 like 1192 but u=6 imp:n=1

1259 like 1193 but u=6 imp:n=1

c

c

c --- Radial shield

c

1326 12 8.32720E-02 28 -29 30 -31 u=7 imp:n=1 TMP=2.5301E-08

c

1327 13 8.32720E-05 1 -2 3 -4 (-28:29:-30:31) u=7 imp:n=1

TMP=2.5301E-08

c

1400 13 8.32720E-05 1 -2 3 -4 u=9 imp:n=1 TMP=2.5301E-08

c

c --- Assembly

c

1419 0 89 -90 91 -92 u=10 lat=1

fill=-3:3 -3:3 0:0

201 135 134 133 132 131 201

138 115 111 109 111 114 137

168 111 108 101 107 111 167

158 106 101 101 101 105 157

148 111 104 101 103 111 147

128 113 111 102 111 112 127

201 125 124 123 122 121 201

imp:n=1

c

c --- Fuel Region

c

1429 0 7 -16 -17 fill=10 imp:n=1

c --- Universe

1430 0 (-7:16:17) imp:n=0

c

c ------------- PLATE ELEMENT CELL CARDS ----------------------------------

c

c The First Regular cell. Cell 1

c

c Na plate

c Na plate core

2162 5 2.324832E-02 802 -803 109 -110 111 -112 u=3 imp:n=1 TMP=2.5301E-08

C Na plate can

2163 6 7.9429E-02 801 -804 21 -22 23 -24 &

(-109:110:-111:112:-802:803) u=3 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2167 3 6.9083E-02 805 -806 105 -106 107 -108 u=3 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2168 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-105:106:-107:108:-805:806) u=3 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2170 7 3.3152E-02 807 -708 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2172 1 3.9991E-02 101 -102 103 -104 709 -710 u=3 imp:n=1 TMP=2.5301E-08

C Pu canning

2173 2 6.6997E-02 708 -711 21 -22 23 -24 &

(-101:102:-103:104:-709:710) u=3 imp:n=1 TMP=2.5301E-08

c

c

c Na plate

c Na plate core

2182 5 2.324832E-02 712 -713 109 -110 111 -112 u=3 imp:n=1 TMP=2.5301E-08

C Na plate can

2183 6 7.9429E-02 711 -814 21 -22 23 -24 &

(-109:110:-111:112:-712:713) u=3 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2187 3 6.9083E-02 815 -816 105 -106 107 -108 u=3 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2188 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-105:106:-107:108:-815:816) u=3 imp:n=1 TMP=2.5301E-08

c

c Na plate

c Na plate core

2192 5 2.324832E-02 818 -819 109 -110 111 -112 u=3 imp:n=1 TMP=2.5301E-08

C Na plate can

2193 6 7.9429E-02 817 -820 21 -22 23 -24 &

(-109:110:-111:112:-818:819) u=3 imp:n=1 TMP=2.5301E-08

c

c End of Cell 1 beginning of Cell 2

c Na plate

c Na plate core

2202 5 2.324832E-02 802 -803 109 -110 111 -112 u=4 imp:n=1 TMP=2.5301E-08

C Na plate can

2203 6 7.9429E-02 801 -804 21 -22 23 -24 &

(-109:110:-111:112:-802:803) u=4 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2207 3 6.9083E-02 805 -806 105 -106 107 -108 u=4 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2208 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-105:106:-107:108:-805:806) u=4 imp:n=1 TMP=2.5301E-08

c

c Na plate

c Na plate core

2211 5 2.324832E-02 808 -809 109 -110 111 -112 u=4 imp:n=1 TMP=2.5301E-08

C Na plate can

2212 6 7.9429E-02 807 -810 21 -22 23 -24 &

(-109:110:-111:112:-808:809) u=4 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2214 1 3.9991E-02 101 -102 103 -104 811 -812 u=4 imp:n=1 TMP=2.5301E-08

C Pu canning

2215 2 6.6997E-02 810 -813 21 -22 23 -24 &

(-101:102:-103:104:-811:812) u=4 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2217 7 3.3152E-02 813 -814 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2219 3 6.9083E-02 815 -816 105 -106 107 -108 u=4 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2220 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-105:106:-107:108:-815:816) u=4 imp:n=1 TMP=2.5301E-08

c

c Na plate

c Na plate core

2222 5 2.324832E-02 818 -819 109 -110 111 -112 u=4 imp:n=1 TMP=2.5301E-08

C Na plate can

2223 6 7.9429E-02 817 -820 21 -22 23 -24 &

(-109:110:-111:112:-818:819) u=4 imp:n=1 TMP=2.5301E-08

c

c End of plate element cell data

c

c ------------------------------------------------------------------

c

c Form arrays of 5x5 elements

c

c

c Central array of 5x5 core elements

c

3001 0 85 -81 87 -83 fill=5 (-10.7442 -10.7442 0) u=101 imp:n=1

c

3002 0 81 -1 87 -83 fill=5 (-5.3721 -10.7442 0) u=101 imp:n=1

c

3003 0 1 -2 87 -83 fill=5 (0 -10.7442 0) u=101 imp:n=1

c

3004 0 2 -82 87 -83 fill=5 (5.3721 -10.7442 0) u=101 imp:n=1

c

3005 0 82 -86 87 -83 fill=5 (10.7442 -10.7442 0) u=101 imp:n=1

c

c

3006 0 85 -81 83 -3 fill=5 (-10.7442 -5.3721 0) u=101 imp:n=1

c

3007 0 81 -1 83 -3 fill=5 (-5.3721 -5.3721 0) u=101 imp:n=1

c

3008 0 1 -2 83 -3 fill=5 (0 -5.3721 0) u=101 imp:n=1

c

3009 0 2 -82 83 -3 fill=5 (5.3721 -5.3721 0) u=101 imp:n=1

c

3010 0 82 -86 83 -3 fill=5 (10.7442 -5.3721 0) u=101 imp:n=1

c

c

3011 0 85 -81 3 -4 fill=5 (-10.7442 0 0) u=101 imp:n=1

c

3012 0 81 -1 3 -4 fill=5 (-5.3721 0 0) u=101 imp:n=1

c

3013 0 1 -2 3 -4 fill=5 (0 0 0) u=101 imp:n=1

c

3014 0 2 -82 3 -4 fill=5 (5.3721 0 0) u=101 imp:n=1

c

3015 0 82 -86 3 -4 fill=5 (10.7442 0 0) u=101 imp:n=1

c

c

3016 0 85 -81 4 -84 fill=5 (-10.7442 5.3721 0) u=101 imp:n=1

c

3017 0 81 -1 4 -84 fill=5 (-5.3721 5.3721 0) u=101 imp:n=1

c

3018 0 1 -2 4 -84 fill=5 (0 5.3721 0) u=101 imp:n=1

c

3019 0 2 -82 4 -84 fill=5 (5.3721 5.3721 0) u=101 imp:n=1

c

3020 0 82 -86 4 -84 fill=5 (10.7442 5.3721 0) u=101 imp:n=1

c

c

3021 0 85 -81 84 -88 fill=5 (-10.7442 10.7442 0) u=101 imp:n=1

c

3022 0 81 -1 84 -88 fill=5 (-5.3721 10.7442 0) u=101 imp:n=1

c

3023 0 1 -2 84 -88 fill=5 (0 10.7442 0) u=101 imp:n=1

c

3024 0 2 -82 84 -88 fill=5 (5.3721 10.7442 0) u=101 imp:n=1

c

3025 0 82 -86 84 -88 fill=5 (10.7442 10.7442 0) u=101 imp:n=1

c

c Surround material

c

3026 0 89 -90 91 -92 (-85:86:-87:88) -71 u=101 imp:n=1

c

3027 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=101 imp:n=1

c

3028 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=101 imp:n=1

c

3029 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=101 imp:n=1

c

3030 0 89 -90 91 -92 (-85:86:-87:88) 74 u=101 imp:n=1

c

c

c ROW 3

c

c Bottom left array of 5x5 core elements in Row 3

c

3031 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=103 imp:n=1

c

3032 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=103 imp:n=1

c

3033 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=103 imp:n=1

c

3034 0 2 -82 87 -83 fill=5 (5.3721 -10.7442 0) u=103 imp:n=1

c

3035 0 82 -86 87 -83 fill=5 (10.7442 -10.7442 0) u=103 imp:n=1

c

c

3036 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=103 imp:n=1

c

3037 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=103 imp:n=1

c

3038 0 1 -2 83 -3 fill=5 (0 -5.3721 0) u=103 imp:n=1

c

3039 0 2 -82 83 -3 fill=5 (5.3721 -5.3721 0) u=103 imp:n=1

c

3040 0 82 -86 83 -3 fill=5 (10.7442 -5.3721 0) u=103 imp:n=1

c

c

3041 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=103 imp:n=1

c

3042 0 81 -1 3 -4 fill=5 (-5.3721 0 0) u=103 imp:n=1

c

3043 0 1 -2 3 -4 fill=5 (0 0 0) u=103 imp:n=1

c

3044 0 2 -82 3 -4 fill=5 (5.3721 0 0) u=103 imp:n=1

c

3045 0 82 -86 3 -4 fill=5 (10.7442 0 0) u=103 imp:n=1

c

c

3046 0 85 -81 4 -84 fill=5 (-10.7442 5.3721 0) u=103 imp:n=1

c

3047 0 81 -1 4 -84 fill=5 (-5.3721 5.3721 0) u=103 imp:n=1

c

3048 0 1 -2 4 -84 fill=5 (0 5.3721 0) u=103 imp:n=1

c

3049 0 2 -82 4 -84 fill=5 (5.3721 5.3721 0) u=103 imp:n=1

c

3050 0 82 -86 4 -84 fill=5 (10.7442 5.3721 0) u=103 imp:n=1

c

c

3051 0 85 -81 84 -88 fill=5 (-10.7442 10.7442 0) u=103 imp:n=1

c

3052 0 81 -1 84 -88 fill=5 (-5.3721 10.7442 0) u=103 imp:n=1

c

3053 0 1 -2 84 -88 fill=5 (0 10.7442 0) u=103 imp:n=1

c

3054 0 2 -82 84 -88 fill=5 (5.3721 10.7442 0) u=103 imp:n=1

c

3055 0 82 -86 84 -88 fill=5 (10.7442 10.7442 0) u=103 imp:n=1

c

c Surround material

c

3056 0 89 -90 91 -92 (-85:86:-87:88) -71 u=103 imp:n=1

c

3057 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=103 imp:n=1

c

3058 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=103 imp:n=1

c

3059 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=103 imp:n=1

c

3060 0 89 -90 91 -92 (-85:86:-87:88) 74 u=103 imp:n=1

c

c

c Bottom right array of 5x5 core elements in Row 3

c

3071 0 85 -81 87 -83 fill=5 (-10.7442 -10.7442 0) u=104 imp:n=1

c

3072 0 81 -1 87 -83 fill=5 (-5.3721 -10.7442 0) u=104 imp:n=1

c

3073 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=104 imp:n=1

c

3074 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=104 imp:n=1

c

3075 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=104 imp:n=1

c

c

3076 0 85 -81 83 -3 fill=5 (-10.7442 -5.3721 0) u=104 imp:n=1

c

3077 0 81 -1 83 -3 fill=5 (-5.3721 -5.3721 0) u=104 imp:n=1

c

3078 0 1 -2 83 -3 fill=5 (0 -5.3721 0) u=104 imp:n=1

c

3079 0 2 -82 83 -3 fill=5 (5.3721 -5.3721 0) u=104 imp:n=1

c

3080 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=104 imp:n=1

c

c

3081 0 85 -81 3 -4 fill=5 (-10.7442 0 0) u=104 imp:n=1

c

3082 0 81 -1 3 -4 fill=5 (-5.3721 0 0) u=104 imp:n=1

c

3083 0 1 -2 3 -4 fill=5 (0 0 0) u=104 imp:n=1

c

3084 0 2 -82 3 -4 fill=5 (5.3721 0 0) u=104 imp:n=1

c

3085 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=104 imp:n=1

c

c

3086 0 85 -81 4 -84 fill=5 (-10.7442 5.3721 0) u=104 imp:n=1

c

3087 0 81 -1 4 -84 fill=5 (-5.3721 5.3721 0) u=104 imp:n=1

c

3088 0 1 -2 4 -84 fill=5 (0 5.3721 0) u=104 imp:n=1

c

3089 0 2 -82 4 -84 fill=5 (5.3721 5.3721 0) u=104 imp:n=1

c

3090 0 82 -86 4 -84 fill=5 (10.7442 5.3721 0) u=104 imp:n=1

c

c

3091 0 85 -81 84 -88 fill=5 (-10.7442 10.7442 0) u=104 imp:n=1

c

3092 0 81 -1 84 -88 fill=5 (-5.3721 10.7442 0) u=104 imp:n=1

c

3093 0 1 -2 84 -88 fill=5 (0 10.7442 0) u=104 imp:n=1

c

3094 0 2 -82 84 -88 fill=5 (5.3721 10.7442 0) u=104 imp:n=1

c

3095 0 82 -86 84 -88 fill=5 (10.7442 10.7442 0) u=104 imp:n=1

c

c Surround material

c

3096 0 89 -90 91 -92 (-85:86:-87:88) -71 u=104 imp:n=1

c

3097 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=104 imp:n=1

c

3098 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=104 imp:n=1

c

3099 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=104 imp:n=1

c

3100 0 89 -90 91 -92 (-85:86:-87:88) 74 u=104 imp:n=1

c

c

c ROW 2

c

c Bottom central array of 5x5 core elements in row 2

c

3201 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=102 imp:n=1

c

3202 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=102 imp:n=1

c

3203 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=102 imp:n=1

c

3204 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=102 imp:n=1

c

3205 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=102 imp:n=1

c

c

3206 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=102 imp:n=1

c

3207 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=102 imp:n=1

c

3208 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=102 imp:n=1

c

3209 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=102 imp:n=1

c

3210 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=102 imp:n=1

c

c

3211 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=102 imp:n=1

c

3212 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=102 imp:n=1

c

3213 0 1 -2 3 -4 fill=6 (0 0 0) u=102 imp:n=1

c

3214 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=102 imp:n=1

c

3215 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=102 imp:n=1

c

c

3216 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=102 imp:n=1

c

3217 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=102 imp:n=1

c

3218 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=102 imp:n=1

c

3219 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=102 imp:n=1

c

3220 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=102 imp:n=1

c

c

3221 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=102 imp:n=1

c

3222 0 81 -1 84 -88 fill=5 (-5.3721 10.7442 0) u=102 imp:n=1

c

3223 0 1 -2 84 -88 fill=5 (0 10.7442 0) u=102 imp:n=1

c

3224 0 2 -82 84 -88 fill=5 (5.3721 10.7442 0) u=102 imp:n=1

c

3225 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=102 imp:n=1

c

c Surround material

c

3226 0 89 -90 91 -92 (-85:86:-87:88) -71 u=102 imp:n=1

c

3227 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=102 imp:n=1

c

3228 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=102 imp:n=1

c

3229 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=102 imp:n=1

c

3230 0 89 -90 91 -92 (-85:86:-87:88) 74 u=102 imp:n=1

c

c

c ROW 4

c

c

c Left edge array of 5x5 core elements in row 4

c

3231 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=105 imp:n=1

c

3232 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=105 imp:n=1

c

3233 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=105 imp:n=1

c

3234 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=105 imp:n=1

c

3235 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=105 imp:n=1

c

c

3236 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=105 imp:n=1

c

3237 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=105 imp:n=1

c

3238 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=105 imp:n=1

c

3239 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=105 imp:n=1

c

3240 0 82 -86 83 -3 fill=5 (10.7442 -5.3721 0) u=105 imp:n=1

c

c

3241 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=105 imp:n=1

c

3242 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=105 imp:n=1

c

3243 0 1 -2 3 -4 fill=6 (0 0 0) u=105 imp:n=1

c

3244 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=105 imp:n=1

c

3245 0 82 -86 3 -4 fill=5 (10.7442 0 0) u=105 imp:n=1

c

c

3246 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=105 imp:n=1

c

3247 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=105 imp:n=1

c

3248 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=105 imp:n=1

c

3249 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=105 imp:n=1

c

3250 0 82 -86 4 -84 fill=5 (10.7442 5.3721 0) u=105 imp:n=1

c

c

3251 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=105 imp:n=1

c

3252 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=105 imp:n=1

c

3253 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=105 imp:n=1

c

3254 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=105 imp:n=1

c

3255 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=105 imp:n=1

c

c Surround material

c

3256 0 89 -90 91 -92 (-85:86:-87:88) -71 u=105 imp:n=1

c

3257 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=105 imp:n=1

c

3258 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=105 imp:n=1

c

3259 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=105 imp:n=1

c

3260 0 89 -90 91 -92 (-85:86:-87:88) 74 u=105 imp:n=1

c

c

c Right edge array of 5x5 core elements in row 4

c

3261 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=106 imp:n=1

c

3262 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=106 imp:n=1

c

3263 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=106 imp:n=1

c

3264 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=106 imp:n=1

c

3265 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=106 imp:n=1

c

c

3266 0 85 -81 83 -3 fill=5 (-10.7442 -5.3721 0) u=106 imp:n=1

c

3267 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=106 imp:n=1

c

3268 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=106 imp:n=1

c

3269 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=106 imp:n=1

c

3270 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=106 imp:n=1

c

c

3271 0 85 -81 3 -4 fill=5 (-10.7442 0 0) u=106 imp:n=1

c

3272 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=106 imp:n=1

c

3273 0 1 -2 3 -4 fill=6 (0 0 0) u=106 imp:n=1

c

3274 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=106 imp:n=1

c

3275 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=106 imp:n=1

c

c

3276 0 85 -81 4 -84 fill=5 (-10.7442 5.3721 0) u=106 imp:n=1

c

3277 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=106 imp:n=1

c

3278 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=106 imp:n=1

c

3279 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=106 imp:n=1

c

3280 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=106 imp:n=1

c

c

3281 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=106 imp:n=1

c

3282 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=106 imp:n=1

c

3283 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=106 imp:n=1

c

3284 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=106 imp:n=1

c

3285 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=106 imp:n=1

c

c Surround material

c

3286 0 89 -90 91 -92 (-85:86:-87:88) -71 u=106 imp:n=1

c

3287 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=106 imp:n=1

c

3288 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=106 imp:n=1

c

3289 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=106 imp:n=1

c

3290 0 89 -90 91 -92 (-85:86:-87:88) 74 u=106 imp:n=1

c

c

c ROW 5

c

c Top left array of 5x5 core elements in Row 5

c

3331 0 85 -81 87 -83 fill=5 (-10.7442 -10.7442 0) u=107 imp:n=1

c

3332 0 81 -1 87 -83 fill=5 (-5.3721 -10.7442 0) u=107 imp:n=1

c

3333 0 1 -2 87 -83 fill=5 (0 -10.7442 0) u=107 imp:n=1

c

3334 0 2 -82 87 -83 fill=5 (5.3721 -10.7442 0) u=107 imp:n=1

c

3335 0 82 -86 87 -83 fill=5 (10.7442 -10.7442 0) u=107 imp:n=1

c

c

3336 0 85 -81 83 -3 fill=5 (-10.7442 -5.3721 0) u=107 imp:n=1

c

3337 0 81 -1 83 -3 fill=5 (-5.3721 -5.3721 0) u=107 imp:n=1

c

3338 0 1 -2 83 -3 fill=5 (0 -5.3721 0) u=107 imp:n=1

c

3339 0 2 -82 83 -3 fill=5 (5.3721 -5.3721 0) u=107 imp:n=1

c

3340 0 82 -86 83 -3 fill=5 (10.7442 -5.3721 0) u=107 imp:n=1

c

c

3341 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=107 imp:n=1

c

3342 0 81 -1 3 -4 fill=5 (-5.3721 0 0) u=107 imp:n=1

c

3343 0 1 -2 3 -4 fill=5 (0 0 0) u=107 imp:n=1

c

3344 0 2 -82 3 -4 fill=5 (5.3721 0 0) u=107 imp:n=1

c

3345 0 82 -86 3 -4 fill=5 (10.7442 0 0) u=107 imp:n=1

c

c

3346 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=107 imp:n=1

c

3347 0 81 -1 4 -84 fill=5 (-5.3721 5.3721 0) u=107 imp:n=1

c

3348 0 1 -2 4 -84 fill=5 (0 5.3721 0) u=107 imp:n=1

c

3349 0 2 -82 4 -84 fill=5 (5.3721 5.3721 0) u=107 imp:n=1

c

3350 0 82 -86 4 -84 fill=5 (10.7442 5.3721 0) u=107 imp:n=1

c

c

3351 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=107 imp:n=1

c

3352 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=107 imp:n=1

c

3353 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=107 imp:n=1

c

3354 0 2 -82 84 -88 fill=5 (5.3721 10.7442 0) u=107 imp:n=1

c

3355 0 82 -86 84 -88 fill=5 (10.7442 10.7442 0) u=107 imp:n=1

c

c Surround material

c

3356 0 89 -90 91 -92 (-85:86:-87:88) -71 u=107 imp:n=1

c

3357 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=107 imp:n=1

c

3358 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=107 imp:n=1

c

3359 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=107 imp:n=1

c

3360 0 89 -90 91 -92 (-85:86:-87:88) 74 u=107 imp:n=1

c

c Top right array of 5x5 core elements in Row 5

c

3371 0 85 -81 87 -83 fill=5 (-10.7442 -10.7442 0) u=108 imp:n=1

c

3372 0 81 -1 87 -83 fill=5 (-5.3721 -10.7442 0) u=108 imp:n=1

c

3373 0 1 -2 87 -83 fill=5 (0 -10.7442 0) u=108 imp:n=1

c

3374 0 2 -82 87 -83 fill=5 (5.3721 -10.7442 0) u=108 imp:n=1

c

3375 0 82 -86 87 -83 fill=5 (10.7442 -10.7442 0) u=108 imp:n=1

c

c

3376 0 85 -81 83 -3 fill=5 (-10.7442 -5.3721 0) u=108 imp:n=1

c

3377 0 81 -1 83 -3 fill=5 (-5.3721 -5.3721 0) u=108 imp:n=1

c

3378 0 1 -2 83 -3 fill=5 (0 -5.3721 0) u=108 imp:n=1

c

3379 0 2 -82 83 -3 fill=5 (5.3721 -5.3721 0) u=108 imp:n=1

c

3380 0 82 -86 83 -3 fill=5 (10.7442 -5.3721 0) u=108 imp:n=1

c

c

3381 0 85 -81 3 -4 fill=5 (-10.7442 0 0) u=108 imp:n=1

c

3382 0 81 -1 3 -4 fill=5 (-5.3721 0 0) u=108 imp:n=1

c

3383 0 1 -2 3 -4 fill=5 (0 0 0) u=108 imp:n=1

c

3384 0 2 -82 3 -4 fill=5 (5.3721 0 0) u=108 imp:n=1

c

3385 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=108 imp:n=1

c

c

3386 0 85 -81 4 -84 fill=5 (-10.7442 5.3721 0) u=108 imp:n=1

c

3387 0 81 -1 4 -84 fill=5 (-5.3721 5.3721 0) u=108 imp:n=1

c

3388 0 1 -2 4 -84 fill=5 (0 5.3721 0) u=108 imp:n=1

c

3389 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=108 imp:n=1

c

3390 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=108 imp:n=1

c

c

3391 0 85 -81 84 -88 fill=5 (-10.7442 10.7442 0) u=108 imp:n=1

c

3392 0 81 -1 84 -88 fill=5 (-5.3721 10.7442 0) u=108 imp:n=1

c

3393 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=108 imp:n=1

c

3394 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=108 imp:n=1

c

3395 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=108 imp:n=1

c

c Surround material

c

3396 0 89 -90 91 -92 (-85:86:-87:88) -71 u=108 imp:n=1

c

3397 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=108 imp:n=1

c

3398 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=108 imp:n=1

c

3399 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=108 imp:n=1

c

3400 0 89 -90 91 -92 (-85:86:-87:88) 74 u=108 imp:n=1

c

c ROW 6

c

c Top central group

c

c

3401 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=109 imp:n=1

c

3402 0 81 -1 87 -83 fill=5 (-5.3721 -10.7442 0) u=109 imp:n=1

c

3403 0 1 -2 87 -83 fill=5 (0 -10.7442 0) u=109 imp:n=1

c

3404 0 2 -82 87 -83 fill=5 (5.3721 -10.7442 0) u=109 imp:n=1

c

3405 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=109 imp:n=1

c

c

3406 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=109 imp:n=1

c

3407 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=109 imp:n=1

c

3408 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=109 imp:n=1

c

3409 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=109 imp:n=1

c

3410 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=109 imp:n=1

c

c

3411 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=109 imp:n=1

c

3412 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=109 imp:n=1

c

3413 0 1 -2 3 -4 fill=6 (0 0 0) u=109 imp:n=1

c

3414 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=109 imp:n=1

c

3415 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=109 imp:n=1

c

c

3416 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=109 imp:n=1

c

3417 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=109 imp:n=1

c

3418 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=109 imp:n=1

c

3419 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=109 imp:n=1

c

3420 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=109 imp:n=1

c

c

3421 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=109 imp:n=1

c

3422 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=109 imp:n=1

c

3423 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=109 imp:n=1

c

3424 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=109 imp:n=1

c

3425 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=109 imp:n=1

c

c Surround material

c

3426 0 89 -90 91 -92 (-85:86:-87:88) -71 u=109 imp:n=1

c

3427 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=109 imp:n=1

c

3428 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=109 imp:n=1

c

3429 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=109 imp:n=1

c

3430 0 89 -90 91 -92 (-85:86:-87:88) 74 u=109 imp:n=1

c

c

c 5x5 array of blanket elements

c

c

3501 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=111 imp:n=1

c

3502 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=111 imp:n=1

c

3503 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=111 imp:n=1

c

3504 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=111 imp:n=1

c

3505 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=111 imp:n=1

c

c

3506 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=111 imp:n=1

c

3507 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=111 imp:n=1

c

3508 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=111 imp:n=1

c

3509 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=111 imp:n=1

c

3510 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=111 imp:n=1

c

c

3511 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=111 imp:n=1

c

3512 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=111 imp:n=1

c

3513 0 1 -2 3 -4 fill=6 (0 0 0) u=111 imp:n=1

c

3514 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=111 imp:n=1

c

3515 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=111 imp:n=1

c

c

3516 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=111 imp:n=1

c

3517 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=111 imp:n=1

c

3518 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=111 imp:n=1

c

3519 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=111 imp:n=1

c

3520 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=111 imp:n=1

c

c

3521 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=111 imp:n=1

c

3522 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=111 imp:n=1

c

3523 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=111 imp:n=1

c

3524 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=111 imp:n=1

c

3525 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=111 imp:n=1

c

c Surround material

c

3526 0 89 -90 91 -92 (-85:86:-87:88) -71 u=111 imp:n=1

c

3527 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=111 imp:n=1

c

3528 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=111 imp:n=1

c

3529 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=111 imp:n=1

c

3530 0 89 -90 91 -92 (-85:86:-87:88) 74 u=111 imp:n=1

c

c

c Blanket-Reflector Arrays

c

c ROW 2

c

c Bottom Left

c

3531 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=112 imp:n=1

c

3532 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=112 imp:n=1

c

3533 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=112 imp:n=1

c

3534 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=112 imp:n=1

c

3535 0 82 -86 87 -83 fill=7 (10.7442 -10.7442 0) u=112 imp:n=1

c

c

3536 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=112 imp:n=1

c

3537 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=112 imp:n=1

c

3538 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=112 imp:n=1

c

3539 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=112 imp:n=1

c

3540 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=112 imp:n=1

c

c

3541 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=112 imp:n=1

c

3542 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=112 imp:n=1

c

3543 0 1 -2 3 -4 fill=7 (0 0 0) u=112 imp:n=1

c

3544 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=112 imp:n=1

c

3545 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=112 imp:n=1

c

c

3546 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=112 imp:n=1

c

3547 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=112 imp:n=1

c

3548 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=112 imp:n=1

c

3549 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=112 imp:n=1

c

3550 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=112 imp:n=1

c

c

3551 0 85 -81 84 -88 fill=7 (-10.7442 10.7442 0) u=112 imp:n=1

c

3552 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=112 imp:n=1

c

3553 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=112 imp:n=1

c

3554 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=112 imp:n=1

c

3555 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=112 imp:n=1

c

c Surround material

c

3556 0 89 -90 91 -92 (-85:86:-87:88) -71 u=112 imp:n=1

c

3557 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=112 imp:n=1

c

3558 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=112 imp:n=1

c

3559 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=112 imp:n=1

c

3560 0 89 -90 91 -92 (-85:86:-87:88) 74 u=112 imp:n=1

c

c

c Row 2 Bottom Right Blanket Reflector Array

c

3561 0 85 -81 87 -83 fill=7 (-10.7442 -10.7442 0) u=113 imp:n=1

c

3562 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=113 imp:n=1

c

3563 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=113 imp:n=1

c

3564 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=113 imp:n=1

c

3565 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=113 imp:n=1

c

c

3566 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=113 imp:n=1

c

3567 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=113 imp:n=1

c

3568 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=113 imp:n=1

c

3569 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=113 imp:n=1

c

3570 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=113 imp:n=1

c

c

3571 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=113 imp:n=1

c

3572 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=113 imp:n=1

c

3573 0 1 -2 3 -4 fill=7 (0 0 0) u=113 imp:n=1

c

3574 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=113 imp:n=1

c

3575 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=113 imp:n=1

c

c

3576 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=113 imp:n=1

c

3577 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=113 imp:n=1

c

3578 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=113 imp:n=1

c

3579 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=113 imp:n=1

c

3580 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=113 imp:n=1

c

c

3581 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=113 imp:n=1

c

3582 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=113 imp:n=1

c

3583 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=113 imp:n=1

c

3584 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=113 imp:n=1

c

3585 0 82 -86 84 -88 fill=7 (10.7442 10.7442 0) u=113 imp:n=1

c

c Surround material

c

3586 0 89 -90 91 -92 (-85:86:-87:88) -71 u=113 imp:n=1

c

3587 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=113 imp:n=1

c

3588 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=113 imp:n=1

c

3589 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=113 imp:n=1

c

3590 0 89 -90 91 -92 (-85:86:-87:88) 74 u=113 imp:n=1

c

c ROW 6

c

c Top Left Blanket-Reflector Array

c

3631 0 85 -81 87 -83 fill=7 (-10.7442 -10.7442 0) u=114 imp:n=1

c

3632 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=114 imp:n=1

c

3633 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=114 imp:n=1

c

3634 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=114 imp:n=1

c

3635 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=114 imp:n=1

c

c

3636 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=114 imp:n=1

c

3637 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=114 imp:n=1

c

3638 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=114 imp:n=1

c

3639 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=114 imp:n=1

c

3640 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=114 imp:n=1

c

c

3641 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=114 imp:n=1

c

3642 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=114 imp:n=1

c

3643 0 1 -2 3 -4 fill=7 (0 0 0) u=114 imp:n=1

c

3644 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=114 imp:n=1

c

3645 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=114 imp:n=1

c

c

3646 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=114 imp:n=1

c

3647 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=114 imp:n=1

c

3648 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=114 imp:n=1

c

3649 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=114 imp:n=1

c

3650 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=114 imp:n=1

c

c

3651 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=114 imp:n=1

c

3652 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=114 imp:n=1

c

3653 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=114 imp:n=1

c

3654 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=114 imp:n=1

c

3655 0 82 -86 84 -88 fill=7 (10.7442 10.7442 0) u=114 imp:n=1

c

c Surround material

c

3656 0 89 -90 91 -92 (-85:86:-87:88) -71 u=114 imp:n=1

c

3657 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=114 imp:n=1

c

3658 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=114 imp:n=1

c

3659 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=114 imp:n=1

c

3660 0 89 -90 91 -92 (-85:86:-87:88) 74 u=114 imp:n=1

c

c

c Row 6 Top Right Blanket Reflector Array

c

3661 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=115 imp:n=1

c

3662 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=115 imp:n=1

c

3663 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=115 imp:n=1

c

3664 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=115 imp:n=1

c

3665 0 82 -86 87 -83 fill=7 (10.7442 -10.7442 0) u=115 imp:n=1

c

c

3666 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=115 imp:n=1

c

3667 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=115 imp:n=1

c

3668 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=115 imp:n=1

c

3669 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=115 imp:n=1

c

3670 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=115 imp:n=1

c

c

3671 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=115 imp:n=1

c

3672 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=115 imp:n=1

c

3673 0 1 -2 3 -4 fill=7 (0 0 0) u=115 imp:n=1

c

3674 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=115 imp:n=1

c

3675 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=115 imp:n=1

c

c

3676 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=115 imp:n=1

c

3677 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=115 imp:n=1

c

3678 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=115 imp:n=1

c

3679 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=115 imp:n=1

c

3680 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=115 imp:n=1

c

c

3681 0 85 -81 84 -88 fill=7 (-10.7442 10.7442 0) u=115 imp:n=1

c

3682 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=115 imp:n=1

c

3683 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=115 imp:n=1

c

3684 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=115 imp:n=1

c

3685 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=115 imp:n=1

c

c Surround material

c

3686 0 89 -90 91 -92 (-85:86:-87:88) -71 u=115 imp:n=1

c

3687 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=115 imp:n=1

c

3688 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=115 imp:n=1

c

3689 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=115 imp:n=1

c

3690 0 89 -90 91 -92 (-85:86:-87:88) 74 u=115 imp:n=1

c

c Row 1 Blanket - Reflector arrays

c

c Row 1 First Left array

c

3701 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=121 imp:n=1

c

3702 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=121 imp:n=1

c

3703 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=121 imp:n=1

c

3704 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=121 imp:n=1

c

3705 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=121 imp:n=1

c

c

3706 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=121 imp:n=1

c

3707 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=121 imp:n=1

c

3708 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=121 imp:n=1

c

3709 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=121 imp:n=1

c

3710 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=121 imp:n=1

c

c

3711 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=121 imp:n=1

c

3712 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=121 imp:n=1

c

3713 0 1 -2 3 -4 fill=9 (0 0 0) u=121 imp:n=1

c

3714 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=121 imp:n=1

c

3715 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=121 imp:n=1

c

c

3716 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=121 imp:n=1

c

3717 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=121 imp:n=1

c

3718 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=121 imp:n=1

c

3719 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=121 imp:n=1

c

3720 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=121 imp:n=1

c

c

3721 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=121 imp:n=1

c

3722 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=121 imp:n=1

c

3723 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=121 imp:n=1

c

3724 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=121 imp:n=1

c

3725 0 82 -86 84 -88 fill=7 (10.7442 10.7442 0) u=121 imp:n=1

c

c Surround material

c

3726 0 89 -90 91 -92 (-85:86:-87:88) -71 u=121 imp:n=1

c

3727 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=121 imp:n=1

c

3728 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=121 imp:n=1

c

3729 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=121 imp:n=1

c

3730 0 89 -90 91 -92 (-85:86:-87:88) 74 u=121 imp:n=1

c

c

c Row 1 Mid-Left

c

3731 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=122 imp:n=1

c

3732 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=122 imp:n=1

c

3733 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=122 imp:n=1

c

3734 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=122 imp:n=1

c

3735 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=122 imp:n=1

c

c

3736 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=122 imp:n=1

c

3737 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=122 imp:n=1

c

3738 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=122 imp:n=1

c

3739 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=122 imp:n=1

c

3740 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=122 imp:n=1

c

c

3741 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=122 imp:n=1

c

3742 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=122 imp:n=1

c

3743 0 1 -2 3 -4 fill=7 (0 0 0) u=122 imp:n=1

c

3744 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=122 imp:n=1

c

3745 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=122 imp:n=1

c

c

3746 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=122 imp:n=1

c

3747 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=122 imp:n=1

c

3748 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=122 imp:n=1

c

3749 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=122 imp:n=1

c

3750 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=122 imp:n=1

c

c

3751 0 85 -81 84 -88 fill=7 (-10.7442 10.7442 0) u=122 imp:n=1

c

3752 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=122 imp:n=1

c

3753 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=122 imp:n=1

c

3754 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=122 imp:n=1

c

3755 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=122 imp:n=1

c

c Surround material

c

3756 0 89 -90 91 -92 (-85:86:-87:88) -71 u=122 imp:n=1

c

3757 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=122 imp:n=1

c

3758 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=122 imp:n=1

c

3759 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=122 imp:n=1

c

3760 0 89 -90 91 -92 (-85:86:-87:88) 74 u=122 imp:n=1

c

c

c Row 1 Central Array

c

3761 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=123 imp:n=1

c

3762 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=123 imp:n=1

c

3763 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=123 imp:n=1

c

3764 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=123 imp:n=1

c

3765 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=123 imp:n=1

c

c

3766 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=123 imp:n=1

c

3767 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=123 imp:n=1

c

3768 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=123 imp:n=1

c

3769 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=123 imp:n=1

c

3770 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=123 imp:n=1

c

c

3771 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=123 imp:n=1

c

3772 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=123 imp:n=1

c

3773 0 1 -2 3 -4 fill=7 (0 0 0) u=123 imp:n=1

c

3774 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=123 imp:n=1

c

3775 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=123 imp:n=1

c

c

3776 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=123 imp:n=1

c

3777 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=123 imp:n=1

c

3778 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=123 imp:n=1

c

3779 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=123 imp:n=1

c

3780 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=123 imp:n=1

c

c

3781 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=123 imp:n=1

c

3782 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=123 imp:n=1

c

3783 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=123 imp:n=1

c

3784 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=123 imp:n=1

c

3785 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=123 imp:n=1

c

c Surround material

c

3786 0 89 -90 91 -92 (-85:86:-87:88) -71 u=123 imp:n=1

c

3787 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=123 imp:n=1

c

3788 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=123 imp:n=1

c

3789 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=123 imp:n=1

c

3790 0 89 -90 91 -92 (-85:86:-87:88) 74 u=123 imp:n=1

c

c

c Row 1 First Right array

c

3801 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=124 imp:n=1

c

3802 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=124 imp:n=1

c

3803 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=124 imp:n=1

c

3804 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=124 imp:n=1

c

3805 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=124 imp:n=1

c

c

3806 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=124 imp:n=1

c

3807 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=124 imp:n=1

c

3808 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=124 imp:n=1

c

3809 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=124 imp:n=1

c

3810 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=124 imp:n=1

c

c

3811 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=124 imp:n=1

c

3812 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=124 imp:n=1

c

3813 0 1 -2 3 -4 fill=7 (0 0 0) u=124 imp:n=1

c

3814 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=124 imp:n=1

c

3815 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=124 imp:n=1

c

c

3816 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=124 imp:n=1

c

3817 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=124 imp:n=1

c

3818 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=124 imp:n=1

c

3819 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=124 imp:n=1

c

3820 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=124 imp:n=1

c

c

3821 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=124 imp:n=1

c

3822 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=124 imp:n=1

c

3823 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=124 imp:n=1

c

3824 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=124 imp:n=1

c

3825 0 82 -86 84 -88 fill=7 (10.7442 10.7442 0) u=124 imp:n=1

c

c Surround material

c

3826 0 89 -90 91 -92 (-85:86:-87:88) -71 u=124 imp:n=1

c

3827 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=124 imp:n=1

c

3828 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=124 imp:n=1

c

3829 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=124 imp:n=1

c

3830 0 89 -90 91 -92 (-85:86:-87:88) 74 u=124 imp:n=1

c

c

c Row 1 Far Right

c

3831 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=125 imp:n=1

c

3832 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=125 imp:n=1

c

3833 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=125 imp:n=1

c

3834 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=125 imp:n=1

c

3835 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=125 imp:n=1

c

c

3836 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=125 imp:n=1

c

3837 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=125 imp:n=1

c

3838 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=125 imp:n=1

c

3839 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=125 imp:n=1

c

3840 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=125 imp:n=1

c

c

3841 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=125 imp:n=1

c

3842 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=125 imp:n=1

c

3843 0 1 -2 3 -4 fill=9 (0 0 0) u=125 imp:n=1

c

3844 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=125 imp:n=1

c

3845 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=125 imp:n=1

c

c

3846 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=125 imp:n=1

c

3847 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=125 imp:n=1

c

3848 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=125 imp:n=1

c

3849 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=125 imp:n=1

c

3850 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=125 imp:n=1

c

c

3851 0 85 -81 84 -88 fill=7 (-10.7442 10.7442 0) u=125 imp:n=1

c

3852 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=125 imp:n=1

c

3853 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=125 imp:n=1

c

3854 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=125 imp:n=1

c

3855 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=125 imp:n=1

c

c Surround material

c

3856 0 89 -90 91 -92 (-85:86:-87:88) -71 u=125 imp:n=1

c

3857 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=125 imp:n=1

c

3858 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=125 imp:n=1

c

3859 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=125 imp:n=1

c

3860 0 89 -90 91 -92 (-85:86:-87:88) 74 u=125 imp:n=1

c

c Row 2 Blanket reflector arrays

c

c Row 2 First Left array

c

3901 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=127 imp:n=1

c

3902 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=127 imp:n=1

c

3903 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=127 imp:n=1

c

3904 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=127 imp:n=1

c

3905 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=127 imp:n=1

c

c

3906 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=127 imp:n=1

c

3907 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=127 imp:n=1

c

3908 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=127 imp:n=1

c

3909 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=127 imp:n=1

c

3910 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=127 imp:n=1

c

c

3911 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=127 imp:n=1

c

3912 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=127 imp:n=1

c

3913 0 1 -2 3 -4 fill=9 (0 0 0) u=127 imp:n=1

c

3914 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=127 imp:n=1

c

3915 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=127 imp:n=1

c

c

3916 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=127 imp:n=1

c

3917 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=127 imp:n=1

c

3918 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=127 imp:n=1

c

3919 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=127 imp:n=1

c

3920 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=127 imp:n=1

c

c

3921 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=127 imp:n=1

c

3922 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=127 imp:n=1

c

3923 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=127 imp:n=1

c

3924 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=127 imp:n=1

c

3925 0 82 -86 84 -88 fill=7 (10.7442 10.7442 0) u=127 imp:n=1

c

c Surround material

c

3926 0 89 -90 91 -92 (-85:86:-87:88) -71 u=127 imp:n=1

c

3927 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=127 imp:n=1

c

3928 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=127 imp:n=1

c

3929 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=127 imp:n=1

c

3930 0 89 -90 91 -92 (-85:86:-87:88) 74 u=127 imp:n=1

c

c

c Row 2 Far Right

c

3931 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=128 imp:n=1

c

3932 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=128 imp:n=1

c

3933 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=128 imp:n=1

c

3934 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=128 imp:n=1

c

3935 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=128 imp:n=1

c

c

3936 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=128 imp:n=1

c

3937 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=128 imp:n=1

c

3938 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=128 imp:n=1

c

3939 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=128 imp:n=1

c

3940 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=128 imp:n=1

c

c

3941 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=128 imp:n=1

c

3942 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=128 imp:n=1

c

3943 0 1 -2 3 -4 fill=9 (0 0 0) u=128 imp:n=1

c

3944 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=128 imp:n=1

c

3945 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=128 imp:n=1

c

c

3946 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=128 imp:n=1

c

3947 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=128 imp:n=1

c

3948 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=128 imp:n=1

c

3949 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=128 imp:n=1

c

3950 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=128 imp:n=1

c

c

3951 0 85 -81 84 -88 fill=7 (-10.7442 10.7442 0) u=128 imp:n=1

c

3952 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=128 imp:n=1

c

3953 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=128 imp:n=1

c

3954 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=128 imp:n=1

c

3955 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=128 imp:n=1

c

c Surround material

c

3956 0 89 -90 91 -92 (-85:86:-87:88) -71 u=128 imp:n=1

c

3957 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=128 imp:n=1

c

3958 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=128 imp:n=1

c

3959 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=128 imp:n=1

c

3960 0 89 -90 91 -92 (-85:86:-87:88) 74 u=128 imp:n=1

c

c

c Row 4 Blanket- Reflector arrays

c

c

c Row 4 First Left array

c

4001 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=157 imp:n=1

c

4002 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=157 imp:n=1

c

4003 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=157 imp:n=1

c

4004 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=157 imp:n=1

c

4005 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=157 imp:n=1

c

c

4006 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=157 imp:n=1

c

4007 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=157 imp:n=1

c

4008 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=157 imp:n=1

c

4009 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=157 imp:n=1

c

4010 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=157 imp:n=1

c

c

4011 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=157 imp:n=1

c

4012 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=157 imp:n=1

c

4013 0 1 -2 3 -4 fill=7 (0 0 0) u=157 imp:n=1

c

4014 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=157 imp:n=1

c

4015 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=157 imp:n=1

c

c

4016 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=157 imp:n=1

c

4017 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=157 imp:n=1

c

4018 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=157 imp:n=1

c

4019 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=157 imp:n=1

c

4020 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=157 imp:n=1

c

c

4021 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=157 imp:n=1

c

4022 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=157 imp:n=1

c

4023 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=157 imp:n=1

c

4024 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=157 imp:n=1

c

4025 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=157 imp:n=1

c

c Surround material

c

4026 0 89 -90 91 -92 (-85:86:-87:88) -71 u=157 imp:n=1

c

4027 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=157 imp:n=1

c

4028 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=157 imp:n=1

c

4029 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=157 imp:n=1

c

4030 0 89 -90 91 -92 (-85:86:-87:88) 74 u=157 imp:n=1

c

c

c Row 4 Far Right

c

4031 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=158 imp:n=1

c

4032 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=158 imp:n=1

c

4033 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=158 imp:n=1

c

4034 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=158 imp:n=1

c

4035 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=158 imp:n=1

c

c

4036 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=158 imp:n=1

c

4037 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=158 imp:n=1

c

4038 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=158 imp:n=1

c

4039 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=158 imp:n=1

c

4040 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=158 imp:n=1

c

c

4041 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=158 imp:n=1

c

4042 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=158 imp:n=1

c

4043 0 1 -2 3 -4 fill=7 (0 0 0) u=158 imp:n=1

c

4044 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=158 imp:n=1

c

4045 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=158 imp:n=1

c

c

4046 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=158 imp:n=1

c

4047 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=158 imp:n=1

c

4048 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=158 imp:n=1

c

4049 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=158 imp:n=1

c

4050 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=158 imp:n=1

c

c

4051 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=158 imp:n=1

c

4052 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=158 imp:n=1

c

4053 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=158 imp:n=1

c

4054 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=158 imp:n=1

c

4055 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=158 imp:n=1

c

c Surround material

c

4056 0 89 -90 91 -92 (-85:86:-87:88) -71 u=158 imp:n=1

c

4057 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=158 imp:n=1

c

4058 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=158 imp:n=1

c

4059 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=158 imp:n=1

c

4060 0 89 -90 91 -92 (-85:86:-87:88) 74 u=158 imp:n=1

c

c

c Row 6 Blanket- Reflector arrays

c

c

c Row 6 First Left array

c

4101 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=137 imp:n=1

c

4102 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=137 imp:n=1

c

4103 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=137 imp:n=1

c

4104 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=137 imp:n=1

c

4105 0 82 -86 87 -83 fill=7 (10.7442 -10.7442 0) u=137 imp:n=1

c

c

4106 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=137 imp:n=1

c

4107 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=137 imp:n=1

c

4108 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=137 imp:n=1

c

4109 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=137 imp:n=1

c

4110 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=137 imp:n=1

c

c

4111 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=137 imp:n=1

c

4112 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=137 imp:n=1

c

4113 0 1 -2 3 -4 fill=9 (0 0 0) u=137 imp:n=1

c

4114 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=137 imp:n=1

c

4115 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=137 imp:n=1

c

c

4116 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=137 imp:n=1

c

4117 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=137 imp:n=1

c

4118 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=137 imp:n=1

c

4119 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=137 imp:n=1

c

4120 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=137 imp:n=1

c

c

4121 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=137 imp:n=1

c

4122 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=137 imp:n=1

c

4123 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=137 imp:n=1

c

4124 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=137 imp:n=1

c

4125 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=137 imp:n=1

c

c Surround material

c

4126 0 89 -90 91 -92 (-85:86:-87:88) -71 u=137 imp:n=1

c

4127 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=137 imp:n=1

c

4128 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=137 imp:n=1

c

4129 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=137 imp:n=1

c

4130 0 89 -90 91 -92 (-85:86:-87:88) 74 u=137 imp:n=1

c

c

c Row 6 Far Right

c

4131 0 85 -81 87 -83 fill=7 (-10.7442 -10.7442 0) u=138 imp:n=1

c

4132 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=138 imp:n=1

c

4133 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=138 imp:n=1

c

4134 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=138 imp:n=1

c

4135 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=138 imp:n=1

c

c

4136 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=138 imp:n=1

c

4137 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=138 imp:n=1

c

4138 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=138 imp:n=1

c

4139 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=138 imp:n=1

c

4140 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=138 imp:n=1

c

c

4141 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=138 imp:n=1

c

4142 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=138 imp:n=1

c

4143 0 1 -2 3 -4 fill=9 (0 0 0) u=138 imp:n=1

c

4144 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=138 imp:n=1

c

4145 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=138 imp:n=1

c

c

4146 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=138 imp:n=1

c

4147 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=138 imp:n=1

c

4148 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=138 imp:n=1

c

4149 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=138 imp:n=1

c

4150 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=138 imp:n=1

c

c

4151 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=138 imp:n=1

c

4152 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=138 imp:n=1

c

4153 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=138 imp:n=1

c

4154 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=138 imp:n=1

c

4155 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=138 imp:n=1

c

c Surround material

c

4156 0 89 -90 91 -92 (-85:86:-87:88) -71 u=138 imp:n=1

c

4157 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=138 imp:n=1

c

4158 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=138 imp:n=1

c

4159 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=138 imp:n=1

c

4160 0 89 -90 91 -92 (-85:86:-87:88) 74 u=138 imp:n=1

c

c

c

c Row 5 Blanket- Reflector arrays

c

c

c Row 5 First Left array

c

4201 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=167 imp:n=1

c

4202 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=167 imp:n=1

c

4203 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=167 imp:n=1

c

4204 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=167 imp:n=1

c

4205 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=167 imp:n=1

c

c

4206 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=167 imp:n=1

c

4207 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=167 imp:n=1

c

4208 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=167 imp:n=1

c

4209 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=167 imp:n=1

c

4210 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=167 imp:n=1

c

c

4211 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=167 imp:n=1

c

4212 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=167 imp:n=1

c

4213 0 1 -2 3 -4 fill=7 (0 0 0) u=167 imp:n=1

c

4214 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=167 imp:n=1

c

4215 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=167 imp:n=1

c

c

4216 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=167 imp:n=1

c

4217 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=167 imp:n=1

c

4218 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=167 imp:n=1

c

4219 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=167 imp:n=1

c

4220 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=167 imp:n=1

c

c

4221 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=167 imp:n=1

c

4222 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=167 imp:n=1

c

4223 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=167 imp:n=1

c

4224 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=167 imp:n=1

c

4225 0 82 -86 84 -88 fill=7 (10.7442 10.7442 0) u=167 imp:n=1

c

c Surround material

c

4226 0 89 -90 91 -92 (-85:86:-87:88) -71 u=167 imp:n=1

c

4227 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=167 imp:n=1

c

4228 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=167 imp:n=1

c

4229 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=167 imp:n=1

c

4230 0 89 -90 91 -92 (-85:86:-87:88) 74 u=167 imp:n=1

c

c

c Row 4 Far Right

c

4231 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=168 imp:n=1

c

4232 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=168 imp:n=1

c

4233 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=168 imp:n=1

c

4234 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=168 imp:n=1

c

4235 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=168 imp:n=1

c

c

4236 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=168 imp:n=1

c

4237 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=168 imp:n=1

c

4238 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=168 imp:n=1

c

4239 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=168 imp:n=1

c

4240 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=168 imp:n=1

c

c

4241 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=168 imp:n=1

c

4242 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=168 imp:n=1

c

4243 0 1 -2 3 -4 fill=7 (0 0 0) u=168 imp:n=1

c

4244 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=168 imp:n=1

c

4245 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=168 imp:n=1

c

c

4246 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=168 imp:n=1

c

4247 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=168 imp:n=1

c

4248 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=168 imp:n=1

c

4249 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=168 imp:n=1

c

4250 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=168 imp:n=1

c

c

4251 0 85 -81 84 -88 fill=7 (-10.7442 10.7442 0) u=168 imp:n=1

c

4252 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=168 imp:n=1

c

4253 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=168 imp:n=1

c

4254 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=168 imp:n=1

c

4255 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=168 imp:n=1

c

c Surround material

c

4256 0 89 -90 91 -92 (-85:86:-87:88) -71 u=168 imp:n=1

c

4257 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=168 imp:n=1

c

4258 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=168 imp:n=1

c

4259 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=168 imp:n=1

c

4260 0 89 -90 91 -92 (-85:86:-87:88) 74 u=168 imp:n=1

c

c

c Row 3 Blanket- Reflector arrays

c

c

c Row 3 First Left array

c

4301 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=147 imp:n=1

c

4302 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=147 imp:n=1

c

4303 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=147 imp:n=1

c

4304 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=147 imp:n=1

c

4305 0 82 -86 87 -83 fill=7 (10.7442 -10.7442 0) u=147 imp:n=1

c

c

4306 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=147 imp:n=1

c

4307 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=147 imp:n=1

c

4308 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=147 imp:n=1

c

4309 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=147 imp:n=1

c

4310 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=147 imp:n=1

c

c

4311 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=147 imp:n=1

c

4312 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=147 imp:n=1

c

4313 0 1 -2 3 -4 fill=7 (0 0 0) u=147 imp:n=1

c

4314 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=147 imp:n=1

c

4315 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=147 imp:n=1

c

c

4316 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=147 imp:n=1

c

4317 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=147 imp:n=1

c

4318 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=147 imp:n=1

c

4319 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=147 imp:n=1

c

4320 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=147 imp:n=1

c

c

4321 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=147 imp:n=1

c

4322 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=147 imp:n=1

c

4323 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=147 imp:n=1

c

4324 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=147 imp:n=1

c

4325 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=147 imp:n=1

c

c Surround material

c

4326 0 89 -90 91 -92 (-85:86:-87:88) -71 u=147 imp:n=1

c

4327 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=147 imp:n=1

c

4328 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=147 imp:n=1

c

4329 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=147 imp:n=1

c

4330 0 89 -90 91 -92 (-85:86:-87:88) 74 u=147 imp:n=1

c

c

c Row 3 Far Right

c

4331 0 85 -81 87 -83 fill=7 (-10.7442 -10.7442 0) u=148 imp:n=1

c

4332 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=148 imp:n=1

c

4333 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=148 imp:n=1

c

4334 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=148 imp:n=1

c

4335 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=148 imp:n=1

c

c

4336 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=148 imp:n=1

c

4337 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=148 imp:n=1

c

4338 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=148 imp:n=1

c

4339 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=148 imp:n=1

c

4340 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=148 imp:n=1

c

c

4341 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=148 imp:n=1

c

4342 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=148 imp:n=1

c

4343 0 1 -2 3 -4 fill=7 (0 0 0) u=148 imp:n=1

c

4344 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=148 imp:n=1

c

4345 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=148 imp:n=1

c

c

4346 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=148 imp:n=1

c

4347 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=148 imp:n=1

c

4348 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=148 imp:n=1

c

4349 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=148 imp:n=1

c

4350 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=148 imp:n=1

c

c

4351 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=148 imp:n=1

c

4352 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=148 imp:n=1

c

4353 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=148 imp:n=1

c

4354 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=148 imp:n=1

c

4355 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=148 imp:n=1

c

c Surround material

c

4356 0 89 -90 91 -92 (-85:86:-87:88) -71 u=148 imp:n=1

c

4357 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=148 imp:n=1

c

4358 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=148 imp:n=1

c

4359 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=148 imp:n=1

c

4360 0 89 -90 91 -92 (-85:86:-87:88) 74 u=148 imp:n=1

c

c

c Row 7 Blanket - Reflector arrays

c

c Row 7 First Left array

c

4701 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=131 imp:n=1

c

4702 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=131 imp:n=1

c

4703 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=131 imp:n=1

c

4704 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=131 imp:n=1

c

4705 0 82 -86 87 -83 fill=7 (10.7442 -10.7442 0) u=131 imp:n=1

c

c

4706 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=131 imp:n=1

c

4707 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=131 imp:n=1

c

4708 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=131 imp:n=1

c

4709 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=131 imp:n=1

c

4710 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=131 imp:n=1

c

c

4711 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=131 imp:n=1

c

4712 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=131 imp:n=1

c

4713 0 1 -2 3 -4 fill=9 (0 0 0) u=131 imp:n=1

c

4714 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=131 imp:n=1

c

4715 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=131 imp:n=1

c

c

4716 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=131 imp:n=1

c

4717 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=131 imp:n=1

c

4718 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=131 imp:n=1

c

4719 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=131 imp:n=1

c

4720 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=131 imp:n=1

c

c

4721 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=131 imp:n=1

c

4722 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=131 imp:n=1

c

4723 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=131 imp:n=1

c

4724 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=131 imp:n=1

c

4725 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=131 imp:n=1

c

c Surround material

c

4726 0 89 -90 91 -92 (-85:86:-87:88) -71 u=131 imp:n=1

c

4727 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=131 imp:n=1

c

4728 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=131 imp:n=1

c

4729 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=131 imp:n=1

c

4730 0 89 -90 91 -92 (-85:86:-87:88) 74 u=131 imp:n=1

c

c

c Row 7 Mid-Left

c

4731 0 85 -81 87 -83 fill=7 (-10.7442 -10.7442 0) u=132 imp:n=1

c

4732 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=132 imp:n=1

c

4733 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=132 imp:n=1

c

4734 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=132 imp:n=1

c

4735 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=132 imp:n=1

c

c

4736 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=132 imp:n=1

c

4737 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=132 imp:n=1

c

4738 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=132 imp:n=1

c

4739 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=132 imp:n=1

c

4740 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=132 imp:n=1

c

c

4741 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=132 imp:n=1

c

4742 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=132 imp:n=1

c

4743 0 1 -2 3 -4 fill=7 (0 0 0) u=132 imp:n=1

c

4744 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=132 imp:n=1

c

4745 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=132 imp:n=1

c

c

4746 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=132 imp:n=1

c

4747 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=132 imp:n=1

c

4748 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=132 imp:n=1

c

4749 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=132 imp:n=1

c

4750 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=132 imp:n=1

c

c

4751 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=132 imp:n=1

c

4752 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=132 imp:n=1

c

4753 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=132 imp:n=1

c

4754 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=132 imp:n=1

c

4755 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=132 imp:n=1

c

c Surround material

c

4756 0 89 -90 91 -92 (-85:86:-87:88) -71 u=132 imp:n=1

c

4757 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=132 imp:n=1

c

4758 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=132 imp:n=1

c

4759 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=132 imp:n=1

c

4760 0 89 -90 91 -92 (-85:86:-87:88) 74 u=132 imp:n=1

c

c

c Row 7 Central Array

c

4761 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=133 imp:n=1

c

4762 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=133 imp:n=1

c

4763 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=133 imp:n=1

c

4764 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=133 imp:n=1

c

4765 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=133 imp:n=1

c

c

4766 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=133 imp:n=1

c

4767 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=133 imp:n=1

c

4768 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=133 imp:n=1

c

4769 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=133 imp:n=1

c

4770 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=133 imp:n=1

c

c

4771 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=133 imp:n=1

c

4772 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=133 imp:n=1

c

4773 0 1 -2 3 -4 fill=7 (0 0 0) u=133 imp:n=1

c

4774 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=133 imp:n=1

c

4775 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=133 imp:n=1

c

c

4776 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=133 imp:n=1

c

4777 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=133 imp:n=1

c

4778 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=133 imp:n=1

c

4779 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=133 imp:n=1

c

4780 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=133 imp:n=1

c

c

4781 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=133 imp:n=1

c

4782 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=133 imp:n=1

c

4783 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=133 imp:n=1

c

4784 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=133 imp:n=1

c

4785 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=133 imp:n=1

c

c Surround material

c

4786 0 89 -90 91 -92 (-85:86:-87:88) -71 u=133 imp:n=1

c

4787 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=133 imp:n=1

c

4788 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=133 imp:n=1

c

4789 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=133 imp:n=1

c

4790 0 89 -90 91 -92 (-85:86:-87:88) 74 u=133 imp:n=1

c

c

c Row 7 First Right array

c

4801 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=134 imp:n=1

c

4802 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=134 imp:n=1

c

4803 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=134 imp:n=1

c

4804 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=134 imp:n=1

c

4805 0 82 -86 87 -83 fill=7 (10.7442 -10.7442 0) u=134 imp:n=1

c

c

4806 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=134 imp:n=1

c

4807 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=134 imp:n=1

c

4808 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=134 imp:n=1

c

4809 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=134 imp:n=1

c

4810 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=134 imp:n=1

c

c

4811 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=134 imp:n=1

c

4812 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=134 imp:n=1

c

4813 0 1 -2 3 -4 fill=7 (0 0 0) u=134 imp:n=1

c

4814 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=134 imp:n=1

c

4815 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=134 imp:n=1

c

c

4816 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=134 imp:n=1

c

4817 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=134 imp:n=1

c

4818 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=134 imp:n=1

c

4819 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=134 imp:n=1

c

4820 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=134 imp:n=1

c

c

4821 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=134 imp:n=1

c

4822 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=134 imp:n=1

c

4823 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=134 imp:n=1

c

4824 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=134 imp:n=1

c

4825 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=134 imp:n=1

c

c Surround material

c

4826 0 89 -90 91 -92 (-85:86:-87:88) -71 u=134 imp:n=1

c

4827 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=134 imp:n=1

c

4828 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=134 imp:n=1

c

4829 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=134 imp:n=1

c

4830 0 89 -90 91 -92 (-85:86:-87:88) 74 u=134 imp:n=1

c

c

c Row 7 Far Right

c

4831 0 85 -81 87 -83 fill=7 (-10.7442 -10.7442 0) u=135 imp:n=1

c

4832 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=135 imp:n=1

c

4833 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=135 imp:n=1

c

4834 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=135 imp:n=1

c

4835 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=135 imp:n=1

c

c

4836 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=135 imp:n=1

c

4837 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=135 imp:n=1

c

4838 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=135 imp:n=1

c

4839 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=135 imp:n=1

c

4840 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=135 imp:n=1

c

c

4841 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=135 imp:n=1

c

4842 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=135 imp:n=1

c

4843 0 1 -2 3 -4 fill=9 (0 0 0) u=135 imp:n=1

c

4844 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=135 imp:n=1

c

4845 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=135 imp:n=1

c

c

4846 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=135 imp:n=1

c

4847 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=135 imp:n=1

c

4848 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=135 imp:n=1

c

4849 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=135 imp:n=1

c

4850 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=135 imp:n=1

c

c

4851 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=135 imp:n=1

c

4852 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=135 imp:n=1

c

4853 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=135 imp:n=1

c

4854 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=135 imp:n=1

c

4855 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=135 imp:n=1

c

c Surround material

c

4856 0 89 -90 91 -92 (-85:86:-87:88) -71 u=135 imp:n=1

c

4857 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=135 imp:n=1

c

4858 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=135 imp:n=1

c

4859 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=135 imp:n=1

c

4860 0 89 -90 91 -92 (-85:86:-87:88) 74 u=135 imp:n=1

c

c

c Beyond the reflector 5x5 Region 9

c

c

5001 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=201 imp:n=1

c

5002 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=201 imp:n=1

c

5003 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=201 imp:n=1

c

5004 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=201 imp:n=1

c

5005 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=201 imp:n=1

c

c

5006 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=201 imp:n=1

c

5007 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=201 imp:n=1

c

5008 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=201 imp:n=1

c

5009 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=201 imp:n=1

c

5010 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=201 imp:n=1

c

c

5011 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=201 imp:n=1

c

5012 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=201 imp:n=1

c

5013 0 1 -2 3 -4 fill=9 (0 0 0) u=201 imp:n=1

c

5014 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=201 imp:n=1

c

5015 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=201 imp:n=1

c

c

5016 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=201 imp:n=1

c

5017 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=201 imp:n=1

c

5018 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=201 imp:n=1

c

5019 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=201 imp:n=1

c

5020 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=201 imp:n=1

c

c

5021 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=201 imp:n=1

c

5022 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=201 imp:n=1

c

5023 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=201 imp:n=1

c

5024 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=201 imp:n=1

c

5025 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=201 imp:n=1

c

c Surround material

c

5026 0 89 -90 91 -92 (-85:86:-87:88) -71 u=201 imp:n=1

c

5027 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=201 imp:n=1

c

5028 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=201 imp:n=1

c

5029 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=201 imp:n=1

c

5030 0 89 -90 91 -92 (-85:86:-87:88) 74 u=201 imp:n=1

c

c -----------------------------------------------------------------------

c

c

c ------------- SURFACE CARDS -------------------------------------------

c

c Lattice 2 (Assembly) Elementary cell surfaces

1 px -2.68605

2 px 2.68605

3 py -2.68605

4 py 2.68605

7 pz 0.0 $ Assembly lower limit

8 pz 30.0 $ End Packing, Start Reflector

9 pz 37.60628 $ End Plenum, Start Lower NU

10 pz 67.77878 $ End Lower NU, Start Fuel

11 pz 157.098748 $ End Fuel, Start Upper NU

12 pz 187.271248 $ End Upper NU, Start Top Reflector

13 pz 194.877528 $ End Reflector, Start Packing

16 pz 224.877528 $ Assembly upper limit

17 cz 94.9

21 px -2.5335 $ Nominal half-width of plates

22 px 2.5335

23 py -2.5335

24 py 2.5335

28 px -2.54 $ Radial shield half-width

29 px 2.54

30 py -2.54

31 py 2.54

c

32 px -2.551 $ sheath inner half-width

33 px 2.551

34 py -2.551

35 py 2.551

36 px -2.6272 $ sheath outer half-width

37 px 2.6272

38 py -2.6272

39 py 2.6272

c

c

c subdivisions in the plate element axial blanket and core cells

c

c 9 pz 37.60628 $ axial reflector / axial blanket

41 pz 45.228780

42 pz 57.951780

c 10 pz 67.77878 $ axial blanket / core

43 pz 71.209862

44 pz 74.957944

45 pz 78.706026

46 pz 82.454108

47 pz 86.202190

48 pz 89.950272

49 pz 93.698354

50 pz 97.446436

51 pz 101.194518

52 pz 104.942600

53 pz 108.690682

54 pz 112.438764

55 pz 116.186846

56 pz 119.934928

57 pz 123.683010

58 pz 127.431092

59 pz 131.179174

60 pz 134.927256

61 pz 138.675338

62 pz 142.423420

63 pz 146.171502

64 pz 149.919584

65 pz 153.667666

c 11 pz 157.098748 $ core / axial blanket

67 pz 166.925748

68 pz 179.648748

c 12 pz 187.271248 $ axial blanket / reflector

c

c Grid plate heights

c

71 pz 31.8

72 pz 62.2

73 pz 162.6

74 pz 193.0

c

c coordinates of the elements in 5x5 arrays

81 px -8.05815

82 px 8.05815

83 py -8.05815

84 py 8.05815

85 px -13.43025

86 px 13.43025

87 py -13.43025

88 py 13.43025

89 px -13.5635

90 px 13.5635

91 py -13.5635

92 py 13.5635

c

101 px -2.3355 $ Pu plate core width

102 px 2.3355

103 py -2.3355

104 py 2.3355

105 px -2.4255 $ UO2 plate core width

106 px 2.4255

107 py -2.4255

108 py 2.4255

109 px -2.4815 $ Na plate core width

110 px 2.4815

111 py -2.4815

112 py 2.4815

c

c

c Cell 2 Axial heights

c

401 pz 153.667666

402 pz 153.704013

403 pz 154.245013

404 pz 154.281360

405 pz 154.318010

406 pz 154.876010

407 pz 154.912660

408 pz 154.958360

409 pz 155.194360

410 pz 155.240060

411 pz 155.276407

412 pz 155.817407

413 pz 155.853754

414 pz 155.890404

415 pz 156.448404

416 pz 156.485054

417 pz 156.521401

418 pz 157.062401

419 pz 157.098748

c

c Cell 12 Axial heights

c

501 pz 67.778780

502 pz 67.815127

503 pz 68.356127

504 pz 68.392474

505 pz 68.429124

506 pz 68.987124

507 pz 69.023774

508 pz 69.060121

509 pz 69.601121

510 pz 69.637468

511 pz 69.683168

512 pz 69.919168

513 pz 69.964868

514 pz 70.001518

515 pz 70.559518

516 pz 70.596168

517 pz 70.632515

518 pz 71.173515

519 pz 71.209862

c

c Basic Cell 1 data

c 701 pz 0.000000

c 702 pz 0.036347 $ Na can

c 703 pz 0.577347 $ Na core

c 704 pz 0.613694

c 705 pz 0.650344 $ UO2 can

c 706 pz 1.208344 $ UO2 core

c 707 pz 1.244994

708 pz 1.561994 $ SS

709 pz 1.607694 $ Pu can

710 pz 1.843694 $ Pu core

711 pz 1.889394

712 pz 1.925741 $ Na can

713 pz 2.466741 $ Na core

c 714 pz 2.503088

c 715 pz 2.539738 $ UO2 can

c 716 pz 3.097738 $ UO2 core

c 717 pz 3.134388

c 718 pz 3.170735 $ Na can

c 719 pz 3.711735 $ Na core

c 720 pz 3.748082 $ Cell 1

c

801 pz 0.000000

802 pz 0.036347

803 pz 0.577347 $ Na

804 pz 0.613694

805 pz 0.650344

806 pz 1.208344 $ UO2

807 pz 1.244994

808 pz 1.281341

809 pz 1.822341 $ Na

810 pz 1.858688

811 pz 1.904388

812 pz 2.140388 $ Pu

813 pz 2.186088

814 pz 2.503088 $ SS

815 pz 2.539738

816 pz 3.097738 $ UO2

817 pz 3.134388

818 pz 3.170735

819 pz 3.711735 $ Na

820 pz 3.748082 $ Cell 11

c

c ----------------------------------------------------------------------

c

c

c

c ------------- TALLY CARDS ---------------------------------------------

c

c --- MATERIALS CARDS ---

c

c

C MATERIAL 1 Pu metal plate core

m1 92238.31c 6.8782E-07

94238.31c 3.0461E-05

94239.31c 2.8920E-02

94240.31c 6.9095E-03

94241.31c 7.3960E-04

94242.31c 1.8699E-04

95241.31c 4.5718E-04

1001.31c 1.2764E-04

6000.31c 4.2260E-04

7014.31c 2.4215E-05

8016.31c 8.8450E-05

13027.31c 2.2973E-05

14028.31c 1.4158E-05

25055.31c 1.4902E-06

24050.31c 1.5637E-07

24052.31c 3.0155E-06

24053.31c 3.4193E-07

24054.31c 8.5114E-08

26054.31c 9.5478E-07

26056.31c 1.4988E-05

26057.31c 3.4614E-07

26058.31c 4.6065E-09

28058.31c 5.8334E-06

28060.31c 2.2470E-06

28061.31c 9.7676E-08

28062.31c 3.1143E-07

28064.31c 7.9313E-08

31000.31c 2.0166E-03

c total 3.9991E-02

c MATERIAL 2 Pu plate canning

m2 1001.31c 1.3760E-05

6000.31c 1.1393E-04

14028.31c 3.6607E-04

15031.31c 1.3731E-05

24050.31c 4.0848E-04

24052.31c 7.8771E-03

24053.31c 8.9320E-04

24054.31c 2.2234E-04

25055.31c 8.5931E-04

26054.31c 2.0774E-03

26056.31c 3.2611E-02

26057.31c 7.5313E-04

26058.31c 1.0023E-05

28058.31c 2.8351E-03

28060.31c 1.0921E-03

28061.31c 4.7472E-05

28062.31c 1.5136E-04

28064.31c 3.8548E-05

29063.31c 1.1629E-02

29065.31c 4.9839E-03

c total 6.6997E-02

C MATERIAL 3 UO2 plate core

m3 1001.31c 3.1773E-05

6000.31c 1.1808E-05

8016.31c 4.6008E-02

13027.31c 3.3911E-06

14028.31c 2.2967E-05

25055.31c 8.3273E-08

26054.31c 7.6610E-08

26056.31c 1.2026E-06

26057.31c 2.7774E-08

26058.31c 3.6962E-10

28058.31c 8.4906E-07

28060.31c 3.2705E-07

28061.31c 1.4217E-08

28062.31c 4.5329E-08

28064.31c 1.1544E-08

c 42000.66c 3.3379E-07

42092.31c 5.0069E-08

42094.31c 3.3379E-08

42095.31c 5.0069E-08

42096.31c 5.0069E-08

42097.31c 3.3379E-08

42098.31c 8.3448E-08

42100.31c 3.3379E-08

92235.31c 1.6544E-04

92238.31c 2.2837E-02

c total 6.9083E-02

c MATERIAL 4 UO2 plate canning

m4 1001.31c 1.9035E-05

6000.31c 1.2831E-04

14028.31c 6.4475E-04

15031.31c 3.5078E-04

16032.31c 3.6041E-05

24050.31c 6.0044E-04

24052.31c 1.1579E-02

24053.31c 1.3129E-03

24054.31c 3.2682E-04

25055.31c 8.5559E-04

26054.31c 2.8235E-03

26056.31c 4.4323E-02

26057.31c 1.0236E-03

26058.31c 1.3622E-05

28058.31c 5.7360E-03

28060.31c 2.2095E-03

28061.31c 9.6046E-05

28062.31c 3.0624E-04

28064.31c 7.7989E-05

c total 7.2463E-02

C MATERIAL 5 sodium plate core

m5 1001.31c 1.3900E-05

8016.31c 5.6492E-06

11023.31c 2.3225E-02

20040.31c 3.6083E-06

26054.31c 9.4595E-09

26056.31c 1.4849E-07

26057.31c 3.4294E-09

26058.31c 4.5639E-11

c total 2.324832E-02

c MATERIAL 6 Sodium plate canning

m6 1001.31c 2.1631E-05

6000.31c 2.9290E-04

14028.31c 6.0867E-04

15031.31c 3.2795E-05

16032.31c 3.3219E-05

24050.31c 6.4128E-04

24052.31c 1.2366E-02

24053.31c 1.4023E-03

24054.31c 3.4905E-04

25055.31c 1.3570E-03

26054.31c 3.2179E-03

26056.31c 5.0514E-02

26057.31c 1.1666E-03

26058.31c 1.5525E-05

28058.31c 4.8322E-03

28060.31c 1.8614E-03

28061.31c 8.0912E-05

28062.31c 2.5798E-04

28064.31c 6.5701E-05

41093.31c 3.1147E-04

c total 7.9429E-02

C MATERIAL 7 40% steel plate

c m7 1001.31c 1.8355E-05

c 6000.31c 8.7794E-05

c 13027.31c 1.1862E-04

c 14028.31c 7.9703E-04

c 15031.31c 4.0018E-05

c 16032.31c 1.4422E-05

c 22048.31c 2.4806E-04

c 24050.31c 6.9120E-04

c 24052.31c 1.3329E-02

c 24053.31c 1.5114E-03

c 24054.31c 3.7622E-04

c 25055.31c 1.4972E-03

c 26054.31c 3.2362E-03

c 26056.31c 5.0801E-02

c 26057.31c 1.1732E-03

c 26058.31c 1.5613E-05

c 28058.31c 5.9891E-03

c 28060.31c 2.3070E-03

c 28061.31c 1.0028E-04

c 28062.31c 3.1975E-04

c 28064.31c 8.1431E-05

c 29063.31c 5.0365E-05

c 41093.31c 4.9781E-06

c 42000.66c 8.0988E-05

c

c 40% ss plate smeared over plate region

c

m7 1001.31c 7.3413E-06

6000.31c 3.5114E-05

13027.31c 4.7443E-05

14028.31c 3.1878E-04

15031.31c 1.6006E-05

16032.31c 5.7682E-06

22048.31c 9.9214E-05

24050.31c 2.7645E-04

24052.31c 5.3311E-03

24053.31c 6.0450E-04

24054.31c 1.5047E-04

25055.31c 5.9882E-04

26054.31c 1.2944E-03

26056.31c 2.0318E-02

26057.31c 4.6923E-04

26058.31c 6.2446E-06

28058.31c 2.3954E-03

28060.31c 9.2271E-04

28061.31c 4.0108E-05

28062.31c 1.2789E-04

28064.31c 3.2569E-05

29063.31c 1.4101E-05

29065.31c 6.0432E-06

41093.31c 1.9910E-06

c 42000.66c 3.2392E-05

42092.31c 4.8588E-06

42094.31c 3.2392E-06

42095.31c 4.8588E-06

42096.31c 4.8588E-06

42097.31c 3.2392E-06

42098.31c 8.0980E-06

42100.31c 3.2392E-06

c total 3.3152E-02

c

C MATERIAL 8 U8 metal plate

m8 1001.31c 4.4048E-05

6000.31c 4.9283E-04

14028.31c 2.1076E-04

26054.31c 6.1951E-06

26056.31c 9.7250E-05

26057.31c 2.2459E-06

26058.31c 2.9889E-08

92235.31c 3.3369E-04

92238.31c 4.6021E-02

c total 4.7208E-02

C MATERIAL 9 U2 metal plate

m9 1001.31c 4.3899E-05

6000.31c 4.6047E-04

14028.31c 1.9692E-04

26054.31c 5.7884E-06

26056.31c 9.0866E-05

26057.31c 2.0985E-06

26058.31c 2.7927E-08

92235.31c 3.3962E-04

92238.31c 4.6785E-02

c total 4.7925E-02

c

c radial shield

m12 1001.31c 4.6306E-05

6000.31c 6.8972E-04

14028.31c 3.1158E-04

15031.31c 4.2944E-05

16032.31c 3.7110E-05

25055.31c 7.1275E-04

26054.31c 4.9065E-03

26056.31c 7.4517E-02

26057.31c 1.7491E-03

26058.31c 2.5903E-04

c total 8.32720E-02

c

c radial shield void surround low density

m13 1001.31c 4.6306E-08

6000.31c 6.8972E-07

14028.31c 3.1158E-07

15031.31c 4.2944E-08

16032.31c 3.7110E-08

25055.31c 7.1275E-07

26054.31c 4.9065E-06

26056.31c 7.4517E-05

26057.31c 1.7491E-06

26058.31c 2.5903E-07

c total 8.32720E-05

c

c Axial shield

m14 1001.31c 2.5700E-05

6000.31c 5.1066E-04

13027.31c 1.3989E-04

22048.31c 3.9416E-05

24050.31c 1.2213E-06

24052.31c 2.2823E-05

24053.31c 2.5531E-06

24054.31c 6.2449E-07

25055.31c 3.2634E-04

26054.31c 5.0496E-03

26056.31c 7.6690E-02

26057.31c 1.8001E-03

26058.31c 2.6658E-04

28058.31c 1.2564E-06

28060.31c 4.6968E-07

28061.31c 2.2000E-08

28062.31c 6.2769E-08

28064.31c 1.6774E-08

29063.31c 3.1184E-05

29065.31c 1.3364E-05

42092.31c 1.4753E-06

42094.31c 9.8355E-07

42095.31c 1.4753E-06

42096.31c 1.4753E-06

42097.31c 9.8355E-07

42098.31c 2.4589E-06

42100.31c 9.8355E-07

c total 8.4932E-02

c

c Natural Uranium Breeder

m15 1001.31c 4.4574E-05

6000.31c 4.7140E-04

14028.31c 2.0160E-04

26054.31c 6.1085E-06

26056.31c 9.2771E-05

26057.31c 2.1776E-06

26058.31c 3.2248E-07

92235.31c 3.4209E-04

92238.31c 4.7156E-02

c Total 4.8317E-02

c

c Element top and bottom packing

m16 1001.31c 3.1777E-05

6000.31c 9.9996E-05

13027.31c 8.3095E-06

24050.31c 6.9087E-08

24052.31c 1.2911E-06

24053.31c 1.4442E-07

24054.31c 3.5326E-08

25055.31c 1.0785E-04

26054.31c 1.9605E-03

26056.31c 2.9775E-02

26057.31c 6.9890E-04

26058.31c 1.0350E-04

28058.31c 1.5636E-07

28060.31c 5.8452E-08

28061.31c 2.7378E-09

28062.31c 7.8115E-09

28064.31c 2.0875E-09

29063.31c 6.5270E-06

29065.31c 2.7973E-06

c Total 3.279692E-02

c

c wrapper material

m17 1001.31c 7.5725E-05

6000.31c 2.3828E-04

13027.31c 1.9802E-05

24050.31c 1.6463E-07

24052.31c 3.0767E-06

24053.31c 3.4414E-07

24054.31c 8.4182E-08

25055.31c 2.5701E-04

26054.31c 4.6718E-03

26056.31c 7.0954E-02

26057.31c 1.6655E-03

26058.31c 2.4664E-04

28058.31c 3.7260E-07

28060.31c 1.3929E-07

28061.31c 6.5242E-09

28062.31c 1.8615E-08

28064.31c 4.9746E-09

29063.31c 1.5554E-05

29065.31c 6.6660E-06

c Total 7.81552E-02

c

c

c Superlattice grid plate

c

m19 1001.31c 2.4442E-04

6000.31c 2.9057E-04

14028.31c 4.3858E-05

15031.31c 1.3256E-05

16032.31c 4.3530E-05

25055.31c 2.5785E-04

26054.31c 4.2756E-03

26056.31c 6.7114E-02

26057.31c 1.5500E-03

26058.31c 2.0627E-04

c Total 19 7.403935E-02

c

c

c --- MODE CARDS ---

mode n

kcode 10000 1.0 100 1500

ksrc 0.0 0.0 77.0 0.0 0.0 87.9 0.0 0.0 107.0

0.0 0.0 117.9 0.0 0.0 137.0 0.0 0.0 147.9

10.74 0.0 77.0 10.74 0.0 87.9 10.74 0.0 107.0

10.74 0.0 117.9 10.74 0.0 137.0 10.74 0.0 147.9

-10.74 0.0 77.0 -10.74 0.0 87.9 -10.74 0.0 107.0

-10.74 0.0 117.9 -10.74 0.0 137.0 -10.74 0.0 147.9

0.0 10.74 77.0 0.0 10.74 87.9 0.0 10.74 107.0

0.0 10.74 117.9 0.0 10.74 137.0 0.0 10.74 147.9

0.0 -10.74 77.0 0.0 -10.74 87.9 -10.74 0.0 107.0

0.0 -10.74 117.9 0.0 -10.74 137.0 0.0 -10.74 147.9

10.74 10.74 77.0 10.74 10.74 87.9 10.74 10.74 107.0

10.74 10.74 117.9 10.74 10.74 137.0 10.74 10.74 147.9

-10.74 10.74 77.0 -10.74 10.74 87.9 -10.74 10.74 107.0

-10.74 10.74 117.9 -10.74 10.74 137.0 -10.74 10.74 147.9

10.74 -10.74 77.0 10.74 -10.74 87.9 10.74 -10.74 107.0

10.74 -10.74 117.9 10.74 -10.74 137.0 10.74 -10.74 147.9

-10.74 -10.74 77.0 -10.74 -10.74 87.9 -10.74 -10.74 107.0

-10.74 -10.74 117.9 -10.74 -10.74 137.0 -10.74 -10.74 147.9

25.335 0.0 77.0 25.335 0.0 87.9 25.335 0.0 107.0

25.335 0.0 117.9 25.335 0.0 137.0 25.335 0.0 147.9

-25.335 0.0 77.0 -25.335 0.0 87.9 -25.335 0.0 107.0

-25.335 0.0 117.9 -25.335 0.0 137.0 -25.335 0.0 147.9

0.0 25.335 77.0 0.0 25.335 87.9 0.0 25.335 107.0

0.0 25.335 117.9 0.0 25.335 137.0 0.0 25.335 147.9

0.0 -25.335 77.0 0.0 -25.335 87.9 -25.335 0.0 107.0

0.0 -25.335 117.9 0.0 -25.335 137.0 0.0 -25.335 147.9

25.335 25.335 77.0 25.335 25.335 87.9 25.335 25.335 107.0

25.335 25.335 117.9 25.335 25.335 137.0 25.335 25.335 147.9

-25.335 25.335 77.0 -25.335 25.335 87.9 -25.335 25.335 107.0

-25.335 25.335 117.9 -25.335 25.335 137.0 -25.335 25.335 147.9

25.335 -25.335 77.0 25.335 -25.335 87.9 25.335 -25.335 107.0

25.335 -25.335 117.9 25.335 -25.335 137.0 25.335 -25.335 147.9

-25.335 -25.335 77.0 -25.335 -25.335 87.9 -25.335 -25.335 107.0

37.6 0.0 77.0 37.6 0.0 87.9 37.6 0.0 107.0

37.6 0.0 117.9 37.6 0.0 137.0 37.6 0.0 147.9

-37.6 0.0 77.0 -37.6 0.0 87.9 -37.6 0.0 107.0

-37.6 0.0 117.9 -37.6 0.0 137.0 -37.6 0.0 147.9

0.0 37.6 77.0 0.0 37.6 87.9 0.0 37.6 107.0

0.0 37.6 117.9 0.0 37.6 137.0 0.0 37.6 147.9

0.0 -37.6 77.0 0.0 -37.6 87.9 -37.6 0.0 107.0

0.0 -37.6 117.9 0.0 -37.6 137.0 0.0 -37.6 147.9

print

### A4.2 MCNP-JEFF-3.1 Zebra 23 Model A.

Z23 detailed model. Superlattice and interelement gaps. JEFF-3.1.

c

c

c ------------- CELL CARDS ----------------------------------------------

c

c --- Core Pin Geometry Element C Calandria NACLIII Pins 8xA and 8xE

c Fuel m21 and m25, can + tube m31 and m35

c Lower padding

1 16 3.279692E-02 -8 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Lower Reflector

2 14 8.4932E-02 8 -9 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

3 15 4.8317E-02 9 -41 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

4 9 4.7925E-02 41 -42 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

5 8 4.7208E-02 42 -10 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

9 27 0.0513781 33 -34 35 -36 10 -82 u=1 imp:n=1 TMP=2.5301E-08

c

c

10 25 7.1167E-02 -91 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

11 21 0.069985 -92 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

12 25 7.1167E-02 -93 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

13 21 0.069985 -94 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

14 21 0.069985 -95 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

15 25 7.1167E-02 -96 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

16 21 0.069985 -97 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

17 25 7.1167E-02 -98 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

18 25 7.1167E-02 -99 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

19 21 0.069985 -100 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

20 25 7.1167E-02 -101 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

21 21 0.069985 -102 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

22 21 0.069985 -103 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

23 25 7.1167E-02 -104 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

24 21 0.069985 -105 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

25 25 7.1167E-02 -106 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

c

30 35 0.0596942 -111 91 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

31 31 0.062241 -112 92 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

32 35 0.0596942 -113 93 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

33 31 0.062241 -114 94 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

34 31 0.062241 -115 95 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

35 35 0.0596942 -116 96 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

36 31 0.062241 -117 97 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

37 35 0.0596942 -118 98 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

38 35 0.0596942 -119 99 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

39 31 0.062241 -120 100 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

40 35 0.0596942 -121 101 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

41 31 0.062241 -122 102 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

42 31 0.062241 -123 103 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

43 35 0.0596942 -124 104 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

44 31 0.062241 -125 105 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

45 35 0.0596942 -126 106 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

46 43 2.3900E-02 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=1 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

48 27 0.0513781 33 -34 35 -36 83 -85 u=1 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

50 25 7.1167E-02 -91 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

51 21 0.069985 -92 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

52 25 7.1167E-02 -93 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

53 21 0.069985 -94 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

54 21 0.069985 -95 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

55 25 7.1167E-02 -96 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

56 21 0.069985 -97 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

57 25 7.1167E-02 -98 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

58 25 7.1167E-02 -99 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

59 21 0.069985 -100 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

60 25 7.1167E-02 -101 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

61 21 0.069985 -102 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

62 21 0.069985 -103 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

63 25 7.1167E-02 -104 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

64 21 0.069985 -105 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

65 25 7.1167E-02 -106 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

c

c

70 35 0.0596942 -111 91 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

71 31 0.062241 -112 92 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

72 35 0.0596942 -113 93 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

73 31 0.062241 -114 94 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

74 31 0.062241 -115 95 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

75 35 0.0596942 -116 96 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

76 31 0.062241 -117 97 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

77 35 0.0596942 -118 98 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

78 35 0.0596942 -119 99 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

79 31 0.062241 -120 100 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

80 35 0.0596942 -121 101 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

81 31 0.062241 -122 102 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

82 31 0.062241 -123 103 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

83 35 0.0596942 -124 104 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

84 31 0.062241 -125 105 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

85 35 0.0596942 -126 106 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

86 43 2.3900E-02 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=1 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

88 27 0.0513781 33 -34 35 -36 86 -88 u=1 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

90 25 7.1167E-02 -91 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

91 21 0.069985 -92 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

92 25 7.1167E-02 -93 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

93 21 0.069985 -94 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

94 21 0.069985 -95 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

95 25 7.1167E-02 -96 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

96 21 0.069985 -97 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

97 25 7.1167E-02 -98 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

98 25 7.1167E-02 -99 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

99 21 0.069985 -100 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

100 25 7.1167E-02 -101 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

101 21 0.069985 -102 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

102 21 0.069985 -103 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

103 25 7.1167E-02 -104 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

104 21 0.069985 -105 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

105 25 7.1167E-02 -106 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

c

c

110 35 0.0596942 -111 91 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

111 31 0.062241 -112 92 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

112 35 0.0596942 -113 93 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

113 31 0.062241 -114 94 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

114 31 0.062241 -115 95 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

115 35 0.0596942 -116 96 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

116 31 0.062241 -117 97 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

117 35 0.0596942 -118 98 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

118 35 0.0596942 -119 99 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

119 31 0.062241 -120 100 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

120 35 0.0596942 -121 101 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

121 31 0.062241 -122 102 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

122 31 0.062241 -123 103 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

123 35 0.0596942 -124 104 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

124 31 0.062241 -125 105 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

125 35 0.0596942 -126 106 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

126 43 2.3900E-02 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=1 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

128 27 0.0513781 33 -34 35 -36 89 -11 u=1 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

129 53 7.44684E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=1 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

131 8 4.7208E-02 11 -67 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

132 9 4.7925E-02 67 -68 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

133 15 4.8317E-02 68 -12 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Upper Reflector

134 14 8.4932E-02 12 -13 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Upper padding

135 16 3.279692E-02 13 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

136 0 132 -133 134 -135 (-21:22:-23:24) u=1 imp:n=1

c Wrapper

137 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=1 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

138 0 1 -2 3 -4 (-136:137:-138:139) u=1 imp:n=1

c

c End of Core Pin Geometry Element C

c

c

c --- Core Pin geometry Element E (& D) NACLIIS Pins 8xD and 8xF

c D 24 7.1085E-02 F 26 7.1415E-02 clad D 34 5.9086E-02 F 36 6.0033E-02

c Lower padding

201 16 3.279692E-02 -8 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Lower Reflector

202 14 8.4932E-02 8 -9 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

203 15 4.8317E-02 9 -41 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

204 9 4.7925E-02 41 -42 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

205 8 4.7208E-02 42 -10 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

209 27 0.0513781 33 -34 35 -36 10 -82 u=2 imp:n=1 TMP=2.5301E-08

c

c

210 26 7.1415E-02 -91 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

211 24 7.1085E-02 -92 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

212 26 7.1415E-02 -93 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

213 24 7.1085E-02 -94 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

214 24 7.1085E-02 -95 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

215 26 7.1415E-02 -96 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

216 24 7.1085E-02 -97 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

217 26 7.1415E-02 -98 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

218 26 7.1415E-02 -99 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

219 24 7.1085E-02 -100 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

220 26 7.1415E-02 -101 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

221 24 7.1085E-02 -102 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

222 24 7.1085E-02 -103 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

223 26 7.1415E-02 -104 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

224 24 7.1085E-02 -105 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

225 26 7.1415E-02 -106 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

c

230 36 6.0033E-02 -111 91 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

231 34 5.9086E-02 -112 92 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

232 36 6.0033E-02 -113 93 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

233 34 5.9086E-02 -114 94 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

234 34 5.9086E-02 -115 95 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

235 36 6.0033E-02 -116 96 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

236 34 5.9086E-02 -117 97 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

237 36 6.0033E-02 -118 98 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

238 36 6.0033E-02 -119 99 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

239 34 5.9086E-02 -120 100 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

240 36 6.0033E-02 -121 101 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

241 34 5.9086E-02 -122 102 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

242 34 5.9086E-02 -123 103 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

243 36 6.0033E-02 -124 104 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

244 34 5.9086E-02 -125 105 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

245 36 6.0033E-02 -126 106 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

246 42 2.43914E-02 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=2 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

248 27 0.0513781 33 -34 35 -36 83 -85 u=2 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

250 26 7.1415E-02 -91 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

251 24 7.1085E-02 -92 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

252 26 7.1415E-02 -93 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

253 24 7.1085E-02 -94 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

254 24 7.1085E-02 -95 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

255 26 7.1415E-02 -96 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

256 24 7.1085E-02 -97 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

257 26 7.1415E-02 -98 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

258 26 7.1415E-02 -99 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

259 24 7.1085E-02 -100 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

260 26 7.1415E-02 -101 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

261 24 7.1085E-02 -102 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

262 24 7.1085E-02 -103 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

263 26 7.1415E-02 -104 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

264 24 7.1085E-02 -105 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

265 26 7.1415E-02 -106 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

c

c

270 36 6.0033E-02 -111 91 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

271 34 5.9086E-02 -112 92 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

272 36 6.0033E-02 -113 93 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

273 34 5.9086E-02 -114 94 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

274 34 5.9086E-02 -115 95 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

275 36 6.0033E-02 -116 96 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

276 34 5.9086E-02 -117 97 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

277 36 6.0033E-02 -118 98 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

278 36 6.0033E-02 -119 99 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

279 34 5.9086E-02 -120 100 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

280 36 6.0033E-02 -121 101 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

281 34 5.9086E-02 -122 102 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

282 34 5.9086E-02 -123 103 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

283 36 6.0033E-02 -124 104 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

284 34 5.9086E-02 -125 105 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

285 36 6.0033E-02 -126 106 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

286 42 2.43914E-02 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=2 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

288 27 0.0513781 33 -34 35 -36 86 -88 u=2 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

290 26 7.1415E-02 -91 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

291 24 7.1085E-02 -92 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

292 26 7.1415E-02 -93 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

293 24 7.1085E-02 -94 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

294 24 7.1085E-02 -95 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

295 26 7.1415E-02 -96 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

296 24 7.1085E-02 -97 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

297 26 7.1415E-02 -98 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

298 26 7.1415E-02 -99 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

299 24 7.1085E-02 -100 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

300 26 7.1415E-02 -101 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

301 24 7.1085E-02 -102 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

302 24 7.1085E-02 -103 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

303 26 7.1415E-02 -104 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

304 24 7.1085E-02 -105 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

305 26 7.1415E-02 -106 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

c

c

310 36 6.0033E-02 -111 91 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

311 34 5.9086E-02 -112 92 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

312 36 6.0033E-02 -113 93 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

313 34 5.9086E-02 -114 94 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

314 34 5.9086E-02 -115 95 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

315 36 6.0033E-02 -116 96 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

316 34 5.9086E-02 -117 97 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

317 36 6.0033E-02 -118 98 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

318 36 6.0033E-02 -119 99 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

319 34 5.9086E-02 -120 100 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

320 36 6.0033E-02 -121 101 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

321 34 5.9086E-02 -122 102 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

322 34 5.9086E-02 -123 103 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

323 36 6.0033E-02 -124 104 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

324 34 5.9086E-02 -125 105 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

325 36 6.0033E-02 -126 106 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

326 42 2.43914E-02 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=2 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

328 27 0.0513781 33 -34 35 -36 89 -11 u=2 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

329 52 7.20749E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=2 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

331 8 4.7208E-02 11 -67 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

332 9 4.7925E-02 67 -68 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

333 15 4.8317E-02 68 -12 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Upper Reflector

334 14 8.4932E-02 12 -13 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Upper padding

335 16 3.279692E-02 13 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

336 0 132 -133 134 -135 (-21:22:-23:24) u=2 imp:n=1

c Wrapper

337 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=2 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

338 0 1 -2 3 -4 (-136:137:-138:139) u=2 imp:n=1

c

c End of Core Pin Geometry Element E (D)

c

c

c --- Core Pin Geometry Element B (H, L) Calandria NACLI Pins 11xB and 5xF

c B 22 7.0537E-02 F 26 7.1415E-02 clad 32 5.8537E-02 F 36 6.0033E-02

c Pin F is in circles 93 98 99 101 and 104

c

c Lower padding

401 16 3.279692E-02 -8 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Lower Reflector

402 14 8.4932E-02 8 -9 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

403 15 4.8317E-02 9 -41 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

404 9 4.7925E-02 41 -42 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

405 8 4.7208E-02 42 -10 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

409 27 0.0513781 33 -34 35 -36 10 -82 u=3 imp:n=1 TMP=2.5301E-08

c

c

410 22 7.0537E-02 -91 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

411 22 7.0537E-02 -92 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

412 26 7.1415E-02 -93 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

413 22 7.0537E-02 -94 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

414 22 7.0537E-02 -95 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

415 22 7.0537E-02 -96 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

416 22 7.0537E-02 -97 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

417 26 7.1415E-02 -98 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

418 26 7.1415E-02 -99 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

419 22 7.0537E-02 -100 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

420 26 7.1415E-02 -101 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

421 22 7.0537E-02 -102 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

422 22 7.0537E-02 -103 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

423 26 7.1415E-02 -104 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

424 22 7.0537E-02 -105 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

425 22 7.0537E-02 -106 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

c

430 32 5.8537E-02 -111 91 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

431 32 5.8537E-02 -112 92 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

432 36 6.0033E-02 -113 93 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

433 32 5.8537E-02 -114 94 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

434 32 5.8537E-02 -115 95 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

435 32 5.8537E-02 -116 96 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

436 32 5.8537E-02 -117 97 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

437 36 6.0033E-02 -118 98 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

438 36 6.0033E-02 -119 99 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

439 32 5.8537E-02 -120 100 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

440 36 6.0033E-02 -121 101 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

441 32 5.8537E-02 -122 102 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

442 32 5.8537E-02 -123 103 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

443 36 6.0033E-02 -124 104 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

444 32 5.8537E-02 -125 105 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

445 32 5.8537E-02 -126 106 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

446 41 2.41414E-02 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=3 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

448 27 0.0513781 33 -34 35 -36 83 -85 u=3 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

450 22 7.0537E-02 -91 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

451 22 7.0537E-02 -92 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

452 26 7.1415E-02 -93 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

453 22 7.0537E-02 -94 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

454 22 7.0537E-02 -95 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

455 22 7.0537E-02 -96 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

456 22 7.0537E-02 -97 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

457 26 7.1415E-02 -98 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

458 26 7.1415E-02 -99 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

459 22 7.0537E-02 -100 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

460 26 7.1415E-02 -101 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

461 22 7.0537E-02 -102 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

462 22 7.0537E-02 -103 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

463 26 7.1415E-02 -104 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

464 22 7.0537E-02 -105 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

465 22 7.0537E-02 -106 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

c

c

470 32 5.8537E-02 -111 91 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

471 32 5.8537E-02 -112 92 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

472 36 6.0033E-02 -113 93 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

473 32 5.8537E-02 -114 94 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

474 32 5.8537E-02 -115 95 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

475 32 5.8537E-02 -116 96 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

476 32 5.8537E-02 -117 97 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

477 36 6.0033E-02 -118 98 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

478 36 6.0033E-02 -119 99 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

479 32 5.8537E-02 -120 100 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

480 36 6.0033E-02 -121 101 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

481 32 5.8537E-02 -122 102 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

482 32 5.8537E-02 -123 103 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

483 36 6.0033E-02 -124 104 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

484 32 5.8537E-02 -125 105 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

485 32 5.8537E-02 -126 106 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

486 41 2.41414E-02 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=3 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

488 27 0.0513781 33 -34 35 -36 86 -88 u=3 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

490 22 7.0537E-02 -91 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

491 22 7.0537E-02 -92 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

492 26 7.1415E-02 -93 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

493 22 7.0537E-02 -94 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

494 22 7.0537E-02 -95 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

495 22 7.0537E-02 -96 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

496 22 7.0537E-02 -97 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

497 26 7.1415E-02 -98 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

498 26 7.1415E-02 -99 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

499 22 7.0537E-02 -100 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

500 26 7.1415E-02 -101 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

501 22 7.0537E-02 -102 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

502 22 7.0537E-02 -103 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

503 26 7.1415E-02 -104 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

504 22 7.0537E-02 -105 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

505 22 7.0537E-02 -106 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

c

c

510 32 5.8537E-02 -111 91 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

511 32 5.8537E-02 -112 92 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

512 36 6.0033E-02 -113 93 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

513 32 5.8537E-02 -114 94 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

514 32 5.8537E-02 -115 95 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

515 32 5.8537E-02 -116 96 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

516 32 5.8537E-02 -117 97 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

517 36 6.0033E-02 -118 98 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

518 36 6.0033E-02 -119 99 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

519 32 5.8537E-02 -120 100 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

520 36 6.0033E-02 -121 101 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

521 32 5.8537E-02 -122 102 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

522 32 5.8537E-02 -123 103 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

523 36 6.0033E-02 -124 104 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

524 32 5.8537E-02 -125 105 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

525 32 5.8537E-02 -126 106 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

526 41 2.41414E-02 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=3 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

528 27 0.0513781 33 -34 35 -36 89 -11 u=3 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

529 51 7.34056E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=3 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

531 8 4.7208E-02 11 -67 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

532 9 4.7925E-02 67 -68 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

533 15 4.8317E-02 68 -12 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Upper Reflector

534 14 8.4932E-02 12 -13 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Upper padding

535 16 3.279692E-02 13 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

536 0 132 -133 134 -135 (-21:22:-23:24) u=3 imp:n=1

c Wrapper

537 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=3 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

538 0 1 -2 3 -4 (-136:137:-138:139) u=3 imp:n=1

c

c End of Core Pin Geometry Element B (H, L)

c

c

c --- Core Pin Geometry Element A Calandria NACLI Pins 16xC

c c 23 7.1230E-02 clad 33 6.15349E-02

c

c Lower padding

601 16 3.279692E-02 -8 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Lower Reflector

602 14 8.4932E-02 8 -9 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

603 15 4.8317E-02 9 -41 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

604 9 4.7925E-02 41 -42 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

605 8 4.7208E-02 42 -10 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

609 27 0.0513781 33 -34 35 -36 10 -82 u=4 imp:n=1 TMP=2.5301E-08

c

c

610 23 7.1230E-02 -91 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

611 23 7.1230E-02 -92 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

612 23 7.1230E-02 -93 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

613 23 7.1230E-02 -94 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

614 23 7.1230E-02 -95 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

615 23 7.1230E-02 -96 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

616 23 7.1230E-02 -97 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

617 23 7.1230E-02 -98 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

618 23 7.1230E-02 -99 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

619 23 7.1230E-02 -100 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

620 23 7.1230E-02 -101 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

621 23 7.1230E-02 -102 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

622 23 7.1230E-02 -103 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

623 23 7.1230E-02 -104 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

624 23 7.1230E-02 -105 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

625 23 7.1230E-02 -106 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

c

630 33 6.15349E-02 -111 91 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

631 33 6.15349E-02 -112 92 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

632 33 6.15349E-02 -113 93 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

633 33 6.15349E-02 -114 94 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

634 33 6.15349E-02 -115 95 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

635 33 6.15349E-02 -116 96 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

636 33 6.15349E-02 -117 97 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

637 33 6.15349E-02 -118 98 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

638 33 6.15349E-02 -119 99 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

639 33 6.15349E-02 -120 100 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

640 33 6.15349E-02 -121 101 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

641 33 6.15349E-02 -122 102 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

642 33 6.15349E-02 -123 103 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

643 33 6.15349E-02 -124 104 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

644 33 6.15349E-02 -125 105 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

645 33 6.15349E-02 -126 106 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

646 41 2.41414E-02 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=4 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

648 27 0.0513781 33 -34 35 -36 83 -85 u=4 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

650 23 7.1230E-02 -91 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

651 23 7.1230E-02 -92 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

652 23 7.1230E-02 -93 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

653 23 7.1230E-02 -94 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

654 23 7.1230E-02 -95 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

655 23 7.1230E-02 -96 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

656 23 7.1230E-02 -97 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

657 23 7.1230E-02 -98 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

658 23 7.1230E-02 -99 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

659 23 7.1230E-02 -100 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

660 23 7.1230E-02 -101 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

661 23 7.1230E-02 -102 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

662 23 7.1230E-02 -103 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

663 23 7.1230E-02 -104 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

664 23 7.1230E-02 -105 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

665 23 7.1230E-02 -106 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

c

c

670 33 6.15349E-02 -111 91 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

671 33 6.15349E-02 -112 92 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

672 33 6.15349E-02 -113 93 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

673 33 6.15349E-02 -114 94 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

674 33 6.15349E-02 -115 95 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

675 33 6.15349E-02 -116 96 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

676 33 6.15349E-02 -117 97 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

677 33 6.15349E-02 -118 98 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

678 33 6.15349E-02 -119 99 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

679 33 6.15349E-02 -120 100 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

680 33 6.15349E-02 -121 101 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

681 33 6.15349E-02 -122 102 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

682 33 6.15349E-02 -123 103 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

683 33 6.15349E-02 -124 104 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

684 33 6.15349E-02 -125 105 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

685 33 6.15349E-02 -126 106 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

686 41 2.41414E-02 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=4 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

688 27 0.0513781 33 -34 35 -36 86 -88 u=4 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

690 23 7.1230E-02 -91 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

691 23 7.1230E-02 -92 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

692 23 7.1230E-02 -93 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

693 23 7.1230E-02 -94 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

694 23 7.1230E-02 -95 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

695 23 7.1230E-02 -96 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

696 23 7.1230E-02 -97 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

697 23 7.1230E-02 -98 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

698 23 7.1230E-02 -99 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

699 23 7.1230E-02 -100 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

700 23 7.1230E-02 -101 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

701 23 7.1230E-02 -102 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

702 23 7.1230E-02 -103 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

703 23 7.1230E-02 -104 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

704 23 7.1230E-02 -105 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

705 23 7.1230E-02 -106 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

c

c

710 33 6.15349E-02 -111 91 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

711 33 6.15349E-02 -112 92 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

712 33 6.15349E-02 -113 93 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

713 33 6.15349E-02 -114 94 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

714 33 6.15349E-02 -115 95 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

715 33 6.15349E-02 -116 96 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

716 33 6.15349E-02 -117 97 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

717 33 6.15349E-02 -118 98 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

718 33 6.15349E-02 -119 99 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

719 33 6.15349E-02 -120 100 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

720 33 6.15349E-02 -121 101 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

721 33 6.15349E-02 -122 102 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

722 33 6.15349E-02 -123 103 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

723 33 6.15349E-02 -124 104 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

724 33 6.15349E-02 -125 105 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

725 33 6.15349E-02 -126 106 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

726 41 2.41414E-02 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=4 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

728 27 0.0513781 33 -34 35 -36 89 -11 u=4 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

729 51 7.34056E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=4 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

731 8 4.7208E-02 11 -67 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

732 9 4.7925E-02 67 -68 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

733 15 4.8317E-02 68 -12 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Upper Reflector

734 14 8.4932E-02 12 -13 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Upper padding

735 16 3.279692E-02 13 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

736 0 132 -133 134 -135 (-21:22:-23:24) u=4 imp:n=1

c Wrapper

737 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=4 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

738 0 1 -2 3 -4 (-136:137:-138:139) u=4 imp:n=1

c

c End of Core Pin Geometry Element A

c

c

c --- Core Pin Geometry Element J Calandria NACLIV Pins 12xE and 4xUO2

c E 25 7.1167E-02 28 7.140034E-02 35 5.96942E-02

c The positions of pin UO2 are the circles 94, 96, 102 and 104

c Lower padding

801 16 3.279692E-02 -8 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Lower Reflector

802 14 8.4932E-02 8 -9 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

803 15 4.8317E-02 9 -41 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

804 9 4.7925E-02 41 -42 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

805 8 4.7208E-02 42 -10 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

809 27 0.0513781 33 -34 35 -36 10 -82 u=5 imp:n=1 TMP=2.5301E-08

c

c

810 25 7.1167E-02 -91 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

811 25 7.1167E-02 -92 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

812 25 7.1167E-02 -93 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

813 28 7.14034E-02 -94 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

814 25 7.1167E-02 -95 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

815 28 7.14034E-02 -96 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

816 25 7.1167E-02 -97 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

817 25 7.1167E-02 -98 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

818 25 7.1167E-02 -99 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

819 25 7.1167E-02 -100 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

820 25 7.1167E-02 -101 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

821 28 7.14034E-02 -102 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

822 25 7.1167E-02 -103 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

823 28 7.14034E-02 -104 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

824 25 7.1167E-02 -105 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

825 25 7.1167E-02 -106 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

c

830 35 5.96942E-02 -111 91 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

831 35 5.96942E-02 -112 92 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

832 35 5.96942E-02 -113 93 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

833 35 5.96942E-02 -114 94 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

834 35 5.96942E-02 -115 95 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

835 35 5.96942E-02 -116 96 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

836 35 5.96942E-02 -117 97 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

837 35 5.96942E-02 -118 98 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

838 35 5.96942E-02 -119 99 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

839 35 5.96942E-02 -120 100 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

840 35 5.96942E-02 -121 101 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

841 35 5.96942E-02 -122 102 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

842 35 5.96942E-02 -123 103 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

843 35 5.96942E-02 -124 104 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

844 35 5.96942E-02 -125 105 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

845 35 5.96942E-02 -126 106 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

846 44 2.4049E-02 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=5 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

848 27 0.0513781 33 -34 35 -36 83 -85 u=5 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

850 25 7.1167E-02 -91 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

851 25 7.1167E-02 -92 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

852 25 7.1167E-02 -93 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

853 28 7.14034E-02 -94 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

854 25 7.1167E-02 -95 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

855 28 7.14034E-02 -96 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

856 25 7.1167E-02 -97 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

857 25 7.1167E-02 -98 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

858 25 7.1167E-02 -99 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

859 25 7.1167E-02 -100 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

860 25 7.1167E-02 -101 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

861 28 7.14034E-02 -102 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

862 25 7.1167E-02 -103 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

863 28 7.14034E-02 -104 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

864 25 7.1167E-02 -105 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

865 25 7.1167E-02 -106 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

c

c

870 35 5.96942E-02 -111 91 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

871 35 5.96942E-02 -112 92 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

872 35 5.96942E-02 -113 93 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

873 35 5.96942E-02 -114 94 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

874 35 5.96942E-02 -115 95 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

875 35 5.96942E-02 -116 96 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

876 35 5.96942E-02 -117 97 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

877 35 5.96942E-02 -118 98 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

878 35 5.96942E-02 -119 99 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

879 35 5.96942E-02 -120 100 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

880 35 5.96942E-02 -121 101 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

881 35 5.96942E-02 -122 102 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

882 35 5.96942E-02 -123 103 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

883 35 5.96942E-02 -124 104 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

884 35 5.96942E-02 -125 105 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

885 35 5.96942E-02 -126 106 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

886 44 2.4049E-02 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=5 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

888 27 0.0513781 33 -34 35 -36 86 -88 u=5 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

890 25 7.1167E-02 -91 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

891 25 7.1167E-02 -92 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

892 25 7.1167E-02 -93 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

893 28 7.14034E-02 -94 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

894 25 7.1167E-02 -95 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

895 28 7.14034E-02 -96 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

896 25 7.1167E-02 -97 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

897 25 7.1167E-02 -98 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

898 25 7.1167E-02 -99 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

899 25 7.1167E-02 -100 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

900 25 7.1167E-02 -101 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

901 28 7.14034E-02 -102 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

902 25 7.1167E-02 -103 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

903 28 7.14034E-02 -104 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

904 25 7.1167E-02 -105 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

905 25 7.1167E-02 -106 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

c

c

910 35 5.96942E-02 -111 91 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

911 35 5.96942E-02 -112 92 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

912 35 5.96942E-02 -113 93 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

913 35 5.96942E-02 -114 94 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

914 35 5.96942E-02 -115 95 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

915 35 5.96942E-02 -116 96 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

916 35 5.96942E-02 -117 97 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

917 35 5.96942E-02 -118 98 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

918 35 5.96942E-02 -119 99 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

919 35 5.96942E-02 -120 100 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

920 35 5.96942E-02 -121 101 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

921 35 5.96942E-02 -122 102 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

922 35 5.96942E-02 -123 103 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

923 35 5.96942E-02 -124 104 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

924 35 5.96942E-02 -125 105 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

925 35 5.96942E-02 -126 106 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

926 44 2.4049E-02 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=5 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

928 27 0.0513781 33 -34 35 -36 89 -11 u=5 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

929 54 6.94698E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=5 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

931 8 4.7208E-02 11 -67 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

932 9 4.7925E-02 67 -68 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

933 15 4.8317E-02 68 -12 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Upper Reflector

934 14 8.4932E-02 12 -13 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Upper padding

935 16 3.279692E-02 13 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

936 0 132 -133 134 -135 (-21:22:-23:24) u=5 imp:n=1

c Wrapper

937 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=5 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

938 0 1 -2 3 -4 (-136:137:-138:139) u=5 imp:n=1

c

c End of Core Pin Geometry Element J

c

c

c

c --- Core Plate Geometry Element

c Lower padding

1011 16 3.279692E-02 -8 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Lower Reflector

1012 14 8.4932E-02 8 -9 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Lower section of the NatU Blanket

1013 15 4.8317E-02 9 -41 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

1014 9 4.7925E-02 41 -42 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

1015 8 4.7208E-02 42 -10 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c Fuelled section

c

c Lowest core Cell, Cell 12

c

c Na plate core

1022 5 2.324832E-02 502 -503 159 -160 161 -162 u=6 imp:n=1 TMP=2.5301E-08

C Na plate can

1023 6 7.9429E-02 10 -504 21 -22 23 -24 &

(-159:160:-161:162:-502:503) u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1027 3 6.9083E-02 505 -506 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1028 4 7.2463E-02 504 -507 21 -22 23 -24 &

(-155:156:-157:158:-505:506) u=6 imp:n=1 TMP=2.5301E-08

c

c Na plate core

1032 5 2.324832E-02 508 -509 159 -160 161 -162 u=6 imp:n=1 TMP=2.5301E-08

C Na plate can

1033 6 7.9429E-02 507 -510 21 -22 23 -24 &

(-159:160:-161:162:-508:509) u=6 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

1035 1 3.9991E-02 151 -152 153 -154 511 -512 u=6 imp:n=1 TMP=2.5301E-08

C Pu canning

1036 2 6.6997E-02 510 -513 21 -22 23 -24 &

(-151:152:-153:154:-511:512) u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1039 3 6.9083E-02 514 -515 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1040 4 7.2463E-02 513 -516 21 -22 23 -24 &

(-155:156:-157:158:-514:515) u=6 imp:n=1 TMP=2.5301E-08

c

c Na plate core

1042 5 2.324832E-02 517 -518 159 -160 161 -162 u=6 imp:n=1 TMP=2.5301E-08

C Na plate can

1043 6 7.9429E-02 516 -43 21 -22 23 -24 &

(-159:160:-161:162:-517:518) u=6 imp:n=1 TMP=2.5301E-08

c

c Insert the 22 central region core cells

c

1051 0 43 -44 21 -22 23 -24 fill=13 (0 0 71.209862) u=6 imp:n=1

c

1052 0 44 -45 21 -22 23 -24 fill=14 (0 0 74.957944) u=6 imp:n=1

c

c

1053 0 45 -46 21 -22 23 -24 fill=13 (0 0 78.706026) u=6 imp:n=1

c

1054 0 46 -47 21 -22 23 -24 fill=14 (0 0 82.454108) u=6 imp:n=1

c

c

1055 0 47 -48 21 -22 23 -24 fill=13 (0 0 86.202190) u=6 imp:n=1

c

1056 0 48 -49 21 -22 23 -24 fill=14 (0 0 89.950272) u=6 imp:n=1

c

c

1057 0 49 -50 21 -22 23 -24 fill=13 (0 0 93.698354) u=6 imp:n=1

c

1058 0 50 -51 21 -22 23 -24 fill=14 (0 0 97.446436) u=6 imp:n=1

c

c

1059 0 51 -52 21 -22 23 -24 fill=13 (0 0 101.194518) u=6 imp:n=1

c

1060 0 52 -53 21 -22 23 -24 fill=14 (0 0 104.942600) u=6 imp:n=1

c

c

1061 0 53 -54 21 -22 23 -24 fill=13 (0 0 108.690682) u=6 imp:n=1

c

1062 0 54 -55 21 -22 23 -24 fill=14 (0 0 112.438764) u=6 imp:n=1

c

c

1063 0 55 -56 21 -22 23 -24 fill=13 (0 0 116.186846) u=6 imp:n=1

c

1064 0 56 -57 21 -22 23 -24 fill=14 (0 0 119.934928) u=6 imp:n=1

c

c

1065 0 57 -58 21 -22 23 -24 fill=13 (0 0 123.683010) u=6 imp:n=1

c

1066 0 58 -59 21 -22 23 -24 fill=14 (0 0 127.431092) u=6 imp:n=1

c

c

1067 0 59 -60 21 -22 23 -24 fill=13 (0 0 131.179174) u=6 imp:n=1

c

1068 0 60 -61 21 -22 23 -24 fill=14 (0 0 134.927256) u=6 imp:n=1

c

c

1069 0 61 -62 21 -22 23 -24 fill=13 (0 0 138.675338) u=6 imp:n=1

c

1070 0 62 -63 21 -22 23 -24 fill=14 (0 0 142.423420) u=6 imp:n=1

c

c

1071 0 63 -64 21 -22 23 -24 fill=13 (0 0 146.171502) u=6 imp:n=1

c

1072 0 64 -65 21 -22 23 -24 fill=14 (0 0 149.919584) u=6 imp:n=1

c

c

c The top core cell, Cell 2

c

c Na plate core

1082 5 2.324832E-02 402 -403 159 -160 161 -162 u=6 imp:n=1 TMP=2.5301E-08

C Na plate can

1083 6 7.9429E-02 65 -404 21 -22 23 -24 &

(-159:160:-161:162:-402:403) u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1087 3 6.9083E-02 405 -406 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1088 4 7.2463E-02 404 -407 21 -22 23 -24 &

(-155:156:-157:158:-405:406) u=6 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

1092 1 3.9991E-02 151 -152 153 -154 408 -409 u=6 imp:n=1 &

TMP=2.5301E-08

C Pu canning

1093 2 6.6997E-02 407 -410 21 -22 23 -24 &

(-151:152:-153:154:-408:409) u=6 imp:n=1 TMP=2.5301E-08

c

c Na plate core

1102 5 2.324832E-02 411 -412 159 -160 161 -162 u=6 imp:n=1 TMP=2.5301E-08

C Na plate can

1103 6 7.9429E-02 410 -413 21 -22 23 -24 &

(-159:160:-161:162:-411:412) u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1107 3 6.9083E-02 414 -415 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1108 4 7.2463E-02 413 -416 21 -22 23 -24 &

(-155:156:-157:158:-414:415) u=6 imp:n=1 TMP=2.5301E-08

c

c Na plate core

1112 5 2.324832E-02 417 -418 159 -160 161 -162 u=6 imp:n=1 TMP=2.5301E-08

C Na plate can

1113 6 7.9429E-02 416 -66 21 -22 23 -24 &

(-159:160:-161:162:-417:418) u=6 imp:n=1 TMP=2.5301E-08

c

c

c Upper Axial blanket.

c

1121 8 4.7208E-02 66 -67 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

1122 9 4.7925E-02 67 -68 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

1123 15 4.8317E-02 68 -12 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c Upper Reflector

1126 14 8.4932E-02 12 -13 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Upper padding

1127 16 3.279692E-02 13 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Wrapper region

c 1128 17 3.87228E-02 1 -2 3 -4 (-21:22:-23:24) u=6 imp:n=1

c TMP=2.5301E-08

c gap between plates and wrapper

1131 0 132 -133 134 -135 (-21:22:-23:24) u=6 imp:n=1

c Wrapper

1132 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=6 &

imp:n=1 TMP=2.5301E-08

c gap outside wrapper

1133 0 1 -2 3 -4 (-136:137:-138:139) u=6 imp:n=1

c

c

c --- Radial Breeder Element

c Lower padding

1241 16 3.279692E-02 -8 21 -22 23 -24 u=7 imp:n=1 TMP=2.5301E-08

c Lower Reflector

1242 14 8.4932E-02 8 -9 21 -22 23 -24 u=7 imp:n=1 TMP=2.5301E-08

c Radial blanket

1244 15 4.8317E-02 9 -12 21 -22 23 -24 u=7 imp:n=1 TMP=2.5301E-08

c Upper reflector

1246 like 134 but u=7 imp:n=1 TMP=2.5301E-08

c Upper padding

1247 like 135 but u=7 imp:n=1 TMP=2.5301E-08

c Wrapper region

c gap between plates and wrapper

1248 0 132 -133 134 -135 (-21:22:-23:24) u=7 imp:n=1

c Wrapper

1249 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=7 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

1250 0 1 -2 3 -4 (-136:137:-138:139) u=7 imp:n=1

c

c

c

c --- Radial shield

c

1326 12 8.32720E-02 28 -29 30 -31 u=8 imp:n=1 TMP=2.5301E-08

c

1327 13 8.32720E-05 1 -2 3 -4 (-28:29:-30:31) u=8 imp:n=1 &

TMP=2.5301E-08

c

c

1400 13 8.32720E-05 1 -2 3 -4 u=9 imp:n=1 TMP=2.5301E-08

c

c --- Assembly

c

1419 0 189 -190 191 -192 u=10 lat=1

fill=-3:3 -3:3 0:0

199 164 162 161 163 165 199

146 144 132 141 143 145 147

126 132 122 121 123 132 127

106 104 102 101 103 105 107

116 132 112 111 113 132 117

136 134 132 131 132 135 137

199 154 152 151 153 155 199

imp:n=1

c

c --- Fuel Region

c

1429 0 7 -16 -17 fill=10 imp:n=1

c --- Universe

1430 0 -7:16:17 imp:n=0

c

c Cell A

c 501 1 6.9985E-02 -71 u=3 imp:n=1 TMP=2.5301E-08

c

c 502 23 0.062241 -74 71 u=3 imp:n=1 TMP=2.5301E-08

c

c 503 5 2.3900E-02 74 u=3 imp:n=1 TMP=2.5301E-08

c

c 504 0 75 -76 77 -78 u=3 fill=1 imp:n=1

c

c Cell E Modified compositions

c

c 506 2 7.1167E-02 -71 u=4 imp:n=1 TMP=2.5301E-08

c

c 507 24 0.0596942 -74 71 u=4 imp:n=1 TMP=2.5301E-08

c

c 508 5 2.3900E-02 74 u=4 imp:n=1 TMP=2.5301E-08

c

c 509 0 75 -76 77 -78 u=4 fill=2 imp:n=1

c

c 511 0 75 -76 77 -78 lat=1 &

c fill -2:1 -2:1 0:0 &

c 3 4 3 4 4 3 4 3 3 4 3 4 4 3 4 3 &

c u=11 imp:n=1

c

c

c ------------- PLATE ELEMENT CELL CARDS ----------------------------------

c

c The First Regular cell. Cell 1

c

c Na plate

c Na plate core

2162 5 2.324832E-02 802 -803 159 -160 161 -162 u=13 imp:n=1 TMP=2.5301E-08

C Na plate can

2163 6 7.9429E-02 801 -804 21 -22 23 -24 &

(-159:160:-161:162:-802:803) u=13 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2167 3 6.9083E-02 805 -806 155 -156 157 -158 u=13 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2168 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-155:156:-157:158:-805:806) u=13 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2170 7 3.3152E-02 807 -708 21 -22 23 -24 u=13 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2172 1 3.9991E-02 151 -152 153 -154 709 -710 u=13 imp:n=1 TMP=2.5301E-08

C Pu canning

2173 2 6.6997E-02 708 -711 21 -22 23 -24 &

(-151:152:-153:154:-709:710) u=13 imp:n=1 TMP=2.5301E-08

c

c

c Na plate

c Na plate core

2182 5 2.324832E-02 712 -713 159 -160 161 -162 u=13 imp:n=1 TMP=2.5301E-08

C Na plate can

2183 6 7.9429E-02 711 -814 21 -22 23 -24 &

(-159:160:-161:162:-712:713) u=13 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2187 3 6.9083E-02 815 -816 155 -156 157 -158 u=13 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2188 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-155:156:-157:158:-815:816) u=13 imp:n=1 TMP=2.5301E-08

c

c Na plate

c Na plate core

2192 5 2.324832E-02 818 -819 159 -160 161 -162 u=13 imp:n=1 TMP=2.5301E-08

C Na plate can

2193 6 7.9429E-02 817 -820 21 -22 23 -24 &

(-159:160:-161:162:-818:819) u=13 imp:n=1 TMP=2.5301E-08

c

c End of Cell 1 beginning of Cell 2

c Na plate

c Na plate core

2202 5 2.324832E-02 802 -803 159 -160 161 -162 u=14 imp:n=1 TMP=2.5301E-08

C Na plate can

2203 6 7.9429E-02 801 -804 21 -22 23 -24 &

(-159:160:-161:162:-802:803) u=14 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2207 3 6.9083E-02 805 -806 155 -156 157 -158 u=14 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2208 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-155:156:-157:158:-805:806) u=14 imp:n=1 TMP=2.5301E-08

c

c Na plate

c Na plate core

2211 5 2.324832E-02 808 -809 159 -160 161 -162 u=14 imp:n=1 TMP=2.5301E-08

C Na plate can

2212 6 7.9429E-02 807 -810 21 -22 23 -24 &

(-159:160:-161:162:-808:809) u=14 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2214 1 3.9991E-02 151 -152 153 -154 811 -812 u=14 imp:n=1 TMP=2.5301E-08

C Pu canning

2215 2 6.6997E-02 810 -813 21 -22 23 -24 &

(-151:152:-153:154:-811:812) u=14 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2217 7 3.3152E-02 813 -814 21 -22 23 -24 u=14 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2219 3 6.9083E-02 815 -816 155 -156 157 -158 u=14 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2220 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-155:156:-157:158:-815:816) u=14 imp:n=1 TMP=2.5301E-08

c

c Na plate

c Na plate core

2222 5 2.324832E-02 818 -819 159 -160 161 -162 u=14 imp:n=1 TMP=2.5301E-08

C Na plate can

2223 6 7.9429E-02 817 -820 21 -22 23 -24 &

(-159:160:-161:162:-818:819) u=14 imp:n=1 TMP=2.5301E-08

c

c End of plate element cell data

c

c

c --------------------------------------------------------------------

c

c Form the region surrounding groups of 5x5 elements, containing grids

c

c

3001 0 189 -190 191 -192 (-185:186:-187:188) -71 u=100 imp:n=1

c

3002 19 7.403935E-02 189 -190 191 -192 (-185:186:-187:188) 71 -72 &

u=100 imp:n=1

c

3003 0 189 -190 191 -192 (-185:186:-187:188) 72 -73 u=100 imp:n=1

c

3004 19 7.403935E-02 189 -190 191 -192 (-185:186:-187:188) 73 -74 &

u=100 imp:n=1

c

3005 0 189 -190 191 -192 (-185:186:-187:188) 74 u=100 imp:n=1

c

c

c ------------------------------------------------------------------

c

c Form arrays of 5x5 elements

c

c Central row

c

c Central array of 5x5 core elements

c

c

3011 0 1 -2 3 -4 u=201 lat=1

fill=-2:2 -2:2 0:0

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

imp:n=1

c

3012 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=101 imp:n=1

c

3013 0 7 -16 185 -186 187 -188 fill=201 u=101 imp:n=1

c

c

c Middle Left array of 5x5 core elements in row 4

c

3014 0 1 -2 3 -4 u=202 lat=1

fill=-2:2 -2:2 0:0

4 5 4 2 2

4 2 4 2 2

3 2 2 2 2

4 2 2 2 2

4 5 2 2 2

imp:n=1

c

c

c Surround material

c

3015 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=102 imp:n=1

c

c

3016 0 7 -16 185 -186 187 -188 fill=202 u=102 imp:n=1

c

c

c Middle Right array of 5x5 core elements in row 4

c

3017 0 1 -2 3 -4 u=203 lat=1

fill=-2:2 -2:2 0:0

2 2 4 5 4

2 2 4 2 4

2 2 2 2 3

2 2 2 2 4

2 2 3 5 4

imp:n=1

c

c

c Surround material

c

3018 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=103 imp:n=1

c

c

3019 0 7 -16 185 -186 187 -188 fill=203 u=103 imp:n=1

c

c

c

c Left edge array of 5x5 core elements in row 4

c

3021 0 1 -2 3 -4 u=204 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 6

7 7 7 7 6

7 7 7 7 6

7 7 7 7 6

7 7 7 7 6

imp:n=1

c

c

c Surround material

c

3022 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=104 imp:n=1

c

c

3023 0 7 -16 185 -186 187 -188 fill=204 u=104 imp:n=1

c

c

c Right edge array of 5x5 core elements in row 4

c

3024 0 1 -2 3 -4 u=205 lat=1

fill=-2:2 -2:2 0:0

6 7 7 7 7

6 7 7 7 7

6 7 7 7 7

6 7 7 7 7

6 7 7 7 7

imp:n=1

c

c

c Surround material

c

3025 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=105 imp:n=1

c

c

3026 0 7 -16 185 -186 187 -188 fill=205 u=105 imp:n=1

c

c

c ROW 3 The row below the central line

c

c

c Middle array of 5x5 core elements in Row 3

c

c

3031 0 1 -2 3 -4 u=211 lat=1

fill=-2:2 -2:2 0:0

1 1 1 1 1

1 1 1 1 1

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

imp:n=1

c

c Surround material

c

3032 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=111 imp:n=1

c

3033 0 7 -16 185 -186 187 -188 fill=211 u=111 imp:n=1

c

c Lower left array of 5x5 core elements in Row 3

c

c

3034 0 1 -2 3 -4 u=212 lat=1

fill=-2:2 -2:2 0:0

6 2 2 1 2

6 2 2 1 2

7 6 4 2 3

7 6 6 3 3

7 7 7 6 6

imp:n=1

c

c Surround material

c

3035 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=112 imp:n=1

c

3036 0 7 -16 185 -186 187 -188 fill=212 u=112 imp:n=1

c

c

c Lower right array of 5x5 core elements in Row 3

c

3037 0 1 -2 3 -4 u=213 lat=1

fill=-2:2 -2:2 0:0

2 2 3 3 6

2 3 3 5 6

3 3 3 6 7

3 3 6 6 7

6 6 7 7 7

imp:n=1

c

c

c Surround material

c

3038 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=113 imp:n=1

c

c

3039 0 7 -16 185 -186 187 -188 fill=213 u=113 imp:n=1

c

c

c

c ROW 5 the row above the central line

c

c Central array of 5x5 core elements in Row 5

c

3051 0 1 -2 3 -4 u=221 lat=1

fill=-2:2 -2:2 0:0

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

1 1 1 1 1

1 1 1 1 1

imp:n=1

c

c

c Surround material

c

3052 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=121 imp:n=1

c

c

3053 0 7 -16 185 -186 187 -188 fill=221 u=121 imp:n=1

c

c

c Top left array of 5x5 core elements in Row 5

c

3054 0 1 -2 3 -4 u=222 lat=1

fill=-2:2 -2:2 0:0

7 7 7 6 6

7 6 6 3 3

7 6 4 2 2

6 5 2 1 2

6 2 2 1 2

imp:n=1

c

c

c Surround material

c

3055 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=122 imp:n=1

c

c

3056 0 7 -16 185 -186 187 -188 fill=222 u=122 imp:n=1

c

c

c Top right array of 5x5 core elements in Row 5

c

3057 0 1 -2 3 -4 u=223 lat=1

fill=-2:2 -2:2 0:0

6 6 7 7 7

3 3 6 6 7

2 2 4 6 7

2 1 2 3 6

2 1 2 2 6

imp:n=1

c

c

c Surround material

c

3058 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=123 imp:n=1

c

c

3059 0 7 -16 185 -186 187 -188 fill=223 u=123 imp:n=1

c

c

c

c ROW 2 The row two down from the central row

c

c Lower central group

c

c

3071 0 1 -2 3 -4 u=231 lat=1

fill=-2:2 -2:2 0:0

6 6 6 6 6

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3072 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=131 imp:n=1

c

3073 0 7 -16 185 -186 187 -188 fill=231 u=131 imp:n=1

c

c

c ROW 6

c

c Top central array of 5x5 core elements in row 6

c

3074 0 1 -2 3 -4 u=241 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

6 6 6 6 6

imp:n=1

c

c Surround material

c

3075 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=141 imp:n=1

c

3076 0 7 -16 185 -186 187 -188 fill=241 u=141 imp:n=1

c

c Right central array in Row 6 with one core element (plate)

c

c

3077 0 1 -2 3 -4 u=243 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

6 7 7 7 7

imp:n=1

c

c Surround material

c

3078 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=143 imp:n=1

c

3079 0 7 -16 185 -186 187 -188 fill=243 u=143 imp:n=1

c

c

c

c 5x5 array of blanket elements

c

c

3101 0 1 -2 3 -4 u=232 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3102 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=132 imp:n=1

c

3103 0 7 -16 185 -186 187 -188 fill=232 u=132 imp:n=1

c

c

c \*\*\* Blanket-Reflector Arrays \*\*\*

c

c ROW 2

c

c Bottom Left

c

c

3111 0 1 -2 3 -4 u=234 lat=1

fill=-2:2 -2:2 0:0

8 7 7 7 7

8 8 7 7 7

8 8 8 7 7

8 8 8 8 7

9 8 8 8 8

imp:n=1

c

c

c Surround material

c

3112 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=134 imp:n=1

c

3113 0 7 -16 185 -186 187 -188 fill=234 u=134 imp:n=1

c

c

c Row 2 Bottom Right Blanket Reflector Array

c

c

3121 0 1 -2 3 -4 u=235 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 8

7 7 7 8 8

7 7 8 8 8

7 8 8 8 8

8 8 8 8 9

imp:n=1

c

c

c Surround material

c

3122 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=135 imp:n=1

c

3123 0 7 -16 185 -186 187 -188 fill=235 u=135 imp:n=1

c

c

c ROW 6

c

c Top Left Blanket-Reflector Array

c

c

3131 0 1 -2 3 -4 u=244 lat=1

fill=-2:2 -2:2 0:0

9 8 8 8 8

8 8 8 8 7

8 8 8 7 7

8 8 7 7 7

8 7 7 7 7

imp:n=1

c

c

c Surround material

c

3132 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=144 imp:n=1

c

3133 0 7 -16 185 -186 187 -188 fill=244 u=144 imp:n=1

c

c Row 6 Top Right Blanket Reflector Array

c

c

3141 0 1 -2 3 -4 u=245 lat=1

fill=-2:2 -2:2 0:0

8 8 8 8 9

7 8 8 8 8

7 7 8 8 8

7 7 7 8 8

7 7 7 7 8

imp:n=1

c

c

c Surround material

c

3142 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=145 imp:n=1

c

3143 0 7 -16 185 -186 187 -188 fill=245 u=145 imp:n=1

c

c

c Row 1 Blanket - Reflector arrays

c

c Row 1 First Left array

c

c

3151 0 1 -2 3 -4 u=254 lat=1

fill=-2:2 -2:2 0:0

9 9 8 8 8

9 9 9 8 8

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3152 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=154 imp:n=1

c

3153 0 7 -16 185 -186 187 -188 fill=254 u=154 imp:n=1

c

c Row 1 Mid-Left

c

c

3161 0 1 -2 3 -4 u=252 lat=1

fill=-2:2 -2:2 0:0

8 8 8 7 7

8 8 8 8 8

8 8 8 8 8

9 9 9 8 8

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3162 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=152 imp:n=1

c

3163 0 7 -16 185 -186 187 -188 fill=252 u=152 imp:n=1

c

c Row 1 Central Array

c

3171 0 1 -2 3 -4 u=251 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

8 8 8 8 8

8 8 8 8 8

8 8 8 8 8

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3172 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=151 imp:n=1

c

3173 0 7 -16 185 -186 187 -188 fill=251 u=151 imp:n=1

c

c Row 1 First Right array

c

c

3181 0 1 -2 3 -4 u=253 lat=1

fill=-2:2 -2:2 0:0

7 7 8 8 8

8 8 8 8 8

8 8 8 8 8

8 8 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3182 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=153 imp:n=1

c

3183 0 7 -16 185 -186 187 -188 fill=253 u=153 imp:n=1

c

c Row 1 Far Right

c

c

3191 0 1 -2 3 -4 u=255 lat=1

fill=-2:2 -2:2 0:0

8 8 8 9 9

8 8 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3192 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=155 imp:n=1

c

3193 0 7 -16 185 -186 187 -188 fill=255 u=155 imp:n=1

c

c

c Row 2 Blanket reflector arrays

c

c Row 2 First Left array

c

c

3201 0 1 -2 3 -4 u=236 lat=1

fill=-2:2 -2:2 0:0

9 9 9 8 8

9 9 9 8 8

9 9 9 9 8

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3202 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=136 imp:n=1

c

3203 0 7 -16 185 -186 187 -188 fill=236 u=136 imp:n=1

c

c Row 2 Far Right

c

c

3211 0 1 -2 3 -4 u=237 lat=1

fill=-2:2 -2:2 0:0

8 8 9 9 9

8 8 9 9 9

8 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3212 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=137 imp:n=1

c

3213 0 7 -16 185 -186 187 -188 fill=237 u=137 imp:n=1

c

c Row 4 Blanket- Reflector arrays

c

c

c Row 4 First Left array

c

c

3221 0 1 -2 3 -4 u=206 lat=1

fill=-2:2 -2:2 0:0

9 8 8 8 7

9 8 8 8 7

9 8 8 8 7

9 8 8 8 7

9 8 8 8 7

imp:n=1

c

c

c Surround material

c

3222 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=106 imp:n=1

c

3223 0 7 -16 185 -186 187 -188 fill=206 u=106 imp:n=1

c

c

c Row 4 Far Right

c

c

3231 0 1 -2 3 -4 u=207 lat=1

fill=-2:2 -2:2 0:0

7 8 8 8 9

7 8 8 8 9

7 8 8 8 9

7 8 8 8 9

7 8 8 8 9

imp:n=1

c

c

c Surround material

c

3232 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=107 imp:n=1

c

3233 0 7 -16 185 -186 187 -188 fill=207 u=107 imp:n=1

c

c Row 6 Blanket- Reflector arrays

c

c

c Row 6 First Left array

c

3241 0 1 -2 3 -4 u=246 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 8

9 9 9 8 8

9 9 9 8 8

imp:n=1

c

c

c Surround material

c

3242 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=146 imp:n=1

c

3243 0 7 -16 185 -186 187 -188 fill=246 u=146 imp:n=1

c

c Row 6 Far Right

c

3251 0 1 -2 3 -4 u=247 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

8 9 9 9 9

8 8 9 9 9

8 8 9 9 9

imp:n=1

c

c

c Surround material

c

3252 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=147 imp:n=1

c

3253 0 7 -16 185 -186 187 -188 fill=247 u=147 imp:n=1

c

c

c Row 5 Blanket- Reflector arrays

c

c

c Row 5 First Left array

c

c

3261 0 1 -2 3 -4 u=226 lat=1

fill=-2:2 -2:2 0:0

9 9 8 8 8

9 9 8 8 8

9 9 8 8 8

9 8 8 8 7

9 8 8 8 7

imp:n=1

c

c

c Surround material

c

3262 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=126 imp:n=1

c

3263 0 7 -16 185 -186 187 -188 fill=226 u=126 imp:n=1

c

c Row 4 Far Right

c

3271 0 1 -2 3 -4 u=227 lat=1

fill=-2:2 -2:2 0:0

8 8 8 9 9

8 8 8 9 9

8 8 8 9 9

7 8 8 8 9

7 8 8 8 9

imp:n=1

c

c

c Surround material

c

3272 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=127 imp:n=1

c

3273 0 7 -16 185 -186 187 -188 fill=227 u=127 imp:n=1

c

c

c Row 3 Blanket- Reflector arrays

c

c Row 3 First Left array

c

3281 0 1 -2 3 -4 u=216 lat=1

fill=-2:2 -2:2 0:0

9 8 8 8 7

9 8 8 8 7

9 9 8 8 8

9 9 8 8 8

9 9 8 8 8

imp:n=1

c

c

c Surround material

c

3282 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=116 imp:n=1

c

3283 0 7 -16 185 -186 187 -188 fill=216 u=116 imp:n=1

c

c Row 3 Far Right

c

3291 0 1 -2 3 -4 u=217 lat=1

fill=-2:2 -2:2 0:0

7 8 8 8 9

7 8 8 8 9

8 8 8 9 9

8 8 8 9 9

8 8 8 9 9

imp:n=1

c

c

c Surround material

c

3292 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=117 imp:n=1

c

3293 0 7 -16 185 -186 187 -188 fill=217 u=117 imp:n=1

c

c Row 7 Blanket - Reflector arrays

c

c Row 7 First Left array

c

c

3301 0 1 -2 3 -4 u=264 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 8 8

9 9 8 8 8

imp:n=1

c

c

c Surround material

c

3302 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=164 imp:n=1

c

3303 0 7 -16 185 -186 187 -188 fill=264 u=164 imp:n=1

c

c Row 7 Mid-Left

c

3311 0 1 -2 3 -4 u=262 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 8 8

8 8 8 8 8

8 8 8 8 8

8 8 8 7 7

imp:n=1

c

c

c Surround material

c

3312 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=162 imp:n=1

c

3313 0 7 -16 185 -186 187 -188 fill=262 u=162 imp:n=1

c

c Row 7 Central Array

c

3321 0 1 -2 3 -4 u=261 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

8 8 8 8 8

8 8 8 8 8

8 8 8 8 8

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3322 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=161 imp:n=1

c

3323 0 7 -16 185 -186 187 -188 fill=261 u=161 imp:n=1

c

c Row 7 First Right array

c

3331 0 1 -2 3 -4 u=263 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

8 8 9 9 9

8 8 8 8 8

8 8 8 8 8

7 7 8 8 8

imp:n=1

c

c

c Surround material

c

3332 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=163 imp:n=1

c

3333 0 7 -16 185 -186 187 -188 fill=263 u=163 imp:n=1

c

c Row 7 Far Right

c

3341 0 1 -2 3 -4 u=265 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

8 8 9 9 9

8 8 8 9 9

imp:n=1

c

c

c Surround material

c

3342 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=165 imp:n=1

c

3343 0 7 -16 185 -186 187 -188 fill=265 u=165 imp:n=1

c

c Beyond the reflector 5x5 Region 9

c

3351 0 1 -2 3 -4 u=299 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3352 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=199 imp:n=1

c

c

3353 0 7 -16 185 -186 187 -188 fill=299 u=199 imp:n=1

c

c

c

c -----------------------------------------------------------------------

c

c

c ------------- SURFACE CARDS -------------------------------------------

c

c Lattice 2 (Assembly) Elementary cell surfaces

1 px -2.68605

2 px 2.68605

3 py -2.68605

4 py 2.68605

7 pz 0.0 $ Assembly lower limit

8 pz 30.0 $ End Packing, Start Reflector

9 pz 37.60628 $ End Plenum, Start Lower NU

10 pz 67.77878 $ End Lower NU, Start Fuel

c

11 pz 156.96878 $ End Fuel, Start Upper NU for Pin element

c

12 pz 187.271248 $ End Upper NU, Start Top Reflector

13 pz 194.877528 $ End Reflector, Start Packing

16 pz 224.877528 $ Assembly upper limit

c

17 cz 94.9

c

21 px -2.5335 $ Nominal half-width of plates

22 px 2.5335 $ and calandria outer half-width

23 py -2.5335

24 py 2.5335

28 px -2.54 $ Radial shield half-width

29 px 2.54

30 py -2.54

31 py 2.54

c

33 px -2.45 $ inner half-width of calandria

34 px 2.45

35 py -2.45

36 py 2.45

c

c

c subdivisions in the plate element axial blanket and core cells

c

c 9 pz 37.60628 $ axial reflector / axial blanket

41 pz 45.228780

42 pz 57.951780

c 10 pz 67.77878 $ axial blanket / core

43 pz 71.209862

44 pz 74.957944

45 pz 78.706026

46 pz 82.454108

47 pz 86.202190

48 pz 89.950272

49 pz 93.698354

50 pz 97.446436

51 pz 101.194518

52 pz 104.942600

53 pz 108.690682

54 pz 112.438764

55 pz 116.186846

56 pz 119.934928

57 pz 123.683010

58 pz 127.431092

59 pz 131.179174

60 pz 134.927256

61 pz 138.675338

62 pz 142.423420

63 pz 146.171502

64 pz 149.919584

65 pz 153.667666

c

66 pz 157.098748 $ core / axial blanket

c in plate elements (this replaces pz=11)

67 pz 166.925748

68 pz 179.648748

c 12 pz 187.271248 $ axial blanket / reflector

c

c differences in the pin elements ?

c 67 pz 166.925748

c 68 pz 179.648748

c 12 pz 187.271248 $ axial blanket / reflector

c

c Grid plate heights

c

71 pz 31.8

72 pz 62.2

73 pz 162.6

74 pz 193.0

c

c 71 c/z 0 0 0.423 $ fuel pin radius

c 71 c/z 0.6125 0.6125 0.423

c 72 c/z 0 0 0.4305 $ fuel can inner radius

c 73 c/z 0 0 0.488 $ calandria tube inner radius

c 74 c/z 0 0 0.513 $ calandria tube outer radius

c 74 c/z 0.6125 0.6125 0.513

c 75 px 0.0

c 76 px 1.225

c 77 py 0.0

c 78 py 1.225

c 79 cz 1.692

c 80 cz 2.052

c

81 pz 67.77878 $ 0.0

82 pz 68.21878 $ 0.44

83 pz 97.39878 $ 29.62

c 84 pz 97.50878 $ 29.73

85 pz 97.94878 $ 0.44

86 pz 127.12878 $ 29.62

c 87 pz 127.23878 $ 29.73

88 pz 127.67878 $ 0.44

89 pz 156.85878 $ 29.62

90 pz 156.96878 $ 29.73

c

91 c/z -1.785 -1.785 0.423

92 c/z -0.595 -1.785 0.423

93 c/z 0.595 -1.785 0.423

94 c/z 1.785 -1.785 0.423

95 c/z -1.785 -0.595 0.423

96 c/z -0.595 -0.595 0.423

97 c/z 0.595 -0.595 0.423

98 c/z 1.785 -0.595 0.423

99 c/z -1.785 0.595 0.423

100 c/z -0.595 0.595 0.423

101 c/z 0.595 0.595 0.423

102 c/z 1.785 0.595 0.423

103 c/z -1.785 1.785 0.423

104 c/z -0.595 1.785 0.423

105 c/z 0.595 1.785 0.423

106 c/z 1.785 1.785 0.423

c

c

111 c/z -1.785 -1.785 0.513

112 c/z -0.595 -1.785 0.513

113 c/z 0.595 -1.785 0.513

114 c/z 1.785 -1.785 0.513

115 c/z -1.785 -0.595 0.513

116 c/z -0.595 -0.595 0.513

117 c/z 0.595 -0.595 0.513

118 c/z 1.785 -0.595 0.513

119 c/z -1.785 0.595 0.513

120 c/z -0.595 0.595 0.513

121 c/z 0.595 0.595 0.513

122 c/z 1.785 0.595 0.513

123 c/z -1.785 1.785 0.513

124 c/z -0.595 1.785 0.513

125 c/z 0.595 1.785 0.513

126 c/z 1.785 1.785 0.513

c

132 px -2.551 $ sheath inner half-width

133 px 2.551

134 py -2.551

135 py 2.551

136 px -2.6272 $ sheath outer half-width

137 px 2.6272

138 py -2.6272

139 py 2.6272

c

c Widths of plate cores

c \* in plate geometry cores these are 101 to 112

151 px -2.3355 $ Pu plate core width

152 px 2.3355

153 py -2.3355

154 py 2.3355

155 px -2.4255 $ UO2 plate core width

156 px 2.4255

157 py -2.4255

158 py 2.4255

159 px -2.4815 $ Na plate core width

160 px 2.4815

161 py -2.4815

162 py 2.4815

c

c

c coordinates of the elements in 5x5 arrays

c \* in the plate geometry cores these are 81 to 92

c 181 px -8.05815

c 182 px 8.05815

c 183 py -8.05815

c 184 py 8.05815

185 px -13.43025

186 px 13.43025

187 py -13.43025

188 py 13.43025

189 px -13.5635

190 px 13.5635

191 py -13.5635

192 py 13.5635

c

c

c Cell 2 Axial heights

c

401 pz 153.667666

402 pz 153.704013

403 pz 154.245013

404 pz 154.281360

405 pz 154.318010

406 pz 154.876010

407 pz 154.912660

408 pz 154.958360

409 pz 155.194360

410 pz 155.240060

411 pz 155.276407

412 pz 155.817407

413 pz 155.853754

414 pz 155.890404

415 pz 156.448404

416 pz 156.485054

417 pz 156.521401

418 pz 157.062401

419 pz 157.098748

c

c Cell 12 Axial heights

c

501 pz 67.778780

502 pz 67.815127

503 pz 68.356127

504 pz 68.392474

505 pz 68.429124

506 pz 68.987124

507 pz 69.023774

508 pz 69.060121

509 pz 69.601121

510 pz 69.637468

511 pz 69.683168

512 pz 69.919168

513 pz 69.964868

514 pz 70.001518

515 pz 70.559518

516 pz 70.596168

517 pz 70.632515

518 pz 71.173515

519 pz 71.209862

c

c Basic Cell 1 data

c 701 pz 0.000000

c 702 pz 0.036347 $ Na can

c 703 pz 0.577347 $ Na core

c 704 pz 0.613694

c 705 pz 0.650344 $ UO2 can

c 706 pz 1.208344 $ UO2 core

c 707 pz 1.244994

708 pz 1.561994 $ SS

709 pz 1.607694 $ Pu can

710 pz 1.843694 $ Pu core

711 pz 1.889394

712 pz 1.925741 $ Na can

713 pz 2.466741 $ Na core

c 714 pz 2.503088

c 715 pz 2.539738 $ UO2 can

c 716 pz 3.097738 $ UO2 core

c 717 pz 3.134388

c 718 pz 3.170735 $ Na can

c 719 pz 3.711735 $ Na core

c 720 pz 3.748082 $ Cell 1

c

801 pz 0.000000

802 pz 0.036347

803 pz 0.577347 $ Na

804 pz 0.613694

805 pz 0.650344

806 pz 1.208344 $ UO2

807 pz 1.244994

808 pz 1.281341

809 pz 1.822341 $ Na

810 pz 1.858688

811 pz 1.904388

812 pz 2.140388 $ Pu

813 pz 2.186088

814 pz 2.503088 $ SS

815 pz 2.539738

816 pz 3.097738 $ UO2

817 pz 3.134388

818 pz 3.170735

819 pz 3.711735 $ Na

820 pz 3.748082 $ Cell 11

c

c ----------------------------------------------------------------------

c

c

c ------------- TALLY CARDS ---------------------------------------------

c

c --- MATERIALS CARDS ---

c

C MATERIAL 1 Pu metal plate core

m1 92238.31c 6.8782E-07

94238.31c 3.0461E-05

94239.31c 2.8920E-02

94240.31c 6.9095E-03

94241.31c 7.3960E-04

94242.31c 1.8699E-04

95241.31c 4.5718E-04

1001.31c 1.2764E-04

6000.31c 4.2260E-04

7014.31c 2.4215E-05

8016.31c 8.8450E-05

13027.31c 2.2973E-05

14028.31c 1.4158E-05

25055.31c 1.4902E-06

24050.31c 1.5637E-07

24052.31c 3.0155E-06

24053.31c 3.4193E-07

24054.31c 8.5114E-08

26054.31c 9.5478E-07

26056.31c 1.4988E-05

26057.31c 3.4614E-07

26058.31c 4.6065E-09

28058.31c 5.8334E-06

28060.31c 2.2470E-06

28061.31c 9.7676E-08

28062.31c 3.1143E-07

28064.31c 7.9313E-08

31000.31c 2.0166E-03

c total 3.9991E-02

c MATERIAL 2 Pu plate canning

m2 1001.31c 1.3760E-05

6000.31c 1.1393E-04

14028.31c 3.6607E-04

15031.31c 1.3731E-05

24050.31c 4.0848E-04

24052.31c 7.8771E-03

24053.31c 8.9320E-04

24054.31c 2.2234E-04

25055.31c 8.5931E-04

26054.31c 2.0774E-03

26056.31c 3.2611E-02

26057.31c 7.5313E-04

26058.31c 1.0023E-05

28058.31c 2.8351E-03

28060.31c 1.0921E-03

28061.31c 4.7472E-05

28062.31c 1.5136E-04

28064.31c 3.8548E-05

29063.31c 1.1629E-02

29065.31c 4.9839E-03

c total 6.6997E-02

C MATERIAL 3 UO2 plate core

m3 1001.31c 3.1773E-05

6000.31c 1.1808E-05

8016.31c 4.6008E-02

13027.31c 3.3911E-06

14028.31c 2.2967E-05

25055.31c 8.3273E-08

26054.31c 7.6610E-08

26056.31c 1.2026E-06

26057.31c 2.7774E-08

26058.31c 3.6962E-10

28058.31c 8.4906E-07

28060.31c 3.2705E-07

28061.31c 1.4217E-08

28062.31c 4.5329E-08

28064.31c 1.1544E-08

42092.31c 5.0069E-08

42094.31c 3.3379E-08

42095.31c 5.0069E-08

42096.31c 5.0069E-08

42097.31c 3.3379E-08

42098.31c 8.3448E-08

42100.31c 3.3379E-08

92235.31c 1.6544E-04

92238.31c 2.2837E-02

c total 6.9083E-02

c MATERIAL 4 UO2 plate canning

m4 1001.31c 1.9035E-05

6000.31c 1.2831E-04

14028.31c 6.4475E-04

15031.31c 3.5078E-04

16032.31c 3.6041E-05

24050.31c 6.0044E-04

24052.31c 1.1579E-02

24053.31c 1.3129E-03

24054.31c 3.2682E-04

25055.31c 8.5559E-04

26054.31c 2.8235E-03

26056.31c 4.4323E-02

26057.31c 1.0236E-03

26058.31c 1.3622E-05

28058.31c 5.7360E-03

28060.31c 2.2095E-03

28061.31c 9.6046E-05

28062.31c 3.0624E-04

28064.31c 7.7989E-05

c total 7.2463E-02

C MATERIAL 5 sodium plate core

m5 1001.31c 1.3900E-05

8016.31c 5.6492E-06

11023.31c 2.3225E-02

20040.31c 3.6083E-06

26054.31c 9.4595E-09

26056.31c 1.4849E-07

26057.31c 3.4294E-09

26058.31c 4.5639E-11

c total 2.324832E-02

c MATERIAL 6 Sodium plate canning

m6 1001.31c 2.1631E-05

6000.31c 2.9290E-04

14028.31c 6.0867E-04

15031.31c 3.2795E-05

16032.31c 3.3219E-05

24050.31c 6.4128E-04

24052.31c 1.2366E-02

24053.31c 1.4023E-03

24054.31c 3.4905E-04

25055.31c 1.3570E-03

26054.31c 3.2179E-03

26056.31c 5.0514E-02

26057.31c 1.1666E-03

26058.31c 1.5525E-05

28058.31c 4.8322E-03

28060.31c 1.8614E-03

28061.31c 8.0912E-05

28062.31c 2.5798E-04

28064.31c 6.5701E-05

41093.31c 3.1147E-04

c total 7.9429E-02

C MATERIAL 7 40% steel plate

c m7 1001.31c 1.8355E-05

c 6000.31c 8.7794E-05

c 13027.31c 1.1862E-04

c 14028.31c 7.9703E-04

c 15031.31c 4.0018E-05

c 16032.31c 1.4422E-05

c 22048.31c 2.4806E-04

c 24050.31c 6.9120E-04

c 24052.31c 1.3329E-02

c 24053.31c 1.5114E-03

c 24054.31c 3.7622E-04

c 25055.31c 1.4972E-03

c 26054.31c 3.2362E-03

c 26056.31c 5.0801E-02

c 26057.31c 1.1732E-03

c 26058.31c 1.5613E-05

c 28058.31c 5.9891E-03

c 28060.31c 2.3070E-03

c 28061.31c 1.0028E-04

c 28062.31c 3.1975E-04

c 28064.31c 8.1431E-05

c 29063.31c 5.0365E-05

c 41093.31c 4.9781E-06

c 42000.66c 8.0988E-05

c

c 40% ss plate smeared over plate region

c

m7 1001.31c 7.3413E-06

6000.31c 3.5114E-05

13027.31c 4.7443E-05

14028.31c 3.1878E-04

15031.31c 1.6006E-05

16032.31c 5.7682E-06

22048.31c 9.9214E-05

24050.31c 2.7645E-04

24052.31c 5.3311E-03

24053.31c 6.0450E-04

24054.31c 1.5047E-04

25055.31c 5.9882E-04

26054.31c 1.2944E-03

26056.31c 2.0318E-02

26057.31c 4.6923E-04

26058.31c 6.2446E-06

28058.31c 2.3954E-03

28060.31c 9.2271E-04

28061.31c 4.0108E-05

28062.31c 1.2789E-04

28064.31c 3.2569E-05

29063.31c 1.4101E-05

29065.31c 6.0432E-06

41093.31c 1.9910E-06

42092.31c 4.8588E-06

42094.31c 3.2392E-06

42095.31c 4.8588E-06

42096.31c 4.8588E-06

42097.31c 3.2392E-06

42098.31c 8.0980E-06

42100.31c 3.2392E-06

c total 3.3152E-02

c

C MATERIAL 8 U8 metal plate

m8 1001.31c 4.4048E-05

6000.31c 4.9283E-04

14028.31c 2.1076E-04

26054.31c 6.1951E-06

26056.31c 9.7250E-05

26057.31c 2.2459E-06

26058.31c 2.9889E-08

92235.31c 3.3369E-04

92238.31c 4.6021E-02

c total 4.7208E-02

C MATERIAL 9 U2 metal plate

m9 1001.31c 4.3899E-05

6000.31c 4.6047E-04

14028.31c 1.9692E-04

26054.31c 5.7884E-06

26056.31c 9.0866E-05

26057.31c 2.0985E-06

26058.31c 2.7927E-08

92235.31c 3.3962E-04

92238.31c 4.6785E-02

c total 4.7925E-02

c

c radial shield

m12 1001.31c 4.6306E-05

6000.31c 6.8972E-04

14028.31c 3.1158E-04

15031.31c 4.2944E-05

16032.31c 3.7110E-05

25055.31c 7.1275E-04

26054.31c 4.9065E-03

26056.31c 7.4517E-02

26057.31c 1.7491E-03

26058.31c 2.5903E-04

c total 8.32720E-02

c

c radial shield void surround low density

m13 1001.31c 4.6306E-08

6000.31c 6.8972E-07

14028.31c 3.1158E-07

15031.31c 4.2944E-08

16032.31c 3.7110E-08

25055.31c 7.1275E-07

26054.31c 4.9065E-06

26056.31c 7.4517E-05

26057.31c 1.7491E-06

26058.31c 2.5903E-07

c total 8.32720E-05

c

c Axial shield

m14 1001.31c 2.5700E-05

6000.31c 5.1066E-04

13027.31c 1.3989E-04

22048.31c 3.9416E-05

24050.31c 1.2213E-06

24052.31c 2.2823E-05

24053.31c 2.5531E-06

24054.31c 6.2449E-07

25055.31c 3.2634E-04

26054.31c 5.0496E-03

26056.31c 7.6690E-02

26057.31c 1.8001E-03

26058.31c 2.6658E-04

28058.31c 1.2564E-06

28060.31c 4.6968E-07

28061.31c 2.2000E-08

28062.31c 6.2769E-08

28064.31c 1.6774E-08

29063.31c 3.1184E-05

29065.31c 1.3364E-05

42092.31c 1.4753E-06

42094.31c 9.8355E-07

42095.31c 1.4753E-06

42096.31c 1.4753E-06

42097.31c 9.8355E-07

42098.31c 2.4589E-06

42100.31c 9.8355E-07

c total 8.4932E-02

c

c Natural Uranium Breeder

m15 1001.31c 4.4574E-05

6000.31c 4.7140E-04

14028.31c 2.0160E-04

26054.31c 6.1085E-06

26056.31c 9.2771E-05

26057.31c 2.1776E-06

26058.31c 3.2248E-07

92235.31c 3.4209E-04

92238.31c 4.7156E-02

c Total 4.8317E-02

c

c Element top and bottom packing

m16 1001.31c 3.1777E-05

6000.31c 9.9996E-05

13027.31c 8.3095E-06

24050.31c 6.9087E-08

24052.31c 1.2911E-06

24053.31c 1.4442E-07

24054.31c 3.5326E-08

25055.31c 1.0785E-04

26054.31c 1.9605E-03

26056.31c 2.9775E-02

26057.31c 6.9890E-04

26058.31c 1.0350E-04

28058.31c 1.5636E-07

28060.31c 5.8452E-08

28061.31c 2.7378E-09

28062.31c 7.8115E-09

28064.31c 2.0875E-09

29063.31c 6.5270E-06

29065.31c 2.7973E-06

c Total 3.279692E-02

c

c mild steel wrapper material

m17 1001.31c 7.5725E-05

6000.31c 2.3828E-04

13027.31c 1.9802E-05

24050.31c 1.6463E-07

24052.31c 3.0767E-06

24053.31c 3.4414E-07

24054.31c 8.4182E-08

25055.31c 2.5701E-04

26054.31c 4.6718E-03

26056.31c 7.0954E-02

26057.31c 1.6655E-03

26058.31c 2.4664E-04

28058.31c 3.7260E-07

28060.31c 1.3929E-07

28061.31c 6.5242E-09

28062.31c 1.8615E-08

28064.31c 4.9746E-09

29063.31c 1.5554E-05

29065.31c 6.6660E-06

c Total 7.81552E-02

c

c

C MATERIAL 18 U8 metal plate

c m18 1001.31c 4.4048E-05

c 6000.31c 4.9283E-04

c 14028.31c 2.1076E-04

c 26054.31c 6.1951E-06

c 26056.31c 9.7250E-05

c 26057.31c 2.2459E-06

c 26058.31c 2.9889E-08

c 92235.31c 3.3369E-04

c 92238.31c 4.6021E-02

c total 4.7208E-02

c

c Superlattice grid plate

c

m19 1001.31c 2.4442E-04

6000.31c 2.9057E-04

14028.31c 4.3858E-05

15031.31c 1.3256E-05

16032.31c 4.3530E-05

25055.31c 2.5785E-04

26054.31c 4.2756E-03

26056.31c 6.7114E-02

26057.31c 1.5500E-03

26058.31c 2.0627E-04

c Total 19 7.403935E-02

c

c -----------------------------------------------

c

c Element C Pin fuel A and E, Calandria NACLIII

c Pin A

m21 1001.31c 3.2784E-05

8016.31c 4.6624E-02

13027.31c 1.1702E-05

20040.31c 7.8782E-06

26054.31c 3.3046E-07

26056.31c 5.1875E-06

26057.31c 1.1980E-07

26058.31c 1.5943E-08

92234.31c 1.3805E-06

92235.31c 1.4114E-04

92236.31c 7.9324E-07

92238.31c 1.9379E-02

94238.31c 3.7786E-06

94239.31c 2.9689E-03

94240.31c 6.7253E-04

94241.31c 7.0350E-05

94242.31c 1.7488E-05

95241.31c 4.7854E-05

c total 21 6.9985E-02

c

c PinB

c

m22 1001.31c 3.2784E-05

8016.31c 4.6994E-02

14028.31c 9.0199E-06

28058.31c 3.7050E-06

28060.31c 1.4272E-06

28061.31c 6.2038E-08

28062.31c 1.9780E-07

28064.31c 5.0375E-08

92234.31c 1.3177E-06

92235.31c 1.3457E-04

92236.31c 7.4658E-07

92238.31c 1.8472E-02

94238.31c 5.8915E-06

94239.31c 3.7341E-03

94240.31c 9.5200E-04

94241.31c 1.1199E-04

94242.31c 2.7984E-05

95241.31c 5.5789E-05

c total 22 7.0537E-02 F 26 7.1415E-02

c

c Pin C

c

M23 1001.31c 3.2784E-05

8016.31c 4.7434E-02

13027.31c 1.9730E-05

14028.31c 7.9741E-06

26054.31c 4.4958E-07

26056.31c 7.0574E-06

26057.31c 1.6298E-07

26058.31c 2.1690E-08

28058.31c 7.4523E-06

28060.31c 2.8707E-06

28061.31c 1.2478E-07

28062.31c 3.9787E-07

28064.31c 1.0132E-07

92234.31c 1.2863E-06

92235.31c 1.2997E-04

92236.31c 7.3103E-07

92238.31c 1.7843E-02

94238.31c 6.9094E-06

94239.31c 4.4708E-03

94240.31c 1.0602E-03

94241.31c 1.1598E-04

94242.31c 3.0047E-05

95241.31c 5.7784E-05

c total 23 7.1230E-02

c

c Pin D

c

M24 1001.31c 3.2784E-05

8016.31c 4.7314E-02

13027.31c 1.8914E-05

14028.31c 2.5099E-05

20040.31c 1.5940E-05

26054.31c 4.0346E-07

26056.31c 6.3335E-06

26057.31c 1.4627E-07

26058.31c 1.9465E-08

28058.31c 9.6247E-06

28060.31c 3.7075E-06

28061.31c 1.6116E-07

28062.31c 5.1385E-07

28064.31c 1.3086E-07

92234.31c 1.4118E-06

92235.31c 1.4266E-04

92236.31c 7.9324E-07

92238.31c 1.9584E-02

94238.31c 4.7348E-06

94239.31c 3.0189E-03

94240.31c 7.5441E-04

94241.31c 8.8443E-05

94242.31c 2.0961E-05

95241.31c 4.0742E-05

c total 24 7.1085E-02

c

c Pin E

m25 1001.31c 3.2784E-05

8016.31c 4.7317E-02

13027.31c 9.5250E-06

14028.31c 4.5753E-05

20040.31c 3.2062E-05

26054.31c 6.0326E-07

26056.31c 9.4699E-06

26057.31c 2.1870E-07

26058.31c 2.9105E-08

92234.31c 1.1295E-06

92235.31c 1.1465E-04

92236.31c 6.3771E-07

92238.31c 1.5739E-02

94238.31c 9.4851E-06

94239.31c 6.0438E-03

94240.31c 1.5103E-03

94241.31c 1.7707E-04

94242.31c 4.1953E-05

95241.31c 8.1559E-05

c total 25 7.1167E-02

c

C Pin F

M26 1001.31c 3.2784E-05

8016.31c 4.7482E-02

13027.31c 1.4287E-05

20040.31c 6.7514E-05

24050.31c 2.1476E-07

24052.31c 4.1414E-06

24053.31c 4.6961E-07

24054.31c 1.1689E-07

26054.31c 6.7247E-07

26056.31c 1.0556E-05

26057.31c 2.4379E-07

26058.31c 3.2444E-08

28058.31c 1.4905E-06

28060.31c 5.7416E-07

28061.31c 2.4958E-08

28062.31c 7.9577E-08

28064.31c 2.0266E-08

92234.31c 1.1452E-06

92235.31c 1.1526E-04

92236.31c 6.3771E-07

92238.31c 1.5824E-02

94238.31c 9.5005E-06

94239.31c 6.0112E-03

94240.31c 1.5285E-03

94241.31c 1.9723E-04

94242.31c 4.4380E-05

95241.31c 6.8035E-05

C total 26 7.1415E-02

c

c Composition of Calandria end plate regions

m27 14028.31c 5.5206E-04

24050.31c 4.3520E-04

24052.31c 8.3923E-03

24053.31c 9.5162E-04

24054.31c 2.3688E-04

25055.31c 7.7198E-04

26054.31c 2.0795E-03

26056.31c 3.2644E-02

26057.31c 7.5390E-04

26058.31c 1.0033E-04

28058.31c 3.0363E-03

28060.31c 1.1696E-03

28061.31c 5.0841E-05

28062.31c 1.6210E-04

28064.31c 4.1283E-05

c total 5.13781E-02

c

c UO2 Pin UO2PINC

c

M28 1001.31c 3.2784E-05

6000.31c 3.2095E-05

8016.31c 4.7501E-02

13027.31c 2.3812E-05

14028.31c 4.0001E-05

20040.31c 1.2825E-05

26054.31c 6.5324E-08

26056.31c 1.0254E-06

26057.31c 2.3682E-08

26058.31c 3.1516E-09

92234.31c 9.7268E-07

92235.31c 1.7084E-04

92238.31c 2.3588E-02

c total 28 7.14034E-02

c

c --------------------------------------------------------------------------

c Pin clad plus calandria tube combined

c

C Pin PUPINA clad plus tube (was 23)

c

m31 1001.31c 1.0832E-05

6000.31c 5.3887E-05

14028.31c 6.6291E-04

15031.31c 1.5357E-05

16032.31c 9.9700E-06

25055.31c 1.0382E-03

24050.31c 5.3769E-04

24052.31c 1.0369E-02

24053.31c 1.1757E-03

24054.31c 2.9267E-04

26054.31c 2.4695E-03

26056.31c 3.8766E-02

26057.31c 8.9527E-04

26058.31c 1.1914E-04

28058.31c 3.9651E-03

28060.31c 1.5274E-03

28061.31c 6.6392E-05

28062.31c 2.1169E-04

28064.31c 5.3910E-05

c

C Total 31 6.2241E-02

c

C Pin PUPINB clad plus tube

c

m32 1001.31c 9.2847E-06

6000.31c 9.6091E-05

14028.31c 7.8508E-04

15031.31c 1.6869E-05

16032.31c 9.2404E-06

25055.31c 1.0424E-03

24050.31c 4.8064E-04

24052.31c 9.2687E-03

24053.31c 1.0510E-03

24054.31c 2.6162E-04

26054.31c 2.3154E-03

26056.31c 3.6347E-02

26057.31c 8.3939E-04

26058.31c 1.1171E-04

28058.31c 3.9370E-03

28060.31c 1.5166E-03

28061.31c 6.5922E-05

28062.31c 2.1019E-04

28064.31c 5.3529E-05

41093.31c 1.1919E-04

c

C Total 32 5.8537E-02 F 36 6.0033E-02

c

C Pin PUPINC clad plus tube

c

m33 1001.31c 1.0832E-05

6000.31c 5.5189E-05

14028.31c 6.5458E-04

15031.31c 1.4602E-05

16032.31c 9.9700E-06

25055.31c 1.0254E-03

24050.31c 5.3131E-04

24052.31c 1.0246E-02

24053.31c 1.1618E-03

24054.31c 2.8919E-04

26054.31c 2.4419E-03

26056.31c 3.8333E-02

26057.31c 8.8527E-04

26058.31c 1.1781E-04

28058.31c 3.9199E-03

28060.31c 1.5099E-03

28061.31c 6.5635E-05

28062.31c 2.0927E-04

28064.31c 5.3296E-05

c

C Total 33 6.15349E-02

c

c Pin PUPIND can plus tube

c

m34 1001.31c 1.0058E-05

6000.31c 8.1804E-05

13027.31c 2.6012E-06

14028.31c 6.7957E-04

15031.31c 1.3847E-05

16032.31c 3.6474E-06

22048.31c 1.1726E-05

25055.31c 8.7351E-04

27059.31c 1.7202E-06

24050.31c 4.9702E-04

24052.31c 9.5846E-03

24053.31c 1.0868E-03

24054.31c 2.7053E-04

26054.31c 2.3766E-03

26056.31c 3.7307E-02

26057.31c 8.6158E-04

26058.31c 1.1466E-04

28058.31c 3.6114E-03

28060.31c 1.3911E-03

28061.31c 6.0470E-05

28062.31c 1.9281E-04

28064.31c 4.9102E-05

29063.31c 1.7181E-06

29065.31c 7.3632E-07

c 42000.66c 8.9408E-07

42092.31c 1.3357E-07

42094.31c 8.9408E-08

42095.31c 1.3357E-07

42096.31c 1.3357E-07

42097.31c 8.9408E-08

42098.31c 2.2262E-07

42100.31c 8.9408E-08

c

C Total 34 5.9086E-02

c

c Pin PUPINE clad plus tube (Was 24)

m35 1001.31c 1.0058E-05

6000.31c 2.9866E-05

13027.31c 2.6012E-06

14028.31c 7.4068E-04

15031.31c 5.5388E-06

16032.31c 7.0518E-06

22048.31c 1.1726E-05

25055.31c 8.0111E-04

27059.31c 1.7202E-06

24050.31c 5.0041E-04

24052.31c 9.6500E-03

24053.31c 1.0942E-03

24054.31c 2.7238E-04

26054.31c 2.4012E-03

26056.31c 3.7694E-02

26057.31c 8.7052E-04

26058.31c 1.1585E-04

28058.31c 3.7263E-03

28060.31c 1.4354E-03

28061.31c 6.2394E-05

28062.31c 1.9894E-04

28064.31c 5.0664E-05

29063.31c 1.7181E-06

29065.31c 7.3632E-07

c 42000.66c 8.6970E-06

42092.31c 1.3046E-06

42094.31c 8.6970E-07

42095.31c 1.3046E-06

42096.31c 1.3046E-06

42097.31c 8.6970E-07

42098.31c 2.1743E-06

42100.31c 8.6970E-07

c

C Total 35 5.96942E-02

c

C Pin PUPINF can plus tube

c

m36 1001.31c 1.0058E-05

6000.31c 2.9217E-05

13027.31c 1.7341E-06

14028.31c 7.4343E-04

15031.31c 5.5388E-06

16032.31c 7.2951E-06

22048.31c 8.7948E-06

25055.31c 8.0253E-04

27059.31c 1.3232E-06

24050.31c 5.0363E-04

24052.31c 9.7120E-03

24053.31c 1.1013E-03

24054.31c 2.7413E-04

26054.31c 2.4145E-03

26056.31c 3.7903E-02

26057.31c 8.7533E-04

26058.31c 1.1649E-04

28058.31c 3.7525E-03

28060.31c 1.4455E-03

28061.31c 6.2833E-05

28062.31c 2.0034E-04

28064.31c 5.1021E-05

29063.31c 1.2885E-06

29065.31c 5.5221E-07

c 42000.66c 8.6159E-06

42092.31c 1.2924E-06

42094.31c 8.6159E-07

42095.31c 1.2924E-06

42096.31c 1.2924E-06

42097.31c 8.6159E-07

42098.31c 2.1540E-06

42100.31c 8.6159E-07

c

c Total 36 6.0033E-02

c

c -------------------------------------------------------------

c

c Calandria sodium contents

c

C sodium NACLI element A and B

m41 1001.31c 5.5075E-06

8016.31c 6.4605E-06

11023.31c 2.4129E-02

20040.31c 1.1080E-07

26056.31c 3.0847E-07

c total 41 2.41414E-02

c

C sodium NACLIIS element E

m42 1001.31c 1.1205E-05

8016.31c 1.0767E-06

11023.31c 2.4379E-02

20040.31c 9.5521E-08

c total 42 2.43914E-02

C sodium NACLIII element C (was 25)

m43 1001.31c 7.5966E-06

8016.31c 3.5892E-06

11023.31c 2.3888E-02

19039.31c 3.4270E-07

20040.31c 6.6865E-07

c total 43 2.3900E-02

C sodium NACLIV Element J

m44 1001.31c 7.5966E-06

8016.31c 3.5892E-06

11023.31c 2.4037E-02

19039.31c 3.4270E-07

20040.31c 6.6865E-07

c total 44 2.4049E-02

C sodium NACLV Element H

c m45 1001.31c 7.5966E-06

c 8016.31c 3.5892E-06

c 11023.31c 2.3829E-02

c 19039.31c 3.4270E-07

c 20040.31c 6.6865E-07

c total 45 2.3841E-02

c

c ------------------------------------------------------------------

c

C Compositions of Calandria outer walls

c

C Calandria Walls NACLI Element Cell A and B

m51 1001.31c 3.9844E-05

6000.31c 2.8167E-04

14028.31c 6.0229E-04

15031.31c 7.3471E-05

16032.31c 3.6808E-05

25055.31c 1.2214E-03

24050.31c 6.5153E-04

24052.31c 1.2564E-02

24053.31c 1.4247E-03

24054.31c 3.5463E-04

26054.31c 2.8589E-03

26056.31c 4.4878E-02

26057.31c 1.0364E-03

26058.31c 1.3793E-04

28058.31c 4.9315E-03

28060.31c 1.8996E-03

28061.31c 8.2574E-05

28062.31c 2.6328E-04

28064.31c 6.7050E-05

C total 51 7.34056E-02

c

C Calandria walls NACLIIS Element Cell E

c

m52 1001.31c 3.8637E-05

6000.31c 6.5351E-04

14028.31c 9.7623E-04

15031.31c 4.7540E-05

16032.31c 3.3014E-05

22048.31c 2.4400E-04

25055.31c 1.1060E-03

27059.31c 1.1151E-05

24050.31c 6.2481E-04

24052.31c 1.2049E-02

24053.31c 1.3662E-03

24054.31c 3.4009E-04

26054.31c 2.7541E-03

26056.31c 4.3233E-02

26057.31c 9.9842E-04

26058.31c 1.3287E-04

28058.31c 5.0735E-03

28060.31c 1.9543E-03

28061.31c 8.4952E-05

28062.31c 2.7086E-04

28064.31c 6.8981E-05

29063.31c 6.9320E-06

29065.31c 3.1020E-06

c 42000.66c 3.4248E-06

42092.31c 5.1372E-07

42094.31c 3.4248E-07

42095.31c 5.1372E-07

42096.31c 5.1372E-07

42097.31c 3.4248E-07

42098.31c 8.5620E-07

42100.31c 3.4248E-07

C total 52 7.20749E-02

c

c Calandria NACLIII Element Cell C and D (was m28)

c

m53 1001.31c 3.9844E-05

6000.31c 1.5948E-04

14028.31c 7.7474E-04

15031.31c 5.2334E-05

16032.31c 2.4551E-05

25055.31c 8.3089E-04

24050.31c 6.1403E-04

24052.31c 1.1841E-02

24053.31c 1.3427E-03

24054.31c 3.3422E-04

26054.31c 2.9672E-03

26056.31c 4.6578E-02

26057.31c 1.0757E-03

26058.31c 1.4315E-04

28058.31c 5.2186E-03

28060.31c 2.0102E-03

28061.31c 8.7382E-05

28062.31c 2.7861E-04

28064.31c 7.0954E-05

c 42000.66c 2.4862E-05

42092.31c 3.7023E-06

42094.31c 2.4862E-06

42095.31c 3.7023E-06

42096.31c 3.7023E-06

42097.31c 2.4862E-06

42098.31c 6.1705E-06

42100.31c 2.4862E-06

C total 53 7.44684E-02

c

C Calandria NACLIV Element 3J and 3L

m54 1001.31c 3.7430E-05

6000.31c 3.5158E-04

14028.31c 8.2197E-04

15031.31c 6.2274E-05

16032.31c 1.6431E-05

25055.31c 1.0026E-03

24050.31c 5.8931E-04

24052.31c 1.1364E-02

24053.31c 1.2886E-03

24054.31c 3.2077E-04

26054.31c 2.7560E-03

26056.31c 4.3263E-02

26057.31c 9.9912E-04

26058.31c 1.3296E-04

28058.31c 4.3943E-03

28060.31c 1.6927E-03

28061.31c 7.3579E-05

28062.31c 2.3460E-04

28064.31c 5.9746E-05

c 42000.66c 8.8791E-06

42092.31c 1.3319E-06

42094.31c 8.8791E-07

42095.31c 1.3319E-06

42096.31c 1.3319E-06

42097.31c 8.8791E-07

42098.31c 2.2198E-06

42100.31c 8.8791E-07

C Total 54 6.94698E-02

c

C Calandria NACLV Element 3H

c m55 1001.31c 3.8637E-05

c 6000.31c 2.6343E-04

c 14028.31c 6.4389E-04

c 15031.31c 6.8560E-05

c 16032.31c 1.7190E-05

c 25055.31c 9.6934E-04

c 24050.31c 6.0091E-04

c 24052.31c 1.1588E-02

c 24053.31c 1.3140E-03

c 24054.31c 3.2708E-04

c 26054.31c 2.8877E-03

c 26056.31c 4.5330E-02

c 26057.31c 1.0469E-03

c 26058.31c 1.3932E-04

c 28058.31c 4.9377E-03

c 28060.31c 1.9020E-03

c 28061.31c 8.2679E-05

c 28062.31c 2.6362E-04

c 28064.31c 6.7135E-05

c 42092.31c 1.3319E-06

c 42094.31c 8.8791E-07

c 42095.31c 1.3319E-06

c 42096.31c 1.3319E-06

c 42097.31c 8.8791E-07

c 42098.31c 2.2198E-06

c 42100.31c 8.8791E-07

C Total 55 7.2497E-02

c

C Calandria VCLVI

c m56 1001.31c 3.8637E-05

c 6000.31c 2.4762E-04

c 14028.31c 9.5110E-04

c 15031.31c 4.5654E-05

c 16032.31c 2.3793E-05

c 25055.31c 8.6191E-04

c 24050.31c 6.0122E-04

c 24052.31c 1.1594E-02

c 24053.31c 1.3147E-03

c 24054.31c 3.2725E-04

c 26054.31c 2.8292E-03

c 26056.31c 4.4413E-02

c 26057.31c 1.0257E-03

c 26058.31c 1.3650E-04

c 28058.31c 4.6653E-03

c 28060.31c 1.7971E-03

c 28061.31c 7.8117E-05

c 28062.31c 2.4907E-04

c 28064.31c 6.3431E-05

c 42092.31c 3.7023E-06

c 42094.31c 2.4862E-06

c 42095.31c 3.7023E-06

c 42096.31c 3.7023E-06

c 42097.31c 2.4862E-06

c 42098.31c 6.1705E-06

c 42100.31c 2.4862E-06

C Total 56 7.12882E-02

c

c --- MODE CARDS ---

mode n

kcode 10000 1.0 100 1500

ksrc 0.6125 0.6125 77.0 0.6125 -0.6125 87.9

-0.6125 -0.6125 107.0

0.6125 0.6125 117.9 0.6125 -0.6125 137.0

0.6125 0.6125 147.9

-0.6125 0.6125 77.0 -0.6125 -0.6125 87.9

0.6125 0.6125 107.0

-0.6125 0.6125 117.9 -0.6125 -0.6125 137.0

-0.6125 0.6125 147.9

11.4633 -0.6125 77.0 11.4633 -0.6125 87.9

11.4633 -0.6125 107.0

11.4633 -0.6125 117.9 11.4633 -0.6125 137.0

11.4633 -0.6125 147.9

-11.4633 -0.6125 77.0 -11.4633 -0.6125 87.9

-11.4633 -0.6125 107.0

-11.4633 -0.6125 117.9 -11.4633 -0.6125 137.0

-11.4633 -0.6125 147.9

-0.6125 11.4633 77.0 -0.6125 11.4633 87.9

-0.6125 11.4633 107.0

-0.6125 11.4633 117.9 -0.6125 11.4633 137.0

-0.6125 11.4633 147.9

-0.6125 -11.4633 77.0 -0.6125 -11.4633 87.9

-0.6125 -11.4633 107.0

-0.6125 -11.4633 117.9 -0.6125 -11.4633 137.0

-0.6125 -11.4633 147.9

11.4633 11.4633 77.0 11.4633 11.4633 87.9

11.4633 11.4633 107.0

11.4633 11.4633 117.9 11.4633 11.4633 137.0

11.4633 11.4633 147.9

-11.4633 11.4633 77.0 -11.4633 11.4633 87.9

-11.4633 11.4633 107.0

-11.4633 11.4633 117.9 -11.4633 11.4633 137.0

-11.4633 11.4633 147.9

11.4633 -11.4633 77.0 11.4633 -11.4633 87.9

11.4633 -11.4633 107.0

11.4633 -11.4633 117.9 11.4633 -11.4633 137.0

11.4633 -11.4633 147.9

-11.4633 -11.4633 77.0 -11.4633 -11.4633 87.9

-11.4633 -11.4633 107.0

-11.4633 -11.4633 117.9 -11.4633 -11.4633 137.0

-11.4633 -11.4633 147.9

25.9475 0.6125 77.0 25.9475 0.6125 87.9

-25.9475 0.6125 107.0

25.9475 0.6125 117.9 25.9475 0.6125 137.0

25.9475 0.6125 147.9

-25.9475 0.6125 77.0 -25.9475 0.6125 87.9

-25.9475 0.6125 107.0

-25.9475 0.6125 117.9 -25.9475 0.6125 137.0

-25.9475 0.6125 147.9

0.6125 25.9475 77.0 0.6125 25.9475 87.9

0.6125 25.9475 107.0

0.6125 25.9475 117.9 0.6125 25.9475 137.0

0.6125 25.9475 147.9

0.6125 -25.9475 77.0 0.6125 -25.9475 87.9

-25.9475 0.6125 107.0

0.6125 -25.9475 117.9 0.6125 -25.9475 137.0

0.6125 -25.9475 147.9

25.9475 25.9475 77.0 25.9475 25.9475 87.9

25.9475 25.9475 107.0

25.9475 25.9475 117.9 25.9475 25.9475 137.0

25.9475 25.9475 147.9

-25.9475 25.9475 77.0 -25.9475 25.9475 87.9

-25.9475 25.9475 107.0

-25.9475 25.9475 117.9 -25.9475 25.9475 137.0

-25.9475 25.9475 147.9

25.9475 -25.9475 77.0 25.9475 -25.9475 87.9

25.9475 -25.9475 107.0

25.9475 -25.9475 117.9 25.9475 -25.9475 137.0

25.9475 -25.9475 147.9

-25.9475 -25.9475 77.0 -25.9475 -25.9475 87.9

-25.9475 -25.9475 107.0

36.9875 0.6125 77.0 36.9875 0.6125 87.9

36.9875 0.6125 107.0

36.9875 0.6125 117.9 36.9875 0.6125 137.0

36.9875 0.6125 147.9

-36.9875 0.6125 77.0 -36.9875 0.6125 87.9

-36.9875 0.6125 107.0

-36.9875 0.6125 117.9 -36.9875 0.6125 137.0

-36.9875 0.6125 147.9

0.6125 36.9875 77.0 0.6125 36.9875 87.9

0.6125 36.9875 107.0

0.6125 36.9875 117.9 0.6125 36.9875 137.0

0.6125 36.9875 147.9

0.6125 -36.9875 77.0 0.6125 -36.9875 87.9

-36.9875 0.6125 107.0

0.6125 -36.9875 117.9 0.6125 -36.9875 137.0

0.6125 -36.9875 147.9

print

### A4.3 MCNP-JEFF-3.1 Zebra24 Model A

Zebra Assembly 24 superlattice model. Void gaps between elements

c JEFF-3.1

c

c ------- Elements of the assembly ----------------------------------

c

c --- Core Elements with X dummy plates

c Lower padding

111 16 3.279692E-02 -8 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Lower Reflector

112 14 8.4932E-02 8 -9 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Lower section of the NatU Blanket

113 15 4.8317E-02 9 -41 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

114 9 4.7925E-02 41 -42 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

115 8 4.7208E-02 42 -10 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c

c Fuelled section

c

c Lowest core Cell, Cell 12

c

c Na dummy region. The X ring

121 0 10 -504 -109 u=1 imp:n=1

C Steel region

122 6 8.84628E-02 10 -504 109 -110 u=1 imp:n=1 TMP=2.5301E-08

c

123 0 10 -504 21 -22 23 -24 110 u=1 imp:n=1

c

c UO2 core

127 3 6.9083E-02 505 -506 105 -106 107 -108 u=1 imp:n=1 TMP=2.5301E-08

c UO2 plate can

128 4 7.2463E-02 504 -507 21 -22 23 -24 &

(-105:106:-107:108:-505:506) u=1 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The X ring

131 0 507 -510 -109 u=1 imp:n=1

C Steel region

132 6 8.84628E-02 507 -510 109 -110 u=1 imp:n=1 TMP=2.5301E-08

c

133 0 507 -510 21 -22 23 -24 110 u=1 imp:n=1

c

C Pu Plate core

135 1 3.9991E-02 101 -102 103 -104 511 -512 u=1 imp:n=1 TMP=2.5301E-08

C Pu canning

136 2 6.6997E-02 510 -513 21 -22 23 -24 &

(-101:102:-103:104:-511:512) u=1 imp:n=1 TMP=2.5301E-08

c

c UO2 core

139 3 6.9083E-02 514 -515 105 -106 107 -108 u=1 imp:n=1 TMP=2.5301E-08

c UO2 plate can

140 4 7.2463E-02 513 -516 21 -22 23 -24 &

(-105:106:-107:108:-514:515) u=1 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The X ring

143 0 516 -43 -109 u=1 imp:n=1

C Steel region

144 6 8.84628E-02 516 -43 109 -110 u=1 imp:n=1 TMP=2.5301E-08

c

145 0 516 -43 21 -22 23 -24 110 u=1 imp:n=1

c

c Insert the 22 central region core cells

c

151 0 43 -44 21 -22 23 -24 fill=3 (0 0 71.21678) u=1 imp:n=1

c

152 0 44 -45 21 -22 23 -24 fill=4 (0 0 74.97178) u=1 imp:n=1

c

c

153 0 45 -46 21 -22 23 -24 fill=3 (0 0 78.72678) u=1 imp:n=1

c

154 0 46 -47 21 -22 23 -24 fill=4 (0 0 82.48178) u=1 imp:n=1

c

c

155 0 47 -48 21 -22 23 -24 fill=3 (0 0 86.23678) u=1 imp:n=1

c

156 0 48 -49 21 -22 23 -24 fill=4 (0 0 89.99178) u=1 imp:n=1

c

c

157 0 49 -50 21 -22 23 -24 fill=3 (0 0 93.74678) u=1 imp:n=1

c

158 0 50 -51 21 -22 23 -24 fill=4 (0 0 97.50178) u=1 imp:n=1

c

c

159 0 51 -52 21 -22 23 -24 fill=3 (0 0 101.25678) u=1 imp:n=1

c

160 0 52 -53 21 -22 23 -24 fill=4 (0 0 105.01178) u=1 imp:n=1

c

c

161 0 53 -54 21 -22 23 -24 fill=3 (0 0 108.76678) u=1 imp:n=1

c

162 0 54 -55 21 -22 23 -24 fill=4 (0 0 112.52178) u=1 imp:n=1

c

c

163 0 55 -56 21 -22 23 -24 fill=3 (0 0 116.27678) u=1 imp:n=1

c

164 0 56 -57 21 -22 23 -24 fill=4 (0 0 120.03178) u=1 imp:n=1

c

c

165 0 57 -58 21 -22 23 -24 fill=3 (0 0 123.78678) u=1 imp:n=1

c

166 0 58 -59 21 -22 23 -24 fill=4 (0 0 127.54178) u=1 imp:n=1

c

c

167 0 59 -60 21 -22 23 -24 fill=3 (0 0 131.29678) u=1 imp:n=1

c

168 0 60 -61 21 -22 23 -24 fill=4 (0 0 135.05178) u=1 imp:n=1

c

c

169 0 61 -62 21 -22 23 -24 fill=3 (0 0 138.80678) u=1 imp:n=1

c

170 0 62 -63 21 -22 23 -24 fill=4 (0 0 142.56178) u=1 imp:n=1

c

c

171 0 63 -64 21 -22 23 -24 fill=3 (0 0 146.31678) u=1 imp:n=1

c

172 0 64 -65 21 -22 23 -24 fill=4 (0 0 150.07178) u=1 imp:n=1

c

c

c The top core cell, Cell 2

c

c Na dummy region. The X ring

175 0 65 -404 -109 u=1 imp:n=1

C Steel region

176 6 8.84628E-02 65 -404 109 -110 u=1 imp:n=1 TMP=2.5301E-08

c

177 0 65 -404 21 -22 23 -24 110 u=1 imp:n=1

c

c UO2 core

178 3 6.9083E-02 405 -406 105 -106 107 -108 u=1 imp:n=1 TMP=2.5301E-08

c UO2 plate can

179 4 7.2463E-02 404 -407 21 -22 23 -24 &

(-105:106:-107:108:-405:406) u=1 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

180 1 3.9991E-02 101 -102 103 -104 408 -409 u=1 imp:n=1 &

TMP=2.5301E-08

C Pu canning

181 2 6.6997E-02 407 -410 21 -22 23 -24 &

(-101:102:-103:104:-408:409) u=1 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The X ring

182 0 410 -413 -109 u=1 imp:n=1

C Steel region

183 6 8.84628E-02 410 -413 109 -110 u=1 imp:n=1 TMP=2.5301E-08

c

184 0 410 -413 21 -22 23 -24 110 u=1 imp:n=1

c

c UO2 core

185 3 6.9083E-02 414 -415 105 -106 107 -108 u=1 imp:n=1 TMP=2.5301E-08

c UO2 plate can

186 4 7.2463E-02 413 -416 21 -22 23 -24 &

(-105:106:-107:108:-414:415) u=1 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The X ring

187 0 416 -11 -109 u=1 imp:n=1

C Steel region

188 6 8.84628E-02 416 -11 109 -110 u=1 imp:n=1 TMP=2.5301E-08

c

189 0 416 -11 21 -22 23 -24 110 u=1 imp:n=1

c

c

c Upper Axial blanket.

c

191 8 4.7208E-02 11 -67 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

192 9 4.7925E-02 67 -68 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

193 15 4.8317E-02 68 -12 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c

c Upper Reflector

194 14 8.4932E-02 12 -13 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Upper padding

195 16 3.279692E-02 13 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Wrapper region

c gap between plates and wrapper

196 0 32 -33 34 -35 (-21:22:-23:24) u=1 imp:n=1

c Wrapper

197 17 7.81552E-02 36 -37 38 -39 (-32:33:-34:35) u=1 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

198 0 1 -2 3 -4 (-36:37:-38:39) u=1 imp:n=1

c

c -------------------------------------------------------

c

c --- Core Elements with Y dummy plates

c Lower padding

211 16 3.279692E-02 -8 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Lower Reflector

212 14 8.4932E-02 8 -9 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Lower section of the NatU Blanket

213 15 4.8317E-02 9 -41 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

214 9 4.7925E-02 41 -42 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

215 8 4.7208E-02 42 -10 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c

c Fuelled section

c

c Lowest core Cell, Cell 12

c

c Na dummy region. The Y ring

221 0 10 -504 -109 u=2 imp:n=1

C Steel region

222 10 8.84614E-02 10 -504 109 -110 u=2 imp:n=1 TMP=2.5301E-08

c

223 0 10 -504 21 -22 23 -24 110 u=2 imp:n=1

c

c UO2 core

227 3 6.9083E-02 505 -506 105 -106 107 -108 u=2 imp:n=1 TMP=2.5301E-08

c UO2 plate can

228 4 7.2463E-02 504 -507 21 -22 23 -24 &

(-105:106:-107:108:-505:506) u=2 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

231 0 507 -510 -109 u=2 imp:n=1

C Steel region

232 10 8.84614E-02 507 -510 109 -110 u=2 imp:n=1 TMP=2.5301E-08

c

233 0 507 -510 21 -22 23 -24 110 u=2 imp:n=1

c

C Pu Plate core

235 1 3.9991E-02 101 -102 103 -104 511 -512 u=2 imp:n=1 TMP=2.5301E-08

C Pu canning

236 2 6.6997E-02 510 -513 21 -22 23 -24 &

(-101:102:-103:104:-511:512) u=2 imp:n=1 TMP=2.5301E-08

c

c UO2 core

239 3 6.9083E-02 514 -515 105 -106 107 -108 u=2 imp:n=1 TMP=2.5301E-08

c UO2 plate can

240 4 7.2463E-02 513 -516 21 -22 23 -24 &

(-105:106:-107:108:-514:515) u=2 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

243 0 516 -43 -109 u=2 imp:n=1

C Steel region

244 10 8.84614E-02 516 -43 109 -110 u=2 imp:n=1 TMP=2.5301E-08

c

245 0 516 -43 21 -22 23 -24 110 u=2 imp:n=1

c

c Insert the 22 central region core cells

c

251 0 43 -44 21 -22 23 -24 fill=13 (0 0 71.21678) u=2 imp:n=1

c

252 0 44 -45 21 -22 23 -24 fill=14 (0 0 74.97178) u=2 imp:n=1

c

c

253 0 45 -46 21 -22 23 -24 fill=13 (0 0 78.72678) u=2 imp:n=1

c

254 0 46 -47 21 -22 23 -24 fill=14 (0 0 82.48178) u=2 imp:n=1

c

c

255 0 47 -48 21 -22 23 -24 fill=13 (0 0 86.23678) u=2 imp:n=1

c

256 0 48 -49 21 -22 23 -24 fill=14 (0 0 89.99178) u=2 imp:n=1

c

c

257 0 49 -50 21 -22 23 -24 fill=13 (0 0 93.74678) u=2 imp:n=1

c

258 0 50 -51 21 -22 23 -24 fill=14 (0 0 97.50178) u=2 imp:n=1

c

c

259 0 51 -52 21 -22 23 -24 fill=13 (0 0 101.25678) u=2 imp:n=1

c

260 0 52 -53 21 -22 23 -24 fill=14 (0 0 105.01178) u=2 imp:n=1

c

c

261 0 53 -54 21 -22 23 -24 fill=13 (0 0 108.76678) u=2 imp:n=1

c

262 0 54 -55 21 -22 23 -24 fill=14 (0 0 112.52178) u=2 imp:n=1

c

c

263 0 55 -56 21 -22 23 -24 fill=13 (0 0 116.27678) u=2 imp:n=1

c

264 0 56 -57 21 -22 23 -24 fill=14 (0 0 120.03178) u=2 imp:n=1

c

c

265 0 57 -58 21 -22 23 -24 fill=13 (0 0 123.78678) u=2 imp:n=1

c

266 0 58 -59 21 -22 23 -24 fill=14 (0 0 127.54178) u=2 imp:n=1

c

c

267 0 59 -60 21 -22 23 -24 fill=13 (0 0 131.29678) u=2 imp:n=1

c

268 0 60 -61 21 -22 23 -24 fill=14 (0 0 135.05178) u=2 imp:n=1

c

c

269 0 61 -62 21 -22 23 -24 fill=13 (0 0 138.80678) u=2 imp:n=1

c

270 0 62 -63 21 -22 23 -24 fill=14 (0 0 142.56178) u=2 imp:n=1

c

c

271 0 63 -64 21 -22 23 -24 fill=13 (0 0 146.31678) u=2 imp:n=1

c

272 0 64 -65 21 -22 23 -24 fill=14 (0 0 150.07178) u=2 imp:n=1

c

c

c The top core cell, Cell 2

c

c Na dummy region. The Y ring

275 0 65 -404 -109 u=2 imp:n=1

C Steel region

276 10 8.84614E-02 65 -404 109 -110 u=2 imp:n=1 TMP=2.5301E-08

c

277 0 65 -404 21 -22 23 -24 110 u=2 imp:n=1

c

c UO2 core

278 3 6.9083E-02 405 -406 105 -106 107 -108 u=2 imp:n=1 TMP=2.5301E-08

c UO2 plate can

279 4 7.2463E-02 404 -407 21 -22 23 -24 &

(-105:106:-107:108:-405:406) u=2 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

280 1 3.9991E-02 101 -102 103 -104 408 -409 u=2 imp:n=1 &

TMP=2.5301E-08

C Pu canning

281 2 6.6997E-02 407 -410 21 -22 23 -24 &

(-101:102:-103:104:-408:409) u=2 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

282 0 410 -413 -109 u=2 imp:n=1

C Steel region

283 10 8.84614E-02 410 -413 109 -110 u=2 imp:n=1 TMP=2.5301E-08

c

284 0 410 -413 21 -22 23 -24 110 u=2 imp:n=1

c

c UO2 core

285 3 6.9083E-02 414 -415 105 -106 107 -108 u=2 imp:n=1 TMP=2.5301E-08

c UO2 plate can

286 4 7.2463E-02 413 -416 21 -22 23 -24 &

(-105:106:-107:108:-414:415) u=2 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

287 0 416 -11 -109 u=2 imp:n=1

C Steel region

288 10 8.84614E-02 416 -11 109 -110 u=2 imp:n=1 TMP=2.5301E-08

c

289 0 416 -11 21 -22 23 -24 110 u=2 imp:n=1

c

c

c Upper Axial blanket.

c

291 8 4.7208E-02 11 -67 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

292 9 4.7925E-02 67 -68 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

293 15 4.8317E-02 68 -12 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c

c Upper Reflector

294 14 8.4932E-02 12 -13 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Upper padding

295 16 3.279692E-02 13 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Wrapper region

c gap between plates and wrapper

296 0 32 -33 34 -35 (-21:22:-23:24) u=2 imp:n=1

c Wrapper

297 17 7.81552E-02 36 -37 38 -39 (-32:33:-34:35) u=2 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

298 0 1 -2 3 -4 (-36:37:-38:39) u=2 imp:n=1

c

c ----------------------------------------------------------------

c

c --- Core Elements with Honeycomb dummy plates

c Lower padding

311 16 3.279692E-02 -8 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Lower Reflector

312 14 8.4932E-02 8 -9 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Lower section of the NatU Blanket

313 15 4.8317E-02 9 -41 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

314 9 4.7925E-02 41 -42 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

315 8 4.7208E-02 42 -10 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c

c Fuelled section

c

c Lowest core Cell, Cell 12

c

c

c Na dummy region.

322 11 1.216928E-02 10 -504 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c

c UO2 core

327 3 6.9083E-02 505 -506 105 -106 107 -108 u=5 imp:n=1 TMP=2.5301E-08

c UO2 plate can

328 4 7.2463E-02 504 -507 21 -22 23 -24 &

(-105:106:-107:108:-505:506) u=5 imp:n=1 TMP=2.5301E-08

c

c Na dummy region.

332 11 1.216928E-02 507 -510 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

335 1 3.9991E-02 101 -102 103 -104 511 -512 u=5 imp:n=1 TMP=2.5301E-08

C Pu canning

336 2 6.6997E-02 510 -513 21 -22 23 -24 &

(-101:102:-103:104:-511:512) u=5 imp:n=1 TMP=2.5301E-08

c

c UO2 core

339 3 6.9083E-02 514 -515 105 -106 107 -108 u=5 imp:n=1 TMP=2.5301E-08

c UO2 plate can

340 4 7.2463E-02 513 -516 21 -22 23 -24 &

(-105:106:-107:108:-514:515) u=5 imp:n=1 TMP=2.5301E-08

c

c Na dummy region.

344 11 1.216928E-02 516 -43 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c

c

c Insert the 22 central region core cells

c

351 0 43 -44 21 -22 23 -24 fill=23 (0 0 71.21678) u=5 imp:n=1

c

352 0 44 -45 21 -22 23 -24 fill=24 (0 0 74.97178) u=5 imp:n=1

c

c

353 0 45 -46 21 -22 23 -24 fill=23 (0 0 78.72678) u=5 imp:n=1

c

354 0 46 -47 21 -22 23 -24 fill=24 (0 0 82.48178) u=5 imp:n=1

c

c

355 0 47 -48 21 -22 23 -24 fill=23 (0 0 86.23678) u=5 imp:n=1

c

356 0 48 -49 21 -22 23 -24 fill=24 (0 0 89.99178) u=5 imp:n=1

c

c

357 0 49 -50 21 -22 23 -24 fill=23 (0 0 93.74678) u=5 imp:n=1

c

358 0 50 -51 21 -22 23 -24 fill=24 (0 0 97.50178) u=5 imp:n=1

c

c

359 0 51 -52 21 -22 23 -24 fill=23 (0 0 101.25678) u=5 imp:n=1

c

360 0 52 -53 21 -22 23 -24 fill=24 (0 0 105.01178) u=5 imp:n=1

c

c

361 0 53 -54 21 -22 23 -24 fill=23 (0 0 108.76678) u=5 imp:n=1

c

362 0 54 -55 21 -22 23 -24 fill=24 (0 0 112.52178) u=5 imp:n=1

c

c

363 0 55 -56 21 -22 23 -24 fill=23 (0 0 116.27678) u=5 imp:n=1

c

364 0 56 -57 21 -22 23 -24 fill=24 (0 0 120.03178) u=5 imp:n=1

c

c

365 0 57 -58 21 -22 23 -24 fill=23 (0 0 123.78678) u=5 imp:n=1

c

366 0 58 -59 21 -22 23 -24 fill=24 (0 0 127.54178) u=5 imp:n=1

c

c

367 0 59 -60 21 -22 23 -24 fill=23 (0 0 131.29678) u=5 imp:n=1

c

368 0 60 -61 21 -22 23 -24 fill=24 (0 0 135.05178) u=5 imp:n=1

c

c

369 0 61 -62 21 -22 23 -24 fill=23 (0 0 138.80678) u=5 imp:n=1

c

370 0 62 -63 21 -22 23 -24 fill=24 (0 0 142.56178) u=5 imp:n=1

c

c

371 0 63 -64 21 -22 23 -24 fill=23 (0 0 146.31678) u=5 imp:n=1

c

372 0 64 -65 21 -22 23 -24 fill=24 (0 0 150.07178) u=5 imp:n=1

c

c

c The top core cell, Cell 2

c

c Na dummy region.

376 11 1.216928E-02 65 -404 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c

c UO2 core

378 3 6.9083E-02 405 -406 105 -106 107 -108 u=5 imp:n=1 TMP=2.5301E-08

c UO2 plate can

379 4 7.2463E-02 404 -407 21 -22 23 -24 &

(-105:106:-107:108:-405:406) u=5 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

380 1 3.9991E-02 101 -102 103 -104 408 -409 u=5 imp:n=1 &

TMP=2.5301E-08

C Pu canning

381 2 6.6997E-02 407 -410 21 -22 23 -24 &

(-101:102:-103:104:-408:409) u=5 imp:n=1 TMP=2.5301E-08

c

c Na dummy region.

383 11 1.216928E-02 410 -413 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c

c UO2 core

385 3 6.9083E-02 414 -415 105 -106 107 -108 u=5 imp:n=1 TMP=2.5301E-08

c UO2 plate can

386 4 7.2463E-02 413 -416 21 -22 23 -24 &

(-105:106:-107:108:-414:415) u=5 imp:n=1 TMP=2.5301E-08

c

c Na dummy region.

388 11 1.216928E-02 416 -11 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c

c

c Upper Axial blanket.

c

391 8 4.7208E-02 11 -67 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

392 9 4.7925E-02 67 -68 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

393 15 4.8317E-02 68 -12 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c

c Upper Reflector

394 14 8.4932E-02 12 -13 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Upper padding

395 16 3.279692E-02 13 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Wrapper region

c gap between plates and wrapper

396 0 32 -33 34 -35 (-21:22:-23:24) u=5 imp:n=1

c Wrapper

397 17 7.81552E-02 36 -37 38 -39 (-32:33:-34:35) u=5 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

398 0 1 -2 3 -4 (-36:37:-38:39) u=5 imp:n=1

c

c --------------------------------------------------------------

c

c --- Radial Blanket Elements

c

c Lower padding

1211 like 111 but u=6 imp:n=1 TMP=2.5301E-08

c Lower Reflector

1212 like 112 but u=6 imp:n=1 TMP=2.5301E-08

c Radial blanket

1214 15 4.8317E-02 9 -12 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Upper reflector

1216 like 194 but u=6 imp:n=1 TMP=2.5301E-08

c Upper padding

1217 like 195 but u=6 imp:n=1 TMP=2.5301E-08

c Wrapper region

1257 like 196 but u=6 imp:n=1

1258 like 197 but u=6 imp:n=1

1259 like 198 but u=6 imp:n=1

c

c

c --- Radial shield

c

1326 12 8.32720E-02 28 -29 30 -31 u=7 imp:n=1 TMP=2.5301E-08

c

1327 13 8.32720E-05 1 -2 3 -4 (-28:29:-30:31) u=7 imp:n=1 &

TMP=2.5301E-08

c

c Low density surround material

c

1400 13 8.32720E-05 1 -2 3 -4 u=9 imp:n=1 TMP=2.5301E-08

c

c --- Assembly

c

1419 0 89 -90 91 -92 u=10 lat=1

fill=-3:3 -3:3 0:0

201 135 134 133 132 131 201

138 115 118 109 119 114 137

168 111 108 129 107 119 167

158 106 141 101 126 105 157

148 117 104 142 103 111 147

128 113 117 102 116 112 127

201 125 124 123 122 121 201

imp:n=1

c

c --- Fuel Region

c

1429 0 7 -16 -17 fill=10 imp:n=1

c --- Universe

1430 0 (-7:16:17) imp:n=0

c

c ------------- CELL CARDS ----------------------------------------------

c

c The First Regular cell. Cell 1 with the X ring

c

c Na dummy region. The X ring

2161 0 801 -804 -109 u=3 imp:n=1

C Steel region

2162 6 8.84628E-02 801 -804 109 -110 u=3 imp:n=1 TMP=2.5301E-08

c

2163 0 801 -804 21 -22 23 -24 110 u=3 imp:n=1

c

c UO2 plate

c UO2 core

2167 3 6.9083E-02 805 -806 105 -106 107 -108 u=3 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2168 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-105:106:-107:108:-805:806) u=3 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2170 7 3.3152E-02 807 -708 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2172 1 3.9991E-02 101 -102 103 -104 709 -710 u=3 imp:n=1 TMP=2.5301E-08

C Pu canning

2173 2 6.6997E-02 708 -711 21 -22 23 -24 &

(-101:102:-103:104:-709:710) u=3 imp:n=1 TMP=2.5301E-08

c

c

c Na dummy region. The X ring

2181 0 711 -814 -109 u=3 imp:n=1

C Steel region

2182 6 8.84628E-02 711 -814 109 -110 u=3 imp:n=1 TMP=2.5301E-08

c

2183 0 711 -814 21 -22 23 -24 110 u=3 imp:n=1

c

c UO2 plate

c UO2 core

2187 3 6.9083E-02 815 -816 105 -106 107 -108 u=3 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2188 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-105:106:-107:108:-815:816) u=3 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The X ring

2191 0 817 -820 -109 u=3 imp:n=1

C Steel region

2192 6 8.84628E-02 817 -820 109 -110 u=3 imp:n=1 TMP=2.5301E-08

c

2193 0 817 -820 21 -22 23 -24 110 u=3 imp:n=1

c

c End of Cell 1 beginning of Cell 2

c Na dummy region. The X ring

2201 0 801 -804 -109 u=4 imp:n=1

C Steel region

2202 6 8.84628E-02 801 -804 109 -110 u=4 imp:n=1 TMP=2.5301E-08

c

2203 0 801 -804 21 -22 23 -24 110 u=4 imp:n=1

c

c UO2 plate

c UO2 core

2207 3 6.9083E-02 805 -806 105 -106 107 -108 u=4 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2208 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-105:106:-107:108:-805:806) u=4 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The X ring

2210 0 807 -810 -109 u=4 imp:n=1

C Steel region

2211 6 8.84628E-02 807 -810 109 -110 u=4 imp:n=1 TMP=2.5301E-08

c

2212 0 807 -810 21 -22 23 -24 110 u=4 imp:n=1

c

c Pu plate

C Plate core

2214 1 3.9991E-02 101 -102 103 -104 811 -812 u=4 imp:n=1 TMP=2.5301E-08

C Pu canning

2215 2 6.6997E-02 810 -813 21 -22 23 -24 &

(-101:102:-103:104:-811:812) u=4 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2217 7 3.3152E-02 813 -814 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2219 3 6.9083E-02 815 -816 105 -106 107 -108 u=4 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2220 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-105:106:-107:108:-815:816) u=4 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The X ring

2222 0 817 -820 -109 u=4 imp:n=1

C Steel region

2223 6 8.84628E-02 817 -820 109 -110 u=4 imp:n=1 TMP=2.5301E-08

c

2224 0 817 -820 21 -22 23 -24 110 u=4 imp:n=1

c

c

c ------------- CELL CARDS with the Y ring----------------------------

c

c The First Regular cell. Cell 1 with the Y ring

c

c Na dummy region. The Y ring

2361 0 801 -804 -109 u=13 imp:n=1

C Steel region

2362 10 8.84614E-02 801 -804 109 -110 u=13 imp:n=1 TMP=2.5301E-08

c

2363 0 801 -804 21 -22 23 -24 110 u=13 imp:n=1

c

c UO2 plate

c UO2 core

2367 3 6.9083E-02 805 -806 105 -106 107 -108 u=13 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2368 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-105:106:-107:108:-805:806) u=13 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2370 7 3.3152E-02 807 -708 21 -22 23 -24 u=13 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2372 1 3.9991E-02 101 -102 103 -104 709 -710 u=13 imp:n=1 TMP=2.5301E-08

C Pu canning

2373 2 6.6997E-02 708 -711 21 -22 23 -24 &

(-101:102:-103:104:-709:710) u=13 imp:n=1 TMP=2.5301E-08

c

c

c Na dummy region. The Y ring

2381 0 711 -814 -109 u=13 imp:n=1

C Steel region

2382 10 8.84614E-02 711 -814 109 -110 u=13 imp:n=1 TMP=2.5301E-08

c

2383 0 711 -814 21 -22 23 -24 110 u=13 imp:n=1

c

c UO2 plate

c UO2 core

2387 3 6.9083E-02 815 -816 105 -106 107 -108 u=13 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2388 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-105:106:-107:108:-815:816) u=13 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

2391 0 817 -820 -109 u=13 imp:n=1

C Steel region

2392 10 8.84614E-02 817 -820 109 -110 u=13 imp:n=1 TMP=2.5301E-08

c

2393 0 817 -820 21 -22 23 -24 110 u=13 imp:n=1

c

c End of Cell 1 beginning of Cell 2

c Na dummy region. The Y ring

2401 0 801 -804 -109 u=14 imp:n=1

C Steel region

2402 10 8.84614E-02 801 -804 109 -110 u=14 imp:n=1 TMP=2.5301E-08

c

2403 0 801 -804 21 -22 23 -24 110 u=14 imp:n=1

c

c UO2 plate

c UO2 core

2407 3 6.9083E-02 805 -806 105 -106 107 -108 u=14 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2408 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-105:106:-107:108:-805:806) u=14 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

2410 0 807 -810 -109 u=14 imp:n=1

C Steel region

2411 10 8.84614E-02 807 -810 109 -110 u=14 imp:n=1 TMP=2.5301E-08

c

2412 0 807 -810 21 -22 23 -24 110 u=14 imp:n=1

c

c Pu plate

C Plate core

2414 1 3.9991E-02 101 -102 103 -104 811 -812 u=14 imp:n=1 TMP=2.5301E-08

C Pu canning

2415 2 6.6997E-02 810 -813 21 -22 23 -24 &

(-101:102:-103:104:-811:812) u=14 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2417 7 3.3152E-02 813 -814 21 -22 23 -24 u=14 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2419 3 6.9083E-02 815 -816 105 -106 107 -108 u=14 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2420 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-105:106:-107:108:-815:816) u=14 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

2422 0 817 -820 -109 u=14 imp:n=1

C Steel region

2423 10 8.84614E-02 817 -820 109 -110 u=14 imp:n=1 TMP=2.5301E-08

c

2424 0 817 -820 21 -22 23 -24 110 u=14 imp:n=1

c

c

c

c ------------- REPEAT CELL CARDS With THE HONEYCOMB DUMMY---------

c

c The First Regular cell. Cell 1 with the Honeycomb dummy

c

c Na dummy region.

2562 11 1.216928E-02 801 -804 21 -22 23 -24 u=23 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2567 3 6.9083E-02 805 -806 105 -106 107 -108 u=23 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2568 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-105:106:-107:108:-805:806) u=23 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2570 7 3.3152E-02 807 -708 21 -22 23 -24 u=23 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2572 1 3.9991E-02 101 -102 103 -104 709 -710 u=23 imp:n=1 TMP=2.5301E-08

C Pu canning

2573 2 6.6997E-02 708 -711 21 -22 23 -24 &

(-101:102:-103:104:-709:710) u=23 imp:n=1 TMP=2.5301E-08

c

c

c Na dummy region.

2582 11 1.216928E-02 711 -814 21 -22 23 -24 u=23 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2587 3 6.9083E-02 815 -816 105 -106 107 -108 u=23 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2588 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-105:106:-107:108:-815:816) u=23 imp:n=1 TMP=2.5301E-08

c

c Na dummy region.

2592 11 1.216928E-02 817 -820 21 -22 23 -24 u=23 imp:n=1 TMP=2.5301E-08

c

c End of Cell 1 beginning of Cell 2

c Na dummy region.

2602 11 1.216928E-02 801 -804 21 -22 23 -24 u=24 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2607 3 6.9083E-02 805 -806 105 -106 107 -108 u=24 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2608 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-105:106:-107:108:-805:806) u=24 imp:n=1 TMP=2.5301E-08

c

c Na dummy region.

2611 11 1.216928E-02 807 -810 21 -22 23 -24 u=24 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2614 1 3.9991E-02 101 -102 103 -104 811 -812 u=24 imp:n=1 TMP=2.5301E-08

C Pu canning

2615 2 6.6997E-02 810 -813 21 -22 23 -24 &

(-101:102:-103:104:-811:812) u=24 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2617 7 3.3152E-02 813 -814 21 -22 23 -24 u=24 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2619 3 6.9083E-02 815 -816 105 -106 107 -108 u=24 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2620 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-105:106:-107:108:-815:816) u=24 imp:n=1 TMP=2.5301E-08

c

c Na dummy region.

2623 11 1.216928E-02 817 -820 21 -22 23 -24 u=24 imp:n=1 TMP=2.5301E-08

c

c ----------------------------------------------------------------------

c ----------------------------------------------------------------------

c

c

c

c Form arrays of 5x5 elements

c

c

c Central array of 5x5 core elements

c

3001 0 85 -81 87 -83 fill=1 (-10.7442 -10.7442 0) u=101 imp:n=1

c

3002 0 81 -1 87 -83 fill=1 (-5.3721 -10.7442 0) u=101 imp:n=1

c

3003 0 1 -2 87 -83 fill=1 (0 -10.7442 0) u=101 imp:n=1

c

3004 0 2 -82 87 -83 fill=1 (5.3721 -10.7442 0) u=101 imp:n=1

c

3005 0 82 -86 87 -83 fill=1 (10.7442 -10.7442 0) u=101 imp:n=1

c

c

3006 0 85 -81 83 -3 fill=1 (-10.7442 -5.3721 0) u=101 imp:n=1

c

3007 0 81 -1 83 -3 fill=1 (-5.3721 -5.3721 0) u=101 imp:n=1

c

3008 0 1 -2 83 -3 fill=1 (0 -5.3721 0) u=101 imp:n=1

c

3009 0 2 -82 83 -3 fill=1 (5.3721 -5.3721 0) u=101 imp:n=1

c

3010 0 82 -86 83 -3 fill=1 (10.7442 -5.3721 0) u=101 imp:n=1

c

c

3011 0 85 -81 3 -4 fill=1 (-10.7442 0 0) u=101 imp:n=1

c

3012 0 81 -1 3 -4 fill=1 (-5.3721 0 0) u=101 imp:n=1

c

3013 0 1 -2 3 -4 fill=1 (0 0 0) u=101 imp:n=1

c

3014 0 2 -82 3 -4 fill=1 (5.3721 0 0) u=101 imp:n=1

c

3015 0 82 -86 3 -4 fill=1 (10.7442 0 0) u=101 imp:n=1

c

c

3016 0 85 -81 4 -84 fill=1 (-10.7442 5.3721 0) u=101 imp:n=1

c

3017 0 81 -1 4 -84 fill=1 (-5.3721 5.3721 0) u=101 imp:n=1

c

3018 0 1 -2 4 -84 fill=1 (0 5.3721 0) u=101 imp:n=1

c

3019 0 2 -82 4 -84 fill=1 (5.3721 5.3721 0) u=101 imp:n=1

c

3020 0 82 -86 4 -84 fill=1 (10.7442 5.3721 0) u=101 imp:n=1

c

c

3021 0 85 -81 84 -88 fill=1 (-10.7442 10.7442 0) u=101 imp:n=1

c

3022 0 81 -1 84 -88 fill=1 (-5.3721 10.7442 0) u=101 imp:n=1

c

3023 0 1 -2 84 -88 fill=1 (0 10.7442 0) u=101 imp:n=1

c

3024 0 2 -82 84 -88 fill=1 (5.3721 10.7442 0) u=101 imp:n=1

c

3025 0 82 -86 84 -88 fill=1 (10.7442 10.7442 0) u=101 imp:n=1

c

c Surround material

c

3026 0 89 -90 91 -92 (-85:86:-87:88) -71 u=101 imp:n=1

c

3027 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=101 imp:n=1

c

3028 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=101 imp:n=1

c

3029 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=101 imp:n=1

c

3030 0 89 -90 91 -92 (-85:86:-87:88) 74 u=101 imp:n=1

c

c

c ROW 3

c

c Bottom left array of 5x5 core elements in Row 3

c

3031 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=103 imp:n=1

c

3032 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=103 imp:n=1

c

3033 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=103 imp:n=1

c

3034 0 2 -82 87 -83 fill=5 (5.3721 -10.7442 0) u=103 imp:n=1

c

3035 0 82 -86 87 -83 fill=5 (10.7442 -10.7442 0) u=103 imp:n=1

c

c

3036 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=103 imp:n=1

c

3037 0 81 -1 83 -3 fill=5 (-5.3721 -5.3721 0) u=103 imp:n=1

c

3038 0 1 -2 83 -3 fill=5 (0 -5.3721 0) u=103 imp:n=1

c

3039 0 2 -82 83 -3 fill=2 (5.3721 -5.3721 0) u=103 imp:n=1

c

3040 0 82 -86 83 -3 fill=2 (10.7442 -5.3721 0) u=103 imp:n=1

c

c

3041 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=103 imp:n=1

c

3042 0 81 -1 3 -4 fill=5 (-5.3721 0 0) u=103 imp:n=1

c

3043 0 1 -2 3 -4 fill=2 (0 0 0) u=103 imp:n=1

c

3044 0 2 -82 3 -4 fill=2 (5.3721 0 0) u=103 imp:n=1

c

3045 0 82 -86 3 -4 fill=2 (10.7442 0 0) u=103 imp:n=1

c

c

3046 0 85 -81 4 -84 fill=5 (-10.7442 5.3721 0) u=103 imp:n=1

c

3047 0 81 -1 4 -84 fill=2 (-5.3721 5.3721 0) u=103 imp:n=1

c

3048 0 1 -2 4 -84 fill=2 (0 5.3721 0) u=103 imp:n=1

c

3049 0 2 -82 4 -84 fill=2 (5.3721 5.3721 0) u=103 imp:n=1

c

3050 0 82 -86 4 -84 fill=2 (10.7442 5.3721 0) u=103 imp:n=1

c

c

3051 0 85 -81 84 -88 fill=5 (-10.7442 10.7442 0) u=103 imp:n=1

c

3052 0 81 -1 84 -88 fill=2 (-5.3721 10.7442 0) u=103 imp:n=1

c

3053 0 1 -2 84 -88 fill=2 (0 10.7442 0) u=103 imp:n=1

c

3054 0 2 -82 84 -88 fill=2 (5.3721 10.7442 0) u=103 imp:n=1

c

3055 0 82 -86 84 -88 fill=1 (10.7442 10.7442 0) u=103 imp:n=1

c

c Surround material

c

3056 0 89 -90 91 -92 (-85:86:-87:88) -71 u=103 imp:n=1

c

3057 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=103 imp:n=1

c

3058 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=103 imp:n=1

c

3059 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=103 imp:n=1

c

3060 0 89 -90 91 -92 (-85:86:-87:88) 74 u=103 imp:n=1

c

c

c Bottom right array of 5x5 core elements in Row 3

c

3071 0 85 -81 87 -83 fill=5 (-10.7442 -10.7442 0) u=104 imp:n=1

c

3072 0 81 -1 87 -83 fill=5 (-5.3721 -10.7442 0) u=104 imp:n=1

c

3073 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=104 imp:n=1

c

3074 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=104 imp:n=1

c

3075 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=104 imp:n=1

c

c

3076 0 85 -81 83 -3 fill=2 (-10.7442 -5.3721 0) u=104 imp:n=1

c

3077 0 81 -1 83 -3 fill=2 (-5.3721 -5.3721 0) u=104 imp:n=1

c

3078 0 1 -2 83 -3 fill=5 (0 -5.3721 0) u=104 imp:n=1

c

3079 0 2 -82 83 -3 fill=5 (5.3721 -5.3721 0) u=104 imp:n=1

c

3080 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=104 imp:n=1

c

c

3081 0 85 -81 3 -4 fill=2 (-10.7442 0 0) u=104 imp:n=1

c

3082 0 81 -1 3 -4 fill=2 (-5.3721 0 0) u=104 imp:n=1

c

3083 0 1 -2 3 -4 fill=2 (0 0 0) u=104 imp:n=1

c

3084 0 2 -82 3 -4 fill=5 (5.3721 0 0) u=104 imp:n=1

c

3085 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=104 imp:n=1

c

c

3086 0 85 -81 4 -84 fill=2 (-10.7442 5.3721 0) u=104 imp:n=1

c

3087 0 81 -1 4 -84 fill=2 (-5.3721 5.3721 0) u=104 imp:n=1

c

3088 0 1 -2 4 -84 fill=2 (0 5.3721 0) u=104 imp:n=1

c

3089 0 2 -82 4 -84 fill=2 (5.3721 5.3721 0) u=104 imp:n=1

c

3090 0 82 -86 4 -84 fill=5 (10.7442 5.3721 0) u=104 imp:n=1

c

c

3091 0 85 -81 84 -88 fill=1 (-10.7442 10.7442 0) u=104 imp:n=1

c

3092 0 81 -1 84 -88 fill=2 (-5.3721 10.7442 0) u=104 imp:n=1

c

3093 0 1 -2 84 -88 fill=2 (0 10.7442 0) u=104 imp:n=1

c

3094 0 2 -82 84 -88 fill=2 (5.3721 10.7442 0) u=104 imp:n=1

c

3095 0 82 -86 84 -88 fill=2 (10.7442 10.7442 0) u=104 imp:n=1

c

c Surround material

c

3096 0 89 -90 91 -92 (-85:86:-87:88) -71 u=104 imp:n=1

c

3097 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=104 imp:n=1

c

3098 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=104 imp:n=1

c

3099 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=104 imp:n=1

c

3100 0 89 -90 91 -92 (-85:86:-87:88) 74 u=104 imp:n=1

c

c

c ROW 2

c

c

c Bottom left array of 5x5 core elements in Row 2

c

3131 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=116 imp:n=1

c

3132 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=116 imp:n=1

c

3133 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=116 imp:n=1

c

3134 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=116 imp:n=1

c

3135 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=116 imp:n=1

c

c

3136 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=116 imp:n=1

c

3137 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=116 imp:n=1

c

3138 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=116 imp:n=1

c

3139 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=116 imp:n=1

c

3140 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=116 imp:n=1

c

c

3141 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=116 imp:n=1

c

3142 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=116 imp:n=1

c

3143 0 1 -2 3 -4 fill=6 (0 0 0) u=116 imp:n=1

c

3144 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=116 imp:n=1

c

3145 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=116 imp:n=1

c

c

3146 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=116 imp:n=1

c

3147 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=116 imp:n=1

c

3148 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=116 imp:n=1

c

3149 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=116 imp:n=1

c

3150 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=116 imp:n=1

c

c

3151 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=116 imp:n=1

c

3152 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=116 imp:n=1

c

3153 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=116 imp:n=1

c

3154 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=116 imp:n=1

c

3155 0 82 -86 84 -88 fill=5 (10.7442 10.7442 0) u=116 imp:n=1

c

c Surround material

c

3156 0 89 -90 91 -92 (-85:86:-87:88) -71 u=116 imp:n=1

c

3157 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=116 imp:n=1

c

3158 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=116 imp:n=1

c

3159 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=116 imp:n=1

c

3160 0 89 -90 91 -92 (-85:86:-87:88) 74 u=116 imp:n=1

c

c

c Bottom right array of 5x5 core elements in Row 2

c

3171 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=117 imp:n=1

c

3172 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=117 imp:n=1

c

3173 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=117 imp:n=1

c

3174 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=117 imp:n=1

c

3175 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=117 imp:n=1

c

c

3176 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=117 imp:n=1

c

3177 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=117 imp:n=1

c

3178 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=117 imp:n=1

c

3179 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=117 imp:n=1

c

3180 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=117 imp:n=1

c

c

3181 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=117 imp:n=1

c

3182 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=117 imp:n=1

c

3183 0 1 -2 3 -4 fill=6 (0 0 0) u=117 imp:n=1

c

3184 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=117 imp:n=1

c

3185 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=117 imp:n=1

c

c

3186 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=117 imp:n=1

c

3187 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=117 imp:n=1

c

3188 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=117 imp:n=1

c

3189 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=117 imp:n=1

c

3190 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=117 imp:n=1

c

c

3191 0 85 -81 84 -88 fill=5 (-10.7442 10.7442 0) u=117 imp:n=1

c

3192 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=117 imp:n=1

c

3193 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=117 imp:n=1

c

3194 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=117 imp:n=1

c

3195 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=117 imp:n=1

c

c Surround material

c

3196 0 89 -90 91 -92 (-85:86:-87:88) -71 u=117 imp:n=1

c

3197 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=117 imp:n=1

c

3198 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=117 imp:n=1

c

3199 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=117 imp:n=1

c

3200 0 89 -90 91 -92 (-85:86:-87:88) 74 u=117 imp:n=1

c

c

c Central array of 5x5 core elements in row 2

c

3201 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=102 imp:n=1

c

3202 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=102 imp:n=1

c

3203 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=102 imp:n=1

c

3204 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=102 imp:n=1

c

3205 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=102 imp:n=1

c

c

3206 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=102 imp:n=1

c

3207 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=102 imp:n=1

c

3208 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=102 imp:n=1

c

3209 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=102 imp:n=1

c

3210 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=102 imp:n=1

c

c

3211 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=102 imp:n=1

c

3212 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=102 imp:n=1

c

3213 0 1 -2 3 -4 fill=6 (0 0 0) u=102 imp:n=1

c

3214 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=102 imp:n=1

c

3215 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=102 imp:n=1

c

c

3216 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=102 imp:n=1

c

3217 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=102 imp:n=1

c

3218 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=102 imp:n=1

c

3219 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=102 imp:n=1

c

3220 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=102 imp:n=1

c

c

3221 0 85 -81 84 -88 fill=5 (-10.7442 10.7442 0) u=102 imp:n=1

c

3222 0 81 -1 84 -88 fill=5 (-5.3721 10.7442 0) u=102 imp:n=1

c

3223 0 1 -2 84 -88 fill=5 (0 10.7442 0) u=102 imp:n=1

c

3224 0 2 -82 84 -88 fill=5 (5.3721 10.7442 0) u=102 imp:n=1

c

3225 0 82 -86 84 -88 fill=5 (10.7442 10.7442 0) u=102 imp:n=1

c

c Surround material

c

3226 0 89 -90 91 -92 (-85:86:-87:88) -71 u=102 imp:n=1

c

3227 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=102 imp:n=1

c

3228 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=102 imp:n=1

c

3229 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=102 imp:n=1

c

3230 0 89 -90 91 -92 (-85:86:-87:88) 74 u=102 imp:n=1

c

c

c ROW 4

c

c

c Left edge array of 5x5 core elements in row 4

c

3231 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=105 imp:n=1

c

3232 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=105 imp:n=1

c

3233 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=105 imp:n=1

c

3234 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=105 imp:n=1

c

3235 0 82 -86 87 -83 fill=5 (10.7442 -10.7442 0) u=105 imp:n=1

c

c

3236 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=105 imp:n=1

c

3237 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=105 imp:n=1

c

3238 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=105 imp:n=1

c

3239 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=105 imp:n=1

c

3240 0 82 -86 83 -3 fill=5 (10.7442 -5.3721 0) u=105 imp:n=1

c

c

3241 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=105 imp:n=1

c

3242 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=105 imp:n=1

c

3243 0 1 -2 3 -4 fill=6 (0 0 0) u=105 imp:n=1

c

3244 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=105 imp:n=1

c

3245 0 82 -86 3 -4 fill=5 (10.7442 0 0) u=105 imp:n=1

c

c

3246 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=105 imp:n=1

c

3247 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=105 imp:n=1

c

3248 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=105 imp:n=1

c

3249 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=105 imp:n=1

c

3250 0 82 -86 4 -84 fill=5 (10.7442 5.3721 0) u=105 imp:n=1

c

c

3251 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=105 imp:n=1

c

3252 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=105 imp:n=1

c

3253 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=105 imp:n=1

c

3254 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=105 imp:n=1

c

3255 0 82 -86 84 -88 fill=5 (10.7442 10.7442 0) u=105 imp:n=1

c

c Surround material

c

3256 0 89 -90 91 -92 (-85:86:-87:88) -71 u=105 imp:n=1

c

3257 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=105 imp:n=1

c

3258 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=105 imp:n=1

c

3259 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=105 imp:n=1

c

3260 0 89 -90 91 -92 (-85:86:-87:88) 74 u=105 imp:n=1

c

c

c Right edge array of 5x5 core elements in row 4

c

3261 0 85 -81 87 -83 fill=5 (-10.7442 -10.7442 0) u=106 imp:n=1

c

3262 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=106 imp:n=1

c

3263 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=106 imp:n=1

c

3264 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=106 imp:n=1

c

3265 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=106 imp:n=1

c

c

3266 0 85 -81 83 -3 fill=5 (-10.7442 -5.3721 0) u=106 imp:n=1

c

3267 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=106 imp:n=1

c

3268 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=106 imp:n=1

c

3269 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=106 imp:n=1

c

3270 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=106 imp:n=1

c

c

3271 0 85 -81 3 -4 fill=5 (-10.7442 0 0) u=106 imp:n=1

c

3272 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=106 imp:n=1

c

3273 0 1 -2 3 -4 fill=6 (0 0 0) u=106 imp:n=1

c

3274 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=106 imp:n=1

c

3275 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=106 imp:n=1

c

c

3276 0 85 -81 4 -84 fill=5 (-10.7442 5.3721 0) u=106 imp:n=1

c

3277 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=106 imp:n=1

c

3278 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=106 imp:n=1

c

3279 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=106 imp:n=1

c

3280 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=106 imp:n=1

c

c

3281 0 85 -81 84 -88 fill=5 (-10.7442 10.7442 0) u=106 imp:n=1

c

3282 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=106 imp:n=1

c

3283 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=106 imp:n=1

c

3284 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=106 imp:n=1

c

3285 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=106 imp:n=1

c

c Surround material

c

3286 0 89 -90 91 -92 (-85:86:-87:88) -71 u=106 imp:n=1

c

3287 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=106 imp:n=1

c

3288 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=106 imp:n=1

c

3289 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=106 imp:n=1

c

3290 0 89 -90 91 -92 (-85:86:-87:88) 74 u=106 imp:n=1

c

c

c ROW 5

c

c Left Blanket array with 1 core element

c

3301 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=119 imp:n=1

c

3302 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=119 imp:n=1

c

3303 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=119 imp:n=1

c

3304 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=119 imp:n=1

c

3305 0 82 -86 87 -83 fill=5 (10.7442 -10.7442 0) u=119 imp:n=1

c

c

3306 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=119 imp:n=1

c

3307 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=119 imp:n=1

c

3308 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=119 imp:n=1

c

3309 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=119 imp:n=1

c

3310 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=119 imp:n=1

c

c

3311 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=119 imp:n=1

c

3312 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=119 imp:n=1

c

3313 0 1 -2 3 -4 fill=6 (0 0 0) u=119 imp:n=1

c

3314 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=119 imp:n=1

c

3315 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=119 imp:n=1

c

c

3316 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=119 imp:n=1

c

3317 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=119 imp:n=1

c

3318 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=119 imp:n=1

c

3319 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=119 imp:n=1

c

3320 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=119 imp:n=1

c

c

3321 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=119 imp:n=1

c

3322 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=119 imp:n=1

c

3323 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=119 imp:n=1

c

3324 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=119 imp:n=1

c

3325 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=119 imp:n=1

c

c Surround material

c

3326 0 89 -90 91 -92 (-85:86:-87:88) -71 u=119 imp:n=1

c

3327 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=119 imp:n=1

c

3328 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=119 imp:n=1

c

3329 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=119 imp:n=1

c

3330 0 89 -90 91 -92 (-85:86:-87:88) 74 u=119 imp:n=1

c

c

c Top left array of 5x5 core elements in Row 5

c

3331 0 85 -81 87 -83 fill=5 (-10.7442 -10.7442 0) u=107 imp:n=1

c

3332 0 81 -1 87 -83 fill=2 (-5.3721 -10.7442 0) u=107 imp:n=1

c

3333 0 1 -2 87 -83 fill=2 (0 -10.7442 0) u=107 imp:n=1

c

3334 0 2 -82 87 -83 fill=2 (5.3721 -10.7442 0) u=107 imp:n=1

c

3335 0 82 -86 87 -83 fill=1 (10.7442 -10.7442 0) u=107 imp:n=1

c

c

3336 0 85 -81 83 -3 fill=5 (-10.7442 -5.3721 0) u=107 imp:n=1

c

3337 0 81 -1 83 -3 fill=2 (-5.3721 -5.3721 0) u=107 imp:n=1

c

3338 0 1 -2 83 -3 fill=2 (0 -5.3721 0) u=107 imp:n=1

c

3339 0 2 -82 83 -3 fill=2 (5.3721 -5.3721 0) u=107 imp:n=1

c

3340 0 82 -86 83 -3 fill=2 (10.7442 -5.3721 0) u=107 imp:n=1

c

c

3341 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=107 imp:n=1

c

3342 0 81 -1 3 -4 fill=5 (-5.3721 0 0) u=107 imp:n=1

c

3343 0 1 -2 3 -4 fill=2 (0 0 0) u=107 imp:n=1

c

3344 0 2 -82 3 -4 fill=2 (5.3721 0 0) u=107 imp:n=1

c

3345 0 82 -86 3 -4 fill=2 (10.7442 0 0) u=107 imp:n=1

c

c

3346 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=107 imp:n=1

c

3347 0 81 -1 4 -84 fill=5 (-5.3721 5.3721 0) u=107 imp:n=1

c

3348 0 1 -2 4 -84 fill=5 (0 5.3721 0) u=107 imp:n=1

c

3349 0 2 -82 4 -84 fill=2 (5.3721 5.3721 0) u=107 imp:n=1

c

3350 0 82 -86 4 -84 fill=2 (10.7442 5.3721 0) u=107 imp:n=1

c

c

3351 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=107 imp:n=1

c

3352 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=107 imp:n=1

c

3353 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=107 imp:n=1

c

3354 0 2 -82 84 -88 fill=5 (5.3721 10.7442 0) u=107 imp:n=1

c

3355 0 82 -86 84 -88 fill=5 (10.7442 10.7442 0) u=107 imp:n=1

c

c Surround material

c

3356 0 89 -90 91 -92 (-85:86:-87:88) -71 u=107 imp:n=1

c

3357 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=107 imp:n=1

c

3358 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=107 imp:n=1

c

3359 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=107 imp:n=1

c

3360 0 89 -90 91 -92 (-85:86:-87:88) 74 u=107 imp:n=1

c

c Top right array of 5x5 core elements in Row 5

c

3371 0 85 -81 87 -83 fill=1 (-10.7442 -10.7442 0) u=108 imp:n=1

c

3372 0 81 -1 87 -83 fill=2 (-5.3721 -10.7442 0) u=108 imp:n=1

c

3373 0 1 -2 87 -83 fill=2 (0 -10.7442 0) u=108 imp:n=1

c

3374 0 2 -82 87 -83 fill=2 (5.3721 -10.7442 0) u=108 imp:n=1

c

3375 0 82 -86 87 -83 fill=5 (10.7442 -10.7442 0) u=108 imp:n=1

c

c

3376 0 85 -81 83 -3 fill=2 (-10.7442 -5.3721 0) u=108 imp:n=1

c

3377 0 81 -1 83 -3 fill=2 (-5.3721 -5.3721 0) u=108 imp:n=1

c

3378 0 1 -2 83 -3 fill=2 (0 -5.3721 0) u=108 imp:n=1

c

3379 0 2 -82 83 -3 fill=2 (5.3721 -5.3721 0) u=108 imp:n=1

c

3380 0 82 -86 83 -3 fill=5 (10.7442 -5.3721 0) u=108 imp:n=1

c

c

3381 0 85 -81 3 -4 fill=2 (-10.7442 0 0) u=108 imp:n=1

c

3382 0 81 -1 3 -4 fill=2 (-5.3721 0 0) u=108 imp:n=1

c

3383 0 1 -2 3 -4 fill=2 (0 0 0) u=108 imp:n=1

c

3384 0 2 -82 3 -4 fill=5 (5.3721 0 0) u=108 imp:n=1

c

3385 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=108 imp:n=1

c

c

3386 0 85 -81 4 -84 fill=2 (-10.7442 5.3721 0) u=108 imp:n=1

c

3387 0 81 -1 4 -84 fill=2 (-5.3721 5.3721 0) u=108 imp:n=1

c

3388 0 1 -2 4 -84 fill=5 (0 5.3721 0) u=108 imp:n=1

c

3389 0 2 -82 4 -84 fill=5 (5.3721 5.3721 0) u=108 imp:n=1

c

3390 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=108 imp:n=1

c

c

3391 0 85 -81 84 -88 fill=5 (-10.7442 10.7442 0) u=108 imp:n=1

c

3392 0 81 -1 84 -88 fill=5 (-5.3721 10.7442 0) u=108 imp:n=1

c

3393 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=108 imp:n=1

c

3394 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=108 imp:n=1

c

3395 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=108 imp:n=1

c

c Surround material

c

3396 0 89 -90 91 -92 (-85:86:-87:88) -71 u=108 imp:n=1

c

3397 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=108 imp:n=1

c

3398 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=108 imp:n=1

c

3399 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=108 imp:n=1

c

3400 0 89 -90 91 -92 (-85:86:-87:88) 74 u=108 imp:n=1

c

c ROW 6

c

c Top central group

c

c

3401 0 85 -81 87 -83 fill=5 (-10.7442 -10.7442 0) u=109 imp:n=1

c

3402 0 81 -1 87 -83 fill=5 (-5.3721 -10.7442 0) u=109 imp:n=1

c

3403 0 1 -2 87 -83 fill=5 (0 -10.7442 0) u=109 imp:n=1

c

3404 0 2 -82 87 -83 fill=5 (5.3721 -10.7442 0) u=109 imp:n=1

c

3405 0 82 -86 87 -83 fill=5 (10.7442 -10.7442 0) u=109 imp:n=1

c

c

3406 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=109 imp:n=1

c

3407 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=109 imp:n=1

c

3408 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=109 imp:n=1

c

3409 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=109 imp:n=1

c

3410 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=109 imp:n=1

c

c

3411 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=109 imp:n=1

c

3412 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=109 imp:n=1

c

3413 0 1 -2 3 -4 fill=6 (0 0 0) u=109 imp:n=1

c

3414 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=109 imp:n=1

c

3415 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=109 imp:n=1

c

c

3416 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=109 imp:n=1

c

3417 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=109 imp:n=1

c

3418 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=109 imp:n=1

c

3419 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=109 imp:n=1

c

3420 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=109 imp:n=1

c

c

3421 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=109 imp:n=1

c

3422 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=109 imp:n=1

c

3423 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=109 imp:n=1

c

3424 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=109 imp:n=1

c

3425 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=109 imp:n=1

c

c Surround material

c

3426 0 89 -90 91 -92 (-85:86:-87:88) -71 u=109 imp:n=1

c

3427 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=109 imp:n=1

c

3428 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=109 imp:n=1

c

3429 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=109 imp:n=1

c

3430 0 89 -90 91 -92 (-85:86:-87:88) 74 u=109 imp:n=1

c

c Right hand blanket array containing one core element

c

3431 0 85 -81 87 -83 fill=5 (-10.7442 -10.7442 0) u=118 imp:n=1

c

3432 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=118 imp:n=1

c

3433 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=118 imp:n=1

c

3434 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=118 imp:n=1

c

3435 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=118 imp:n=1

c

c

3436 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=118 imp:n=1

c

3437 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=118 imp:n=1

c

3438 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=118 imp:n=1

c

3439 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=118 imp:n=1

c

3440 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=118 imp:n=1

c

c

3441 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=118 imp:n=1

c

3442 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=118 imp:n=1

c

3443 0 1 -2 3 -4 fill=6 (0 0 0) u=118 imp:n=1

c

3444 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=118 imp:n=1

c

3445 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=118 imp:n=1

c

c

3446 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=118 imp:n=1

c

3447 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=118 imp:n=1

c

3448 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=118 imp:n=1

c

3449 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=118 imp:n=1

c

3450 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=118 imp:n=1

c

c

3451 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=118 imp:n=1

c

3452 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=118 imp:n=1

c

3453 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=118 imp:n=1

c

3454 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=118 imp:n=1

c

3455 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=118 imp:n=1

c

c Surround material

c

3456 0 89 -90 91 -92 (-85:86:-87:88) -71 u=118 imp:n=1

c

3457 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=118 imp:n=1

c

3458 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=118 imp:n=1

c

3459 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=118 imp:n=1

c

3460 0 89 -90 91 -92 (-85:86:-87:88) 74 u=118 imp:n=1

c

c

c 5x5 array of blanket elements

c

c

3501 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=111 imp:n=1

c

3502 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=111 imp:n=1

c

3503 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=111 imp:n=1

c

3504 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=111 imp:n=1

c

3505 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=111 imp:n=1

c

c

3506 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=111 imp:n=1

c

3507 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=111 imp:n=1

c

3508 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=111 imp:n=1

c

3509 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=111 imp:n=1

c

3510 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=111 imp:n=1

c

c

3511 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=111 imp:n=1

c

3512 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=111 imp:n=1

c

3513 0 1 -2 3 -4 fill=6 (0 0 0) u=111 imp:n=1

c

3514 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=111 imp:n=1

c

3515 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=111 imp:n=1

c

c

3516 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=111 imp:n=1

c

3517 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=111 imp:n=1

c

3518 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=111 imp:n=1

c

3519 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=111 imp:n=1

c

3520 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=111 imp:n=1

c

c

3521 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=111 imp:n=1

c

3522 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=111 imp:n=1

c

3523 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=111 imp:n=1

c

3524 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=111 imp:n=1

c

3525 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=111 imp:n=1

c

c Surround material

c

3526 0 89 -90 91 -92 (-85:86:-87:88) -71 u=111 imp:n=1

c

3527 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=111 imp:n=1

c

3528 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=111 imp:n=1

c

3529 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=111 imp:n=1

c

3530 0 89 -90 91 -92 (-85:86:-87:88) 74 u=111 imp:n=1

c

c

c Blanket-Reflector Arrays

c

c ROW 2

c

c Bottom Left

c

3531 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=112 imp:n=1

c

3532 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=112 imp:n=1

c

3533 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=112 imp:n=1

c

3534 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=112 imp:n=1

c

3535 0 82 -86 87 -83 fill=7 (10.7442 -10.7442 0) u=112 imp:n=1

c

c

3536 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=112 imp:n=1

c

3537 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=112 imp:n=1

c

3538 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=112 imp:n=1

c

3539 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=112 imp:n=1

c

3540 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=112 imp:n=1

c

c

3541 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=112 imp:n=1

c

3542 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=112 imp:n=1

c

3543 0 1 -2 3 -4 fill=7 (0 0 0) u=112 imp:n=1

c

3544 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=112 imp:n=1

c

3545 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=112 imp:n=1

c

c

3546 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=112 imp:n=1

c

3547 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=112 imp:n=1

c

3548 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=112 imp:n=1

c

3549 0 2 -82 4 -84 fill=6 (5.3721 5.3721 0) u=112 imp:n=1

c

3550 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=112 imp:n=1

c

c

3551 0 85 -81 84 -88 fill=7 (-10.7442 10.7442 0) u=112 imp:n=1

c

3552 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=112 imp:n=1

c

3553 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=112 imp:n=1

c

3554 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=112 imp:n=1

c

3555 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=112 imp:n=1

c

c Surround material

c

3556 0 89 -90 91 -92 (-85:86:-87:88) -71 u=112 imp:n=1

c

3557 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=112 imp:n=1

c

3558 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=112 imp:n=1

c

3559 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=112 imp:n=1

c

3560 0 89 -90 91 -92 (-85:86:-87:88) 74 u=112 imp:n=1

c

c

c Row 2 Bottom Right Blanket Reflector Array

c

3561 0 85 -81 87 -83 fill=7 (-10.7442 -10.7442 0) u=113 imp:n=1

c

3562 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=113 imp:n=1

c

3563 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=113 imp:n=1

c

3564 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=113 imp:n=1

c

3565 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=113 imp:n=1

c

c

3566 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=113 imp:n=1

c

3567 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=113 imp:n=1

c

3568 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=113 imp:n=1

c

3569 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=113 imp:n=1

c

3570 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=113 imp:n=1

c

c

3571 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=113 imp:n=1

c

3572 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=113 imp:n=1

c

3573 0 1 -2 3 -4 fill=7 (0 0 0) u=113 imp:n=1

c

3574 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=113 imp:n=1

c

3575 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=113 imp:n=1

c

c

3576 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=113 imp:n=1

c

3577 0 81 -1 4 -84 fill=6 (-5.3721 5.3721 0) u=113 imp:n=1

c

3578 0 1 -2 4 -84 fill=6 (0 5.3721 0) u=113 imp:n=1

c

3579 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=113 imp:n=1

c

3580 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=113 imp:n=1

c

c

3581 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=113 imp:n=1

c

3582 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=113 imp:n=1

c

3583 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=113 imp:n=1

c

3584 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=113 imp:n=1

c

3585 0 82 -86 84 -88 fill=7 (10.7442 10.7442 0) u=113 imp:n=1

c

c Surround material

c

3586 0 89 -90 91 -92 (-85:86:-87:88) -71 u=113 imp:n=1

c

3587 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=113 imp:n=1

c

3588 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=113 imp:n=1

c

3589 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=113 imp:n=1

c

3590 0 89 -90 91 -92 (-85:86:-87:88) 74 u=113 imp:n=1

c

c ROW 6

c

c Top Left Blanket-Reflector Array

c

3631 0 85 -81 87 -83 fill=7 (-10.7442 -10.7442 0) u=114 imp:n=1

c

3632 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=114 imp:n=1

c

3633 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=114 imp:n=1

c

3634 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=114 imp:n=1

c

3635 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=114 imp:n=1

c

c

3636 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=114 imp:n=1

c

3637 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=114 imp:n=1

c

3638 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=114 imp:n=1

c

3639 0 2 -82 83 -3 fill=6 (5.3721 -5.3721 0) u=114 imp:n=1

c

3640 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=114 imp:n=1

c

c

3641 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=114 imp:n=1

c

3642 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=114 imp:n=1

c

3643 0 1 -2 3 -4 fill=7 (0 0 0) u=114 imp:n=1

c

3644 0 2 -82 3 -4 fill=6 (5.3721 0 0) u=114 imp:n=1

c

3645 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=114 imp:n=1

c

c

3646 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=114 imp:n=1

c

3647 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=114 imp:n=1

c

3648 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=114 imp:n=1

c

3649 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=114 imp:n=1

c

3650 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=114 imp:n=1

c

c

3651 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=114 imp:n=1

c

3652 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=114 imp:n=1

c

3653 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=114 imp:n=1

c

3654 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=114 imp:n=1

c

3655 0 82 -86 84 -88 fill=7 (10.7442 10.7442 0) u=114 imp:n=1

c

c Surround material

c

3656 0 89 -90 91 -92 (-85:86:-87:88) -71 u=114 imp:n=1

c

3657 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=114 imp:n=1

c

3658 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=114 imp:n=1

c

3659 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=114 imp:n=1

c

3660 0 89 -90 91 -92 (-85:86:-87:88) 74 u=114 imp:n=1

c

c

c Row 6 Top Right Blanket Reflector Array

c

3661 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=115 imp:n=1

c

3662 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=115 imp:n=1

c

3663 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=115 imp:n=1

c

3664 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=115 imp:n=1

c

3665 0 82 -86 87 -83 fill=7 (10.7442 -10.7442 0) u=115 imp:n=1

c

c

3666 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=115 imp:n=1

c

3667 0 81 -1 83 -3 fill=6 (-5.3721 -5.3721 0) u=115 imp:n=1

c

3668 0 1 -2 83 -3 fill=6 (0 -5.3721 0) u=115 imp:n=1

c

3669 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=115 imp:n=1

c

3670 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=115 imp:n=1

c

c

3671 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=115 imp:n=1

c

3672 0 81 -1 3 -4 fill=6 (-5.3721 0 0) u=115 imp:n=1

c

3673 0 1 -2 3 -4 fill=7 (0 0 0) u=115 imp:n=1

c

3674 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=115 imp:n=1

c

3675 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=115 imp:n=1

c

c

3676 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=115 imp:n=1

c

3677 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=115 imp:n=1

c

3678 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=115 imp:n=1

c

3679 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=115 imp:n=1

c

3680 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=115 imp:n=1

c

c

3681 0 85 -81 84 -88 fill=7 (-10.7442 10.7442 0) u=115 imp:n=1

c

3682 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=115 imp:n=1

c

3683 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=115 imp:n=1

c

3684 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=115 imp:n=1

c

3685 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=115 imp:n=1

c

c Surround material

c

3686 0 89 -90 91 -92 (-85:86:-87:88) -71 u=115 imp:n=1

c

3687 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=115 imp:n=1

c

3688 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=115 imp:n=1

c

3689 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=115 imp:n=1

c

3690 0 89 -90 91 -92 (-85:86:-87:88) 74 u=115 imp:n=1

c

c Row 1 Blanket - Reflector arrays

c

c Row 1 First Left array

c

3701 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=121 imp:n=1

c

3702 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=121 imp:n=1

c

3703 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=121 imp:n=1

c

3704 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=121 imp:n=1

c

3705 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=121 imp:n=1

c

c

3706 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=121 imp:n=1

c

3707 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=121 imp:n=1

c

3708 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=121 imp:n=1

c

3709 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=121 imp:n=1

c

3710 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=121 imp:n=1

c

c

3711 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=121 imp:n=1

c

3712 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=121 imp:n=1

c

3713 0 1 -2 3 -4 fill=9 (0 0 0) u=121 imp:n=1

c

3714 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=121 imp:n=1

c

3715 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=121 imp:n=1

c

c

3716 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=121 imp:n=1

c

3717 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=121 imp:n=1

c

3718 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=121 imp:n=1

c

3719 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=121 imp:n=1

c

3720 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=121 imp:n=1

c

c

3721 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=121 imp:n=1

c

3722 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=121 imp:n=1

c

3723 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=121 imp:n=1

c

3724 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=121 imp:n=1

c

3725 0 82 -86 84 -88 fill=7 (10.7442 10.7442 0) u=121 imp:n=1

c

c Surround material

c

3726 0 89 -90 91 -92 (-85:86:-87:88) -71 u=121 imp:n=1

c

3727 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=121 imp:n=1

c

3728 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=121 imp:n=1

c

3729 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=121 imp:n=1

c

3730 0 89 -90 91 -92 (-85:86:-87:88) 74 u=121 imp:n=1

c

c

c Row 1 Mid-Left

c

3731 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=122 imp:n=1

c

3732 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=122 imp:n=1

c

3733 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=122 imp:n=1

c

3734 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=122 imp:n=1

c

3735 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=122 imp:n=1

c

c

3736 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=122 imp:n=1

c

3737 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=122 imp:n=1

c

3738 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=122 imp:n=1

c

3739 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=122 imp:n=1

c

3740 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=122 imp:n=1

c

c

3741 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=122 imp:n=1

c

3742 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=122 imp:n=1

c

3743 0 1 -2 3 -4 fill=7 (0 0 0) u=122 imp:n=1

c

3744 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=122 imp:n=1

c

3745 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=122 imp:n=1

c

c

3746 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=122 imp:n=1

c

3747 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=122 imp:n=1

c

3748 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=122 imp:n=1

c

3749 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=122 imp:n=1

c

3750 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=122 imp:n=1

c

c

3751 0 85 -81 84 -88 fill=7 (-10.7442 10.7442 0) u=122 imp:n=1

c

3752 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=122 imp:n=1

c

3753 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=122 imp:n=1

c

3754 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=122 imp:n=1

c

3755 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=122 imp:n=1

c

c Surround material

c

3756 0 89 -90 91 -92 (-85:86:-87:88) -71 u=122 imp:n=1

c

3757 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=122 imp:n=1

c

3758 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=122 imp:n=1

c

3759 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=122 imp:n=1

c

3760 0 89 -90 91 -92 (-85:86:-87:88) 74 u=122 imp:n=1

c

c

c Row 1 Central Array

c

3761 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=123 imp:n=1

c

3762 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=123 imp:n=1

c

3763 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=123 imp:n=1

c

3764 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=123 imp:n=1

c

3765 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=123 imp:n=1

c

c

3766 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=123 imp:n=1

c

3767 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=123 imp:n=1

c

3768 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=123 imp:n=1

c

3769 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=123 imp:n=1

c

3770 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=123 imp:n=1

c

c

3771 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=123 imp:n=1

c

3772 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=123 imp:n=1

c

3773 0 1 -2 3 -4 fill=7 (0 0 0) u=123 imp:n=1

c

3774 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=123 imp:n=1

c

3775 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=123 imp:n=1

c

c

3776 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=123 imp:n=1

c

3777 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=123 imp:n=1

c

3778 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=123 imp:n=1

c

3779 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=123 imp:n=1

c

3780 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=123 imp:n=1

c

c

3781 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=123 imp:n=1

c

3782 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=123 imp:n=1

c

3783 0 1 -2 84 -88 fill=6 (0 10.7442 0) u=123 imp:n=1

c

3784 0 2 -82 84 -88 fill=6 (5.3721 10.7442 0) u=123 imp:n=1

c

3785 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=123 imp:n=1

c

c Surround material

c

3786 0 89 -90 91 -92 (-85:86:-87:88) -71 u=123 imp:n=1

c

3787 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=123 imp:n=1

c

3788 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=123 imp:n=1

c

3789 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=123 imp:n=1

c

3790 0 89 -90 91 -92 (-85:86:-87:88) 74 u=123 imp:n=1

c

c

c Row 1 First Right array

c

3801 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=124 imp:n=1

c

3802 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=124 imp:n=1

c

3803 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=124 imp:n=1

c

3804 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=124 imp:n=1

c

3805 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=124 imp:n=1

c

c

3806 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=124 imp:n=1

c

3807 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=124 imp:n=1

c

3808 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=124 imp:n=1

c

3809 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=124 imp:n=1

c

3810 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=124 imp:n=1

c

c

3811 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=124 imp:n=1

c

3812 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=124 imp:n=1

c

3813 0 1 -2 3 -4 fill=7 (0 0 0) u=124 imp:n=1

c

3814 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=124 imp:n=1

c

3815 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=124 imp:n=1

c

c

3816 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=124 imp:n=1

c

3817 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=124 imp:n=1

c

3818 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=124 imp:n=1

c

3819 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=124 imp:n=1

c

3820 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=124 imp:n=1

c

c

3821 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=124 imp:n=1

c

3822 0 81 -1 84 -88 fill=6 (-5.3721 10.7442 0) u=124 imp:n=1

c

3823 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=124 imp:n=1

c

3824 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=124 imp:n=1

c

3825 0 82 -86 84 -88 fill=7 (10.7442 10.7442 0) u=124 imp:n=1

c

c Surround material

c

3826 0 89 -90 91 -92 (-85:86:-87:88) -71 u=124 imp:n=1

c

3827 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=124 imp:n=1

c

3828 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=124 imp:n=1

c

3829 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=124 imp:n=1

c

3830 0 89 -90 91 -92 (-85:86:-87:88) 74 u=124 imp:n=1

c

c

c Row 1 Far Right

c

3831 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=125 imp:n=1

c

3832 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=125 imp:n=1

c

3833 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=125 imp:n=1

c

3834 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=125 imp:n=1

c

3835 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=125 imp:n=1

c

c

3836 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=125 imp:n=1

c

3837 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=125 imp:n=1

c

3838 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=125 imp:n=1

c

3839 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=125 imp:n=1

c

3840 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=125 imp:n=1

c

c

3841 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=125 imp:n=1

c

3842 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=125 imp:n=1

c

3843 0 1 -2 3 -4 fill=9 (0 0 0) u=125 imp:n=1

c

3844 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=125 imp:n=1

c

3845 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=125 imp:n=1

c

c

3846 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=125 imp:n=1

c

3847 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=125 imp:n=1

c

3848 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=125 imp:n=1

c

3849 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=125 imp:n=1

c

3850 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=125 imp:n=1

c

c

3851 0 85 -81 84 -88 fill=7 (-10.7442 10.7442 0) u=125 imp:n=1

c

3852 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=125 imp:n=1

c

3853 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=125 imp:n=1

c

3854 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=125 imp:n=1

c

3855 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=125 imp:n=1

c

c Surround material

c

3856 0 89 -90 91 -92 (-85:86:-87:88) -71 u=125 imp:n=1

c

3857 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=125 imp:n=1

c

3858 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=125 imp:n=1

c

3859 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=125 imp:n=1

c

3860 0 89 -90 91 -92 (-85:86:-87:88) 74 u=125 imp:n=1

c

c Row 2 Blanket reflector arrays

c

c Row 2 First Left array

c

3901 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=127 imp:n=1

c

3902 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=127 imp:n=1

c

3903 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=127 imp:n=1

c

3904 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=127 imp:n=1

c

3905 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=127 imp:n=1

c

c

3906 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=127 imp:n=1

c

3907 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=127 imp:n=1

c

3908 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=127 imp:n=1

c

3909 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=127 imp:n=1

c

3910 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=127 imp:n=1

c

c

3911 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=127 imp:n=1

c

3912 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=127 imp:n=1

c

3913 0 1 -2 3 -4 fill=9 (0 0 0) u=127 imp:n=1

c

3914 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=127 imp:n=1

c

3915 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=127 imp:n=1

c

c

3916 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=127 imp:n=1

c

3917 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=127 imp:n=1

c

3918 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=127 imp:n=1

c

3919 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=127 imp:n=1

c

3920 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=127 imp:n=1

c

c

3921 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=127 imp:n=1

c

3922 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=127 imp:n=1

c

3923 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=127 imp:n=1

c

3924 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=127 imp:n=1

c

3925 0 82 -86 84 -88 fill=7 (10.7442 10.7442 0) u=127 imp:n=1

c

c Surround material

c

3926 0 89 -90 91 -92 (-85:86:-87:88) -71 u=127 imp:n=1

c

3927 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=127 imp:n=1

c

3928 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=127 imp:n=1

c

3929 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=127 imp:n=1

c

3930 0 89 -90 91 -92 (-85:86:-87:88) 74 u=127 imp:n=1

c

c

c Row 2 Far Right

c

3931 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=128 imp:n=1

c

3932 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=128 imp:n=1

c

3933 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=128 imp:n=1

c

3934 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=128 imp:n=1

c

3935 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=128 imp:n=1

c

c

3936 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=128 imp:n=1

c

3937 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=128 imp:n=1

c

3938 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=128 imp:n=1

c

3939 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=128 imp:n=1

c

3940 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=128 imp:n=1

c

c

3941 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=128 imp:n=1

c

3942 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=128 imp:n=1

c

3943 0 1 -2 3 -4 fill=9 (0 0 0) u=128 imp:n=1

c

3944 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=128 imp:n=1

c

3945 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=128 imp:n=1

c

c

3946 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=128 imp:n=1

c

3947 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=128 imp:n=1

c

3948 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=128 imp:n=1

c

3949 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=128 imp:n=1

c

3950 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=128 imp:n=1

c

c

3951 0 85 -81 84 -88 fill=7 (-10.7442 10.7442 0) u=128 imp:n=1

c

3952 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=128 imp:n=1

c

3953 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=128 imp:n=1

c

3954 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=128 imp:n=1

c

3955 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=128 imp:n=1

c

c Surround material

c

3956 0 89 -90 91 -92 (-85:86:-87:88) -71 u=128 imp:n=1

c

3957 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=128 imp:n=1

c

3958 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=128 imp:n=1

c

3959 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=128 imp:n=1

c

3960 0 89 -90 91 -92 (-85:86:-87:88) 74 u=128 imp:n=1

c

c

c Row 4 Blanket- Reflector arrays

c

c

c Row 4 First Left array

c

4001 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=157 imp:n=1

c

4002 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=157 imp:n=1

c

4003 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=157 imp:n=1

c

4004 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=157 imp:n=1

c

4005 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=157 imp:n=1

c

c

4006 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=157 imp:n=1

c

4007 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=157 imp:n=1

c

4008 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=157 imp:n=1

c

4009 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=157 imp:n=1

c

4010 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=157 imp:n=1

c

c

4011 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=157 imp:n=1

c

4012 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=157 imp:n=1

c

4013 0 1 -2 3 -4 fill=7 (0 0 0) u=157 imp:n=1

c

4014 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=157 imp:n=1

c

4015 0 82 -86 3 -4 fill=6 (10.7442 0 0) u=157 imp:n=1

c

c

4016 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=157 imp:n=1

c

4017 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=157 imp:n=1

c

4018 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=157 imp:n=1

c

4019 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=157 imp:n=1

c

4020 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=157 imp:n=1

c

c

4021 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=157 imp:n=1

c

4022 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=157 imp:n=1

c

4023 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=157 imp:n=1

c

4024 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=157 imp:n=1

c

4025 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=157 imp:n=1

c

c Surround material

c

4026 0 89 -90 91 -92 (-85:86:-87:88) -71 u=157 imp:n=1

c

4027 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=157 imp:n=1

c

4028 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=157 imp:n=1

c

4029 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=157 imp:n=1

c

4030 0 89 -90 91 -92 (-85:86:-87:88) 74 u=157 imp:n=1

c

c

c Row 4 Far Right

c

4031 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=158 imp:n=1

c

4032 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=158 imp:n=1

c

4033 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=158 imp:n=1

c

4034 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=158 imp:n=1

c

4035 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=158 imp:n=1

c

c

4036 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=158 imp:n=1

c

4037 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=158 imp:n=1

c

4038 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=158 imp:n=1

c

4039 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=158 imp:n=1

c

4040 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=158 imp:n=1

c

c

4041 0 85 -81 3 -4 fill=6 (-10.7442 0 0) u=158 imp:n=1

c

4042 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=158 imp:n=1

c

4043 0 1 -2 3 -4 fill=7 (0 0 0) u=158 imp:n=1

c

4044 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=158 imp:n=1

c

4045 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=158 imp:n=1

c

c

4046 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=158 imp:n=1

c

4047 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=158 imp:n=1

c

4048 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=158 imp:n=1

c

4049 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=158 imp:n=1

c

4050 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=158 imp:n=1

c

c

4051 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=158 imp:n=1

c

4052 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=158 imp:n=1

c

4053 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=158 imp:n=1

c

4054 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=158 imp:n=1

c

4055 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=158 imp:n=1

c

c Surround material

c

4056 0 89 -90 91 -92 (-85:86:-87:88) -71 u=158 imp:n=1

c

4057 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=158 imp:n=1

c

4058 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=158 imp:n=1

c

4059 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=158 imp:n=1

c

4060 0 89 -90 91 -92 (-85:86:-87:88) 74 u=158 imp:n=1

c

c

c Row 6 Blanket- Reflector arrays

c

c

c Row 6 First Left array

c

4101 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=137 imp:n=1

c

4102 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=137 imp:n=1

c

4103 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=137 imp:n=1

c

4104 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=137 imp:n=1

c

4105 0 82 -86 87 -83 fill=7 (10.7442 -10.7442 0) u=137 imp:n=1

c

c

4106 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=137 imp:n=1

c

4107 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=137 imp:n=1

c

4108 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=137 imp:n=1

c

4109 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=137 imp:n=1

c

4110 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=137 imp:n=1

c

c

4111 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=137 imp:n=1

c

4112 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=137 imp:n=1

c

4113 0 1 -2 3 -4 fill=9 (0 0 0) u=137 imp:n=1

c

4114 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=137 imp:n=1

c

4115 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=137 imp:n=1

c

c

4116 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=137 imp:n=1

c

4117 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=137 imp:n=1

c

4118 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=137 imp:n=1

c

4119 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=137 imp:n=1

c

4120 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=137 imp:n=1

c

c

4121 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=137 imp:n=1

c

4122 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=137 imp:n=1

c

4123 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=137 imp:n=1

c

4124 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=137 imp:n=1

c

4125 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=137 imp:n=1

c

c Surround material

c

4126 0 89 -90 91 -92 (-85:86:-87:88) -71 u=137 imp:n=1

c

4127 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=137 imp:n=1

c

4128 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=137 imp:n=1

c

4129 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=137 imp:n=1

c

4130 0 89 -90 91 -92 (-85:86:-87:88) 74 u=137 imp:n=1

c

c

c Row 6 Far Right

c

4131 0 85 -81 87 -83 fill=7 (-10.7442 -10.7442 0) u=138 imp:n=1

c

4132 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=138 imp:n=1

c

4133 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=138 imp:n=1

c

4134 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=138 imp:n=1

c

4135 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=138 imp:n=1

c

c

4136 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=138 imp:n=1

c

4137 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=138 imp:n=1

c

4138 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=138 imp:n=1

c

4139 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=138 imp:n=1

c

4140 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=138 imp:n=1

c

c

4141 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=138 imp:n=1

c

4142 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=138 imp:n=1

c

4143 0 1 -2 3 -4 fill=9 (0 0 0) u=138 imp:n=1

c

4144 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=138 imp:n=1

c

4145 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=138 imp:n=1

c

c

4146 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=138 imp:n=1

c

4147 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=138 imp:n=1

c

4148 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=138 imp:n=1

c

4149 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=138 imp:n=1

c

4150 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=138 imp:n=1

c

c

4151 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=138 imp:n=1

c

4152 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=138 imp:n=1

c

4153 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=138 imp:n=1

c

4154 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=138 imp:n=1

c

4155 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=138 imp:n=1

c

c Surround material

c

4156 0 89 -90 91 -92 (-85:86:-87:88) -71 u=138 imp:n=1

c

4157 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=138 imp:n=1

c

4158 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=138 imp:n=1

c

4159 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=138 imp:n=1

c

4160 0 89 -90 91 -92 (-85:86:-87:88) 74 u=138 imp:n=1

c

c

c

c Row 5 Blanket- Reflector arrays

c

c

c Row 5 First Left array

c

4201 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=167 imp:n=1

c

4202 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=167 imp:n=1

c

4203 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=167 imp:n=1

c

4204 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=167 imp:n=1

c

4205 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=167 imp:n=1

c

c

4206 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=167 imp:n=1

c

4207 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=167 imp:n=1

c

4208 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=167 imp:n=1

c

4209 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=167 imp:n=1

c

4210 0 82 -86 83 -3 fill=6 (10.7442 -5.3721 0) u=167 imp:n=1

c

c

4211 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=167 imp:n=1

c

4212 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=167 imp:n=1

c

4213 0 1 -2 3 -4 fill=7 (0 0 0) u=167 imp:n=1

c

4214 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=167 imp:n=1

c

4215 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=167 imp:n=1

c

c

4216 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=167 imp:n=1

c

4217 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=167 imp:n=1

c

4218 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=167 imp:n=1

c

4219 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=167 imp:n=1

c

4220 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=167 imp:n=1

c

c

4221 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=167 imp:n=1

c

4222 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=167 imp:n=1

c

4223 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=167 imp:n=1

c

4224 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=167 imp:n=1

c

4225 0 82 -86 84 -88 fill=7 (10.7442 10.7442 0) u=167 imp:n=1

c

c Surround material

c

4226 0 89 -90 91 -92 (-85:86:-87:88) -71 u=167 imp:n=1

c

4227 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=167 imp:n=1

c

4228 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=167 imp:n=1

c

4229 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=167 imp:n=1

c

4230 0 89 -90 91 -92 (-85:86:-87:88) 74 u=167 imp:n=1

c

c

c Row 4 Far Right

c

4231 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=168 imp:n=1

c

4232 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=168 imp:n=1

c

4233 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=168 imp:n=1

c

4234 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=168 imp:n=1

c

4235 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=168 imp:n=1

c

c

4236 0 85 -81 83 -3 fill=6 (-10.7442 -5.3721 0) u=168 imp:n=1

c

4237 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=168 imp:n=1

c

4238 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=168 imp:n=1

c

4239 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=168 imp:n=1

c

4240 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=168 imp:n=1

c

c

4241 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=168 imp:n=1

c

4242 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=168 imp:n=1

c

4243 0 1 -2 3 -4 fill=7 (0 0 0) u=168 imp:n=1

c

4244 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=168 imp:n=1

c

4245 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=168 imp:n=1

c

c

4246 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=168 imp:n=1

c

4247 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=168 imp:n=1

c

4248 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=168 imp:n=1

c

4249 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=168 imp:n=1

c

4250 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=168 imp:n=1

c

c

4251 0 85 -81 84 -88 fill=7 (-10.7442 10.7442 0) u=168 imp:n=1

c

4252 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=168 imp:n=1

c

4253 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=168 imp:n=1

c

4254 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=168 imp:n=1

c

4255 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=168 imp:n=1

c

c Surround material

c

4256 0 89 -90 91 -92 (-85:86:-87:88) -71 u=168 imp:n=1

c

4257 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=168 imp:n=1

c

4258 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=168 imp:n=1

c

4259 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=168 imp:n=1

c

4260 0 89 -90 91 -92 (-85:86:-87:88) 74 u=168 imp:n=1

c

c

c Row 3 Blanket- Reflector arrays

c

c

c Row 3 First Left array

c

4301 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=147 imp:n=1

c

4302 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=147 imp:n=1

c

4303 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=147 imp:n=1

c

4304 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=147 imp:n=1

c

4305 0 82 -86 87 -83 fill=7 (10.7442 -10.7442 0) u=147 imp:n=1

c

c

4306 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=147 imp:n=1

c

4307 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=147 imp:n=1

c

4308 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=147 imp:n=1

c

4309 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=147 imp:n=1

c

4310 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=147 imp:n=1

c

c

4311 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=147 imp:n=1

c

4312 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=147 imp:n=1

c

4313 0 1 -2 3 -4 fill=7 (0 0 0) u=147 imp:n=1

c

4314 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=147 imp:n=1

c

4315 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=147 imp:n=1

c

c

4316 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=147 imp:n=1

c

4317 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=147 imp:n=1

c

4318 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=147 imp:n=1

c

4319 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=147 imp:n=1

c

4320 0 82 -86 4 -84 fill=6 (10.7442 5.3721 0) u=147 imp:n=1

c

c

4321 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=147 imp:n=1

c

4322 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=147 imp:n=1

c

4323 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=147 imp:n=1

c

4324 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=147 imp:n=1

c

4325 0 82 -86 84 -88 fill=6 (10.7442 10.7442 0) u=147 imp:n=1

c

c Surround material

c

4326 0 89 -90 91 -92 (-85:86:-87:88) -71 u=147 imp:n=1

c

4327 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=147 imp:n=1

c

4328 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=147 imp:n=1

c

4329 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=147 imp:n=1

c

4330 0 89 -90 91 -92 (-85:86:-87:88) 74 u=147 imp:n=1

c

c

c Row 3 Far Right

c

4331 0 85 -81 87 -83 fill=7 (-10.7442 -10.7442 0) u=148 imp:n=1

c

4332 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=148 imp:n=1

c

4333 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=148 imp:n=1

c

4334 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=148 imp:n=1

c

4335 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=148 imp:n=1

c

c

4336 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=148 imp:n=1

c

4337 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=148 imp:n=1

c

4338 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=148 imp:n=1

c

4339 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=148 imp:n=1

c

4340 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=148 imp:n=1

c

c

4341 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=148 imp:n=1

c

4342 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=148 imp:n=1

c

4343 0 1 -2 3 -4 fill=7 (0 0 0) u=148 imp:n=1

c

4344 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=148 imp:n=1

c

4345 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=148 imp:n=1

c

c

4346 0 85 -81 4 -84 fill=6 (-10.7442 5.3721 0) u=148 imp:n=1

c

4347 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=148 imp:n=1

c

4348 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=148 imp:n=1

c

4349 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=148 imp:n=1

c

4350 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=148 imp:n=1

c

c

4351 0 85 -81 84 -88 fill=6 (-10.7442 10.7442 0) u=148 imp:n=1

c

4352 0 81 -1 84 -88 fill=7 (-5.3721 10.7442 0) u=148 imp:n=1

c

4353 0 1 -2 84 -88 fill=7 (0 10.7442 0) u=148 imp:n=1

c

4354 0 2 -82 84 -88 fill=7 (5.3721 10.7442 0) u=148 imp:n=1

c

4355 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=148 imp:n=1

c

c Surround material

c

4356 0 89 -90 91 -92 (-85:86:-87:88) -71 u=148 imp:n=1

c

4357 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=148 imp:n=1

c

4358 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=148 imp:n=1

c

4359 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=148 imp:n=1

c

4360 0 89 -90 91 -92 (-85:86:-87:88) 74 u=148 imp:n=1

c

c

c Core region with XYZ elements. Central Upper Array

c

4561 0 85 -81 87 -83 fill=1 (-10.7442 -10.7442 0) u=129 imp:n=1

c

4562 0 81 -1 87 -83 fill=1 (-5.3721 -10.7442 0) u=129 imp:n=1

c

4563 0 1 -2 87 -83 fill=2 (0 -10.7442 0) u=129 imp:n=1

c

4564 0 2 -82 87 -83 fill=1 (5.3721 -10.7442 0) u=129 imp:n=1

c

4565 0 82 -86 87 -83 fill=1 (10.7442 -10.7442 0) u=129 imp:n=1

c

c

4566 0 85 -81 83 -3 fill=1 (-10.7442 -5.3721 0) u=129 imp:n=1

c

4567 0 81 -1 83 -3 fill=1 (-5.3721 -5.3721 0) u=129 imp:n=1

c

4568 0 1 -2 83 -3 fill=2 (0 -5.3721 0) u=129 imp:n=1

c

4569 0 2 -82 83 -3 fill=1 (5.3721 -5.3721 0) u=129 imp:n=1

c

4570 0 82 -86 83 -3 fill=1 (10.7442 -5.3721 0) u=129 imp:n=1

c

c

4571 0 85 -81 3 -4 fill=2 (-10.7442 0 0) u=129 imp:n=1

c

4572 0 81 -1 3 -4 fill=2 (-5.3721 0 0) u=129 imp:n=1

c

4573 0 1 -2 3 -4 fill=1 (0 0 0) u=129 imp:n=1

c

4574 0 2 -82 3 -4 fill=2 (5.3721 0 0) u=129 imp:n=1

c

4575 0 82 -86 3 -4 fill=2 (10.7442 0 0) u=129 imp:n=1

c

c

4576 0 85 -81 4 -84 fill=2 (-10.7442 5.3721 0) u=129 imp:n=1

c

4577 0 81 -1 4 -84 fill=2 (-5.3721 5.3721 0) u=129 imp:n=1

c

4578 0 1 -2 4 -84 fill=1 (0 5.3721 0) u=129 imp:n=1

c

4579 0 2 -82 4 -84 fill=2 (5.3721 5.3721 0) u=129 imp:n=1

c

4580 0 82 -86 4 -84 fill=2 (10.7442 5.3721 0) u=129 imp:n=1

c

c

4581 0 85 -81 84 -88 fill=2 (-10.7442 10.7442 0) u=129 imp:n=1

c

4582 0 81 -1 84 -88 fill=2 (-5.3721 10.7442 0) u=129 imp:n=1

c

4583 0 1 -2 84 -88 fill=2 (0 10.7442 0) u=129 imp:n=1

c

4584 0 2 -82 84 -88 fill=2 (5.3721 10.7442 0) u=129 imp:n=1

c

4585 0 82 -86 84 -88 fill=2 (10.7442 10.7442 0) u=129 imp:n=1

c

c Surround material

c

4586 0 89 -90 91 -92 (-85:86:-87:88) -71 u=129 imp:n=1

c

4587 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=129 imp:n=1

c

4588 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=129 imp:n=1

c

4589 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=129 imp:n=1

c

4590 0 89 -90 91 -92 (-85:86:-87:88) 74 u=129 imp:n=1

c

c

c Core region with XYZ elements. Central line Left array

c

4601 0 85 -81 87 -83 fill=2 (-10.7442 -10.7442 0) u=126 imp:n=1

c

4602 0 81 -1 87 -83 fill=2 (-5.3721 -10.7442 0) u=126 imp:n=1

c

4603 0 1 -2 87 -83 fill=2 (0 -10.7442 0) u=126 imp:n=1

c

4604 0 2 -82 87 -83 fill=1 (5.3721 -10.7442 0) u=126 imp:n=1

c

4605 0 82 -86 87 -83 fill=1 (10.7442 -10.7442 0) u=126 imp:n=1

c

c

4606 0 85 -81 83 -3 fill=2 (-10.7442 -5.3721 0) u=126 imp:n=1

c

4607 0 81 -1 83 -3 fill=2 (-5.3721 -5.3721 0) u=126 imp:n=1

c

4608 0 1 -2 83 -3 fill=2 (0 -5.3721 0) u=126 imp:n=1

c

4609 0 2 -82 83 -3 fill=1 (5.3721 -5.3721 0) u=126 imp:n=1

c

4610 0 82 -86 83 -3 fill=1 (10.7442 -5.3721 0) u=126 imp:n=1

c

c

4611 0 85 -81 3 -4 fill=2 (-10.7442 0 0) u=126 imp:n=1

c

4612 0 81 -1 3 -4 fill=2 (-5.3721 0 0) u=126 imp:n=1

c

4613 0 1 -2 3 -4 fill=2 (0 0 0) u=126 imp:n=1

c

4614 0 2 -82 3 -4 fill=1 (5.3721 0 0) u=126 imp:n=1

c

4615 0 82 -86 3 -4 fill=1 (10.7442 0 0) u=126 imp:n=1

c

c

4616 0 85 -81 4 -84 fill=2 (-10.7442 5.3721 0) u=126 imp:n=1

c

4617 0 81 -1 4 -84 fill=2 (-5.3721 5.3721 0) u=126 imp:n=1

c

4618 0 1 -2 4 -84 fill=2 (0 5.3721 0) u=126 imp:n=1

c

4619 0 2 -82 4 -84 fill=1 (5.3721 5.3721 0) u=126 imp:n=1

c

4620 0 82 -86 4 -84 fill=1 (10.7442 5.3721 0) u=126 imp:n=1

c

c

4621 0 85 -81 84 -88 fill=2 (-10.7442 10.7442 0) u=126 imp:n=1

c

4622 0 81 -1 84 -88 fill=2 (-5.3721 10.7442 0) u=126 imp:n=1

c

4623 0 1 -2 84 -88 fill=2 (0 10.7442 0) u=126 imp:n=1

c

4624 0 2 -82 84 -88 fill=1 (5.3721 10.7442 0) u=126 imp:n=1

c

4625 0 82 -86 84 -88 fill=1 (10.7442 10.7442 0) u=126 imp:n=1

c

c Surround material

c

4626 0 89 -90 91 -92 (-85:86:-87:88) -71 u=126 imp:n=1

c

4627 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=126 imp:n=1

c

4628 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=126 imp:n=1

c

4629 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=126 imp:n=1

c

4630 0 89 -90 91 -92 (-85:86:-87:88) 74 u=126 imp:n=1

c

c

c Core region with XYZ elements. Central line Right Array

c

4631 0 85 -81 87 -83 fill=1 (-10.7442 -10.7442 0) u=141 imp:n=1

c

4632 0 81 -1 87 -83 fill=2 (-5.3721 -10.7442 0) u=141 imp:n=1

c

4633 0 1 -2 87 -83 fill=2 (0 -10.7442 0) u=141 imp:n=1

c

4634 0 2 -82 87 -83 fill=2 (5.3721 -10.7442 0) u=141 imp:n=1

c

4635 0 82 -86 87 -83 fill=2 (10.7442 -10.7442 0) u=141 imp:n=1

c

c

4636 0 85 -81 83 -3 fill=1 (-10.7442 -5.3721 0) u=141 imp:n=1

c

4637 0 81 -1 83 -3 fill=2 (-5.3721 -5.3721 0) u=141 imp:n=1

c

4638 0 1 -2 83 -3 fill=2 (0 -5.3721 0) u=141 imp:n=1

c

4639 0 2 -82 83 -3 fill=2 (5.3721 -5.3721 0) u=141 imp:n=1

c

4640 0 82 -86 83 -3 fill=2 (10.7442 -5.3721 0) u=141 imp:n=1

c

c

4641 0 85 -81 3 -4 fill=1 (-10.7442 0 0) u=141 imp:n=1

c

4642 0 81 -1 3 -4 fill=2 (-5.3721 0 0) u=141 imp:n=1

c

4643 0 1 -2 3 -4 fill=2 (0 0 0) u=141 imp:n=1

c

4644 0 2 -82 3 -4 fill=2 (5.3721 0 0) u=141 imp:n=1

c

4645 0 82 -86 3 -4 fill=2 (10.7442 0 0) u=141 imp:n=1

c

c

4646 0 85 -81 4 -84 fill=1 (-10.7442 5.3721 0) u=141 imp:n=1

c

4647 0 81 -1 4 -84 fill=2 (-5.3721 5.3721 0) u=141 imp:n=1

c

4648 0 1 -2 4 -84 fill=2 (0 5.3721 0) u=141 imp:n=1

c

4649 0 2 -82 4 -84 fill=2 (5.3721 5.3721 0) u=141 imp:n=1

c

4650 0 82 -86 4 -84 fill=2 (10.7442 5.3721 0) u=141 imp:n=1

c

c

4651 0 85 -81 84 -88 fill=1 (-10.7442 10.7442 0) u=141 imp:n=1

c

4652 0 81 -1 84 -88 fill=2 (-5.3721 10.7442 0) u=141 imp:n=1

c

4653 0 1 -2 84 -88 fill=2 (0 10.7442 0) u=141 imp:n=1

c

4654 0 2 -82 84 -88 fill=2 (5.3721 10.7442 0) u=141 imp:n=1

c

4655 0 82 -86 84 -88 fill=2 (10.7442 10.7442 0) u=141 imp:n=1

c

c Surround material

c

4656 0 89 -90 91 -92 (-85:86:-87:88) -71 u=141 imp:n=1

c

4657 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=141 imp:n=1

c

4658 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=141 imp:n=1

c

4659 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=141 imp:n=1

c

4660 0 89 -90 91 -92 (-85:86:-87:88) 74 u=141 imp:n=1

c

c

c Core region with XYZ elements. Central Lower Array

c

4661 0 85 -81 87 -83 fill=2 (-10.7442 -10.7442 0) u=142 imp:n=1

c

4662 0 81 -1 87 -83 fill=2 (-5.3721 -10.7442 0) u=142 imp:n=1

c

4663 0 1 -2 87 -83 fill=2 (0 -10.7442 0) u=142 imp:n=1

c

4664 0 2 -82 87 -83 fill=2 (5.3721 -10.7442 0) u=142 imp:n=1

c

4665 0 82 -86 87 -83 fill=2 (10.7442 -10.7442 0) u=142 imp:n=1

c

c

4666 0 85 -81 83 -3 fill=2 (-10.7442 -5.3721 0) u=142 imp:n=1

c

4667 0 81 -1 83 -3 fill=2 (-5.3721 -5.3721 0) u=142 imp:n=1

c

4668 0 1 -2 83 -3 fill=2 (0 -5.3721 0) u=142 imp:n=1

c

4669 0 2 -82 83 -3 fill=2 (5.3721 -5.3721 0) u=142 imp:n=1

c

4670 0 82 -86 83 -3 fill=2 (10.7442 -5.3721 0) u=142 imp:n=1

c

c

4671 0 85 -81 3 -4 fill=2 (-10.7442 0 0) u=142 imp:n=1

c

4672 0 81 -1 3 -4 fill=2 (-5.3721 0 0) u=142 imp:n=1

c

4673 0 1 -2 3 -4 fill=2 (0 0 0) u=142 imp:n=1

c

4674 0 2 -82 3 -4 fill=2 (5.3721 0 0) u=142 imp:n=1

c

4675 0 82 -86 3 -4 fill=2 (10.7442 0 0) u=142 imp:n=1

c

c

4676 0 85 -81 4 -84 fill=1 (-10.7442 5.3721 0) u=142 imp:n=1

c

4677 0 81 -1 4 -84 fill=1 (-5.3721 5.3721 0) u=142 imp:n=1

c

4678 0 1 -2 4 -84 fill=1 (0 5.3721 0) u=142 imp:n=1

c

4679 0 2 -82 4 -84 fill=1 (5.3721 5.3721 0) u=142 imp:n=1

c

4680 0 82 -86 4 -84 fill=1 (10.7442 5.3721 0) u=142 imp:n=1

c

c

4681 0 85 -81 84 -88 fill=1 (-10.7442 10.7442 0) u=142 imp:n=1

c

4682 0 81 -1 84 -88 fill=1 (-5.3721 10.7442 0) u=142 imp:n=1

c

4683 0 1 -2 84 -88 fill=1 (0 10.7442 0) u=142 imp:n=1

c

4684 0 2 -82 84 -88 fill=1 (5.3721 10.7442 0) u=142 imp:n=1

c

4685 0 82 -86 84 -88 fill=1 (10.7442 10.7442 0) u=142 imp:n=1

c

c Surround material

c

4686 0 89 -90 91 -92 (-85:86:-87:88) -71 u=142 imp:n=1

c

4687 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=142 imp:n=1

c

4688 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=142 imp:n=1

c

4689 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=142 imp:n=1

c

4690 0 89 -90 91 -92 (-85:86:-87:88) 74 u=142 imp:n=1

c

c

c Row 7 Blanket - Reflector arrays

c

c Row 7 First Left array

c

4701 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=131 imp:n=1

c

4702 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=131 imp:n=1

c

4703 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=131 imp:n=1

c

4704 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=131 imp:n=1

c

4705 0 82 -86 87 -83 fill=7 (10.7442 -10.7442 0) u=131 imp:n=1

c

c

4706 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=131 imp:n=1

c

4707 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=131 imp:n=1

c

4708 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=131 imp:n=1

c

4709 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=131 imp:n=1

c

4710 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=131 imp:n=1

c

c

4711 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=131 imp:n=1

c

4712 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=131 imp:n=1

c

4713 0 1 -2 3 -4 fill=9 (0 0 0) u=131 imp:n=1

c

4714 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=131 imp:n=1

c

4715 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=131 imp:n=1

c

c

4716 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=131 imp:n=1

c

4717 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=131 imp:n=1

c

4718 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=131 imp:n=1

c

4719 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=131 imp:n=1

c

4720 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=131 imp:n=1

c

c

4721 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=131 imp:n=1

c

4722 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=131 imp:n=1

c

4723 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=131 imp:n=1

c

4724 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=131 imp:n=1

c

4725 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=131 imp:n=1

c

c Surround material

c

4726 0 89 -90 91 -92 (-85:86:-87:88) -71 u=131 imp:n=1

c

4727 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=131 imp:n=1

c

4728 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=131 imp:n=1

c

4729 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=131 imp:n=1

c

4730 0 89 -90 91 -92 (-85:86:-87:88) 74 u=131 imp:n=1

c

c

c Row 7 Mid-Left

c

4731 0 85 -81 87 -83 fill=7 (-10.7442 -10.7442 0) u=132 imp:n=1

c

4732 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=132 imp:n=1

c

4733 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=132 imp:n=1

c

4734 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=132 imp:n=1

c

4735 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=132 imp:n=1

c

c

4736 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=132 imp:n=1

c

4737 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=132 imp:n=1

c

4738 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=132 imp:n=1

c

4739 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=132 imp:n=1

c

4740 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=132 imp:n=1

c

c

4741 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=132 imp:n=1

c

4742 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=132 imp:n=1

c

4743 0 1 -2 3 -4 fill=7 (0 0 0) u=132 imp:n=1

c

4744 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=132 imp:n=1

c

4745 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=132 imp:n=1

c

c

4746 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=132 imp:n=1

c

4747 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=132 imp:n=1

c

4748 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=132 imp:n=1

c

4749 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=132 imp:n=1

c

4750 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=132 imp:n=1

c

c

4751 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=132 imp:n=1

c

4752 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=132 imp:n=1

c

4753 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=132 imp:n=1

c

4754 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=132 imp:n=1

c

4755 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=132 imp:n=1

c

c Surround material

c

4756 0 89 -90 91 -92 (-85:86:-87:88) -71 u=132 imp:n=1

c

4757 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=132 imp:n=1

c

4758 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=132 imp:n=1

c

4759 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=132 imp:n=1

c

4760 0 89 -90 91 -92 (-85:86:-87:88) 74 u=132 imp:n=1

c

c

c Row 7 Central Array

c

4761 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=133 imp:n=1

c

4762 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=133 imp:n=1

c

4763 0 1 -2 87 -83 fill=6 (0 -10.7442 0) u=133 imp:n=1

c

4764 0 2 -82 87 -83 fill=6 (5.3721 -10.7442 0) u=133 imp:n=1

c

4765 0 82 -86 87 -83 fill=6 (10.7442 -10.7442 0) u=133 imp:n=1

c

c

4766 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=133 imp:n=1

c

4767 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=133 imp:n=1

c

4768 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=133 imp:n=1

c

4769 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=133 imp:n=1

c

4770 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=133 imp:n=1

c

c

4771 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=133 imp:n=1

c

4772 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=133 imp:n=1

c

4773 0 1 -2 3 -4 fill=7 (0 0 0) u=133 imp:n=1

c

4774 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=133 imp:n=1

c

4775 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=133 imp:n=1

c

c

4776 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=133 imp:n=1

c

4777 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=133 imp:n=1

c

4778 0 1 -2 4 -84 fill=7 (0 5.3721 0) u=133 imp:n=1

c

4779 0 2 -82 4 -84 fill=7 (5.3721 5.3721 0) u=133 imp:n=1

c

4780 0 82 -86 4 -84 fill=7 (10.7442 5.3721 0) u=133 imp:n=1

c

c

4781 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=133 imp:n=1

c

4782 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=133 imp:n=1

c

4783 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=133 imp:n=1

c

4784 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=133 imp:n=1

c

4785 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=133 imp:n=1

c

c Surround material

c

4786 0 89 -90 91 -92 (-85:86:-87:88) -71 u=133 imp:n=1

c

4787 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=133 imp:n=1

c

4788 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=133 imp:n=1

c

4789 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=133 imp:n=1

c

4790 0 89 -90 91 -92 (-85:86:-87:88) 74 u=133 imp:n=1

c

c

c Row 7 First Right array

c

4801 0 85 -81 87 -83 fill=6 (-10.7442 -10.7442 0) u=134 imp:n=1

c

4802 0 81 -1 87 -83 fill=6 (-5.3721 -10.7442 0) u=134 imp:n=1

c

4803 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=134 imp:n=1

c

4804 0 2 -82 87 -83 fill=7 (5.3721 -10.7442 0) u=134 imp:n=1

c

4805 0 82 -86 87 -83 fill=7 (10.7442 -10.7442 0) u=134 imp:n=1

c

c

4806 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=134 imp:n=1

c

4807 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=134 imp:n=1

c

4808 0 1 -2 83 -3 fill=7 (0 -5.3721 0) u=134 imp:n=1

c

4809 0 2 -82 83 -3 fill=7 (5.3721 -5.3721 0) u=134 imp:n=1

c

4810 0 82 -86 83 -3 fill=7 (10.7442 -5.3721 0) u=134 imp:n=1

c

c

4811 0 85 -81 3 -4 fill=7 (-10.7442 0 0) u=134 imp:n=1

c

4812 0 81 -1 3 -4 fill=7 (-5.3721 0 0) u=134 imp:n=1

c

4813 0 1 -2 3 -4 fill=7 (0 0 0) u=134 imp:n=1

c

4814 0 2 -82 3 -4 fill=7 (5.3721 0 0) u=134 imp:n=1

c

4815 0 82 -86 3 -4 fill=7 (10.7442 0 0) u=134 imp:n=1

c

c

4816 0 85 -81 4 -84 fill=7 (-10.7442 5.3721 0) u=134 imp:n=1

c

4817 0 81 -1 4 -84 fill=7 (-5.3721 5.3721 0) u=134 imp:n=1

c

4818 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=134 imp:n=1

c

4819 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=134 imp:n=1

c

4820 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=134 imp:n=1

c

c

4821 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=134 imp:n=1

c

4822 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=134 imp:n=1

c

4823 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=134 imp:n=1

c

4824 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=134 imp:n=1

c

4825 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=134 imp:n=1

c

c Surround material

c

4826 0 89 -90 91 -92 (-85:86:-87:88) -71 u=134 imp:n=1

c

4827 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=134 imp:n=1

c

4828 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=134 imp:n=1

c

4829 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=134 imp:n=1

c

4830 0 89 -90 91 -92 (-85:86:-87:88) 74 u=134 imp:n=1

c

c

c Row 7 Far Right

c

4831 0 85 -81 87 -83 fill=7 (-10.7442 -10.7442 0) u=135 imp:n=1

c

4832 0 81 -1 87 -83 fill=7 (-5.3721 -10.7442 0) u=135 imp:n=1

c

4833 0 1 -2 87 -83 fill=7 (0 -10.7442 0) u=135 imp:n=1

c

4834 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=135 imp:n=1

c

4835 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=135 imp:n=1

c

c

4836 0 85 -81 83 -3 fill=7 (-10.7442 -5.3721 0) u=135 imp:n=1

c

4837 0 81 -1 83 -3 fill=7 (-5.3721 -5.3721 0) u=135 imp:n=1

c

4838 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=135 imp:n=1

c

4839 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=135 imp:n=1

c

4840 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=135 imp:n=1

c

c

4841 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=135 imp:n=1

c

4842 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=135 imp:n=1

c

4843 0 1 -2 3 -4 fill=9 (0 0 0) u=135 imp:n=1

c

4844 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=135 imp:n=1

c

4845 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=135 imp:n=1

c

c

4846 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=135 imp:n=1

c

4847 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=135 imp:n=1

c

4848 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=135 imp:n=1

c

4849 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=135 imp:n=1

c

4850 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=135 imp:n=1

c

c

4851 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=135 imp:n=1

c

4852 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=135 imp:n=1

c

4853 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=135 imp:n=1

c

4854 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=135 imp:n=1

c

4855 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=135 imp:n=1

c

c Surround material

c

4856 0 89 -90 91 -92 (-85:86:-87:88) -71 u=135 imp:n=1

c

4857 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=135 imp:n=1

c

4858 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=135 imp:n=1

c

4859 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=135 imp:n=1

c

4860 0 89 -90 91 -92 (-85:86:-87:88) 74 u=135 imp:n=1

c

c

c Beyond the reflector 5x5 Region 9

c

c

5001 0 85 -81 87 -83 fill=9 (-10.7442 -10.7442 0) u=201 imp:n=1

c

5002 0 81 -1 87 -83 fill=9 (-5.3721 -10.7442 0) u=201 imp:n=1

c

5003 0 1 -2 87 -83 fill=9 (0 -10.7442 0) u=201 imp:n=1

c

5004 0 2 -82 87 -83 fill=9 (5.3721 -10.7442 0) u=201 imp:n=1

c

5005 0 82 -86 87 -83 fill=9 (10.7442 -10.7442 0) u=201 imp:n=1

c

c

5006 0 85 -81 83 -3 fill=9 (-10.7442 -5.3721 0) u=201 imp:n=1

c

5007 0 81 -1 83 -3 fill=9 (-5.3721 -5.3721 0) u=201 imp:n=1

c

5008 0 1 -2 83 -3 fill=9 (0 -5.3721 0) u=201 imp:n=1

c

5009 0 2 -82 83 -3 fill=9 (5.3721 -5.3721 0) u=201 imp:n=1

c

5010 0 82 -86 83 -3 fill=9 (10.7442 -5.3721 0) u=201 imp:n=1

c

c

5011 0 85 -81 3 -4 fill=9 (-10.7442 0 0) u=201 imp:n=1

c

5012 0 81 -1 3 -4 fill=9 (-5.3721 0 0) u=201 imp:n=1

c

5013 0 1 -2 3 -4 fill=9 (0 0 0) u=201 imp:n=1

c

5014 0 2 -82 3 -4 fill=9 (5.3721 0 0) u=201 imp:n=1

c

5015 0 82 -86 3 -4 fill=9 (10.7442 0 0) u=201 imp:n=1

c

c

5016 0 85 -81 4 -84 fill=9 (-10.7442 5.3721 0) u=201 imp:n=1

c

5017 0 81 -1 4 -84 fill=9 (-5.3721 5.3721 0) u=201 imp:n=1

c

5018 0 1 -2 4 -84 fill=9 (0 5.3721 0) u=201 imp:n=1

c

5019 0 2 -82 4 -84 fill=9 (5.3721 5.3721 0) u=201 imp:n=1

c

5020 0 82 -86 4 -84 fill=9 (10.7442 5.3721 0) u=201 imp:n=1

c

c

5021 0 85 -81 84 -88 fill=9 (-10.7442 10.7442 0) u=201 imp:n=1

c

5022 0 81 -1 84 -88 fill=9 (-5.3721 10.7442 0) u=201 imp:n=1

c

5023 0 1 -2 84 -88 fill=9 (0 10.7442 0) u=201 imp:n=1

c

5024 0 2 -82 84 -88 fill=9 (5.3721 10.7442 0) u=201 imp:n=1

c

5025 0 82 -86 84 -88 fill=9 (10.7442 10.7442 0) u=201 imp:n=1

c

c Surround material

c

5026 0 89 -90 91 -92 (-85:86:-87:88) -71 u=201 imp:n=1

c

5027 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 71 -72 u=201 imp:n=1

c

5028 0 89 -90 91 -92 (-85:86:-87:88) 72 -73 u=201 imp:n=1

c

5029 19 7.403935E-02 89 -90 91 -92 (-85:86:-87:88) 73 -74 u=201 imp:n=1

c

5030 0 89 -90 91 -92 (-85:86:-87:88) 74 u=201 imp:n=1

c

c

c -----------------------------------------------------------------------

c

c

c ------------- SURFACE CARDS -------------------------------------------

c

c Lattice 2 (Assembly) Elementary cell surfaces

1 px -2.68605

2 px 2.68605

3 py -2.68605

4 py 2.68605

7 pz 0.0 $ Assembly lower limit

8 pz 30.0 $ End Packing, Start Reflector

9 pz 37.60628 $ End Plenum, Start Lower NU

10 pz 67.77878 $ End Lower NU, Start Fuel

11 pz 157.26478 $ End Fuel, Start Upper NU

12 pz 187.43728 $ End Upper NU, Start Top Reflector

13 pz 195.04356 $ End Reflector, Start Packing

16 pz 225.04356 $ Assembly upper limit

17 cz 94.9 $ Outer radius of the assembly

21 px -2.5335 $ Nominal half-width of plates

22 px 2.5335

23 py -2.5335

24 py 2.5335

28 px -2.54 $ Radial shield half-width

29 px 2.54

30 py -2.54

31 py 2.54

32 px -2.551 $ sheath inner half-width

33 px 2.551

34 py -2.551

35 py 2.551

36 px -2.6272 $ sheath outer half-width

37 px 2.6272

38 py -2.6272

39 py 2.6272

c

c

c subdivisions in the axial blanket and core cells

c

c 9 pz 37.60628 $ axial reflector / axial blanket

41 pz 45.228780

42 pz 57.951780

c 10 pz 67.77878 $ axial blanket / core

43 pz 71.21678

44 pz 74.97178

45 pz 78.72678

46 pz 82.48178

47 pz 86.23678

48 pz 89.99178

49 pz 93.74678

50 pz 97.50178

51 pz 101.25678

52 pz 105.01178

53 pz 108.76678

54 pz 112.52178

55 pz 116.27678

56 pz 120.03178

57 pz 123.78678

58 pz 127.54178

59 pz 131.29678

60 pz 135.05178

61 pz 138.80678

62 pz 142.56178

63 pz 146.31678

64 pz 150.07178

65 pz 153.82678

c 11 pz 157.26478 $ core / axial blanket

67 pz 167.09178

68 pz 179.81478

c 12 pz 187.43728 $ axial blanket / reflector

c

c Grid plate heights

c

71 pz 31.8

72 pz 62.2

73 pz 162.6

74 pz 193.0

c

c coordinates of the elements in 5x5 arrays

81 px -8.05815

82 px 8.05815

83 py -8.05815

84 py 8.05815

85 px -13.43025

86 px 13.43025

87 py -13.43025

88 py 13.43025

89 px -13.5635

90 px 13.5635

91 py -13.5635

92 py 13.5635

c

c

101 px -2.3355 $ Pu plate core width

102 px 2.3355

103 py -2.3355

104 py 2.3355

105 px -2.4255 $ UO2 plate core width

106 px 2.4255

107 py -2.4255

108 py 2.4255

c the sodium dummy plate type X = STNAVR4 (ring shaped)

109 cz 2.3

c 110 cz 2.5335

110 cz 2.5334

c 109 px -2.4815 $ Na plate core width

c 110 px 2.4815

c 111 py -2.4815

c 112 py 2.4815

c

c

c Cell 2 Axial heights

c

401 pz 153.82678

402 pz 153.86428

403 pz 154.40528

404 pz 154.44278

405 pz 154.47943

406 pz 155.03743

407 pz 155.07408

408 pz 155.11978

409 pz 155.35578

410 pz 155.40148

411 pz 155.43898

412 pz 155.97998

413 pz 156.01748

414 pz 156.05413

415 pz 156.61213

416 pz 156.64878

417 pz 156.68628

418 pz 157.22728

419 pz 157.26478

c

c Cell 12 Axial heights

c

501 pz 67.77878

502 pz 67.816280

503 pz 68.357280

504 pz 68.394780

505 pz 68.431430

506 pz 68.989430

507 pz 69.026080

508 pz 69.063580

509 pz 69.604580

510 pz 69.642080

511 pz 69.687780

512 pz 69.923780

513 pz 69.969480

514 pz 70.006130

515 pz 70.564130

516 pz 70.600780

517 pz 70.638280

518 pz 71.179280

519 pz 71.216780

c

c Basic Cell 1 data

c 701 pz 0.000000

c 702 pz 0.037500

c 703 pz 0.578500 $ Na

c 704 pz 0.616000

c 705 pz 0.652650

c 706 pz 1.210650 $ UO2

c 707 pz 1.247300

708 pz 1.564300 $ SS

709 pz 1.610000 $ Pu can

710 pz 1.846000 $ Pu core

711 pz 1.891700

712 pz 1.929200 $ Na can

713 pz 2.470200 $ Na core

c 714 pz 2.507700 $ SS

c 715 pz 2.544350

c 716 pz 3.102350 $ UO2

c 717 pz 3.139000

c 718 pz 3.176500

c 719 pz 3.717500 $ Na

c 720 pz 3.755000 $ Cell 1

c

801 pz 0.000000

802 pz 0.037500

803 pz 0.578500 $ Na

804 pz 0.616000

805 pz 0.652650

806 pz 1.210650 $ UO2

807 pz 1.247300

808 pz 1.284800

809 pz 1.825800 $ Na

810 pz 1.863300

811 pz 1.909000

812 pz 2.145000 $ Pu

813 pz 2.190700

814 pz 2.507700 $ SS

815 pz 2.544350

816 pz 3.102350 $ UO2

817 pz 3.139000

818 pz 3.176500

819 pz 3.717500 $ Na

820 pz 3.755000 $ Cell 11

c

c ----------------------------------------------------------------------

c

c

c

c ------------- TALLY CARDS ---------------------------------------------

c

c --- MATERIALS CARDS ---

c

c

C MATERIAL 1 Pu metal plate core

m1 92238.31c 6.8782E-07

94238.31c 3.0461E-05

94239.31c 2.8920E-02

94240.31c 6.9095E-03

94241.31c 7.3960E-04

94242.31c 1.8699E-04

95241.31c 4.5718E-04

1001.31c 1.2764E-04

6000.31c 4.2260E-04

7014.31c 2.4215E-05

8016.31c 8.8450E-05

13027.31c 2.2973E-05

14028.31c 1.4158E-05

25055.31c 1.4902E-06

24050.31c 1.5637E-07

24052.31c 3.0155E-06

24053.31c 3.4193E-07

24054.31c 8.5114E-08

26054.31c 9.5478E-07

26056.31c 1.4988E-05

26057.31c 3.4614E-07

26058.31c 4.6065E-09

28058.31c 5.8334E-06

28060.31c 2.2470E-06

28061.31c 9.7676E-08

28062.31c 3.1143E-07

28064.31c 7.9313E-08

31000.31c 2.0166E-03

c total 3.9991E-02

c MATERIAL 2 Pu plate canning

m2 1001.31c 1.3760E-05

6000.31c 1.1393E-04

14028.31c 3.6607E-04

15031.31c 1.3731E-05

24050.31c 4.0848E-04

24052.31c 7.8771E-03

24053.31c 8.9320E-04

24054.31c 2.2234E-04

25055.31c 8.5931E-04

26054.31c 2.0774E-03

26056.31c 3.2611E-02

26057.31c 7.5313E-04

26058.31c 1.0023E-05

28058.31c 2.8351E-03

28060.31c 1.0921E-03

28061.31c 4.7472E-05

28062.31c 1.5136E-04

28064.31c 3.8548E-05

29063.31c 1.1629E-02

29065.31c 4.9839E-03

c total 6.6997E-02

C MATERIAL 3 UO2 plate core

m3 1001.31c 3.1773E-05

6000.31c 1.1808E-05

8016.31c 4.6008E-02

13027.31c 3.3911E-06

14028.31c 2.2967E-05

25055.31c 8.3273E-08

26054.31c 7.6610E-08

26056.31c 1.2026E-06

26057.31c 2.7774E-08

26058.31c 3.6962E-10

28058.31c 8.4906E-07

28060.31c 3.2705E-07

28061.31c 1.4217E-08

28062.31c 4.5329E-08

28064.31c 1.1544E-08

42000.66c 3.3379E-07

92235.31c 1.6544E-04

92238.31c 2.2837E-02

c total 6.9083E-02

c MATERIAL 4 UO2 plate canning

m4 1001.31c 1.9035E-05

6000.31c 1.2831E-04

14028.31c 6.4475E-04

15031.31c 3.5078E-04

16032.31c 3.6041E-05

24050.31c 6.0044E-04

24052.31c 1.1579E-02

24053.31c 1.3129E-03

24054.31c 3.2682E-04

25055.31c 8.5559E-04

26054.31c 2.8235E-03

26056.31c 4.4323E-02

26057.31c 1.0236E-03

26058.31c 1.3622E-05

28058.31c 5.7360E-03

28060.31c 2.2095E-03

28061.31c 9.6046E-05

28062.31c 3.0624E-04

28064.31c 7.7989E-05

c total 7.2463E-02

c MATERIAL 6 Dummy plate X

m6 1001.31c 2.4073E-05

6000.31c 2.7547E-04

14028.31c 7.5592E-04

15031.31c 4.5399E-05

16032.31c 1.2036E-05

25055.31c 1.1688E-03

24050.31c 7.2101E-04

24052.31c 1.3904E-02

24053.31c 1.5766E-03

24054.31c 3.9245E-04

26054.31c 3.4629E-03

26056.31c 5.4360E-02

26057.31c 1.2554E-03

26058.31c 1.6707E-04

28058.31c 6.7629E-03

28060.31c 2.6051E-03

28061.31c 1.1324E-04

28062.31c 3.6106E-04

28064.31c 9.1951E-05

41093.31c 4.0746E-04

c total 8.84628E-02

C MATERIAL 7 40% steel plate

c m7 1001.31c 1.8355E-05

c 6000.31c 8.7794E-05

c 13027.31c 1.1862E-04

c 14028.31c 7.9703E-04

c 15031.31c 4.0018E-05

c 16032.31c 1.4422E-05

c 22000.62c 2.4806E-04

c 24050.31c 6.9120E-04

c 24052.31c 1.3329E-02

c 24053.31c 1.5114E-03

c 24054.31c 3.7622E-04

c 25055.31c 1.4972E-03

c 26054.31c 3.2362E-03

c 26056.31c 5.0801E-02

c 26057.31c 1.1732E-03

c 26058.31c 1.5613E-05

c 28058.31c 5.9891E-03

c 28060.31c 2.3070E-03

c 28061.31c 1.0028E-04

c 28062.31c 3.1975E-04

c 28064.31c 8.1431E-05

c 29063.31c 5.0365E-05

c 41093.31c 4.9781E-06

c 42000.66c 8.0988E-05

c

c 40% ss plate smeared over plate region

c

m7 1001.31c 7.3413E-06

6000.31c 3.5114E-05

13027.31c 4.7443E-05

14028.31c 3.1878E-04

15031.31c 1.6006E-05

16032.31c 5.7682E-06

22000.62c 9.9214E-05

24050.31c 2.7645E-04

24052.31c 5.3311E-03

24053.31c 6.0450E-04

24054.31c 1.5047E-04

25055.31c 5.9882E-04

26054.31c 1.2944E-03

26056.31c 2.0318E-02

26057.31c 4.6923E-04

26058.31c 6.2446E-06

28058.31c 2.3954E-03

28060.31c 9.2271E-04

28061.31c 4.0108E-05

28062.31c 1.2789E-04

28064.31c 3.2569E-05

29063.31c 1.4101E-05

29065.31c 6.0432E-06

41093.31c 1.9910E-06

42000.66c 3.2392E-05

c total 3.3152E-02

c

C MATERIAL 8 U8 metal plate

m8 1001.31c 4.4048E-05

6000.31c 4.9283E-04

14028.31c 2.1076E-04

26054.31c 6.1951E-06

26056.31c 9.7250E-05

26057.31c 2.2459E-06

26058.31c 2.9889E-08

92235.31c 3.3369E-04

92238.31c 4.6021E-02

c total 4.7208E-02

C MATERIAL 9 U2 metal plate

m9 1001.31c 4.3899E-05

6000.31c 4.6047E-04

14028.31c 1.9692E-04

26054.31c 5.7884E-06

26056.31c 9.0866E-05

26057.31c 2.0985E-06

26058.31c 2.7927E-08

92235.31c 3.3962E-04

92238.31c 4.6785E-02

c total 4.7925E-02

c

c MATERIAL 10 Dummy plate Y

c

m10 1001.31c 2.4073E-05

6000.31c 2.5251E-04

14028.31c 7.4610E-04

15031.31c 1.7803E-05

16032.31c 1.7195E-05

25055.31c 1.5006E-03

24050.31c 7.0597E-04

24052.31c 1.3614E-02

24053.31c 1.5437E-03

24054.31c 3.8427E-04

26054.31c 3.5001E-03

26056.31c 5.4943E-02

26057.31c 1.2689E-03

26058.31c 1.6886E-04

28058.31c 6.3995E-03

28060.31c 2.4651E-03

28061.31c 1.0716E-04

28062.31c 3.4166E-04

28064.31c 8.7011E-05

41093.31c 3.7393E-04

c total 8.84614E-02

c MATERIAL 11 Honeycomb dummy plate

c CR 2.4643E-03 FE 8.0717E-03 NI 1.2195E-03

m11 1001.31c 3.3245E-06

6000.31c 3.3477E-05

14028.31c 1.2169E-04

15031.31c 4.9764E-06

16032.31c 2.5076E-06

25055.31c 1.9518E-04

24050.31c 1.0707E-04

24052.31c 2.0648E-03

24053.31c 2.3413E-04

24054.31c 5.8281E-05

26054.31c 4.7179E-04

26056.31c 7.4061E-03

26057.31c 1.7104E-04

26058.31c 2.2762E-05

28058.31c 8.3019E-04

28060.31c 3.1979E-04

28061.31c 1.3901E-05

28062.31c 4.4323E-05

28064.31c 1.1288E-05

41093.31c 5.2657E-05

c total 1.216928E-02

c

c Material 12 Radial shield

m12 1001.31c 4.6306E-05

6000.31c 6.8972E-04

14028.31c 3.1158E-04

15031.31c 4.2944E-05

16032.31c 3.7110E-05

25055.31c 7.1275E-04

26054.31c 4.9065E-03

26056.31c 7.4517E-02

26057.31c 1.7491E-03

26058.31c 2.5903E-04

c total 8.32720E-02

c

c radial shield void surround low density

m13 1001.31c 4.6306E-08

6000.31c 6.8972E-07

14028.31c 3.1158E-07

15031.31c 4.2944E-08

16032.31c 3.7110E-08

25055.31c 7.1275E-07

26054.31c 4.9065E-06

26056.31c 7.4517E-05

26057.31c 1.7491E-06

26058.31c 2.5903E-07

c total 8.32720E-05

c

c Axial shield

m14 1001.31c 2.5700E-05

6000.31c 5.1066E-04

13027.31c 1.3989E-04

22000.62c 3.9416E-05

24050.31c 1.2213E-06

24052.31c 2.2823E-05

24053.31c 2.5531E-06

24054.31c 6.2449E-07

25055.31c 3.2634E-04

26054.31c 5.0496E-03

26056.31c 7.6690E-02

26057.31c 1.8001E-03

26058.31c 2.6658E-04

28058.31c 1.2564E-06

28060.31c 4.6968E-07

28061.31c 2.2000E-08

28062.31c 6.2769E-08

28064.31c 1.6774E-08

29063.31c 3.1184E-05

29065.31c 1.3364E-05

42000.66c 9.8355E-06

c total 8.4932E-02

c

c Natural Uranium Breeder

m15 1001.31c 4.4574E-05

6000.31c 4.7140E-04

14028.31c 2.0160E-04

26054.31c 6.1085E-06

26056.31c 9.2771E-05

26057.31c 2.1776E-06

26058.31c 3.2248E-07

92235.31c 3.4209E-04

92238.31c 4.7156E-02

c Total 4.8317E-02

c

c Assembly Foot and Top Plates

m16 1001.31c 3.1777E-05

6000.31c 9.9996E-05

13027.31c 8.3095E-06

24050.31c 6.9087E-08

24052.31c 1.2911E-06

24053.31c 1.4442E-07

24054.31c 3.5326E-08

25055.31c 1.0785E-04

26054.31c 1.9605E-03

26056.31c 2.9775E-02

26057.31c 6.9890E-04

26058.31c 1.0350E-04

28058.31c 1.5636E-07

28060.31c 5.8452E-08

28061.31c 2.7378E-09

28062.31c 7.8115E-09

28064.31c 2.0875E-09

29063.31c 6.5270E-06

29065.31c 2.7973E-06

c Total 3.279692E-02

c

c wrapper material

m17 1001.31c 7.5725E-05

6000.31c 2.3828E-04

13027.31c 1.9802E-05

24050.31c 1.6463E-07

24052.31c 3.0767E-06

24053.31c 3.4414E-07

24054.31c 8.4182E-08

25055.31c 2.5701E-04

26054.31c 4.6718E-03

26056.31c 7.0954E-02

26057.31c 1.6655E-03

26058.31c 2.4664E-04

28058.31c 3.7260E-07

28060.31c 1.3929E-07

28061.31c 6.5242E-09

28062.31c 1.8615E-08

28064.31c 4.9746E-09

29063.31c 1.5554E-05

29065.31c 6.6660E-06

c Total 7.81552E-02

c

c

c Superlattice grid plate

c

m19 1001.31c 2.4442E-04

6000.31c 2.9057E-04

14028.31c 4.3858E-05

15031.31c 1.3256E-05

16032.31c 4.3530E-05

25055.31c 2.5785E-04

26054.31c 4.2756E-03

26056.31c 6.7114E-02

26057.31c 1.5500E-03

26058.31c 2.0627E-04

c Total 19 7.403935E-02

c

c

c --- MODE CARDS ---

mode n

kcode 10000 1.0 100 1500

ksrc 0.0 0.0 77.0 0.0 0.0 87.9 0.0 0.0 107.0

0.0 0.0 117.9 0.0 0.0 137.0 0.0 0.0 147.9

10.74 0.0 77.0 10.74 0.0 87.9 10.74 0.0 107.0

10.74 0.0 117.9 10.74 0.0 137.0 10.74 0.0 147.9

-10.74 0.0 77.0 -10.74 0.0 87.9 -10.74 0.0 107.0

-10.74 0.0 117.9 -10.74 0.0 137.0 -10.74 0.0 147.9

0.0 10.74 77.0 0.0 10.74 87.9 0.0 10.74 107.0

0.0 10.74 117.9 0.0 10.74 137.0 0.0 10.74 147.9

0.0 -10.74 77.0 0.0 -10.74 87.9 -10.74 0.0 107.0

0.0 -10.74 117.9 0.0 -10.74 137.0 0.0 -10.74 147.9

10.74 10.74 77.0 10.74 10.74 87.9 10.74 10.74 107.0

10.74 10.74 117.9 10.74 10.74 137.0 10.74 10.74 147.9

-10.74 10.74 77.0 -10.74 10.74 87.9 -10.74 10.74 107.0

-10.74 10.74 117.9 -10.74 10.74 137.0 -10.74 10.74 147.9

10.74 -10.74 77.0 10.74 -10.74 87.9 10.74 -10.74 107.0

10.74 -10.74 117.9 10.74 -10.74 137.0 10.74 -10.74 147.9

-10.74 -10.74 77.0 -10.74 -10.74 87.9 -10.74 -10.74 107.0

-10.74 -10.74 117.9 -10.74 -10.74 137.0 -10.74 -10.74 147.9

25.335 0.0 77.0 25.335 0.0 87.9 25.335 0.0 107.0

25.335 0.0 117.9 25.335 0.0 137.0 25.335 0.0 147.9

-25.335 0.0 77.0 -25.335 0.0 87.9 -25.335 0.0 107.0

-25.335 0.0 117.9 -25.335 0.0 137.0 -25.335 0.0 147.9

0.0 25.335 77.0 0.0 25.335 87.9 0.0 25.335 107.0

0.0 25.335 117.9 0.0 25.335 137.0 0.0 25.335 147.9

0.0 -25.335 77.0 0.0 -25.335 87.9 -25.335 0.0 107.0

0.0 -25.335 117.9 0.0 -25.335 137.0 0.0 -25.335 147.9

25.335 25.335 77.0 25.335 25.335 87.9 25.335 25.335 107.0

25.335 25.335 117.9 25.335 25.335 137.0 25.335 25.335 147.9

-25.335 25.335 77.0 -25.335 25.335 87.9 -25.335 25.335 107.0

-25.335 25.335 117.9 -25.335 25.335 137.0 -25.335 25.335 147.9

25.335 -25.335 77.0 25.335 -25.335 87.9 25.335 -25.335 107.0

25.335 -25.335 117.9 25.335 -25.335 137.0 25.335 -25.335 147.9

-25.335 -25.335 77.0 -25.335 -25.335 87.9 -25.335 -25.335 107.0

37.6 0.0 77.0 37.6 0.0 87.9 37.6 0.0 107.0

37.6 0.0 117.9 37.6 0.0 137.0 37.6 0.0 147.9

-37.6 0.0 77.0 -37.6 0.0 87.9 -37.6 0.0 107.0

-37.6 0.0 117.9 -37.6 0.0 137.0 -37.6 0.0 147.9

0.0 37.6 77.0 0.0 37.6 87.9 0.0 37.6 107.0

0.0 37.6 117.9 0.0 37.6 137.0 0.0 37.6 147.9

0.0 -37.6 77.0 0.0 -37.6 87.9 -37.6 0.0 107.0

0.0 -37.6 117.9 0.0 -37.6 137.0 0.0 -37.6 147.9

print

### A4.4 MCNP-JEFF-3.1 Zebra25 Model A

Z25 model with main elements represented. JENDL-3.3

c Pin Elements C, E, B, A and J are represented and the equivalent pin cells

c for Pin Elements D, H and L.

c

c

c ------------- CELL CARDS ----------------------------------------------

c

c --- Core Pin Geometry Element C Calandria NACLIII Pins 8xA and 8xE

c Fuel m21 and m25, can + tube m31 and m35

c Lower padding

1 16 3.279692E-02 -8 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Lower Reflector

2 14 8.4932E-02 8 -9 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

3 15 4.8317E-02 9 -41 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

4 9 4.7925E-02 41 -42 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

5 8 4.7208E-02 42 -10 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

9 27 0.0513781 33 -34 35 -36 10 -82 u=1 imp:n=1 TMP=2.5301E-08

c

c

10 25 7.1167E-02 -91 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

11 21 0.069985 -92 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

12 25 7.1167E-02 -93 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

13 21 0.069985 -94 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

14 21 0.069985 -95 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

15 25 7.1167E-02 -96 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

16 21 0.069985 -97 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

17 25 7.1167E-02 -98 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

18 25 7.1167E-02 -99 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

19 21 0.069985 -100 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

20 25 7.1167E-02 -101 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

21 21 0.069985 -102 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

22 21 0.069985 -103 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

23 25 7.1167E-02 -104 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

24 21 0.069985 -105 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

25 25 7.1167E-02 -106 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

c

30 35 0.0596942 -111 91 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

31 31 0.062241 -112 92 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

32 35 0.0596942 -113 93 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

33 31 0.062241 -114 94 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

34 31 0.062241 -115 95 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

35 35 0.0596942 -116 96 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

36 31 0.062241 -117 97 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

37 35 0.0596942 -118 98 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

38 35 0.0596942 -119 99 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

39 31 0.062241 -120 100 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

40 35 0.0596942 -121 101 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

41 31 0.062241 -122 102 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

42 31 0.062241 -123 103 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

43 35 0.0596942 -124 104 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

44 31 0.062241 -125 105 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

45 35 0.0596942 -126 106 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

46 0 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=1 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

48 27 0.0513781 33 -34 35 -36 83 -85 u=1 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

50 25 7.1167E-02 -91 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

51 21 0.069985 -92 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

52 25 7.1167E-02 -93 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

53 21 0.069985 -94 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

54 21 0.069985 -95 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

55 25 7.1167E-02 -96 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

56 21 0.069985 -97 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

57 25 7.1167E-02 -98 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

58 25 7.1167E-02 -99 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

59 21 0.069985 -100 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

60 25 7.1167E-02 -101 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

61 21 0.069985 -102 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

62 21 0.069985 -103 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

63 25 7.1167E-02 -104 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

64 21 0.069985 -105 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

65 25 7.1167E-02 -106 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

c

c

70 35 0.0596942 -111 91 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

71 31 0.062241 -112 92 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

72 35 0.0596942 -113 93 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

73 31 0.062241 -114 94 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

74 31 0.062241 -115 95 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

75 35 0.0596942 -116 96 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

76 31 0.062241 -117 97 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

77 35 0.0596942 -118 98 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

78 35 0.0596942 -119 99 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

79 31 0.062241 -120 100 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

80 35 0.0596942 -121 101 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

81 31 0.062241 -122 102 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

82 31 0.062241 -123 103 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

83 35 0.0596942 -124 104 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

84 31 0.062241 -125 105 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

85 35 0.0596942 -126 106 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

86 0 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=1 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

88 27 0.0513781 33 -34 35 -36 86 -88 u=1 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

90 25 7.1167E-02 -91 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

91 21 0.069985 -92 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

92 25 7.1167E-02 -93 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

93 21 0.069985 -94 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

94 21 0.069985 -95 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

95 25 7.1167E-02 -96 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

96 21 0.069985 -97 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

97 25 7.1167E-02 -98 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

98 25 7.1167E-02 -99 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

99 21 0.069985 -100 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

100 25 7.1167E-02 -101 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

101 21 0.069985 -102 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

102 21 0.069985 -103 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

103 25 7.1167E-02 -104 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

104 21 0.069985 -105 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

105 25 7.1167E-02 -106 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

c

c

110 35 0.0596942 -111 91 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

111 31 0.062241 -112 92 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

112 35 0.0596942 -113 93 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

113 31 0.062241 -114 94 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

114 31 0.062241 -115 95 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

115 35 0.0596942 -116 96 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

116 31 0.062241 -117 97 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

117 35 0.0596942 -118 98 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

118 35 0.0596942 -119 99 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

119 31 0.062241 -120 100 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

120 35 0.0596942 -121 101 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

121 31 0.062241 -122 102 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

122 31 0.062241 -123 103 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

123 35 0.0596942 -124 104 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

124 31 0.062241 -125 105 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

125 35 0.0596942 -126 106 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

126 0 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=1 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

128 27 0.0513781 33 -34 35 -36 89 -11 u=1 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

129 53 7.44684E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=1 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

131 8 4.7208E-02 11 -67 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

132 9 4.7925E-02 67 -68 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

133 15 4.8317E-02 68 -12 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Upper Reflector

134 14 8.4932E-02 12 -13 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Upper padding

135 16 3.279692E-02 13 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

136 0 132 -133 134 -135 (-21:22:-23:24) u=1 imp:n=1

c Wrapper

137 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=1 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

138 0 1 -2 3 -4 (-136:137:-138:139) u=1 imp:n=1

c

c End of Core Pin Geometry Element C

c

c

c --- Core Pin geometry Element E (& D) NACLIIS Pins 8xD and 8xF

c D 24 7.1085E-02 F 26 7.1415E-02 clad D 34 5.9086E-02 F 36 6.0033E-02

c Lower padding

201 16 3.279692E-02 -8 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Lower Reflector

202 14 8.4932E-02 8 -9 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

203 15 4.8317E-02 9 -41 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

204 9 4.7925E-02 41 -42 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

205 8 4.7208E-02 42 -10 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

209 27 0.0513781 33 -34 35 -36 10 -82 u=2 imp:n=1 TMP=2.5301E-08

c

c

210 26 7.1415E-02 -91 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

211 24 7.1085E-02 -92 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

212 26 7.1415E-02 -93 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

213 24 7.1085E-02 -94 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

214 24 7.1085E-02 -95 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

215 26 7.1415E-02 -96 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

216 24 7.1085E-02 -97 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

217 26 7.1415E-02 -98 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

218 26 7.1415E-02 -99 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

219 24 7.1085E-02 -100 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

220 26 7.1415E-02 -101 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

221 24 7.1085E-02 -102 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

222 24 7.1085E-02 -103 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

223 26 7.1415E-02 -104 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

224 24 7.1085E-02 -105 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

225 26 7.1415E-02 -106 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

c

230 36 6.0033E-02 -111 91 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

231 34 5.9086E-02 -112 92 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

232 36 6.0033E-02 -113 93 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

233 34 5.9086E-02 -114 94 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

234 34 5.9086E-02 -115 95 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

235 36 6.0033E-02 -116 96 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

236 34 5.9086E-02 -117 97 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

237 36 6.0033E-02 -118 98 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

238 36 6.0033E-02 -119 99 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

239 34 5.9086E-02 -120 100 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

240 36 6.0033E-02 -121 101 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

241 34 5.9086E-02 -122 102 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

242 34 5.9086E-02 -123 103 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

243 36 6.0033E-02 -124 104 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

244 34 5.9086E-02 -125 105 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

245 36 6.0033E-02 -126 106 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

246 0 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=2 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

248 27 0.0513781 33 -34 35 -36 83 -85 u=2 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

250 26 7.1415E-02 -91 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

251 24 7.1085E-02 -92 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

252 26 7.1415E-02 -93 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

253 24 7.1085E-02 -94 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

254 24 7.1085E-02 -95 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

255 26 7.1415E-02 -96 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

256 24 7.1085E-02 -97 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

257 26 7.1415E-02 -98 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

258 26 7.1415E-02 -99 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

259 24 7.1085E-02 -100 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

260 26 7.1415E-02 -101 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

261 24 7.1085E-02 -102 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

262 24 7.1085E-02 -103 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

263 26 7.1415E-02 -104 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

264 24 7.1085E-02 -105 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

265 26 7.1415E-02 -106 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

c

c

270 36 6.0033E-02 -111 91 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

271 34 5.9086E-02 -112 92 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

272 36 6.0033E-02 -113 93 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

273 34 5.9086E-02 -114 94 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

274 34 5.9086E-02 -115 95 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

275 36 6.0033E-02 -116 96 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

276 34 5.9086E-02 -117 97 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

277 36 6.0033E-02 -118 98 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

278 36 6.0033E-02 -119 99 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

279 34 5.9086E-02 -120 100 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

280 36 6.0033E-02 -121 101 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

281 34 5.9086E-02 -122 102 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

282 34 5.9086E-02 -123 103 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

283 36 6.0033E-02 -124 104 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

284 34 5.9086E-02 -125 105 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

285 36 6.0033E-02 -126 106 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

286 0 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=2 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

288 27 0.0513781 33 -34 35 -36 86 -88 u=2 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

290 26 7.1415E-02 -91 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

291 24 7.1085E-02 -92 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

292 26 7.1415E-02 -93 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

293 24 7.1085E-02 -94 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

294 24 7.1085E-02 -95 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

295 26 7.1415E-02 -96 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

296 24 7.1085E-02 -97 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

297 26 7.1415E-02 -98 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

298 26 7.1415E-02 -99 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

299 24 7.1085E-02 -100 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

300 26 7.1415E-02 -101 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

301 24 7.1085E-02 -102 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

302 24 7.1085E-02 -103 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

303 26 7.1415E-02 -104 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

304 24 7.1085E-02 -105 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

305 26 7.1415E-02 -106 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

c

c

310 36 6.0033E-02 -111 91 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

311 34 5.9086E-02 -112 92 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

312 36 6.0033E-02 -113 93 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

313 34 5.9086E-02 -114 94 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

314 34 5.9086E-02 -115 95 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

315 36 6.0033E-02 -116 96 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

316 34 5.9086E-02 -117 97 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

317 36 6.0033E-02 -118 98 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

318 36 6.0033E-02 -119 99 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

319 34 5.9086E-02 -120 100 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

320 36 6.0033E-02 -121 101 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

321 34 5.9086E-02 -122 102 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

322 34 5.9086E-02 -123 103 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

323 36 6.0033E-02 -124 104 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

324 34 5.9086E-02 -125 105 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

325 36 6.0033E-02 -126 106 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

326 0 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=2 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

328 27 0.0513781 33 -34 35 -36 89 -11 u=2 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

329 52 7.20749E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=2 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

331 8 4.7208E-02 11 -67 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

332 9 4.7925E-02 67 -68 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

333 15 4.8317E-02 68 -12 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Upper Reflector

334 14 8.4932E-02 12 -13 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Upper padding

335 16 3.279692E-02 13 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

336 0 132 -133 134 -135 (-21:22:-23:24) u=2 imp:n=1

c Wrapper

337 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=2 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

338 0 1 -2 3 -4 (-136:137:-138:139) u=2 imp:n=1

c

c End of Core Pin Geometry Element E (D)

c

c

c --- Core Pin Geometry Element B (H, L) Calandria NACLI Pins 11xB and 5xF

c B 22 7.0537E-02 F 26 7.1415E-02 clad 32 5.8537E-02 F 36 6.0033E-02

c Pin F is in circles 93 98 99 101 and 104

c

c Lower padding

401 16 3.279692E-02 -8 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Lower Reflector

402 14 8.4932E-02 8 -9 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

403 15 4.8317E-02 9 -41 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

404 9 4.7925E-02 41 -42 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

405 8 4.7208E-02 42 -10 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

409 27 0.0513781 33 -34 35 -36 10 -82 u=3 imp:n=1 TMP=2.5301E-08

c

c

410 22 7.0537E-02 -91 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

411 22 7.0537E-02 -92 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

412 26 7.1415E-02 -93 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

413 22 7.0537E-02 -94 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

414 22 7.0537E-02 -95 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

415 22 7.0537E-02 -96 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

416 22 7.0537E-02 -97 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

417 26 7.1415E-02 -98 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

418 26 7.1415E-02 -99 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

419 22 7.0537E-02 -100 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

420 26 7.1415E-02 -101 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

421 22 7.0537E-02 -102 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

422 22 7.0537E-02 -103 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

423 26 7.1415E-02 -104 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

424 22 7.0537E-02 -105 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

425 22 7.0537E-02 -106 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

c

430 32 5.8537E-02 -111 91 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

431 32 5.8537E-02 -112 92 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

432 36 6.0033E-02 -113 93 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

433 32 5.8537E-02 -114 94 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

434 32 5.8537E-02 -115 95 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

435 32 5.8537E-02 -116 96 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

436 32 5.8537E-02 -117 97 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

437 36 6.0033E-02 -118 98 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

438 36 6.0033E-02 -119 99 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

439 32 5.8537E-02 -120 100 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

440 36 6.0033E-02 -121 101 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

441 32 5.8537E-02 -122 102 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

442 32 5.8537E-02 -123 103 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

443 36 6.0033E-02 -124 104 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

444 32 5.8537E-02 -125 105 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

445 32 5.8537E-02 -126 106 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

446 0 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=3 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

448 27 0.0513781 33 -34 35 -36 83 -85 u=3 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

450 22 7.0537E-02 -91 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

451 22 7.0537E-02 -92 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

452 26 7.1415E-02 -93 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

453 22 7.0537E-02 -94 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

454 22 7.0537E-02 -95 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

455 22 7.0537E-02 -96 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

456 22 7.0537E-02 -97 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

457 26 7.1415E-02 -98 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

458 26 7.1415E-02 -99 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

459 22 7.0537E-02 -100 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

460 26 7.1415E-02 -101 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

461 22 7.0537E-02 -102 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

462 22 7.0537E-02 -103 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

463 26 7.1415E-02 -104 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

464 22 7.0537E-02 -105 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

465 22 7.0537E-02 -106 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

c

c

470 32 5.8537E-02 -111 91 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

471 32 5.8537E-02 -112 92 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

472 36 6.0033E-02 -113 93 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

473 32 5.8537E-02 -114 94 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

474 32 5.8537E-02 -115 95 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

475 32 5.8537E-02 -116 96 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

476 32 5.8537E-02 -117 97 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

477 36 6.0033E-02 -118 98 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

478 36 6.0033E-02 -119 99 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

479 32 5.8537E-02 -120 100 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

480 36 6.0033E-02 -121 101 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

481 32 5.8537E-02 -122 102 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

482 32 5.8537E-02 -123 103 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

483 36 6.0033E-02 -124 104 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

484 32 5.8537E-02 -125 105 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

485 32 5.8537E-02 -126 106 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

486 0 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=3 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

488 27 0.0513781 33 -34 35 -36 86 -88 u=3 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

490 22 7.0537E-02 -91 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

491 22 7.0537E-02 -92 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

492 26 7.1415E-02 -93 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

493 22 7.0537E-02 -94 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

494 22 7.0537E-02 -95 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

495 22 7.0537E-02 -96 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

496 22 7.0537E-02 -97 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

497 26 7.1415E-02 -98 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

498 26 7.1415E-02 -99 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

499 22 7.0537E-02 -100 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

500 26 7.1415E-02 -101 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

501 22 7.0537E-02 -102 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

502 22 7.0537E-02 -103 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

503 26 7.1415E-02 -104 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

504 22 7.0537E-02 -105 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

505 22 7.0537E-02 -106 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

c

c

510 32 5.8537E-02 -111 91 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

511 32 5.8537E-02 -112 92 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

512 36 6.0033E-02 -113 93 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

513 32 5.8537E-02 -114 94 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

514 32 5.8537E-02 -115 95 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

515 32 5.8537E-02 -116 96 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

516 32 5.8537E-02 -117 97 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

517 36 6.0033E-02 -118 98 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

518 36 6.0033E-02 -119 99 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

519 32 5.8537E-02 -120 100 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

520 36 6.0033E-02 -121 101 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

521 32 5.8537E-02 -122 102 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

522 32 5.8537E-02 -123 103 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

523 36 6.0033E-02 -124 104 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

524 32 5.8537E-02 -125 105 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

525 32 5.8537E-02 -126 106 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

526 0 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=3 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

528 27 0.0513781 33 -34 35 -36 89 -11 u=3 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

529 51 7.34056E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=3 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

531 8 4.7208E-02 11 -67 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

532 9 4.7925E-02 67 -68 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

533 15 4.8317E-02 68 -12 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Upper Reflector

534 14 8.4932E-02 12 -13 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Upper padding

535 16 3.279692E-02 13 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

536 0 132 -133 134 -135 (-21:22:-23:24) u=3 imp:n=1

c Wrapper

537 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=3 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

538 0 1 -2 3 -4 (-136:137:-138:139) u=3 imp:n=1

c

c End of Core Pin Geometry Element B (H, L)

c

c

c --- Core Pin Geometry Element A Calandria NACLI Pins 16xC

c c 23 7.1230E-02 clad 33 6.15349E-02

c

c Lower padding

601 16 3.279692E-02 -8 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Lower Reflector

602 14 8.4932E-02 8 -9 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

603 15 4.8317E-02 9 -41 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

604 9 4.7925E-02 41 -42 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

605 8 4.7208E-02 42 -10 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

609 27 0.0513781 33 -34 35 -36 10 -82 u=4 imp:n=1 TMP=2.5301E-08

c

c

610 23 7.1230E-02 -91 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

611 23 7.1230E-02 -92 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

612 23 7.1230E-02 -93 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

613 23 7.1230E-02 -94 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

614 23 7.1230E-02 -95 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

615 23 7.1230E-02 -96 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

616 23 7.1230E-02 -97 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

617 23 7.1230E-02 -98 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

618 23 7.1230E-02 -99 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

619 23 7.1230E-02 -100 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

620 23 7.1230E-02 -101 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

621 23 7.1230E-02 -102 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

622 23 7.1230E-02 -103 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

623 23 7.1230E-02 -104 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

624 23 7.1230E-02 -105 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

625 23 7.1230E-02 -106 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

c

630 33 6.15349E-02 -111 91 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

631 33 6.15349E-02 -112 92 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

632 33 6.15349E-02 -113 93 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

633 33 6.15349E-02 -114 94 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

634 33 6.15349E-02 -115 95 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

635 33 6.15349E-02 -116 96 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

636 33 6.15349E-02 -117 97 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

637 33 6.15349E-02 -118 98 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

638 33 6.15349E-02 -119 99 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

639 33 6.15349E-02 -120 100 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

640 33 6.15349E-02 -121 101 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

641 33 6.15349E-02 -122 102 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

642 33 6.15349E-02 -123 103 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

643 33 6.15349E-02 -124 104 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

644 33 6.15349E-02 -125 105 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

645 33 6.15349E-02 -126 106 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

646 0 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=4 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

648 27 0.0513781 33 -34 35 -36 83 -85 u=4 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

650 23 7.1230E-02 -91 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

651 23 7.1230E-02 -92 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

652 23 7.1230E-02 -93 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

653 23 7.1230E-02 -94 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

654 23 7.1230E-02 -95 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

655 23 7.1230E-02 -96 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

656 23 7.1230E-02 -97 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

657 23 7.1230E-02 -98 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

658 23 7.1230E-02 -99 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

659 23 7.1230E-02 -100 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

660 23 7.1230E-02 -101 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

661 23 7.1230E-02 -102 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

662 23 7.1230E-02 -103 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

663 23 7.1230E-02 -104 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

664 23 7.1230E-02 -105 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

665 23 7.1230E-02 -106 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

c

c

670 33 6.15349E-02 -111 91 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

671 33 6.15349E-02 -112 92 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

672 33 6.15349E-02 -113 93 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

673 33 6.15349E-02 -114 94 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

674 33 6.15349E-02 -115 95 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

675 33 6.15349E-02 -116 96 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

676 33 6.15349E-02 -117 97 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

677 33 6.15349E-02 -118 98 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

678 33 6.15349E-02 -119 99 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

679 33 6.15349E-02 -120 100 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

680 33 6.15349E-02 -121 101 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

681 33 6.15349E-02 -122 102 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

682 33 6.15349E-02 -123 103 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

683 33 6.15349E-02 -124 104 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

684 33 6.15349E-02 -125 105 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

685 33 6.15349E-02 -126 106 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

686 0 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=4 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

688 27 0.0513781 33 -34 35 -36 86 -88 u=4 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

690 23 7.1230E-02 -91 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

691 23 7.1230E-02 -92 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

692 23 7.1230E-02 -93 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

693 23 7.1230E-02 -94 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

694 23 7.1230E-02 -95 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

695 23 7.1230E-02 -96 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

696 23 7.1230E-02 -97 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

697 23 7.1230E-02 -98 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

698 23 7.1230E-02 -99 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

699 23 7.1230E-02 -100 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

700 23 7.1230E-02 -101 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

701 23 7.1230E-02 -102 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

702 23 7.1230E-02 -103 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

703 23 7.1230E-02 -104 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

704 23 7.1230E-02 -105 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

705 23 7.1230E-02 -106 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

c

c

710 33 6.15349E-02 -111 91 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

711 33 6.15349E-02 -112 92 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

712 33 6.15349E-02 -113 93 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

713 33 6.15349E-02 -114 94 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

714 33 6.15349E-02 -115 95 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

715 33 6.15349E-02 -116 96 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

716 33 6.15349E-02 -117 97 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

717 33 6.15349E-02 -118 98 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

718 33 6.15349E-02 -119 99 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

719 33 6.15349E-02 -120 100 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

720 33 6.15349E-02 -121 101 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

721 33 6.15349E-02 -122 102 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

722 33 6.15349E-02 -123 103 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

723 33 6.15349E-02 -124 104 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

724 33 6.15349E-02 -125 105 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

725 33 6.15349E-02 -126 106 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

726 0 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=4 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

728 27 0.0513781 33 -34 35 -36 89 -11 u=4 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

729 51 7.34056E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=4 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

731 8 4.7208E-02 11 -67 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

732 9 4.7925E-02 67 -68 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

733 15 4.8317E-02 68 -12 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Upper Reflector

734 14 8.4932E-02 12 -13 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Upper padding

735 16 3.279692E-02 13 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

736 0 132 -133 134 -135 (-21:22:-23:24) u=4 imp:n=1

c Wrapper

737 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=4 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

738 0 1 -2 3 -4 (-136:137:-138:139) u=4 imp:n=1

c

c End of Core Pin Geometry Element A

c

c

c --- Core Pin Geometry Element J Calandria NACLIV Pins 12xE and 4xUO2

c E 25 7.1167E-02 28 7.14034E-02 35 5.96942E-02

c The positions of pin UO2 are the circles 94, 96, 102 and 104

c Lower padding

801 16 3.279692E-02 -8 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Lower Reflector

802 14 8.4932E-02 8 -9 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

803 15 4.8317E-02 9 -41 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

804 9 4.7925E-02 41 -42 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

805 8 4.7208E-02 42 -10 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

809 27 0.0513781 33 -34 35 -36 10 -82 u=5 imp:n=1 TMP=2.5301E-08

c

c

810 25 7.1167E-02 -91 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

811 25 7.1167E-02 -92 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

812 25 7.1167E-02 -93 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

813 28 7.14034E-02 -94 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

814 25 7.1167E-02 -95 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

815 28 7.14034E-02 -96 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

816 25 7.1167E-02 -97 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

817 25 7.1167E-02 -98 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

818 25 7.1167E-02 -99 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

819 25 7.1167E-02 -100 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

820 25 7.1167E-02 -101 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

821 28 7.14034E-02 -102 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

822 25 7.1167E-02 -103 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

823 28 7.14034E-02 -104 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

824 25 7.1167E-02 -105 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

825 25 7.1167E-02 -106 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

c

830 35 5.96942E-02 -111 91 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

831 35 5.96942E-02 -112 92 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

832 35 5.96942E-02 -113 93 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

833 35 5.96942E-02 -114 94 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

834 35 5.96942E-02 -115 95 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

835 35 5.96942E-02 -116 96 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

836 35 5.96942E-02 -117 97 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

837 35 5.96942E-02 -118 98 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

838 35 5.96942E-02 -119 99 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

839 35 5.96942E-02 -120 100 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

840 35 5.96942E-02 -121 101 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

841 35 5.96942E-02 -122 102 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

842 35 5.96942E-02 -123 103 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

843 35 5.96942E-02 -124 104 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

844 35 5.96942E-02 -125 105 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

845 35 5.96942E-02 -126 106 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

846 0 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=5 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

848 27 0.0513781 33 -34 35 -36 83 -85 u=5 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

850 25 7.1167E-02 -91 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

851 25 7.1167E-02 -92 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

852 25 7.1167E-02 -93 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

853 28 7.14034E-02 -94 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

854 25 7.1167E-02 -95 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

855 28 7.14034E-02 -96 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

856 25 7.1167E-02 -97 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

857 25 7.1167E-02 -98 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

858 25 7.1167E-02 -99 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

859 25 7.1167E-02 -100 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

860 25 7.1167E-02 -101 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

861 28 7.14034E-02 -102 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

862 25 7.1167E-02 -103 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

863 28 7.14034E-02 -104 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

864 25 7.1167E-02 -105 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

865 25 7.1167E-02 -106 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

c

c

870 35 5.96942E-02 -111 91 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

871 35 5.96942E-02 -112 92 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

872 35 5.96942E-02 -113 93 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

873 35 5.96942E-02 -114 94 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

874 35 5.96942E-02 -115 95 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

875 35 5.96942E-02 -116 96 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

876 35 5.96942E-02 -117 97 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

877 35 5.96942E-02 -118 98 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

878 35 5.96942E-02 -119 99 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

879 35 5.96942E-02 -120 100 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

880 35 5.96942E-02 -121 101 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

881 35 5.96942E-02 -122 102 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

882 35 5.96942E-02 -123 103 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

883 35 5.96942E-02 -124 104 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

884 35 5.96942E-02 -125 105 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

885 35 5.96942E-02 -126 106 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

886 0 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=5 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

888 27 0.0513781 33 -34 35 -36 86 -88 u=5 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

890 25 7.1167E-02 -91 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

891 25 7.1167E-02 -92 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

892 25 7.1167E-02 -93 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

893 28 7.14034E-02 -94 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

894 25 7.1167E-02 -95 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

895 28 7.14034E-02 -96 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

896 25 7.1167E-02 -97 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

897 25 7.1167E-02 -98 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

898 25 7.1167E-02 -99 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

899 25 7.1167E-02 -100 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

900 25 7.1167E-02 -101 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

901 28 7.14034E-02 -102 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

902 25 7.1167E-02 -103 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

903 28 7.14034E-02 -104 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

904 25 7.1167E-02 -105 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

905 25 7.1167E-02 -106 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

c

c

910 35 5.96942E-02 -111 91 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

911 35 5.96942E-02 -112 92 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

912 35 5.96942E-02 -113 93 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

913 35 5.96942E-02 -114 94 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

914 35 5.96942E-02 -115 95 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

915 35 5.96942E-02 -116 96 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

916 35 5.96942E-02 -117 97 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

917 35 5.96942E-02 -118 98 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

918 35 5.96942E-02 -119 99 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

919 35 5.96942E-02 -120 100 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

920 35 5.96942E-02 -121 101 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

921 35 5.96942E-02 -122 102 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

922 35 5.96942E-02 -123 103 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

923 35 5.96942E-02 -124 104 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

924 35 5.96942E-02 -125 105 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

925 35 5.96942E-02 -126 106 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

926 0 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=5 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

928 27 0.0513781 33 -34 35 -36 89 -11 u=5 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

929 54 6.94698E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=5 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

931 8 4.7208E-02 11 -67 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

932 9 4.7925E-02 67 -68 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

933 15 4.8317E-02 68 -12 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Upper Reflector

934 14 8.4932E-02 12 -13 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Upper padding

935 16 3.279692E-02 13 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

936 0 132 -133 134 -135 (-21:22:-23:24) u=5 imp:n=1

c Wrapper

937 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=5 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

938 0 1 -2 3 -4 (-136:137:-138:139) u=5 imp:n=1

c

c End of Core Pin Geometry Element J

c

c

c

c --- Core Plate Geometry Element

c Lower padding

1011 16 3.279692E-02 -8 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Lower Reflector

1012 14 8.4932E-02 8 -9 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Lower section of the NatU Blanket

1013 15 4.8317E-02 9 -41 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

1014 9 4.7925E-02 41 -42 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

1015 8 4.7208E-02 42 -10 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c Fuelled section

c

c Lowest core Cell, Cell 12

c

c Na dummy

1022 11 1.216928E-02 10 -504 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1027 3 6.9083E-02 505 -506 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1028 4 7.2463E-02 504 -507 21 -22 23 -24 &

(-155:156:-157:158:-505:506) u=6 imp:n=1 TMP=2.5301E-08

c

c Na dummy

1032 11 1.216928E-02 507 -510 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

1035 1 3.9991E-02 151 -152 153 -154 511 -512 u=6 imp:n=1 TMP=2.5301E-08

C Pu canning

1036 2 6.6997E-02 510 -513 21 -22 23 -24 &

(-151:152:-153:154:-511:512) u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1039 3 6.9083E-02 514 -515 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1040 4 7.2463E-02 513 -516 21 -22 23 -24 &

(-155:156:-157:158:-514:515) u=6 imp:n=1 TMP=2.5301E-08

c

c Na dummy

1042 11 1.216928E-02 516 -43 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c Insert the 22 central region core cells

c

1051 0 43 -44 21 -22 23 -24 fill=13 (0 0 71.209862) u=6 imp:n=1

c

1052 0 44 -45 21 -22 23 -24 fill=14 (0 0 74.957944) u=6 imp:n=1

c

c

1053 0 45 -46 21 -22 23 -24 fill=13 (0 0 78.706026) u=6 imp:n=1

c

1054 0 46 -47 21 -22 23 -24 fill=14 (0 0 82.454108) u=6 imp:n=1

c

c

1055 0 47 -48 21 -22 23 -24 fill=13 (0 0 86.202190) u=6 imp:n=1

c

1056 0 48 -49 21 -22 23 -24 fill=14 (0 0 89.950272) u=6 imp:n=1

c

c

1057 0 49 -50 21 -22 23 -24 fill=13 (0 0 93.698354) u=6 imp:n=1

c

1058 0 50 -51 21 -22 23 -24 fill=14 (0 0 97.446436) u=6 imp:n=1

c

c

1059 0 51 -52 21 -22 23 -24 fill=13 (0 0 101.194518) u=6 imp:n=1

c

1060 0 52 -53 21 -22 23 -24 fill=14 (0 0 104.942600) u=6 imp:n=1

c

c

1061 0 53 -54 21 -22 23 -24 fill=13 (0 0 108.690682) u=6 imp:n=1

c

1062 0 54 -55 21 -22 23 -24 fill=14 (0 0 112.438764) u=6 imp:n=1

c

c

1063 0 55 -56 21 -22 23 -24 fill=13 (0 0 116.186846) u=6 imp:n=1

c

1064 0 56 -57 21 -22 23 -24 fill=14 (0 0 119.934928) u=6 imp:n=1

c

c

1065 0 57 -58 21 -22 23 -24 fill=13 (0 0 123.683010) u=6 imp:n=1

c

1066 0 58 -59 21 -22 23 -24 fill=14 (0 0 127.431092) u=6 imp:n=1

c

c

1067 0 59 -60 21 -22 23 -24 fill=13 (0 0 131.179174) u=6 imp:n=1

c

1068 0 60 -61 21 -22 23 -24 fill=14 (0 0 134.927256) u=6 imp:n=1

c

c

1069 0 61 -62 21 -22 23 -24 fill=13 (0 0 138.675338) u=6 imp:n=1

c

1070 0 62 -63 21 -22 23 -24 fill=14 (0 0 142.423420) u=6 imp:n=1

c

c

1071 0 63 -64 21 -22 23 -24 fill=13 (0 0 146.171502) u=6 imp:n=1

c

1072 0 64 -65 21 -22 23 -24 fill=14 (0 0 149.919584) u=6 imp:n=1

c

c

c The top core cell, Cell 2

c

c Na dummy

1082 11 1.216928E-02 65 -404 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1087 3 6.9083E-02 405 -406 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1088 4 7.2463E-02 404 -407 21 -22 23 -24 &

(-155:156:-157:158:-405:406) u=6 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

1092 1 3.9991E-02 151 -152 153 -154 408 -409 u=6 imp:n=1 &

TMP=2.5301E-08

C Pu canning

1093 2 6.6997E-02 407 -410 21 -22 23 -24 &

(-151:152:-153:154:-408:409) u=6 imp:n=1 TMP=2.5301E-08

c

c Na dummy

1102 11 1.216928E-02 410 -413 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1107 3 6.9083E-02 414 -415 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1108 4 7.2463E-02 413 -416 21 -22 23 -24 &

(-155:156:-157:158:-414:415) u=6 imp:n=1 TMP=2.5301E-08

c

c Na dummy

1112 11 1.216928E-02 416 -66 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c

c Upper Axial blanket.

c

1121 8 4.7208E-02 66 -67 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

1122 9 4.7925E-02 67 -68 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

1123 15 4.8317E-02 68 -12 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c Upper Reflector

1126 14 8.4932E-02 12 -13 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Upper padding

1127 16 3.279692E-02 13 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Wrapper region

c 1128 17 3.87228E-02 1 -2 3 -4 (-21:22:-23:24) u=6 imp:n=1

c TMP=2.5301E-08

c gap between plates and wrapper

1131 0 132 -133 134 -135 (-21:22:-23:24) u=6 imp:n=1

c Wrapper

1132 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=6 &

imp:n=1 TMP=2.5301E-08

c gap outside wrapper

1133 0 1 -2 3 -4 (-136:137:-138:139) u=6 imp:n=1

c

c

c --- Radial Breeder Element

c Lower padding

1241 16 3.279692E-02 -8 21 -22 23 -24 u=7 imp:n=1 TMP=2.5301E-08

c Lower Reflector

1242 14 8.4932E-02 8 -9 21 -22 23 -24 u=7 imp:n=1 TMP=2.5301E-08

c Radial blanket

1244 15 4.8317E-02 9 -12 21 -22 23 -24 u=7 imp:n=1 TMP=2.5301E-08

c Upper reflector

1246 like 134 but u=7 imp:n=1 TMP=2.5301E-08

c Upper padding

1247 like 135 but u=7 imp:n=1 TMP=2.5301E-08

c Wrapper region

c gap between plates and wrapper

1248 0 132 -133 134 -135 (-21:22:-23:24) u=7 imp:n=1

c Wrapper

1249 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=7 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

1250 0 1 -2 3 -4 (-136:137:-138:139) u=7 imp:n=1

c

c

c

c --- Radial shield

c

1326 12 8.32720E-02 28 -29 30 -31 u=8 imp:n=1 TMP=2.5301E-08

c

1327 13 8.32720E-05 1 -2 3 -4 (-28:29:-30:31) u=8 imp:n=1 &

TMP=2.5301E-08

c

c

1400 13 8.32720E-05 1 -2 3 -4 u=9 imp:n=1 TMP=2.5301E-08

c

c --- Assembly

c

1419 0 189 -190 191 -192 u=10 lat=1

fill=-3:3 -3:3 0:0

199 164 162 161 163 165 199

146 144 142 141 143 145 147

126 124 122 121 123 125 127

106 104 102 101 103 105 107

116 114 112 111 113 115 117

136 134 132 131 133 135 137

199 154 152 151 153 155 199

imp:n=1

c

c --- Fuel Region

c

1429 0 7 -16 -17 fill=10 imp:n=1

c --- Universe

1430 0 -7:16:17 imp:n=0

c

c Cell A

c 501 1 6.9985E-02 -71 u=3 imp:n=1 TMP=2.5301E-08

c

c 502 23 0.062241 -74 71 u=3 imp:n=1 TMP=2.5301E-08

c

c 503 5 2.3900E-02 74 u=3 imp:n=1 TMP=2.5301E-08

c

c 504 0 75 -76 77 -78 u=3 fill=1 imp:n=1

c

c Cell E Modified compositions

c

c 506 2 7.1167E-02 -71 u=4 imp:n=1 TMP=2.5301E-08

c

c 507 24 0.0596942 -74 71 u=4 imp:n=1 TMP=2.5301E-08

c

c 508 5 2.3900E-02 74 u=4 imp:n=1 TMP=2.5301E-08

c

c 509 0 75 -76 77 -78 u=4 fill=2 imp:n=1

c

c 511 0 75 -76 77 -78 lat=1 &

c fill -2:1 -2:1 0:0 &

c 3 4 3 4 4 3 4 3 3 4 3 4 4 3 4 3 &

c u=11 imp:n=1

c

c

c ------------- PLATE ELEMENT CELL CARDS ----------------------------------

c

c The First Regular cell. Cell 1

c

c Na dummy

c

2162 11 1.216928E-02 801 -804 21 -22 23 -24 u=13 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2167 3 6.9083E-02 805 -806 155 -156 157 -158 u=13 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2168 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-155:156:-157:158:-805:806) u=13 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2170 7 3.3152E-02 807 -708 21 -22 23 -24 u=13 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2172 1 3.9991E-02 151 -152 153 -154 709 -710 u=13 imp:n=1 TMP=2.5301E-08

C Pu canning

2173 2 6.6997E-02 708 -711 21 -22 23 -24 &

(-151:152:-153:154:-709:710) u=13 imp:n=1 TMP=2.5301E-08

c

c

c Na dummy

c

2182 11 1.216928E-02 711 -814 21 -22 23 -24 u=13 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2187 3 6.9083E-02 815 -816 155 -156 157 -158 u=13 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2188 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-155:156:-157:158:-815:816) u=13 imp:n=1 TMP=2.5301E-08

c

c Na dummy

c

2192 11 1.216928E-02 817 -820 21 -22 23 -24 u=13 imp:n=1 TMP=2.5301E-08

c

c End of Cell 1 beginning of Cell 2

c Na dummy

c

2202 11 1.216928E-02 801 -804 21 -22 23 -24 u=14 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2207 3 6.9083E-02 805 -806 155 -156 157 -158 u=14 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2208 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-155:156:-157:158:-805:806) u=14 imp:n=1 TMP=2.5301E-08

c

c Na dummy

c

2211 11 1.216928E-02 807 -810 21 -22 23 -24 u=14 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2214 1 3.9991E-02 151 -152 153 -154 811 -812 u=14 imp:n=1 TMP=2.5301E-08

C Pu canning

2215 2 6.6997E-02 810 -813 21 -22 23 -24 &

(-151:152:-153:154:-811:812) u=14 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2217 7 3.3152E-02 813 -814 21 -22 23 -24 u=14 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2219 3 6.9083E-02 815 -816 155 -156 157 -158 u=14 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2220 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-155:156:-157:158:-815:816) u=14 imp:n=1 TMP=2.5301E-08

c

c Na dummy

c

2222 11 1.216928E-02 817 -820 21 -22 23 -24 u=14 imp:n=1 TMP=2.5301E-08

c

c End of plate element cell data

c

c

c --------------------------------------------------------------------

c

c Form the region surrounding groups of 5x5 elements, containing grids

c

c

3001 0 189 -190 191 -192 (-185:186:-187:188) -71 u=100 imp:n=1

c

3002 19 7.403935E-02 189 -190 191 -192 (-185:186:-187:188) 71 -72 &

u=100 imp:n=1

c

3003 0 189 -190 191 -192 (-185:186:-187:188) 72 -73 u=100 imp:n=1

c

3004 19 7.403935E-02 189 -190 191 -192 (-185:186:-187:188) 73 -74 &

u=100 imp:n=1

c

3005 0 189 -190 191 -192 (-185:186:-187:188) 74 u=100 imp:n=1

c

c

c ------------------------------------------------------------------

c

c Form arrays of 5x5 elements

c

c Central row

c

c Central array of 5x5 core elements

c

c

3011 0 1 -2 3 -4 u=201 lat=1

fill=-2:2 -2:2 0:0

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

imp:n=1

c

3012 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=101 imp:n=1

c

3013 0 7 -16 185 -186 187 -188 fill=201 u=101 imp:n=1

c

c

c Middle Left array of 5x5 core elements in row 4

c

3014 0 1 -2 3 -4 u=202 lat=1

fill=-2:2 -2:2 0:0

4 5 4 2 2

4 2 4 2 2

3 2 2 2 2

4 2 2 2 2

4 5 2 2 2

imp:n=1

c

c

c Surround material

c

3015 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=102 imp:n=1

c

c

3016 0 7 -16 185 -186 187 -188 fill=202 u=102 imp:n=1

c

c

c Middle Right array of 5x5 core elements in row 4

c

3017 0 1 -2 3 -4 u=203 lat=1

fill=-2:2 -2:2 0:0

2 2 4 5 4

2 2 4 2 4

2 2 2 2 3

2 2 2 2 4

2 2 3 5 4

imp:n=1

c

c

c Surround material

c

3018 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=103 imp:n=1

c

c

3019 0 7 -16 185 -186 187 -188 fill=203 u=103 imp:n=1

c

c

c

c Left core edge array of 5x5 elements in row 4

c

3021 0 1 -2 3 -4 u=204 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 6

7 7 7 7 6

7 7 7 7 6

7 7 7 7 6

7 7 7 7 6

imp:n=1

c

c

c Surround material

c

3022 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=104 imp:n=1

c

c

3023 0 7 -16 185 -186 187 -188 fill=204 u=104 imp:n=1

c

c

c Right core edge array of 5x5 elements in row 4

c

3024 0 1 -2 3 -4 u=205 lat=1

fill=-2:2 -2:2 0:0

6 7 7 7 7

6 7 7 7 7

6 7 7 7 7

6 7 7 7 7

6 7 7 7 7

imp:n=1

c

c

c Surround material

c

3025 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=105 imp:n=1

c

c

3026 0 7 -16 185 -186 187 -188 fill=205 u=105 imp:n=1

c

c

c ROW 3 The row below the central line

c

c

c Middle array of 5x5 core elements in Row 3

c

c

3031 0 1 -2 3 -4 u=211 lat=1

fill=-2:2 -2:2 0:0

1 1 1 1 1

1 1 1 1 1

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

imp:n=1

c

c Surround material

c

3032 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=111 imp:n=1

c

3033 0 7 -16 185 -186 187 -188 fill=211 u=111 imp:n=1

c

c Lower left array of 5x5 core elements in Row 3

c

c

3034 0 1 -2 3 -4 u=212 lat=1

fill=-2:2 -2:2 0:0

6 2 2 1 2

6 2 2 1 2

6 6 4 2 3

7 6 6 3 3

7 7 6 6 6

imp:n=1

c

c Surround material

c

3035 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=112 imp:n=1

c

3036 0 7 -16 185 -186 187 -188 fill=212 u=112 imp:n=1

c

c

c Lower right array of 5x5 core elements in Row 3

c

3037 0 1 -2 3 -4 u=213 lat=1

fill=-2:2 -2:2 0:0

2 2 3 3 6

2 3 3 5 6

3 3 3 6 6

3 3 6 6 7

6 6 6 7 7

imp:n=1

c

c

c Surround material

c

3038 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=113 imp:n=1

c

c

3039 0 7 -16 185 -186 187 -188 fill=213 u=113 imp:n=1

c

c

c

c left array of blanket elements with a single core element

c

c

3041 0 1 -2 3 -4 u=214 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 6

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3042 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=114 imp:n=1

c

3043 0 7 -16 185 -186 187 -188 fill=214 u=114 imp:n=1

c

c

c right array of blanket elements with two core elements

c

c

3045 0 1 -2 3 -4 u=215 lat=1

fill=-2:2 -2:2 0:0

6 7 7 7 7

6 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3046 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=115 imp:n=1

c

3047 0 7 -16 185 -186 187 -188 fill=215 u=115 imp:n=1

c

c

c ROW 5 the row above the central line

c

c Central array of 5x5 core elements in Row 5

c

3051 0 1 -2 3 -4 u=221 lat=1

fill=-2:2 -2:2 0:0

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

1 1 1 1 1

1 1 1 1 1

imp:n=1

c

c

c Surround material

c

3052 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=121 imp:n=1

c

c

3053 0 7 -16 185 -186 187 -188 fill=221 u=121 imp:n=1

c

c

c Top left array of 5x5 core elements in Row 5

c

3054 0 1 -2 3 -4 u=222 lat=1

fill=-2:2 -2:2 0:0

7 7 6 6 6

7 6 6 3 3

6 6 4 2 2

6 5 2 1 2

6 2 2 1 2

imp:n=1

c

c

c Surround material

c

3055 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=122 imp:n=1

c

c

3056 0 7 -16 185 -186 187 -188 fill=222 u=122 imp:n=1

c

c

c Top right array of 5x5 core elements in Row 5

c

3057 0 1 -2 3 -4 u=223 lat=1

fill=-2:2 -2:2 0:0

6 6 6 7 7

3 3 6 6 7

2 2 4 6 6

2 1 2 3 6

2 1 2 2 6

imp:n=1

c

c

c Surround material

c

3058 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=123 imp:n=1

c

c

3059 0 7 -16 185 -186 187 -188 fill=223 u=123 imp:n=1

c

c

c

c left array of blanket elements with two core plate elements

c

c

3061 0 1 -2 3 -4 u=224 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 6

7 7 7 7 6

imp:n=1

c

c

c Surround material

c

3062 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=124 imp:n=1

c

3063 0 7 -16 185 -186 187 -188 fill=224 u=124 imp:n=1

c

c

c Right array of blanket elements with one core plate element

c

c

3064 0 1 -2 3 -4 u=225 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

6 7 7 7 7

imp:n=1

c

c

c Surround material

c

3065 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=125 imp:n=1

c

3066 0 7 -16 185 -186 187 -188 fill=225 u=125 imp:n=1

c

c

c ROW 2 The row two down from the central row

c

c Lower central group

c

c

3071 0 1 -2 3 -4 u=231 lat=1

fill=-2:2 -2:2 0:0

6 6 6 6 6

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3072 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=131 imp:n=1

c

3073 0 7 -16 185 -186 187 -188 fill=231 u=131 imp:n=1

c

c

c Left array of blanket elements with one core plate element

c

c

3074 0 1 -2 3 -4 u=232 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 6

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3075 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=132 imp:n=1

c

3076 0 7 -16 185 -186 187 -188 fill=232 u=132 imp:n=1

c

c

c

c Right array of blanket elements with one core plate element

c

c

3077 0 1 -2 3 -4 u=233 lat=1

fill=-2:2 -2:2 0:0

6 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3078 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=133 imp:n=1

c

3079 0 7 -16 185 -186 187 -188 fill=233 u=133 imp:n=1

c

c

c

c ROW 6

c

c Top central array of 5x5 core elements in row 6

c

3081 0 1 -2 3 -4 u=241 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

6 6 6 6 6

imp:n=1

c

c Surround material

c

3082 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=141 imp:n=1

c

3083 0 7 -16 185 -186 187 -188 fill=241 u=141 imp:n=1

c

c

c

c Left array of blanket elements with one core plate element

c

c

3085 0 1 -2 3 -4 u=242 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 6

imp:n=1

c

c

c Surround material

c

3086 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=142 imp:n=1

c

3087 0 7 -16 185 -186 187 -188 fill=242 u=142 imp:n=1

c

c

c Right central array in Row 6 with one core element (plate)

c

c

3088 0 1 -2 3 -4 u=243 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

6 7 7 7 7

imp:n=1

c

c Surround material

c

3089 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=143 imp:n=1

c

3090 0 7 -16 185 -186 187 -188 fill=243 u=143 imp:n=1

c

c

c

c \*\*\* Blanket-Reflector Arrays \*\*\*

c

c ROW 2

c

c Bottom Left

c

c

3111 0 1 -2 3 -4 u=234 lat=1

fill=-2:2 -2:2 0:0

8 7 7 7 7

8 8 7 7 7

8 8 8 7 7

8 8 8 8 7

9 8 8 8 8

imp:n=1

c

c

c Surround material

c

3112 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=134 imp:n=1

c

3113 0 7 -16 185 -186 187 -188 fill=234 u=134 imp:n=1

c

c

c Row 2 Bottom Right Blanket Reflector Array

c

c

3121 0 1 -2 3 -4 u=235 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 8

7 7 7 8 8

7 7 8 8 8

7 8 8 8 8

8 8 8 8 9

imp:n=1

c

c

c Surround material

c

3122 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=135 imp:n=1

c

3123 0 7 -16 185 -186 187 -188 fill=235 u=135 imp:n=1

c

c

c ROW 6

c

c Top Left Blanket-Reflector Array

c

c

3131 0 1 -2 3 -4 u=244 lat=1

fill=-2:2 -2:2 0:0

9 8 8 8 8

8 8 8 8 7

8 8 8 7 7

8 8 7 7 7

8 7 7 7 7

imp:n=1

c

c

c Surround material

c

3132 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=144 imp:n=1

c

3133 0 7 -16 185 -186 187 -188 fill=244 u=144 imp:n=1

c

c Row 6 Top Right Blanket Reflector Array

c

c

3141 0 1 -2 3 -4 u=245 lat=1

fill=-2:2 -2:2 0:0

8 8 8 8 9

7 8 8 8 8

7 7 8 8 8

7 7 7 8 8

7 7 7 7 8

imp:n=1

c

c

c Surround material

c

3142 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=145 imp:n=1

c

3143 0 7 -16 185 -186 187 -188 fill=245 u=145 imp:n=1

c

c

c Row 1 Blanket - Reflector arrays

c

c Row 1 First Left array

c

c

3151 0 1 -2 3 -4 u=254 lat=1

fill=-2:2 -2:2 0:0

9 9 8 8 8

9 9 9 8 8

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3152 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=154 imp:n=1

c

3153 0 7 -16 185 -186 187 -188 fill=254 u=154 imp:n=1

c

c Row 1 Mid-Left

c

c

3161 0 1 -2 3 -4 u=252 lat=1

fill=-2:2 -2:2 0:0

8 8 8 7 7

8 8 8 8 8

8 8 8 8 8

9 9 9 8 8

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3162 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=152 imp:n=1

c

3163 0 7 -16 185 -186 187 -188 fill=252 u=152 imp:n=1

c

c Row 1 Central Array

c

3171 0 1 -2 3 -4 u=251 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

8 8 8 8 8

8 8 8 8 8

8 8 8 8 8

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3172 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=151 imp:n=1

c

3173 0 7 -16 185 -186 187 -188 fill=251 u=151 imp:n=1

c

c Row 1 First Right array

c

c

3181 0 1 -2 3 -4 u=253 lat=1

fill=-2:2 -2:2 0:0

7 7 8 8 8

8 8 8 8 8

8 8 8 8 8

8 8 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3182 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=153 imp:n=1

c

3183 0 7 -16 185 -186 187 -188 fill=253 u=153 imp:n=1

c

c Row 1 Far Right

c

c

3191 0 1 -2 3 -4 u=255 lat=1

fill=-2:2 -2:2 0:0

8 8 8 9 9

8 8 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3192 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=155 imp:n=1

c

3193 0 7 -16 185 -186 187 -188 fill=255 u=155 imp:n=1

c

c

c Row 2 Blanket reflector arrays

c

c Row 2 First Left array

c

c

3201 0 1 -2 3 -4 u=236 lat=1

fill=-2:2 -2:2 0:0

9 9 9 8 8

9 9 9 8 8

9 9 9 9 8

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3202 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=136 imp:n=1

c

3203 0 7 -16 185 -186 187 -188 fill=236 u=136 imp:n=1

c

c Row 2 Far Right

c

c

3211 0 1 -2 3 -4 u=237 lat=1

fill=-2:2 -2:2 0:0

8 8 9 9 9

8 8 9 9 9

8 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3212 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=137 imp:n=1

c

3213 0 7 -16 185 -186 187 -188 fill=237 u=137 imp:n=1

c

c Row 4 Blanket- Reflector arrays

c

c

c Row 4 First Left array

c

c

3221 0 1 -2 3 -4 u=206 lat=1

fill=-2:2 -2:2 0:0

9 8 8 8 7

9 8 8 8 7

9 8 8 8 7

9 8 8 8 7

9 8 8 8 7

imp:n=1

c

c

c Surround material

c

3222 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=106 imp:n=1

c

3223 0 7 -16 185 -186 187 -188 fill=206 u=106 imp:n=1

c

c

c Row 4 Far Right

c

c

3231 0 1 -2 3 -4 u=207 lat=1

fill=-2:2 -2:2 0:0

7 8 8 8 9

7 8 8 8 9

7 8 8 8 9

7 8 8 8 9

7 8 8 8 9

imp:n=1

c

c

c Surround material

c

3232 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=107 imp:n=1

c

3233 0 7 -16 185 -186 187 -188 fill=207 u=107 imp:n=1

c

c Row 6 Blanket- Reflector arrays

c

c

c Row 6 First Left array

c

3241 0 1 -2 3 -4 u=246 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 8

9 9 9 8 8

9 9 9 8 8

imp:n=1

c

c

c Surround material

c

3242 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=146 imp:n=1

c

3243 0 7 -16 185 -186 187 -188 fill=246 u=146 imp:n=1

c

c Row 6 Far Right

c

3251 0 1 -2 3 -4 u=247 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

8 9 9 9 9

8 8 9 9 9

8 8 9 9 9

imp:n=1

c

c

c Surround material

c

3252 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=147 imp:n=1

c

3253 0 7 -16 185 -186 187 -188 fill=247 u=147 imp:n=1

c

c

c Row 5 Blanket- Reflector arrays

c

c

c Row 5 First Left array

c

c

3261 0 1 -2 3 -4 u=226 lat=1

fill=-2:2 -2:2 0:0

9 9 8 8 8

9 9 8 8 8

9 9 8 8 8

9 8 8 8 7

9 8 8 8 7

imp:n=1

c

c

c Surround material

c

3262 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=126 imp:n=1

c

3263 0 7 -16 185 -186 187 -188 fill=226 u=126 imp:n=1

c

c Row 4 Far Right

c

3271 0 1 -2 3 -4 u=227 lat=1

fill=-2:2 -2:2 0:0

8 8 8 9 9

8 8 8 9 9

8 8 8 9 9

7 8 8 8 9

7 8 8 8 9

imp:n=1

c

c

c Surround material

c

3272 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=127 imp:n=1

c

3273 0 7 -16 185 -186 187 -188 fill=227 u=127 imp:n=1

c

c

c Row 3 Blanket- Reflector arrays

c

c Row 3 First Left array

c

3281 0 1 -2 3 -4 u=216 lat=1

fill=-2:2 -2:2 0:0

9 8 8 8 7

9 8 8 8 7

9 9 8 8 8

9 9 8 8 8

9 9 8 8 8

imp:n=1

c

c

c Surround material

c

3282 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=116 imp:n=1

c

3283 0 7 -16 185 -186 187 -188 fill=216 u=116 imp:n=1

c

c Row 3 Far Right

c

3291 0 1 -2 3 -4 u=217 lat=1

fill=-2:2 -2:2 0:0

7 8 8 8 9

7 8 8 8 9

8 8 8 9 9

8 8 8 9 9

8 8 8 9 9

imp:n=1

c

c

c Surround material

c

3292 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=117 imp:n=1

c

3293 0 7 -16 185 -186 187 -188 fill=217 u=117 imp:n=1

c

c Row 7 Blanket - Reflector arrays

c

c Row 7 First Left array

c

c

3301 0 1 -2 3 -4 u=264 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 8 8

9 9 8 8 8

imp:n=1

c

c

c Surround material

c

3302 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=164 imp:n=1

c

3303 0 7 -16 185 -186 187 -188 fill=264 u=164 imp:n=1

c

c Row 7 Mid-Left

c

3311 0 1 -2 3 -4 u=262 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 8 8

8 8 8 8 8

8 8 8 8 8

8 8 8 7 7

imp:n=1

c

c

c Surround material

c

3312 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=162 imp:n=1

c

3313 0 7 -16 185 -186 187 -188 fill=262 u=162 imp:n=1

c

c Row 7 Central Array

c

3321 0 1 -2 3 -4 u=261 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

8 8 8 8 8

8 8 8 8 8

8 8 8 8 8

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3322 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=161 imp:n=1

c

3323 0 7 -16 185 -186 187 -188 fill=261 u=161 imp:n=1

c

c Row 7 First Right array

c

3331 0 1 -2 3 -4 u=263 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

8 8 9 9 9

8 8 8 8 8

8 8 8 8 8

7 7 8 8 8

imp:n=1

c

c

c Surround material

c

3332 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=163 imp:n=1

c

3333 0 7 -16 185 -186 187 -188 fill=263 u=163 imp:n=1

c

c Row 7 Far Right

c

3341 0 1 -2 3 -4 u=265 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

8 8 9 9 9

8 8 8 9 9

imp:n=1

c

c

c Surround material

c

3342 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=165 imp:n=1

c

3343 0 7 -16 185 -186 187 -188 fill=265 u=165 imp:n=1

c

c Beyond the reflector 5x5 Region 9

c

3351 0 1 -2 3 -4 u=299 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3352 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=199 imp:n=1

c

c

3353 0 7 -16 185 -186 187 -188 fill=299 u=199 imp:n=1

c

c

c

c -----------------------------------------------------------------------

c

c

c ------------- SURFACE CARDS -------------------------------------------

c

c Lattice 2 (Assembly) Elementary cell surfaces

1 px -2.68605

2 px 2.68605

3 py -2.68605

4 py 2.68605

7 pz 0.0 $ Assembly lower limit

8 pz 30.0 $ End Packing, Start Reflector

9 pz 37.60628 $ End Plenum, Start Lower NU

10 pz 67.77878 $ End Lower NU, Start Fuel

c

11 pz 156.96878 $ End Fuel, Start Upper NU for Pin element

c

12 pz 187.271248 $ End Upper NU, Start Top Reflector

13 pz 194.877528 $ End Reflector, Start Packing

16 pz 224.877528 $ Assembly upper limit

c

c 17 cz 94.9

17 cz 89.5

21 px -2.5335 $ Nominal half-width of plates

22 px 2.5335 $ and calandria outer half-width

23 py -2.5335

24 py 2.5335

28 px -2.54 $ Radial shield half-width

29 px 2.54

30 py -2.54

31 py 2.54

c

33 px -2.45 $ inner half-width of calandria

34 px 2.45

35 py -2.45

36 py 2.45

c

c

c subdivisions in the plate element axial blanket and core cells

c

c 9 pz 37.60628 $ axial reflector / axial blanket

41 pz 45.228780

42 pz 57.951780

c 10 pz 67.77878 $ axial blanket / core

43 pz 71.209862

44 pz 74.957944

45 pz 78.706026

46 pz 82.454108

47 pz 86.202190

48 pz 89.950272

49 pz 93.698354

50 pz 97.446436

51 pz 101.194518

52 pz 104.942600

53 pz 108.690682

54 pz 112.438764

55 pz 116.186846

56 pz 119.934928

57 pz 123.683010

58 pz 127.431092

59 pz 131.179174

60 pz 134.927256

61 pz 138.675338

62 pz 142.423420

63 pz 146.171502

64 pz 149.919584

65 pz 153.667666

c

66 pz 157.098748 $ core / axial blanket

c in plate elements (this replaces pz=11)

67 pz 166.925748

68 pz 179.648748

c 12 pz 187.271248 $ axial blanket / reflector

c

c differences in the pin elements ?

c 67 pz 166.925748

c 68 pz 179.648748

c 12 pz 187.271248 $ axial blanket / reflector

c

c Grid plate heights

c

71 pz 31.8

72 pz 62.2

73 pz 162.6

74 pz 193.0

c

c 71 c/z 0 0 0.423 $ fuel pin radius

c 71 c/z 0.6125 0.6125 0.423

c 72 c/z 0 0 0.4305 $ fuel can inner radius

c 73 c/z 0 0 0.488 $ calandria tube inner radius

c 74 c/z 0 0 0.513 $ calandria tube outer radius

c 74 c/z 0.6125 0.6125 0.513

c 75 px 0.0

c 76 px 1.225

c 77 py 0.0

c 78 py 1.225

c 79 cz 1.692

c 80 cz 2.052

c

81 pz 67.77878 $ 0.0

82 pz 68.21878 $ 0.44

83 pz 97.39878 $ 29.62

c 84 pz 97.50878 $ 29.73

85 pz 97.94878 $ 0.44

86 pz 127.12878 $ 29.62

c 87 pz 127.23878 $ 29.73

88 pz 127.67878 $ 0.44

89 pz 156.85878 $ 29.62

90 pz 156.96878 $ 29.73

c

91 c/z -1.785 -1.785 0.423

92 c/z -0.595 -1.785 0.423

93 c/z 0.595 -1.785 0.423

94 c/z 1.785 -1.785 0.423

95 c/z -1.785 -0.595 0.423

96 c/z -0.595 -0.595 0.423

97 c/z 0.595 -0.595 0.423

98 c/z 1.785 -0.595 0.423

99 c/z -1.785 0.595 0.423

100 c/z -0.595 0.595 0.423

101 c/z 0.595 0.595 0.423

102 c/z 1.785 0.595 0.423

103 c/z -1.785 1.785 0.423

104 c/z -0.595 1.785 0.423

105 c/z 0.595 1.785 0.423

106 c/z 1.785 1.785 0.423

c

c

111 c/z -1.785 -1.785 0.513

112 c/z -0.595 -1.785 0.513

113 c/z 0.595 -1.785 0.513

114 c/z 1.785 -1.785 0.513

115 c/z -1.785 -0.595 0.513

116 c/z -0.595 -0.595 0.513

117 c/z 0.595 -0.595 0.513

118 c/z 1.785 -0.595 0.513

119 c/z -1.785 0.595 0.513

120 c/z -0.595 0.595 0.513

121 c/z 0.595 0.595 0.513

122 c/z 1.785 0.595 0.513

123 c/z -1.785 1.785 0.513

124 c/z -0.595 1.785 0.513

125 c/z 0.595 1.785 0.513

126 c/z 1.785 1.785 0.513

c

132 px -2.551 $ sheath inner half-width

133 px 2.551

134 py -2.551

135 py 2.551

136 px -2.6272 $ sheath outer half-width

137 px 2.6272

138 py -2.6272

139 py 2.6272

c

c Widths of plate cores

c \* in plate geometry cores these are 101 to 112

151 px -2.3355 $ Pu plate core width

152 px 2.3355

153 py -2.3355

154 py 2.3355

155 px -2.4255 $ UO2 plate core width

156 px 2.4255

157 py -2.4255

158 py 2.4255

c 159 px -2.4815 $ Na plate core width

c 160 px 2.4815

c 161 py -2.4815

c 162 py 2.4815

c

c

c coordinates of the elements in 5x5 arrays

c \* in the plate geometry cores these are 81 to 92

c 181 px -8.05815

c 182 px 8.05815

c 183 py -8.05815

c 184 py 8.05815

185 px -13.43025

186 px 13.43025

187 py -13.43025

188 py 13.43025

189 px -13.5635

190 px 13.5635

191 py -13.5635

192 py 13.5635

c

c

c Cell 2 Axial heights

c

401 pz 153.667666

c 402 pz 153.704013

c 403 pz 154.245013

404 pz 154.281360

405 pz 154.318010

406 pz 154.876010

407 pz 154.912660

408 pz 154.958360

409 pz 155.194360

410 pz 155.240060

c 411 pz 155.276407

c 412 pz 155.817407

413 pz 155.853754

414 pz 155.890404

415 pz 156.448404

416 pz 156.485054

c 417 pz 156.521401

c 418 pz 157.062401

419 pz 157.098748

c

c Cell 12 Axial heights

c

501 pz 67.778780

c 502 pz 67.815127

c 503 pz 68.356127

504 pz 68.392474

505 pz 68.429124

506 pz 68.987124

507 pz 69.023774

c 508 pz 69.060121

c 509 pz 69.601121

510 pz 69.637468

511 pz 69.683168

512 pz 69.919168

513 pz 69.964868

514 pz 70.001518

515 pz 70.559518

516 pz 70.596168

c 517 pz 70.632515

c 518 pz 71.173515

519 pz 71.209862

c

c Basic Cell 1 data

c 701 pz 0.000000

c 702 pz 0.036347 $ Na can

c 703 pz 0.577347 $ Na core

c 704 pz 0.613694

c 705 pz 0.650344 $ UO2 can

c 706 pz 1.208344 $ UO2 core

c 707 pz 1.244994

708 pz 1.561994 $ SS

709 pz 1.607694 $ Pu can

710 pz 1.843694 $ Pu core

711 pz 1.889394

c 712 pz 1.925741 $ Na can

c 713 pz 2.466741 $ Na core

c 714 pz 2.503088

c 715 pz 2.539738 $ UO2 can

c 716 pz 3.097738 $ UO2 core

c 717 pz 3.134388

c 718 pz 3.170735 $ Na can

c 719 pz 3.711735 $ Na core

c 720 pz 3.748082 $ Cell 1

c

801 pz 0.000000

c 802 pz 0.036347

c 803 pz 0.577347 $ Na

804 pz 0.613694

805 pz 0.650344

806 pz 1.208344 $ UO2

807 pz 1.244994

c 808 pz 1.281341

c 809 pz 1.822341 $ Na

810 pz 1.858688

811 pz 1.904388

812 pz 2.140388 $ Pu

813 pz 2.186088

814 pz 2.503088 $ SS

815 pz 2.539738

816 pz 3.097738 $ UO2

817 pz 3.134388

c 818 pz 3.170735

c 819 pz 3.711735 $ Na

820 pz 3.748082 $ Cell 11

c

c ----------------------------------------------------------------------

c

c

c

c ------------- TALLY CARDS ---------------------------------------------

c

c --- MATERIALS CARDS ---

c

c

C MATERIAL 1 Pu metal plate core

m1 92238.31c 6.8782E-07

94238.31c 3.0461E-05

94239.31c 2.8920E-02

94240.31c 6.9095E-03

94241.31c 7.3960E-04

94242.31c 1.8699E-04

95241.31c 4.5718E-04

1001.31c 1.2764E-04

6000.31c 4.2260E-04

7014.31c 2.4215E-05

8016.31c 8.8450E-05

13027.31c 2.2973E-05

14028.31c 1.4158E-05

25055.31c 1.4902E-06

24050.31c 1.5637E-07

24052.31c 3.0155E-06

24053.31c 3.4193E-07

24054.31c 8.5114E-08

26054.31c 9.5478E-07

26056.31c 1.4988E-05

26057.31c 3.4614E-07

26058.31c 4.6065E-09

28058.31c 5.8334E-06

28060.31c 2.2470E-06

28061.31c 9.7676E-08

28062.31c 3.1143E-07

28064.31c 7.9313E-08

31000.31c 2.0166E-03

c total 3.9991E-02

c MATERIAL 2 Pu plate canning

m2 1001.31c 1.3760E-05

6000.31c 1.1393E-04

14028.31c 3.6607E-04

15031.31c 1.3731E-05

24050.31c 4.0848E-04

24052.31c 7.8771E-03

24053.31c 8.9320E-04

24054.31c 2.2234E-04

25055.31c 8.5931E-04

26054.31c 2.0774E-03

26056.31c 3.2611E-02

26057.31c 7.5313E-04

26058.31c 1.0023E-05

28058.31c 2.8351E-03

28060.31c 1.0921E-03

28061.31c 4.7472E-05

28062.31c 1.5136E-04

28064.31c 3.8548E-05

29063.31c 1.1629E-02

29065.31c 4.9839E-03

c total 6.6997E-02

C MATERIAL 3 UO2 plate core

m3 1001.31c 3.1773E-05

6000.31c 1.1808E-05

8016.31c 4.6008E-02

13027.31c 3.3911E-06

14028.31c 2.2967E-05

25055.31c 8.3273E-08

26054.31c 7.6610E-08

26056.31c 1.2026E-06

26057.31c 2.7774E-08

26058.31c 3.6962E-10

28058.31c 8.4906E-07

28060.31c 3.2705E-07

28061.31c 1.4217E-08

28062.31c 4.5329E-08

28064.31c 1.1544E-08

42000.66c 3.3379E-07

92235.31c 1.6544E-04

92238.31c 2.2837E-02

c total 6.9083E-02

c MATERIAL 4 UO2 plate canning

m4 1001.31c 1.9035E-05

6000.31c 1.2831E-04

14028.31c 6.4475E-04

15031.31c 3.5078E-04

16032.31c 3.6041E-05

24050.31c 6.0044E-04

24052.31c 1.1579E-02

24053.31c 1.3129E-03

24054.31c 3.2682E-04

25055.31c 8.5559E-04

26054.31c 2.8235E-03

26056.31c 4.4323E-02

26057.31c 1.0236E-03

26058.31c 1.3622E-05

28058.31c 5.7360E-03

28060.31c 2.2095E-03

28061.31c 9.6046E-05

28062.31c 3.0624E-04

28064.31c 7.7989E-05

c total 7.2463E-02

C MATERIAL 5 sodium plate core

c m5 1001.31c 1.3900E-05

c 8016.31c 5.6492E-06

c 11023.31c 2.3225E-02

c 20040.31c 3.6083E-06

c 26054.31c 9.4595E-09

c 26056.31c 1.4849E-07

c 26057.31c 3.4294E-09

c 26058.31c 4.5639E-11

c total 2.324832E-02

c MATERIAL 6 Sodium plate canning

c m6 1001.31c 2.1631E-05

c 6000.31c 2.9290E-04

c 14028.31c 6.0867E-04

c 15031.31c 3.2795E-05

c 16032.31c 3.3219E-05

c 24050.31c 6.4128E-04

c 24052.31c 1.2366E-02

c 24053.31c 1.4023E-03

c 24054.31c 3.4905E-04

c 25055.31c 1.3570E-03

c 26054.31c 3.2179E-03

c 26056.31c 5.0514E-02

c 26057.31c 1.1666E-03

c 26058.31c 1.5525E-05

c 28058.31c 4.8322E-03

c 28060.31c 1.8614E-03

c 28061.31c 8.0912E-05

c 28062.31c 2.5798E-04

c 28064.31c 6.5701E-05

c 41093.31c 3.1147E-04

c total 7.9429E-02

C MATERIAL 7 40% steel plate

c m7 1001.31c 1.8355E-05

c 6000.31c 8.7794E-05

c 13027.31c 1.1862E-04

c 14028.31c 7.9703E-04

c 15031.31c 4.0018E-05

c 16032.31c 1.4422E-05

c 22000.62c 2.4806E-04

c 24050.31c 6.9120E-04

c 24052.31c 1.3329E-02

c 24053.31c 1.5114E-03

c 24054.31c 3.7622E-04

c 25055.31c 1.4972E-03

c 26054.31c 3.2362E-03

c 26056.31c 5.0801E-02

c 26057.31c 1.1732E-03

c 26058.31c 1.5613E-05

c 28058.31c 5.9891E-03

c 28060.31c 2.3070E-03

c 28061.31c 1.0028E-04

c 28062.31c 3.1975E-04

c 28064.31c 8.1431E-05

c 29063.31c 5.0365E-05

c 41093.31c 4.9781E-06

c 42000.66c 8.0988E-05

c

c 40% ss plate smeared over plate region

c

m7 1001.31c 7.3413E-06

6000.31c 3.5114E-05

13027.31c 4.7443E-05

14028.31c 3.1878E-04

15031.31c 1.6006E-05

16032.31c 5.7682E-06

22000.62c 9.9214E-05

24050.31c 2.7645E-04

24052.31c 5.3311E-03

24053.31c 6.0450E-04

24054.31c 1.5047E-04

25055.31c 5.9882E-04

26054.31c 1.2944E-03

26056.31c 2.0318E-02

26057.31c 4.6923E-04

26058.31c 6.2446E-06

28058.31c 2.3954E-03

28060.31c 9.2271E-04

28061.31c 4.0108E-05

28062.31c 1.2789E-04

28064.31c 3.2569E-05

29063.31c 1.4101E-05

29065.31c 6.0432E-06

41093.31c 1.9910E-06

42000.66c 3.2392E-05

c total 3.3152E-02

c

C MATERIAL 8 U8 metal plate

m8 1001.31c 4.4048E-05

6000.31c 4.9283E-04

14028.31c 2.1076E-04

26054.31c 6.1951E-06

26056.31c 9.7250E-05

26057.31c 2.2459E-06

26058.31c 2.9889E-08

92235.31c 3.3369E-04

92238.31c 4.6021E-02

c total 4.7208E-02

C MATERIAL 9 U2 metal plate

m9 1001.31c 4.3899E-05

6000.31c 4.6047E-04

14028.31c 1.9692E-04

26054.31c 5.7884E-06

26056.31c 9.0866E-05

26057.31c 2.0985E-06

26058.31c 2.7927E-08

92235.31c 3.3962E-04

92238.31c 4.6785E-02

c total 4.7925E-02

c

c MATERIAL 11 Honeycomb dummy plate

c

m11 1001.31c 3.3245E-06

6000.31c 3.3477E-05

14028.31c 1.2169E-04

15031.31c 4.9764E-06

16032.31c 2.5076E-06

25055.31c 1.9518E-04

24050.31c 1.0707E-04

24052.31c 2.0648E-03

24053.31c 2.3413E-04

24054.31c 5.8281E-05

26054.31c 4.7179E-04

26056.31c 7.4061E-03

26057.31c 1.7104E-04

26058.31c 2.2762E-05

28058.31c 8.3019E-04

28060.31c 3.1979E-04

28061.31c 1.3901E-05

28062.31c 4.4323E-05

28064.31c 1.1288E-05

41093.31c 5.2657E-05

c total 1.216928E-02

c

c

c radial shield

m12 1001.31c 4.6306E-05

6000.31c 6.8972E-04

14028.31c 3.1158E-04

15031.31c 4.2944E-05

16032.31c 3.7110E-05

25055.31c 7.1275E-04

26054.31c 4.9065E-03

26056.31c 7.4517E-02

26057.31c 1.7491E-03

26058.31c 2.5903E-04

c total 8.32720E-02

c

c radial shield void surround low density

m13 1001.31c 4.6306E-08

6000.31c 6.8972E-07

14028.31c 3.1158E-07

15031.31c 4.2944E-08

16032.31c 3.7110E-08

25055.31c 7.1275E-07

26054.31c 4.9065E-06

26056.31c 7.4517E-05

26057.31c 1.7491E-06

26058.31c 2.5903E-07

c total 8.32720E-05

c

c Axial shield

m14 1001.31c 2.5700E-05

6000.31c 5.1066E-04

13027.31c 1.3989E-04

22000.62c 3.9416E-05

24050.31c 1.2213E-06

24052.31c 2.2823E-05

24053.31c 2.5531E-06

24054.31c 6.2449E-07

25055.31c 3.2634E-04

26054.31c 5.0496E-03

26056.31c 7.6690E-02

26057.31c 1.8001E-03

26058.31c 2.6658E-04

28058.31c 1.2564E-06

28060.31c 4.6968E-07

28061.31c 2.2000E-08

28062.31c 6.2769E-08

28064.31c 1.6774E-08

29063.31c 3.1184E-05

29065.31c 1.3364E-05

42000.66c 9.8355E-06

c total 8.4932E-02

c

c Natural Uranium Breeder

m15 1001.31c 4.4574E-05

6000.31c 4.7140E-04

14028.31c 2.0160E-04

26054.31c 6.1085E-06

26056.31c 9.2771E-05

26057.31c 2.1776E-06

26058.31c 3.2248E-07

92235.31c 3.4209E-04

92238.31c 4.7156E-02

c Total 4.8317E-02

c

c Element top and bottom packing

m16 1001.31c 3.1777E-05

6000.31c 9.9996E-05

13027.31c 8.3095E-06

24050.31c 6.9087E-08

24052.31c 1.2911E-06

24053.31c 1.4442E-07

24054.31c 3.5326E-08

25055.31c 1.0785E-04

26054.31c 1.9605E-03

26056.31c 2.9775E-02

26057.31c 6.9890E-04

26058.31c 1.0350E-04

28058.31c 1.5636E-07

28060.31c 5.8452E-08

28061.31c 2.7378E-09

28062.31c 7.8115E-09

28064.31c 2.0875E-09

29063.31c 6.5270E-06

29065.31c 2.7973E-06

c Total 3.279692E-02

c

c mild steel wrapper material

m17 1001.31c 7.5725E-05

6000.31c 2.3828E-04

13027.31c 1.9802E-05

24050.31c 1.6463E-07

24052.31c 3.0767E-06

24053.31c 3.4414E-07

24054.31c 8.4182E-08

25055.31c 2.5701E-04

26054.31c 4.6718E-03

26056.31c 7.0954E-02

26057.31c 1.6655E-03

26058.31c 2.4664E-04

28058.31c 3.7260E-07

28060.31c 1.3929E-07

28061.31c 6.5242E-09

28062.31c 1.8615E-08

28064.31c 4.9746E-09

29063.31c 1.5554E-05

29065.31c 6.6660E-06

c Total 7.81552E-02

c

c

C MATERIAL 18 U8 metal plate

c m18 1001.31c 4.4048E-05

c 6000.31c 4.9283E-04

c 14028.31c 2.1076E-04

c 26054.31c 6.1951E-06

c 26056.31c 9.7250E-05

c 26057.31c 2.2459E-06

c 26058.31c 2.9889E-08

c 92235.31c 3.3369E-04

c 92238.31c 4.6021E-02

c total 4.7208E-02

c

c Superlattice grid plate

c

m19 1001.31c 2.4442E-04

6000.31c 2.9057E-04

14028.31c 4.3858E-05

15031.31c 1.3256E-05

16032.31c 4.3530E-05

25055.31c 2.5785E-04

26054.31c 4.2756E-03

26056.31c 6.7114E-02

26057.31c 1.5500E-03

26058.31c 2.0627E-04

c Total 19 7.403935E-02

c

c -----------------------------------------------

c

c Element C Pin fuel A and E, Calandria NACLIII

c Pin A

m21 1001.31c 3.2784E-05

8016.31c 4.6624E-02

13027.31c 1.1702E-05

20040.31c 7.8782E-06

26054.31c 3.3046E-07

26056.31c 5.1875E-06

26057.31c 1.1980E-07

26058.31c 1.5943E-08

92234.31c 1.3805E-06

92235.31c 1.4114E-04

92236.31c 7.9324E-07

92238.31c 1.9379E-02

94238.31c 3.7786E-06

94239.31c 2.9689E-03

94240.31c 6.7253E-04

94241.31c 7.0350E-05

94242.31c 1.7488E-05

95241.31c 4.7854E-05

c total 21 6.9985E-02

c

c PinB

c

m22 1001.31c 3.2784E-05

8016.31c 4.6994E-02

14028.31c 9.0199E-06

28058.31c 3.7050E-06

28060.31c 1.4272E-06

28061.31c 6.2038E-08

28062.31c 1.9780E-07

28064.31c 5.0375E-08

92234.31c 1.3177E-06

92235.31c 1.3457E-04

92236.31c 7.4658E-07

92238.31c 1.8472E-02

94238.31c 5.8915E-06

94239.31c 3.7341E-03

94240.31c 9.5200E-04

94241.31c 1.1199E-04

94242.31c 2.7984E-05

95241.31c 5.5789E-05

c total 22 7.0537E-02 F 26 7.1415E-02

c

c Pin C

c

M23 1001.31c 3.2784E-05

8016.31c 4.7434E-02

13027.31c 1.9730E-05

14028.31c 7.9741E-06

26054.31c 4.4958E-07

26056.31c 7.0574E-06

26057.31c 1.6298E-07

26058.31c 2.1690E-08

28058.31c 7.4523E-06

28060.31c 2.8707E-06

28061.31c 1.2478E-07

28062.31c 3.9787E-07

28064.31c 1.0132E-07

92234.31c 1.2863E-06

92235.31c 1.2997E-04

92236.31c 7.3103E-07

92238.31c 1.7843E-02

94238.31c 6.9094E-06

94239.31c 4.4708E-03

94240.31c 1.0602E-03

94241.31c 1.1598E-04

94242.31c 3.0047E-05

95241.31c 5.7784E-05

c total 23 7.1230E-02

c

c Pin D

c

M24 1001.31c 3.2784E-05

8016.31c 4.7314E-02

13027.31c 1.8914E-05

14028.31c 2.5099E-05

20040.31c 1.5940E-05

26054.31c 4.0346E-07

26056.31c 6.3335E-06

26057.31c 1.4627E-07

26058.31c 1.9465E-08

28058.31c 9.6247E-06

28060.31c 3.7075E-06

28061.31c 1.6116E-07

28062.31c 5.1385E-07

28064.31c 1.3086E-07

92234.31c 1.4118E-06

92235.31c 1.4266E-04

92236.31c 7.9324E-07

92238.31c 1.9584E-02

94238.31c 4.7348E-06

94239.31c 3.0189E-03

94240.31c 7.5441E-04

94241.31c 8.8443E-05

94242.31c 2.0961E-05

95241.31c 4.0742E-05

c total 24 7.1085E-02

c

c Pin E

m25 1001.31c 3.2784E-05

8016.31c 4.7317E-02

13027.31c 9.5250E-06

14028.31c 4.5753E-05

20040.31c 3.2062E-05

26054.31c 6.0326E-07

26056.31c 9.4699E-06

26057.31c 2.1870E-07

26058.31c 2.9105E-08

92234.31c 1.1295E-06

92235.31c 1.1465E-04

92236.31c 6.3771E-07

92238.31c 1.5739E-02

94238.31c 9.4851E-06

94239.31c 6.0438E-03

94240.31c 1.5103E-03

94241.31c 1.7707E-04

94242.31c 4.1953E-05

95241.31c 8.1559E-05

c total 25 7.1167E-02

c

C Pin F

M26 1001.31c 3.2784E-05

8016.31c 4.7482E-02

13027.31c 1.4287E-05

20040.31c 6.7514E-05

24050.31c 2.1476E-07

24052.31c 4.1414E-06

24053.31c 4.6961E-07

24054.31c 1.1689E-07

26054.31c 6.7247E-07

26056.31c 1.0556E-05

26057.31c 2.4379E-07

26058.31c 3.2444E-08

28058.31c 1.4905E-06

28060.31c 5.7416E-07

28061.31c 2.4958E-08

28062.31c 7.9577E-08

28064.31c 2.0266E-08

92234.31c 1.1452E-06

92235.31c 1.1526E-04

92236.31c 6.3771E-07

92238.31c 1.5824E-02

94238.31c 9.5005E-06

94239.31c 6.0112E-03

94240.31c 1.5285E-03

94241.31c 1.9723E-04

94242.31c 4.4380E-05

95241.31c 6.8035E-05

C total 26 7.1415E-02

c

c

c Composition of Calandria end plate regions

m27 14028.31c 5.5206E-04

24050.31c 4.3520E-04

24052.31c 8.3923E-03

24053.31c 9.5162E-04

24054.31c 2.3688E-04

25055.31c 7.7198E-04

26054.31c 2.0795E-03

26056.31c 3.2644E-02

26057.31c 7.5390E-04

26058.31c 1.0033E-04

28058.31c 3.0363E-03

28060.31c 1.1696E-03

28061.31c 5.0841E-05

28062.31c 1.6210E-04

28064.31c 4.1283E-05

c total 5.13781E-02

c

c UO2 Pin UO2PINC

c

M28 1001.31c 3.2784E-05

6000.31c 3.2095E-05

8016.31c 4.7501E-02

13027.31c 2.3812E-05

14028.31c 4.0001E-05

20040.31c 1.2825E-05

26054.31c 6.5324E-08

26056.31c 1.0254E-06

26057.31c 2.3682E-08

26058.31c 3.1516E-09

92234.31c 9.7268E-07

92235.31c 1.7084E-04

92238.31c 2.3588E-02

c total 28 7.14034E-02

c

c

c --------------------------------------------------------------------------

c Pin clad plus calandria tube combined

c

C Pin PUPINA clad plus tube (was 23)

c

m31 1001.31c 1.0832E-05

6000.31c 5.3887E-05

14028.31c 6.6291E-04

15031.31c 1.5357E-05

16032.31c 9.9700E-06

25055.31c 1.0382E-03

24050.31c 5.3769E-04

24052.31c 1.0369E-02

24053.31c 1.1757E-03

24054.31c 2.9267E-04

26054.31c 2.4695E-03

26056.31c 3.8766E-02

26057.31c 8.9527E-04

26058.31c 1.1914E-04

28058.31c 3.9651E-03

28060.31c 1.5274E-03

28061.31c 6.6392E-05

28062.31c 2.1169E-04

28064.31c 5.3910E-05

c

C Total 31 6.2241E-02

c

C Pin PUPINB clad plus tube

c

m32 1001.31c 9.2847E-06

6000.31c 9.6091E-05

14028.31c 7.8508E-04

15031.31c 1.6869E-05

16032.31c 9.2404E-06

25055.31c 1.0424E-03

24050.31c 4.8064E-04

24052.31c 9.2687E-03

24053.31c 1.0510E-03

24054.31c 2.6162E-04

26054.31c 2.3154E-03

26056.31c 3.6347E-02

26057.31c 8.3939E-04

26058.31c 1.1171E-04

28058.31c 3.9370E-03

28060.31c 1.5166E-03

28061.31c 6.5922E-05

28062.31c 2.1019E-04

28064.31c 5.3529E-05

41093.31c 1.1919E-04

c

C Total 32 5.8537E-02 F 36 6.0033E-02

c

C Pin PUPINC clad plus tube

c

m33 1001.31c 1.0832E-05

6000.31c 5.5189E-05

14028.31c 6.5458E-04

15031.31c 1.4602E-05

16032.31c 9.9700E-06

25055.31c 1.0254E-03

24050.31c 5.3131E-04

24052.31c 1.0246E-02

24053.31c 1.1618E-03

24054.31c 2.8919E-04

26054.31c 2.4419E-03

26056.31c 3.8333E-02

26057.31c 8.8527E-04

26058.31c 1.1781E-04

28058.31c 3.9199E-03

28060.31c 1.5099E-03

28061.31c 6.5635E-05

28062.31c 2.0927E-04

28064.31c 5.3296E-05

c

C Total 33 6.15349E-02

c

c Pin PUPIND can plus tube

c

m34 1001.31c 1.0058E-05

6000.31c 8.1804E-05

13027.31c 2.6012E-06

14028.31c 6.7957E-04

15031.31c 1.3847E-05

16032.31c 3.6474E-06

22048.31c 1.1726E-05

25055.31c 8.7351E-04

27059.31c 1.7202E-06

24050.31c 4.9702E-04

24052.31c 9.5846E-03

24053.31c 1.0868E-03

24054.31c 2.7053E-04

26054.31c 2.3766E-03

26056.31c 3.7307E-02

26057.31c 8.6158E-04

26058.31c 1.1466E-04

28058.31c 3.6114E-03

28060.31c 1.3911E-03

28061.31c 6.0470E-05

28062.31c 1.9281E-04

28064.31c 4.9102E-05

29063.31c 1.7181E-06

29065.31c 7.3632E-07

42000.66c 8.9408E-07

c

C Total 34 5.9086E-02

c

c Pin PUPINE clad plus tube (Was 24)

m35 1001.31c 1.0058E-05

6000.31c 2.9866E-05

13027.31c 2.6012E-06

14028.31c 7.4068E-04

15031.31c 5.5388E-06

16032.31c 7.0518E-06

22048.31c 1.1726E-05

25055.31c 8.0111E-04

27059.31c 1.7202E-06

24050.31c 5.0041E-04

24052.31c 9.6500E-03

24053.31c 1.0942E-03

24054.31c 2.7238E-04

26054.31c 2.4012E-03

26056.31c 3.7694E-02

26057.31c 8.7052E-04

26058.31c 1.1585E-04

28058.31c 3.7263E-03

28060.31c 1.4354E-03

28061.31c 6.2394E-05

28062.31c 1.9894E-04

28064.31c 5.0664E-05

29063.31c 1.7181E-06

29065.31c 7.3632E-07

42000.66c 8.6970E-06

c

C Total 35 5.96942E-02

c

c

C Pin PUPINF can plus tube

c

m36 1001.31c 1.0058E-05

6000.31c 2.9217E-05

13027.31c 1.7341E-06

14028.31c 7.4343E-04

15031.31c 5.5388E-06

16032.31c 7.2951E-06

22048.31c 8.7948E-06

25055.31c 8.0253E-04

27059.31c 1.3232E-06

24050.31c 5.0363E-04

24052.31c 9.7120E-03

24053.31c 1.1013E-03

24054.31c 2.7413E-04

26054.31c 2.4145E-03

26056.31c 3.7903E-02

26057.31c 8.7533E-04

26058.31c 1.1649E-04

28058.31c 3.7525E-03

28060.31c 1.4455E-03

28061.31c 6.2833E-05

28062.31c 2.0034E-04

28064.31c 5.1021E-05

29063.31c 1.2885E-06

29065.31c 5.5221E-07

42000.66c 8.6159E-06

c

c Total 36 6.0033E-02

c

c -------------------------------------------------------------

c

C Compositions of Calandria outer walls

c

C Calandria Walls NACLI Element Cell A and B

m51 1001.31c 3.9844E-05

6000.31c 2.8167E-04

14028.31c 6.0229E-04

15031.31c 7.3471E-05

16032.31c 3.6808E-05

25055.31c 1.2214E-03

24050.31c 6.5153E-04

24052.31c 1.2564E-02

24053.31c 1.4247E-03

24054.31c 3.5463E-04

26054.31c 2.8589E-03

26056.31c 4.4878E-02

26057.31c 1.0364E-03

26058.31c 1.3793E-04

28058.31c 4.9315E-03

28060.31c 1.8996E-03

28061.31c 8.2574E-05

28062.31c 2.6328E-04

28064.31c 6.7050E-05

C total 51 7.34056E-02

c

C Calandria walls NACLIIS Element Cell E

c

m52 1001.31c 3.8637E-05

6000.31c 6.5351E-04

14028.31c 9.7623E-04

15031.31c 4.7540E-05

16032.31c 3.3014E-05

22048.31c 2.4400E-04

25055.31c 1.1060E-03

27059.31c 1.1151E-05

24050.31c 6.2481E-04

24052.31c 1.2049E-02

24053.31c 1.3662E-03

24054.31c 3.4009E-04

26054.31c 2.7541E-03

26056.31c 4.3233E-02

26057.31c 9.9842E-04

26058.31c 1.3287E-04

28058.31c 5.0735E-03

28060.31c 1.9543E-03

28061.31c 8.4952E-05

28062.31c 2.7086E-04

28064.31c 6.8981E-05

29063.31c 6.9320E-06

29065.31c 3.1020E-06

42000.66c 3.4248E-06

C total 52 7.20749E-02

c

c Calandria NACLIII Element Cell C and D

c

m53 1001.31c 3.9844E-05

6000.31c 1.5948E-04

14028.31c 7.7474E-04

15031.31c 5.2334E-05

16032.31c 2.4551E-05

25055.31c 8.3089E-04

24050.31c 6.1403E-04

24052.31c 1.1841E-02

24053.31c 1.3427E-03

24054.31c 3.3422E-04

26054.31c 2.9672E-03

26056.31c 4.6578E-02

26057.31c 1.0757E-03

26058.31c 1.4315E-04

28058.31c 5.2186E-03

28060.31c 2.0102E-03

28061.31c 8.7382E-05

28062.31c 2.7861E-04

28064.31c 7.0954E-05

42000.66c 2.4862E-05

C total 53 7.44684E-02

c

C Calandria NACLIV Element 3J and 3L

m54 1001.31c 3.7430E-05

6000.31c 3.5158E-04

14028.31c 8.2197E-04

15031.31c 6.2274E-05

16032.31c 1.6431E-05

25055.31c 1.0026E-03

24050.31c 5.8931E-04

24052.31c 1.1364E-02

24053.31c 1.2886E-03

24054.31c 3.2077E-04

26054.31c 2.7560E-03

26056.31c 4.3263E-02

26057.31c 9.9912E-04

26058.31c 1.3296E-04

28058.31c 4.3943E-03

28060.31c 1.6927E-03

28061.31c 7.3579E-05

28062.31c 2.3460E-04

28064.31c 5.9746E-05

42000.66c 8.8791E-06

C Total 54 6.94698E-02

c

c --- MODE CARDS ---

mode n

kcode 10000 1.0 200 1600

ksrc 0.6125 0.6125 77.0 0.6125 -0.6125 87.9

-0.6125 -0.6125 107.0

0.6125 0.6125 117.9 0.6125 -0.6125 137.0

0.6125 0.6125 147.9

-0.6125 0.6125 77.0 -0.6125 -0.6125 87.9

0.6125 0.6125 107.0

-0.6125 0.6125 117.9 -0.6125 -0.6125 137.0

-0.6125 0.6125 147.9

11.4633 -0.6125 77.0 11.4633 -0.6125 87.9

11.4633 -0.6125 107.0

11.4633 -0.6125 117.9 11.4633 -0.6125 137.0

11.4633 -0.6125 147.9

-11.4633 -0.6125 77.0 -11.4633 -0.6125 87.9

-11.4633 -0.6125 107.0

-11.4633 -0.6125 117.9 -11.4633 -0.6125 137.0

-11.4633 -0.6125 147.9

-0.6125 11.4633 77.0 -0.6125 11.4633 87.9

-0.6125 11.4633 107.0

-0.6125 11.4633 117.9 -0.6125 11.4633 137.0

-0.6125 11.4633 147.9

-0.6125 -11.4633 77.0 -0.6125 -11.4633 87.9

-0.6125 -11.4633 107.0

-0.6125 -11.4633 117.9 -0.6125 -11.4633 137.0

-0.6125 -11.4633 147.9

11.4633 11.4633 77.0 11.4633 11.4633 87.9

11.4633 11.4633 107.0

11.4633 11.4633 117.9 11.4633 11.4633 137.0

11.4633 11.4633 147.9

-11.4633 11.4633 77.0 -11.4633 11.4633 87.9

-11.4633 11.4633 107.0

-11.4633 11.4633 117.9 -11.4633 11.4633 137.0

-11.4633 11.4633 147.9

11.4633 -11.4633 77.0 11.4633 -11.4633 87.9

11.4633 -11.4633 107.0

11.4633 -11.4633 117.9 11.4633 -11.4633 137.0

11.4633 -11.4633 147.9

-11.4633 -11.4633 77.0 -11.4633 -11.4633 87.9

-11.4633 -11.4633 107.0

-11.4633 -11.4633 117.9 -11.4633 -11.4633 137.0

-11.4633 -11.4633 147.9

25.9475 0.6125 77.0 25.9475 0.6125 87.9

-25.9475 0.6125 107.0

25.9475 0.6125 117.9 25.9475 0.6125 137.0

25.9475 0.6125 147.9

-25.9475 0.6125 77.0 -25.9475 0.6125 87.9

-25.9475 0.6125 107.0

-25.9475 0.6125 117.9 -25.9475 0.6125 137.0

-25.9475 0.6125 147.9

0.6125 25.9475 77.0 0.6125 25.9475 87.9

0.6125 25.9475 107.0

0.6125 25.9475 117.9 0.6125 25.9475 137.0

0.6125 25.9475 147.9

0.6125 -25.9475 77.0 0.6125 -25.9475 87.9

-25.9475 0.6125 107.0

0.6125 -25.9475 117.9 0.6125 -25.9475 137.0

0.6125 -25.9475 147.9

25.9475 25.9475 77.0 25.9475 25.9475 87.9

25.9475 25.9475 107.0

25.9475 25.9475 117.9 25.9475 25.9475 137.0

25.9475 25.9475 147.9

-25.9475 25.9475 77.0 -25.9475 25.9475 87.9

-25.9475 25.9475 107.0

-25.9475 25.9475 117.9 -25.9475 25.9475 137.0

-25.9475 25.9475 147.9

25.9475 -25.9475 77.0 25.9475 -25.9475 87.9

25.9475 -25.9475 107.0

25.9475 -25.9475 117.9 25.9475 -25.9475 137.0

25.9475 -25.9475 147.9

-25.9475 -25.9475 77.0 -25.9475 -25.9475 87.9

-25.9475 -25.9475 107.0

36.9875 0.6125 77.0 36.9875 0.6125 87.9

36.9875 0.6125 107.0

36.9875 0.6125 117.9 36.9875 0.6125 137.0

36.9875 0.6125 147.9

-36.9875 0.6125 77.0 -36.9875 0.6125 87.9

-36.9875 0.6125 107.0

-36.9875 0.6125 117.9 -36.9875 0.6125 137.0

-36.9875 0.6125 147.9

0.6125 36.9875 77.0 0.6125 36.9875 87.9

0.6125 36.9875 107.0

0.6125 36.9875 117.9 0.6125 36.9875 137.0

0.6125 36.9875 147.9

0.6125 -36.9875 77.0 0.6125 -36.9875 87.9

-36.9875 0.6125 107.0

0.6125 -36.9875 117.9 0.6125 -36.9875 137.0

0.6125 -36.9875 147.9

print

### A4.5 MCNP-JEFF-3.1 Zebra23 Model with Central Plate Zone

Z23 with central plate zone. JEFF-3.1. Gaps & superlattice represented.

c

c The experimental value of k-effective to be used with this model is

c 1.0029 +/- 0.0013

c See www.zebra.webnik.org for details.

c

c ------------- CELL CARDS ----------------------------------------------

c

c --- Core Pin Geometry Element C Calandria NACLIII Pins 8xA and 8xE

c Fuel m21 and m25, can + tube m31 and m35

c Lower padding

1 16 3.279692E-02 -8 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Lower Reflector

2 14 8.4932E-02 8 -9 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

3 15 4.8317E-02 9 -41 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

4 9 4.7925E-02 41 -42 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

5 8 4.7208E-02 42 -10 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

9 27 0.0513781 33 -34 35 -36 10 -82 u=1 imp:n=1 TMP=2.5301E-08

c

c

10 25 7.1167E-02 -91 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

11 21 0.069985 -92 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

12 25 7.1167E-02 -93 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

13 21 0.069985 -94 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

14 21 0.069985 -95 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

15 25 7.1167E-02 -96 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

16 21 0.069985 -97 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

17 25 7.1167E-02 -98 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

18 25 7.1167E-02 -99 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

19 21 0.069985 -100 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

20 25 7.1167E-02 -101 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

21 21 0.069985 -102 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

22 21 0.069985 -103 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

23 25 7.1167E-02 -104 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

24 21 0.069985 -105 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

25 25 7.1167E-02 -106 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

c

30 35 0.0596942 -111 91 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

31 31 0.062241 -112 92 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

32 35 0.0596942 -113 93 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

33 31 0.062241 -114 94 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

34 31 0.062241 -115 95 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

35 35 0.0596942 -116 96 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

36 31 0.062241 -117 97 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

37 35 0.0596942 -118 98 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

38 35 0.0596942 -119 99 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

39 31 0.062241 -120 100 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

40 35 0.0596942 -121 101 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

41 31 0.062241 -122 102 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

42 31 0.062241 -123 103 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

43 35 0.0596942 -124 104 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

44 31 0.062241 -125 105 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

45 35 0.0596942 -126 106 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

46 43 2.3900E-02 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=1 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

48 27 0.0513781 33 -34 35 -36 83 -85 u=1 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

50 25 7.1167E-02 -91 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

51 21 0.069985 -92 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

52 25 7.1167E-02 -93 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

53 21 0.069985 -94 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

54 21 0.069985 -95 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

55 25 7.1167E-02 -96 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

56 21 0.069985 -97 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

57 25 7.1167E-02 -98 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

58 25 7.1167E-02 -99 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

59 21 0.069985 -100 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

60 25 7.1167E-02 -101 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

61 21 0.069985 -102 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

62 21 0.069985 -103 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

63 25 7.1167E-02 -104 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

64 21 0.069985 -105 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

65 25 7.1167E-02 -106 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

c

c

70 35 0.0596942 -111 91 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

71 31 0.062241 -112 92 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

72 35 0.0596942 -113 93 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

73 31 0.062241 -114 94 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

74 31 0.062241 -115 95 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

75 35 0.0596942 -116 96 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

76 31 0.062241 -117 97 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

77 35 0.0596942 -118 98 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

78 35 0.0596942 -119 99 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

79 31 0.062241 -120 100 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

80 35 0.0596942 -121 101 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

81 31 0.062241 -122 102 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

82 31 0.062241 -123 103 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

83 35 0.0596942 -124 104 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

84 31 0.062241 -125 105 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

85 35 0.0596942 -126 106 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

86 43 2.3900E-02 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=1 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

88 27 0.0513781 33 -34 35 -36 86 -88 u=1 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

90 25 7.1167E-02 -91 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

91 21 0.069985 -92 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

92 25 7.1167E-02 -93 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

93 21 0.069985 -94 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

94 21 0.069985 -95 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

95 25 7.1167E-02 -96 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

96 21 0.069985 -97 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

97 25 7.1167E-02 -98 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

98 25 7.1167E-02 -99 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

99 21 0.069985 -100 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

100 25 7.1167E-02 -101 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

101 21 0.069985 -102 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

102 21 0.069985 -103 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

103 25 7.1167E-02 -104 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

104 21 0.069985 -105 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

105 25 7.1167E-02 -106 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

c

c

110 35 0.0596942 -111 91 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

111 31 0.062241 -112 92 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

112 35 0.0596942 -113 93 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

113 31 0.062241 -114 94 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

114 31 0.062241 -115 95 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

115 35 0.0596942 -116 96 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

116 31 0.062241 -117 97 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

117 35 0.0596942 -118 98 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

118 35 0.0596942 -119 99 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

119 31 0.062241 -120 100 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

120 35 0.0596942 -121 101 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

121 31 0.062241 -122 102 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

122 31 0.062241 -123 103 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

123 35 0.0596942 -124 104 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

124 31 0.062241 -125 105 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

125 35 0.0596942 -126 106 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

126 43 2.3900E-02 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=1 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

128 27 0.0513781 33 -34 35 -36 89 -11 u=1 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

129 53 7.44684E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=1 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

131 8 4.7208E-02 11 -67 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

132 9 4.7925E-02 67 -68 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

133 15 4.8317E-02 68 -12 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Upper Reflector

134 14 8.4932E-02 12 -13 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Upper padding

135 16 3.279692E-02 13 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

136 0 132 -133 134 -135 (-21:22:-23:24) u=1 imp:n=1

c Wrapper

137 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=1 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

138 0 1 -2 3 -4 (-136:137:-138:139) u=1 imp:n=1

c

c End of Core Pin Geometry Element C

c

c

c --- Core Pin geometry Element E (& D) NACLIIS Pins 8xD and 8xF

c D 24 7.1085E-02 F 26 7.1415E-02 clad D 34 5.9086E-02 F 36 6.0033E-02

c Lower padding

201 16 3.279692E-02 -8 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Lower Reflector

202 14 8.4932E-02 8 -9 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

203 15 4.8317E-02 9 -41 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

204 9 4.7925E-02 41 -42 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

205 8 4.7208E-02 42 -10 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

209 27 0.0513781 33 -34 35 -36 10 -82 u=2 imp:n=1 TMP=2.5301E-08

c

c

210 26 7.1415E-02 -91 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

211 24 7.1085E-02 -92 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

212 26 7.1415E-02 -93 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

213 24 7.1085E-02 -94 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

214 24 7.1085E-02 -95 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

215 26 7.1415E-02 -96 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

216 24 7.1085E-02 -97 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

217 26 7.1415E-02 -98 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

218 26 7.1415E-02 -99 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

219 24 7.1085E-02 -100 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

220 26 7.1415E-02 -101 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

221 24 7.1085E-02 -102 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

222 24 7.1085E-02 -103 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

223 26 7.1415E-02 -104 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

224 24 7.1085E-02 -105 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

225 26 7.1415E-02 -106 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

c

230 36 6.0033E-02 -111 91 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

231 34 5.9086E-02 -112 92 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

232 36 6.0033E-02 -113 93 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

233 34 5.9086E-02 -114 94 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

234 34 5.9086E-02 -115 95 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

235 36 6.0033E-02 -116 96 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

236 34 5.9086E-02 -117 97 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

237 36 6.0033E-02 -118 98 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

238 36 6.0033E-02 -119 99 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

239 34 5.9086E-02 -120 100 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

240 36 6.0033E-02 -121 101 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

241 34 5.9086E-02 -122 102 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

242 34 5.9086E-02 -123 103 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

243 36 6.0033E-02 -124 104 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

244 34 5.9086E-02 -125 105 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

245 36 6.0033E-02 -126 106 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

246 42 2.43914E-02 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=2 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

248 27 0.0513781 33 -34 35 -36 83 -85 u=2 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

250 26 7.1415E-02 -91 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

251 24 7.1085E-02 -92 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

252 26 7.1415E-02 -93 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

253 24 7.1085E-02 -94 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

254 24 7.1085E-02 -95 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

255 26 7.1415E-02 -96 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

256 24 7.1085E-02 -97 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

257 26 7.1415E-02 -98 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

258 26 7.1415E-02 -99 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

259 24 7.1085E-02 -100 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

260 26 7.1415E-02 -101 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

261 24 7.1085E-02 -102 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

262 24 7.1085E-02 -103 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

263 26 7.1415E-02 -104 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

264 24 7.1085E-02 -105 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

265 26 7.1415E-02 -106 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

c

c

270 36 6.0033E-02 -111 91 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

271 34 5.9086E-02 -112 92 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

272 36 6.0033E-02 -113 93 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

273 34 5.9086E-02 -114 94 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

274 34 5.9086E-02 -115 95 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

275 36 6.0033E-02 -116 96 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

276 34 5.9086E-02 -117 97 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

277 36 6.0033E-02 -118 98 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

278 36 6.0033E-02 -119 99 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

279 34 5.9086E-02 -120 100 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

280 36 6.0033E-02 -121 101 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

281 34 5.9086E-02 -122 102 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

282 34 5.9086E-02 -123 103 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

283 36 6.0033E-02 -124 104 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

284 34 5.9086E-02 -125 105 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

285 36 6.0033E-02 -126 106 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

286 42 2.43914E-02 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=2 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

288 27 0.0513781 33 -34 35 -36 86 -88 u=2 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

290 26 7.1415E-02 -91 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

291 24 7.1085E-02 -92 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

292 26 7.1415E-02 -93 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

293 24 7.1085E-02 -94 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

294 24 7.1085E-02 -95 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

295 26 7.1415E-02 -96 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

296 24 7.1085E-02 -97 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

297 26 7.1415E-02 -98 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

298 26 7.1415E-02 -99 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

299 24 7.1085E-02 -100 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

300 26 7.1415E-02 -101 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

301 24 7.1085E-02 -102 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

302 24 7.1085E-02 -103 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

303 26 7.1415E-02 -104 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

304 24 7.1085E-02 -105 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

305 26 7.1415E-02 -106 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

c

c

310 36 6.0033E-02 -111 91 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

311 34 5.9086E-02 -112 92 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

312 36 6.0033E-02 -113 93 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

313 34 5.9086E-02 -114 94 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

314 34 5.9086E-02 -115 95 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

315 36 6.0033E-02 -116 96 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

316 34 5.9086E-02 -117 97 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

317 36 6.0033E-02 -118 98 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

318 36 6.0033E-02 -119 99 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

319 34 5.9086E-02 -120 100 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

320 36 6.0033E-02 -121 101 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

321 34 5.9086E-02 -122 102 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

322 34 5.9086E-02 -123 103 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

323 36 6.0033E-02 -124 104 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

324 34 5.9086E-02 -125 105 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

325 36 6.0033E-02 -126 106 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

326 42 2.43914E-02 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=2 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

328 27 0.0513781 33 -34 35 -36 89 -11 u=2 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

329 52 7.20749E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=2 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

331 8 4.7208E-02 11 -67 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

332 9 4.7925E-02 67 -68 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

333 15 4.8317E-02 68 -12 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Upper Reflector

334 14 8.4932E-02 12 -13 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Upper padding

335 16 3.279692E-02 13 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

336 0 132 -133 134 -135 (-21:22:-23:24) u=2 imp:n=1

c Wrapper

337 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=2 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

338 0 1 -2 3 -4 (-136:137:-138:139) u=2 imp:n=1

c

c End of Core Pin Geometry Element E (D)

c

c

c --- Core Pin Geometry Element B (H, L) Calandria NACLI Pins 11xB and 5xF

c B 22 7.0537E-02 F 26 7.1415E-02 clad 32 5.8537E-02 F 36 6.0033E-02

c Pin F is in circles 93 98 99 101 and 104

c

c Lower padding

401 16 3.279692E-02 -8 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Lower Reflector

402 14 8.4932E-02 8 -9 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

403 15 4.8317E-02 9 -41 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

404 9 4.7925E-02 41 -42 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

405 8 4.7208E-02 42 -10 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

409 27 0.0513781 33 -34 35 -36 10 -82 u=3 imp:n=1 TMP=2.5301E-08

c

c

410 22 7.0537E-02 -91 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

411 22 7.0537E-02 -92 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

412 26 7.1415E-02 -93 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

413 22 7.0537E-02 -94 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

414 22 7.0537E-02 -95 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

415 22 7.0537E-02 -96 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

416 22 7.0537E-02 -97 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

417 26 7.1415E-02 -98 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

418 26 7.1415E-02 -99 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

419 22 7.0537E-02 -100 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

420 26 7.1415E-02 -101 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

421 22 7.0537E-02 -102 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

422 22 7.0537E-02 -103 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

423 26 7.1415E-02 -104 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

424 22 7.0537E-02 -105 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

425 22 7.0537E-02 -106 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

c

430 32 5.8537E-02 -111 91 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

431 32 5.8537E-02 -112 92 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

432 36 6.0033E-02 -113 93 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

433 32 5.8537E-02 -114 94 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

434 32 5.8537E-02 -115 95 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

435 32 5.8537E-02 -116 96 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

436 32 5.8537E-02 -117 97 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

437 36 6.0033E-02 -118 98 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

438 36 6.0033E-02 -119 99 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

439 32 5.8537E-02 -120 100 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

440 36 6.0033E-02 -121 101 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

441 32 5.8537E-02 -122 102 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

442 32 5.8537E-02 -123 103 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

443 36 6.0033E-02 -124 104 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

444 32 5.8537E-02 -125 105 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

445 32 5.8537E-02 -126 106 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

446 41 2.41414E-02 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=3 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

448 27 0.0513781 33 -34 35 -36 83 -85 u=3 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

450 22 7.0537E-02 -91 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

451 22 7.0537E-02 -92 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

452 26 7.1415E-02 -93 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

453 22 7.0537E-02 -94 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

454 22 7.0537E-02 -95 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

455 22 7.0537E-02 -96 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

456 22 7.0537E-02 -97 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

457 26 7.1415E-02 -98 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

458 26 7.1415E-02 -99 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

459 22 7.0537E-02 -100 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

460 26 7.1415E-02 -101 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

461 22 7.0537E-02 -102 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

462 22 7.0537E-02 -103 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

463 26 7.1415E-02 -104 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

464 22 7.0537E-02 -105 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

465 22 7.0537E-02 -106 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

c

c

470 32 5.8537E-02 -111 91 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

471 32 5.8537E-02 -112 92 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

472 36 6.0033E-02 -113 93 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

473 32 5.8537E-02 -114 94 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

474 32 5.8537E-02 -115 95 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

475 32 5.8537E-02 -116 96 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

476 32 5.8537E-02 -117 97 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

477 36 6.0033E-02 -118 98 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

478 36 6.0033E-02 -119 99 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

479 32 5.8537E-02 -120 100 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

480 36 6.0033E-02 -121 101 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

481 32 5.8537E-02 -122 102 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

482 32 5.8537E-02 -123 103 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

483 36 6.0033E-02 -124 104 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

484 32 5.8537E-02 -125 105 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

485 32 5.8537E-02 -126 106 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

486 41 2.41414E-02 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=3 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

488 27 0.0513781 33 -34 35 -36 86 -88 u=3 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

490 22 7.0537E-02 -91 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

491 22 7.0537E-02 -92 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

492 26 7.1415E-02 -93 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

493 22 7.0537E-02 -94 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

494 22 7.0537E-02 -95 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

495 22 7.0537E-02 -96 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

496 22 7.0537E-02 -97 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

497 26 7.1415E-02 -98 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

498 26 7.1415E-02 -99 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

499 22 7.0537E-02 -100 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

500 26 7.1415E-02 -101 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

501 22 7.0537E-02 -102 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

502 22 7.0537E-02 -103 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

503 26 7.1415E-02 -104 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

504 22 7.0537E-02 -105 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

505 22 7.0537E-02 -106 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

c

c

510 32 5.8537E-02 -111 91 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

511 32 5.8537E-02 -112 92 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

512 36 6.0033E-02 -113 93 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

513 32 5.8537E-02 -114 94 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

514 32 5.8537E-02 -115 95 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

515 32 5.8537E-02 -116 96 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

516 32 5.8537E-02 -117 97 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

517 36 6.0033E-02 -118 98 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

518 36 6.0033E-02 -119 99 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

519 32 5.8537E-02 -120 100 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

520 36 6.0033E-02 -121 101 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

521 32 5.8537E-02 -122 102 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

522 32 5.8537E-02 -123 103 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

523 36 6.0033E-02 -124 104 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

524 32 5.8537E-02 -125 105 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

525 32 5.8537E-02 -126 106 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

526 41 2.41414E-02 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=3 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

528 27 0.0513781 33 -34 35 -36 89 -11 u=3 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

529 51 7.34056E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=3 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

531 8 4.7208E-02 11 -67 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

532 9 4.7925E-02 67 -68 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

533 15 4.8317E-02 68 -12 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Upper Reflector

534 14 8.4932E-02 12 -13 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Upper padding

535 16 3.279692E-02 13 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

536 0 132 -133 134 -135 (-21:22:-23:24) u=3 imp:n=1

c Wrapper

537 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=3 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

538 0 1 -2 3 -4 (-136:137:-138:139) u=3 imp:n=1

c

c End of Core Pin Geometry Element B (H, L)

c

c

c --- Core Pin Geometry Element A Calandria NACLI Pins 16xC

c c 23 7.1230E-02 clad 33 6.15349E-02

c

c Lower padding

601 16 3.279692E-02 -8 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Lower Reflector

602 14 8.4932E-02 8 -9 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

603 15 4.8317E-02 9 -41 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

604 9 4.7925E-02 41 -42 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

605 8 4.7208E-02 42 -10 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

609 27 0.0513781 33 -34 35 -36 10 -82 u=4 imp:n=1 TMP=2.5301E-08

c

c

610 23 7.1230E-02 -91 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

611 23 7.1230E-02 -92 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

612 23 7.1230E-02 -93 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

613 23 7.1230E-02 -94 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

614 23 7.1230E-02 -95 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

615 23 7.1230E-02 -96 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

616 23 7.1230E-02 -97 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

617 23 7.1230E-02 -98 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

618 23 7.1230E-02 -99 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

619 23 7.1230E-02 -100 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

620 23 7.1230E-02 -101 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

621 23 7.1230E-02 -102 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

622 23 7.1230E-02 -103 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

623 23 7.1230E-02 -104 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

624 23 7.1230E-02 -105 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

625 23 7.1230E-02 -106 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

c

630 33 6.15349E-02 -111 91 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

631 33 6.15349E-02 -112 92 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

632 33 6.15349E-02 -113 93 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

633 33 6.15349E-02 -114 94 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

634 33 6.15349E-02 -115 95 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

635 33 6.15349E-02 -116 96 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

636 33 6.15349E-02 -117 97 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

637 33 6.15349E-02 -118 98 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

638 33 6.15349E-02 -119 99 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

639 33 6.15349E-02 -120 100 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

640 33 6.15349E-02 -121 101 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

641 33 6.15349E-02 -122 102 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

642 33 6.15349E-02 -123 103 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

643 33 6.15349E-02 -124 104 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

644 33 6.15349E-02 -125 105 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

645 33 6.15349E-02 -126 106 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

646 41 2.41414E-02 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=4 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

648 27 0.0513781 33 -34 35 -36 83 -85 u=4 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

650 23 7.1230E-02 -91 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

651 23 7.1230E-02 -92 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

652 23 7.1230E-02 -93 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

653 23 7.1230E-02 -94 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

654 23 7.1230E-02 -95 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

655 23 7.1230E-02 -96 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

656 23 7.1230E-02 -97 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

657 23 7.1230E-02 -98 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

658 23 7.1230E-02 -99 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

659 23 7.1230E-02 -100 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

660 23 7.1230E-02 -101 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

661 23 7.1230E-02 -102 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

662 23 7.1230E-02 -103 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

663 23 7.1230E-02 -104 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

664 23 7.1230E-02 -105 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

665 23 7.1230E-02 -106 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

c

c

670 33 6.15349E-02 -111 91 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

671 33 6.15349E-02 -112 92 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

672 33 6.15349E-02 -113 93 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

673 33 6.15349E-02 -114 94 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

674 33 6.15349E-02 -115 95 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

675 33 6.15349E-02 -116 96 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

676 33 6.15349E-02 -117 97 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

677 33 6.15349E-02 -118 98 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

678 33 6.15349E-02 -119 99 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

679 33 6.15349E-02 -120 100 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

680 33 6.15349E-02 -121 101 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

681 33 6.15349E-02 -122 102 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

682 33 6.15349E-02 -123 103 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

683 33 6.15349E-02 -124 104 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

684 33 6.15349E-02 -125 105 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

685 33 6.15349E-02 -126 106 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

686 41 2.41414E-02 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=4 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

688 27 0.0513781 33 -34 35 -36 86 -88 u=4 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

690 23 7.1230E-02 -91 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

691 23 7.1230E-02 -92 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

692 23 7.1230E-02 -93 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

693 23 7.1230E-02 -94 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

694 23 7.1230E-02 -95 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

695 23 7.1230E-02 -96 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

696 23 7.1230E-02 -97 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

697 23 7.1230E-02 -98 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

698 23 7.1230E-02 -99 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

699 23 7.1230E-02 -100 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

700 23 7.1230E-02 -101 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

701 23 7.1230E-02 -102 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

702 23 7.1230E-02 -103 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

703 23 7.1230E-02 -104 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

704 23 7.1230E-02 -105 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

705 23 7.1230E-02 -106 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

c

c

710 33 6.15349E-02 -111 91 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

711 33 6.15349E-02 -112 92 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

712 33 6.15349E-02 -113 93 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

713 33 6.15349E-02 -114 94 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

714 33 6.15349E-02 -115 95 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

715 33 6.15349E-02 -116 96 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

716 33 6.15349E-02 -117 97 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

717 33 6.15349E-02 -118 98 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

718 33 6.15349E-02 -119 99 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

719 33 6.15349E-02 -120 100 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

720 33 6.15349E-02 -121 101 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

721 33 6.15349E-02 -122 102 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

722 33 6.15349E-02 -123 103 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

723 33 6.15349E-02 -124 104 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

724 33 6.15349E-02 -125 105 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

725 33 6.15349E-02 -126 106 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

726 41 2.41414E-02 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=4 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

728 27 0.0513781 33 -34 35 -36 89 -11 u=4 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

729 51 7.34056E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=4 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

731 8 4.7208E-02 11 -67 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

732 9 4.7925E-02 67 -68 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

733 15 4.8317E-02 68 -12 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Upper Reflector

734 14 8.4932E-02 12 -13 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Upper padding

735 16 3.279692E-02 13 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

736 0 132 -133 134 -135 (-21:22:-23:24) u=4 imp:n=1

c Wrapper

737 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=4 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

738 0 1 -2 3 -4 (-136:137:-138:139) u=4 imp:n=1

c

c End of Core Pin Geometry Element A

c

c

c --- Core Pin Geometry Element J Calandria NACLIV Pins 12xE and 4xUO2

c E 25 7.1167E-02 28 7.1400E-02 35 5.96942E-02

c The positions of pin UO2 are the circles 94, 96, 102 and 104

c Lower padding

801 16 3.279692E-02 -8 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Lower Reflector

802 14 8.4932E-02 8 -9 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

803 15 4.8317E-02 9 -41 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

804 9 4.7925E-02 41 -42 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

805 8 4.7208E-02 42 -10 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

809 27 0.0513781 33 -34 35 -36 10 -82 u=5 imp:n=1 TMP=2.5301E-08

c

c

810 25 7.1167E-02 -91 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

811 25 7.1167E-02 -92 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

812 25 7.1167E-02 -93 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

813 28 7.1400E-02 -94 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

814 25 7.1167E-02 -95 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

815 28 7.1400E-02 -96 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

816 25 7.1167E-02 -97 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

817 25 7.1167E-02 -98 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

818 25 7.1167E-02 -99 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

819 25 7.1167E-02 -100 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

820 25 7.1167E-02 -101 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

821 28 7.1400E-02 -102 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

822 25 7.1167E-02 -103 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

823 28 7.1400E-02 -104 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

824 25 7.1167E-02 -105 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

825 25 7.1167E-02 -106 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

c

830 35 5.96942E-02 -111 91 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

831 35 5.96942E-02 -112 92 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

832 35 5.96942E-02 -113 93 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

833 35 5.96942E-02 -114 94 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

834 35 5.96942E-02 -115 95 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

835 35 5.96942E-02 -116 96 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

836 35 5.96942E-02 -117 97 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

837 35 5.96942E-02 -118 98 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

838 35 5.96942E-02 -119 99 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

839 35 5.96942E-02 -120 100 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

840 35 5.96942E-02 -121 101 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

841 35 5.96942E-02 -122 102 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

842 35 5.96942E-02 -123 103 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

843 35 5.96942E-02 -124 104 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

844 35 5.96942E-02 -125 105 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

845 35 5.96942E-02 -126 106 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

846 44 2.4049E-02 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=5 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

848 27 0.0513781 33 -34 35 -36 83 -85 u=5 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

850 25 7.1167E-02 -91 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

851 25 7.1167E-02 -92 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

852 25 7.1167E-02 -93 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

853 28 7.1400E-02 -94 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

854 25 7.1167E-02 -95 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

855 28 7.1400E-02 -96 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

856 25 7.1167E-02 -97 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

857 25 7.1167E-02 -98 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

858 25 7.1167E-02 -99 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

859 25 7.1167E-02 -100 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

860 25 7.1167E-02 -101 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

861 28 7.1400E-02 -102 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

862 25 7.1167E-02 -103 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

863 28 7.1400E-02 -104 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

864 25 7.1167E-02 -105 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

865 25 7.1167E-02 -106 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

c

c

870 35 5.96942E-02 -111 91 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

871 35 5.96942E-02 -112 92 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

872 35 5.96942E-02 -113 93 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

873 35 5.96942E-02 -114 94 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

874 35 5.96942E-02 -115 95 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

875 35 5.96942E-02 -116 96 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

876 35 5.96942E-02 -117 97 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

877 35 5.96942E-02 -118 98 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

878 35 5.96942E-02 -119 99 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

879 35 5.96942E-02 -120 100 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

880 35 5.96942E-02 -121 101 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

881 35 5.96942E-02 -122 102 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

882 35 5.96942E-02 -123 103 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

883 35 5.96942E-02 -124 104 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

884 35 5.96942E-02 -125 105 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

885 35 5.96942E-02 -126 106 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

886 44 2.4049E-02 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=5 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

888 27 0.0513781 33 -34 35 -36 86 -88 u=5 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

890 25 7.1167E-02 -91 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

891 25 7.1167E-02 -92 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

892 25 7.1167E-02 -93 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

893 28 7.1400E-02 -94 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

894 25 7.1167E-02 -95 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

895 28 7.1400E-02 -96 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

896 25 7.1167E-02 -97 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

897 25 7.1167E-02 -98 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

898 25 7.1167E-02 -99 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

899 25 7.1167E-02 -100 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

900 25 7.1167E-02 -101 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

901 28 7.1400E-02 -102 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

902 25 7.1167E-02 -103 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

903 28 7.1400E-02 -104 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

904 25 7.1167E-02 -105 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

905 25 7.1167E-02 -106 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

c

c

910 35 5.96942E-02 -111 91 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

911 35 5.96942E-02 -112 92 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

912 35 5.96942E-02 -113 93 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

913 35 5.96942E-02 -114 94 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

914 35 5.96942E-02 -115 95 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

915 35 5.96942E-02 -116 96 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

916 35 5.96942E-02 -117 97 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

917 35 5.96942E-02 -118 98 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

918 35 5.96942E-02 -119 99 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

919 35 5.96942E-02 -120 100 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

920 35 5.96942E-02 -121 101 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

921 35 5.96942E-02 -122 102 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

922 35 5.96942E-02 -123 103 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

923 35 5.96942E-02 -124 104 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

924 35 5.96942E-02 -125 105 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

925 35 5.96942E-02 -126 106 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

926 44 2.4049E-02 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=5 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

928 27 0.0513781 33 -34 35 -36 89 -11 u=5 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

929 54 6.94698E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=5 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

931 8 4.7208E-02 11 -67 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

932 9 4.7925E-02 67 -68 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

933 15 4.8317E-02 68 -12 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Upper Reflector

934 14 8.4932E-02 12 -13 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Upper padding

935 16 3.279692E-02 13 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

936 0 132 -133 134 -135 (-21:22:-23:24) u=5 imp:n=1

c Wrapper

937 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=5 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

938 0 1 -2 3 -4 (-136:137:-138:139) u=5 imp:n=1

c

c End of Core Pin Geometry Element J

c

c

c

c --- Core Plate Geometry Element

c Lower padding

1011 16 3.279692E-02 -8 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Lower Reflector

1012 14 8.4932E-02 8 -9 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Lower section of the NatU Blanket

1013 15 4.8317E-02 9 -41 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

1014 9 4.7925E-02 41 -42 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

1015 8 4.7208E-02 42 -10 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c Fuelled section

c

c Lowest core Cell, Cell 12

c

c Na plate core

1022 5 2.324832E-02 502 -503 159 -160 161 -162 u=6 imp:n=1 TMP=2.5301E-08

C Na plate can

1023 6 7.9429E-02 10 -504 21 -22 23 -24 &

(-159:160:-161:162:-502:503) u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1027 3 6.9083E-02 505 -506 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1028 4 7.2463E-02 504 -507 21 -22 23 -24 &

(-155:156:-157:158:-505:506) u=6 imp:n=1 TMP=2.5301E-08

c

c Na plate core

1032 5 2.324832E-02 508 -509 159 -160 161 -162 u=6 imp:n=1 TMP=2.5301E-08

C Na plate can

1033 6 7.9429E-02 507 -510 21 -22 23 -24 &

(-159:160:-161:162:-508:509) u=6 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

1035 1 3.9991E-02 151 -152 153 -154 511 -512 u=6 imp:n=1 TMP=2.5301E-08

C Pu canning

1036 2 6.6997E-02 510 -513 21 -22 23 -24 &

(-151:152:-153:154:-511:512) u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1039 3 6.9083E-02 514 -515 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1040 4 7.2463E-02 513 -516 21 -22 23 -24 &

(-155:156:-157:158:-514:515) u=6 imp:n=1 TMP=2.5301E-08

c

c Na plate core

1042 5 2.324832E-02 517 -518 159 -160 161 -162 u=6 imp:n=1 TMP=2.5301E-08

C Na plate can

1043 6 7.9429E-02 516 -43 21 -22 23 -24 &

(-159:160:-161:162:-517:518) u=6 imp:n=1 TMP=2.5301E-08

c

c Insert the 22 central region core cells

c

1051 0 43 -44 21 -22 23 -24 fill=13 (0 0 71.209862) u=6 imp:n=1

c

1052 0 44 -45 21 -22 23 -24 fill=14 (0 0 74.957944) u=6 imp:n=1

c

c

1053 0 45 -46 21 -22 23 -24 fill=13 (0 0 78.706026) u=6 imp:n=1

c

1054 0 46 -47 21 -22 23 -24 fill=14 (0 0 82.454108) u=6 imp:n=1

c

c

1055 0 47 -48 21 -22 23 -24 fill=13 (0 0 86.202190) u=6 imp:n=1

c

1056 0 48 -49 21 -22 23 -24 fill=14 (0 0 89.950272) u=6 imp:n=1

c

c

1057 0 49 -50 21 -22 23 -24 fill=13 (0 0 93.698354) u=6 imp:n=1

c

1058 0 50 -51 21 -22 23 -24 fill=14 (0 0 97.446436) u=6 imp:n=1

c

c

1059 0 51 -52 21 -22 23 -24 fill=13 (0 0 101.194518) u=6 imp:n=1

c

1060 0 52 -53 21 -22 23 -24 fill=14 (0 0 104.942600) u=6 imp:n=1

c

c

1061 0 53 -54 21 -22 23 -24 fill=13 (0 0 108.690682) u=6 imp:n=1

c

1062 0 54 -55 21 -22 23 -24 fill=14 (0 0 112.438764) u=6 imp:n=1

c

c

1063 0 55 -56 21 -22 23 -24 fill=13 (0 0 116.186846) u=6 imp:n=1

c

1064 0 56 -57 21 -22 23 -24 fill=14 (0 0 119.934928) u=6 imp:n=1

c

c

1065 0 57 -58 21 -22 23 -24 fill=13 (0 0 123.683010) u=6 imp:n=1

c

1066 0 58 -59 21 -22 23 -24 fill=14 (0 0 127.431092) u=6 imp:n=1

c

c

1067 0 59 -60 21 -22 23 -24 fill=13 (0 0 131.179174) u=6 imp:n=1

c

1068 0 60 -61 21 -22 23 -24 fill=14 (0 0 134.927256) u=6 imp:n=1

c

c

1069 0 61 -62 21 -22 23 -24 fill=13 (0 0 138.675338) u=6 imp:n=1

c

1070 0 62 -63 21 -22 23 -24 fill=14 (0 0 142.423420) u=6 imp:n=1

c

c

1071 0 63 -64 21 -22 23 -24 fill=13 (0 0 146.171502) u=6 imp:n=1

c

1072 0 64 -65 21 -22 23 -24 fill=14 (0 0 149.919584) u=6 imp:n=1

c

c

c The top core cell, Cell 2

c

c Na plate core

1082 5 2.324832E-02 402 -403 159 -160 161 -162 u=6 imp:n=1 TMP=2.5301E-08

C Na plate can

1083 6 7.9429E-02 65 -404 21 -22 23 -24 &

(-159:160:-161:162:-402:403) u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1087 3 6.9083E-02 405 -406 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1088 4 7.2463E-02 404 -407 21 -22 23 -24 &

(-155:156:-157:158:-405:406) u=6 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

1092 1 3.9991E-02 151 -152 153 -154 408 -409 u=6 imp:n=1 &

TMP=2.5301E-08

C Pu canning

1093 2 6.6997E-02 407 -410 21 -22 23 -24 &

(-151:152:-153:154:-408:409) u=6 imp:n=1 TMP=2.5301E-08

c

c Na plate core

1102 5 2.324832E-02 411 -412 159 -160 161 -162 u=6 imp:n=1 TMP=2.5301E-08

C Na plate can

1103 6 7.9429E-02 410 -413 21 -22 23 -24 &

(-159:160:-161:162:-411:412) u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1107 3 6.9083E-02 414 -415 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1108 4 7.2463E-02 413 -416 21 -22 23 -24 &

(-155:156:-157:158:-414:415) u=6 imp:n=1 TMP=2.5301E-08

c

c Na plate core

1112 5 2.324832E-02 417 -418 159 -160 161 -162 u=6 imp:n=1 TMP=2.5301E-08

C Na plate can

1113 6 7.9429E-02 416 -66 21 -22 23 -24 &

(-159:160:-161:162:-417:418) u=6 imp:n=1 TMP=2.5301E-08

c

c

c Upper Axial blanket.

c

1121 8 4.7208E-02 66 -67 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

1122 9 4.7925E-02 67 -68 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

1123 15 4.8317E-02 68 -12 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c Upper Reflector

1126 14 8.4932E-02 12 -13 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Upper padding

1127 16 3.279692E-02 13 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Wrapper region

c 1128 17 3.87228E-02 1 -2 3 -4 (-21:22:-23:24) u=6 imp:n=1

c TMP=2.5301E-08

c gap between plates and wrapper

1131 0 132 -133 134 -135 (-21:22:-23:24) u=6 imp:n=1

c Wrapper

1132 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=6 &

imp:n=1 TMP=2.5301E-08

c gap outside wrapper

1133 0 1 -2 3 -4 (-136:137:-138:139) u=6 imp:n=1

c

c

c --- Radial Breeder Element

c Lower padding

1241 16 3.279692E-02 -8 21 -22 23 -24 u=7 imp:n=1 TMP=2.5301E-08

c Lower Reflector

1242 14 8.4932E-02 8 -9 21 -22 23 -24 u=7 imp:n=1 TMP=2.5301E-08

c Radial blanket

1244 15 4.8317E-02 9 -12 21 -22 23 -24 u=7 imp:n=1 TMP=2.5301E-08

c Upper reflector

1246 like 134 but u=7 imp:n=1 TMP=2.5301E-08

c Upper padding

1247 like 135 but u=7 imp:n=1 TMP=2.5301E-08

c Wrapper region

c gap between plates and wrapper

1248 0 132 -133 134 -135 (-21:22:-23:24) u=7 imp:n=1

c Wrapper

1249 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=7 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

1250 0 1 -2 3 -4 (-136:137:-138:139) u=7 imp:n=1

c

c

c

c --- Radial shield

c

1326 12 8.32720E-02 28 -29 30 -31 u=8 imp:n=1 TMP=2.5301E-08

c

1327 13 8.32720E-05 1 -2 3 -4 (-28:29:-30:31) u=8 imp:n=1 &

TMP=2.5301E-08

c

c

1400 13 8.32720E-05 1 -2 3 -4 u=9 imp:n=1 TMP=2.5301E-08

c

c --- Assembly

c

1419 0 189 -190 191 -192 u=10 lat=1

fill=-3:3 -3:3 0:0

199 164 162 161 163 165 199

146 144 132 141 132 145 147

126 132 122 121 123 132 127

106 104 102 101 103 105 107

116 132 112 111 113 132 117

136 134 132 131 132 135 137

199 154 152 151 153 155 199

imp:n=1

c

c --- Fuel Region

c

1429 0 7 -16 -17 fill=10 imp:n=1

c --- Universe

1430 0 -7:16:17 imp:n=0

c

c Cell A

c 501 1 6.9985E-02 -71 u=3 imp:n=1 TMP=2.5301E-08

c

c 502 23 0.062241 -74 71 u=3 imp:n=1 TMP=2.5301E-08

c

c 503 5 2.3900E-02 74 u=3 imp:n=1 TMP=2.5301E-08

c

c 504 0 75 -76 77 -78 u=3 fill=1 imp:n=1

c

c Cell E Modified compositions

c

c 506 2 7.1167E-02 -71 u=4 imp:n=1 TMP=2.5301E-08

c

c 507 24 0.0596942 -74 71 u=4 imp:n=1 TMP=2.5301E-08

c

c 508 5 2.3900E-02 74 u=4 imp:n=1 TMP=2.5301E-08

c

c 509 0 75 -76 77 -78 u=4 fill=2 imp:n=1

c

c 511 0 75 -76 77 -78 lat=1 &

c fill -2:1 -2:1 0:0 &

c 3 4 3 4 4 3 4 3 3 4 3 4 4 3 4 3 &

c u=11 imp:n=1

c

c

c ------------- PLATE ELEMENT CELL CARDS ----------------------------------

c

c The First Regular cell. Cell 1

c

c Na plate

c Na plate core

2162 5 2.324832E-02 802 -803 159 -160 161 -162 u=13 imp:n=1 TMP=2.5301E-08

C Na plate can

2163 6 7.9429E-02 801 -804 21 -22 23 -24 &

(-159:160:-161:162:-802:803) u=13 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2167 3 6.9083E-02 805 -806 155 -156 157 -158 u=13 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2168 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-155:156:-157:158:-805:806) u=13 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2170 7 3.3152E-02 807 -708 21 -22 23 -24 u=13 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2172 1 3.9991E-02 151 -152 153 -154 709 -710 u=13 imp:n=1 TMP=2.5301E-08

C Pu canning

2173 2 6.6997E-02 708 -711 21 -22 23 -24 &

(-151:152:-153:154:-709:710) u=13 imp:n=1 TMP=2.5301E-08

c

c

c Na plate

c Na plate core

2182 5 2.324832E-02 712 -713 159 -160 161 -162 u=13 imp:n=1 TMP=2.5301E-08

C Na plate can

2183 6 7.9429E-02 711 -814 21 -22 23 -24 &

(-159:160:-161:162:-712:713) u=13 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2187 3 6.9083E-02 815 -816 155 -156 157 -158 u=13 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2188 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-155:156:-157:158:-815:816) u=13 imp:n=1 TMP=2.5301E-08

c

c Na plate

c Na plate core

2192 5 2.324832E-02 818 -819 159 -160 161 -162 u=13 imp:n=1 TMP=2.5301E-08

C Na plate can

2193 6 7.9429E-02 817 -820 21 -22 23 -24 &

(-159:160:-161:162:-818:819) u=13 imp:n=1 TMP=2.5301E-08

c

c End of Cell 1 beginning of Cell 2

c Na plate

c Na plate core

2202 5 2.324832E-02 802 -803 159 -160 161 -162 u=14 imp:n=1 TMP=2.5301E-08

C Na plate can

2203 6 7.9429E-02 801 -804 21 -22 23 -24 &

(-159:160:-161:162:-802:803) u=14 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2207 3 6.9083E-02 805 -806 155 -156 157 -158 u=14 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2208 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-155:156:-157:158:-805:806) u=14 imp:n=1 TMP=2.5301E-08

c

c Na plate

c Na plate core

2211 5 2.324832E-02 808 -809 159 -160 161 -162 u=14 imp:n=1 TMP=2.5301E-08

C Na plate can

2212 6 7.9429E-02 807 -810 21 -22 23 -24 &

(-159:160:-161:162:-808:809) u=14 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2214 1 3.9991E-02 151 -152 153 -154 811 -812 u=14 imp:n=1 TMP=2.5301E-08

C Pu canning

2215 2 6.6997E-02 810 -813 21 -22 23 -24 &

(-151:152:-153:154:-811:812) u=14 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2217 7 3.3152E-02 813 -814 21 -22 23 -24 u=14 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2219 3 6.9083E-02 815 -816 155 -156 157 -158 u=14 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2220 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-155:156:-157:158:-815:816) u=14 imp:n=1 TMP=2.5301E-08

c

c Na plate

c Na plate core

2222 5 2.324832E-02 818 -819 159 -160 161 -162 u=14 imp:n=1 TMP=2.5301E-08

C Na plate can

2223 6 7.9429E-02 817 -820 21 -22 23 -24 &

(-159:160:-161:162:-818:819) u=14 imp:n=1 TMP=2.5301E-08

c

c End of plate element cell data

c

c

c --------------------------------------------------------------------

c

c Form the region surrounding groups of 5x5 elements, containing grids

c

c

3001 0 189 -190 191 -192 (-185:186:-187:188) -71 u=100 imp:n=1

c

3002 20 7.403935E-02 189 -190 191 -192 (-185:186:-187:188) 71 -72 &

u=100 imp:n=1

c

3003 0 189 -190 191 -192 (-185:186:-187:188) 72 -73 u=100 imp:n=1

c

3004 20 7.403935E-02 189 -190 191 -192 (-185:186:-187:188) 73 -74 &

u=100 imp:n=1

c

3005 0 189 -190 191 -192 (-185:186:-187:188) 74 u=100 imp:n=1

c

c

c ------------------------------------------------------------------

c

c Form arrays of 5x5 elements

c

c Central row

c

c Central array of 5x5 core elements

c

c

3011 0 1 -2 3 -4 u=201 lat=1

fill=-2:2 -2:2 0:0

6 6 6 6 6

6 6 6 6 6

6 6 6 6 6

6 6 6 6 6

6 6 6 6 6

imp:n=1

c

3012 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=101 imp:n=1

c

3013 0 7 -16 185 -186 187 -188 fill=201 u=101 imp:n=1

c

c

c Middle Left array of 5x5 core elements in row 4

c

3014 0 1 -2 3 -4 u=202 lat=1

fill=-2:2 -2:2 0:0

4 5 4 2 6

4 2 4 2 6

3 2 2 2 6

4 2 2 2 6

4 5 2 2 6

imp:n=1

c

c

c Surround material

c

3015 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=102 imp:n=1

c

c

3016 0 7 -16 185 -186 187 -188 fill=202 u=102 imp:n=1

c

c

c Middle Right array of 5x5 core elements in row 4

c

3017 0 1 -2 3 -4 u=203 lat=1

fill=-2:2 -2:2 0:0

6 2 4 5 4

6 2 4 2 4

6 2 2 2 3

6 2 2 2 4

6 2 3 5 4

imp:n=1

c

c

c Surround material

c

3018 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=103 imp:n=1

c

c

3019 0 7 -16 185 -186 187 -188 fill=203 u=103 imp:n=1

c

c

c

c Left edge array of 5x5 core elements in row 4

c

3021 0 1 -2 3 -4 u=204 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 1

7 7 7 7 1

7 7 7 7 1

7 7 7 7 1

7 7 7 7 1

imp:n=1

c

c

c Surround material

c

3022 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=104 imp:n=1

c

c

3023 0 7 -16 185 -186 187 -188 fill=204 u=104 imp:n=1

c

c

c Right edge array of 5x5 core elements in row 4

c

3024 0 1 -2 3 -4 u=205 lat=1

fill=-2:2 -2:2 0:0

1 7 7 7 7

1 7 7 7 7

1 7 7 7 7

1 7 7 7 7

1 7 7 7 7

imp:n=1

c

c

c Surround material

c

3025 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=105 imp:n=1

c

c

3026 0 7 -16 185 -186 187 -188 fill=205 u=105 imp:n=1

c

c

c ROW 3 The row below the central line

c

c

c Middle array of 5x5 core elements in Row 3

c

c

3031 0 1 -2 3 -4 u=211 lat=1

fill=-2:2 -2:2 0:0

6 6 6 6 6

1 1 1 1 1

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

imp:n=1

c

c Surround material

c

3032 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=111 imp:n=1

c

3033 0 7 -16 185 -186 187 -188 fill=211 u=111 imp:n=1

c

c Lower left array of 5x5 core elements in Row 3

c

c

3034 0 1 -2 3 -4 u=212 lat=1

fill=-2:2 -2:2 0:0

1 2 2 1 2

1 2 2 1 2

7 1 4 2 3

7 7 1 3 3

7 7 7 1 1

imp:n=1

c

c Surround material

c

3035 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=112 imp:n=1

c

3036 0 7 -16 185 -186 187 -188 fill=212 u=112 imp:n=1

c

c

c Lower right array of 5x5 core elements in Row 3

c

3037 0 1 -2 3 -4 u=213 lat=1

fill=-2:2 -2:2 0:0

2 2 3 3 1

2 3 3 5 1

3 3 3 1 7

3 3 5 7 7

1 1 7 7 7

imp:n=1

c

c

c Surround material

c

3038 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=113 imp:n=1

c

c

3039 0 7 -16 185 -186 187 -188 fill=213 u=113 imp:n=1

c

c

c

c ROW 5 the row above the central line

c

c Central array of 5x5 core elements in Row 5

c

3051 0 1 -2 3 -4 u=221 lat=1

fill=-2:2 -2:2 0:0

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

1 1 1 1 1

6 6 6 6 6

imp:n=1

c

c

c Surround material

c

3052 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=121 imp:n=1

c

c

3053 0 7 -16 185 -186 187 -188 fill=221 u=121 imp:n=1

c

c

c Top left array of 5x5 core elements in Row 5

c

3054 0 1 -2 3 -4 u=222 lat=1

fill=-2:2 -2:2 0:0

7 7 7 2 2

7 7 2 3 3

7 2 4 2 2

1 5 2 1 2

1 2 2 1 2

imp:n=1

c

c

c Surround material

c

3055 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=122 imp:n=1

c

c

3056 0 7 -16 185 -186 187 -188 fill=222 u=122 imp:n=1

c

c

c Top right array of 5x5 core elements in Row 5

c

3057 0 1 -2 3 -4 u=223 lat=1

fill=-2:2 -2:2 0:0

1 1 7 7 7

3 3 2 7 7

2 2 4 2 7

2 1 2 3 1

2 1 2 2 1

imp:n=1

c

c

c Surround material

c

3058 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=123 imp:n=1

c

c

3059 0 7 -16 185 -186 187 -188 fill=223 u=123 imp:n=1

c

c

c

c ROW 2 The row two down from the central row

c

c Lower central group

c

c

3071 0 1 -2 3 -4 u=231 lat=1

fill=-2:2 -2:2 0:0

1 1 1 1 1

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3072 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=131 imp:n=1

c

3073 0 7 -16 185 -186 187 -188 fill=231 u=131 imp:n=1

c

c

c ROW 6

c

c Top central array of 5x5 core elements in row 6

c

3074 0 1 -2 3 -4 u=241 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

1 1 1 1 1

imp:n=1

c

c Surround material

c

3075 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=141 imp:n=1

c

3076 0 7 -16 185 -186 187 -188 fill=241 u=141 imp:n=1

c

c

c

c 5x5 array of blanket elements

c

c

3101 0 1 -2 3 -4 u=232 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3102 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=132 imp:n=1

c

3103 0 7 -16 185 -186 187 -188 fill=232 u=132 imp:n=1

c

c

c \*\*\* Blanket-Reflector Arrays \*\*\*

c

c ROW 2

c

c Bottom Left

c

c

3111 0 1 -2 3 -4 u=234 lat=1

fill=-2:2 -2:2 0:0

8 7 7 7 7

8 8 7 7 7

8 8 8 7 7

8 8 8 8 7

9 8 8 8 8

imp:n=1

c

c

c Surround material

c

3112 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=134 imp:n=1

c

3113 0 7 -16 185 -186 187 -188 fill=234 u=134 imp:n=1

c

c

c Row 2 Bottom Right Blanket Reflector Array

c

c

3121 0 1 -2 3 -4 u=235 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 8

7 7 7 8 8

7 7 8 8 8

7 8 8 8 8

8 8 8 8 9

imp:n=1

c

c

c Surround material

c

3122 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=135 imp:n=1

c

3123 0 7 -16 185 -186 187 -188 fill=235 u=135 imp:n=1

c

c

c ROW 6

c

c Top Left Blanket-Reflector Array

c

c

3131 0 1 -2 3 -4 u=244 lat=1

fill=-2:2 -2:2 0:0

9 8 8 8 8

8 8 8 8 7

8 8 8 7 7

8 8 7 7 7

8 7 7 7 7

imp:n=1

c

c

c Surround material

c

3132 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=144 imp:n=1

c

3133 0 7 -16 185 -186 187 -188 fill=244 u=144 imp:n=1

c

c Row 6 Top Right Blanket Reflector Array

c

c

3141 0 1 -2 3 -4 u=245 lat=1

fill=-2:2 -2:2 0:0

8 8 8 8 9

7 8 8 8 8

7 7 8 8 8

7 7 7 8 8

7 7 7 7 8

imp:n=1

c

c

c Surround material

c

3142 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=145 imp:n=1

c

3143 0 7 -16 185 -186 187 -188 fill=245 u=145 imp:n=1

c

c

c Row 1 Blanket - Reflector arrays

c

c Row 1 First Left array

c

c

3151 0 1 -2 3 -4 u=254 lat=1

fill=-2:2 -2:2 0:0

9 9 8 8 8

9 9 9 8 8

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3152 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=154 imp:n=1

c

3153 0 7 -16 185 -186 187 -188 fill=254 u=154 imp:n=1

c

c Row 1 Mid-Left

c

c

3161 0 1 -2 3 -4 u=252 lat=1

fill=-2:2 -2:2 0:0

8 8 8 7 7

8 8 8 8 8

8 8 8 8 8

9 9 9 8 8

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3162 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=152 imp:n=1

c

3163 0 7 -16 185 -186 187 -188 fill=252 u=152 imp:n=1

c

c Row 1 Central Array

c

3171 0 1 -2 3 -4 u=251 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

8 8 8 8 8

8 8 8 8 8

8 8 8 8 8

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3172 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=151 imp:n=1

c

3173 0 7 -16 185 -186 187 -188 fill=251 u=151 imp:n=1

c

c Row 1 First Right array

c

c

3181 0 1 -2 3 -4 u=253 lat=1

fill=-2:2 -2:2 0:0

7 7 8 8 8

8 8 8 8 8

8 8 8 8 8

8 8 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3182 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=153 imp:n=1

c

3183 0 7 -16 185 -186 187 -188 fill=253 u=153 imp:n=1

c

c Row 1 Far Right

c

c

3191 0 1 -2 3 -4 u=255 lat=1

fill=-2:2 -2:2 0:0

8 8 8 9 9

8 8 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3192 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=155 imp:n=1

c

3193 0 7 -16 185 -186 187 -188 fill=255 u=155 imp:n=1

c

c

c Row 2 Blanket reflector arrays

c

c Row 2 First Left array

c

c

3201 0 1 -2 3 -4 u=236 lat=1

fill=-2:2 -2:2 0:0

9 9 9 8 8

9 9 9 8 8

9 9 9 9 8

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3202 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=136 imp:n=1

c

3203 0 7 -16 185 -186 187 -188 fill=236 u=136 imp:n=1

c

c Row 2 Far Right

c

c

3211 0 1 -2 3 -4 u=237 lat=1

fill=-2:2 -2:2 0:0

8 8 9 9 9

8 8 9 9 9

8 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3212 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=137 imp:n=1

c

3213 0 7 -16 185 -186 187 -188 fill=237 u=137 imp:n=1

c

c Row 4 Blanket- Reflector arrays

c

c

c Row 4 First Left array

c

c

3221 0 1 -2 3 -4 u=206 lat=1

fill=-2:2 -2:2 0:0

9 8 8 8 7

9 8 8 8 7

9 8 8 8 7

9 8 8 8 7

9 8 8 8 7

imp:n=1

c

c

c Surround material

c

3222 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=106 imp:n=1

c

3223 0 7 -16 185 -186 187 -188 fill=206 u=106 imp:n=1

c

c

c Row 4 Far Right

c

c

3231 0 1 -2 3 -4 u=207 lat=1

fill=-2:2 -2:2 0:0

7 8 8 8 9

7 8 8 8 9

7 8 8 8 9

7 8 8 8 9

7 8 8 8 9

imp:n=1

c

c

c Surround material

c

3232 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=107 imp:n=1

c

3233 0 7 -16 185 -186 187 -188 fill=207 u=107 imp:n=1

c

c Row 6 Blanket- Reflector arrays

c

c

c Row 6 First Left array

c

3241 0 1 -2 3 -4 u=246 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 8

9 9 9 8 8

9 9 9 8 8

imp:n=1

c

c

c Surround material

c

3242 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=146 imp:n=1

c

3243 0 7 -16 185 -186 187 -188 fill=246 u=146 imp:n=1

c

c Row 6 Far Right

c

3251 0 1 -2 3 -4 u=247 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

8 9 9 9 9

8 8 9 9 9

8 8 9 9 9

imp:n=1

c

c

c Surround material

c

3252 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=147 imp:n=1

c

3253 0 7 -16 185 -186 187 -188 fill=247 u=147 imp:n=1

c

c

c Row 5 Blanket- Reflector arrays

c

c

c Row 5 First Left array

c

c

3261 0 1 -2 3 -4 u=226 lat=1

fill=-2:2 -2:2 0:0

9 9 8 8 8

9 9 8 8 8

9 9 8 8 8

9 8 8 8 7

9 8 8 8 7

imp:n=1

c

c

c Surround material

c

3262 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=126 imp:n=1

c

3263 0 7 -16 185 -186 187 -188 fill=226 u=126 imp:n=1

c

c Row 4 Far Right

c

3271 0 1 -2 3 -4 u=227 lat=1

fill=-2:2 -2:2 0:0

8 8 8 9 9

8 8 8 9 9

8 8 8 9 9

7 8 8 8 9

7 8 8 8 9

imp:n=1

c

c

c Surround material

c

3272 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=127 imp:n=1

c

3273 0 7 -16 185 -186 187 -188 fill=227 u=127 imp:n=1

c

c

c Row 3 Blanket- Reflector arrays

c

c Row 3 First Left array

c

3281 0 1 -2 3 -4 u=216 lat=1

fill=-2:2 -2:2 0:0

9 8 8 8 7

9 8 8 8 7

9 9 8 8 8

9 9 8 8 8

9 9 8 8 8

imp:n=1

c

c

c Surround material

c

3282 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=116 imp:n=1

c

3283 0 7 -16 185 -186 187 -188 fill=216 u=116 imp:n=1

c

c Row 3 Far Right

c

3291 0 1 -2 3 -4 u=217 lat=1

fill=-2:2 -2:2 0:0

7 8 8 8 9

7 8 8 8 9

8 8 8 9 9

8 8 8 9 9

8 8 8 9 9

imp:n=1

c

c

c Surround material

c

3292 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=117 imp:n=1

c

3293 0 7 -16 185 -186 187 -188 fill=217 u=117 imp:n=1

c

c Row 7 Blanket - Reflector arrays

c

c Row 7 First Left array

c

c

3301 0 1 -2 3 -4 u=264 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 8 8

9 9 8 8 8

imp:n=1

c

c

c Surround material

c

3302 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=164 imp:n=1

c

3303 0 7 -16 185 -186 187 -188 fill=264 u=164 imp:n=1

c

c Row 7 Mid-Left

c

3311 0 1 -2 3 -4 u=262 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 8 8

8 8 8 8 8

8 8 8 8 8

8 8 8 7 7

imp:n=1

c

c

c Surround material

c

3312 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=162 imp:n=1

c

3313 0 7 -16 185 -186 187 -188 fill=262 u=162 imp:n=1

c

c Row 7 Central Array

c

3321 0 1 -2 3 -4 u=261 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

8 8 8 8 8

8 8 8 8 8

8 8 8 8 8

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3322 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=161 imp:n=1

c

3323 0 7 -16 185 -186 187 -188 fill=261 u=161 imp:n=1

c

c Row 7 First Right array

c

3331 0 1 -2 3 -4 u=263 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

8 8 9 9 9

8 8 8 8 8

8 8 8 8 8

7 7 8 8 8

imp:n=1

c

c

c Surround material

c

3332 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=163 imp:n=1

c

3333 0 7 -16 185 -186 187 -188 fill=263 u=163 imp:n=1

c

c Row 7 Far Right

c

3341 0 1 -2 3 -4 u=265 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

8 8 9 9 9

8 8 8 9 9

imp:n=1

c

c

c Surround material

c

3342 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=165 imp:n=1

c

3343 0 7 -16 185 -186 187 -188 fill=265 u=165 imp:n=1

c

c Beyond the reflector 5x5 Region 9

c

3351 0 1 -2 3 -4 u=299 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3352 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=199 imp:n=1

c

c

3353 0 7 -16 185 -186 187 -188 fill=299 u=199 imp:n=1

c

c

c

c -----------------------------------------------------------------------

c

c

c ------------- SURFACE CARDS -------------------------------------------

c

c Lattice 2 (Assembly) Elementary cell surfaces

1 px -2.68605

2 px 2.68605

3 py -2.68605

4 py 2.68605

7 pz 0.0 $ Assembly lower limit

8 pz 30.0 $ End Packing, Start Reflector

9 pz 37.60628 $ End Plenum, Start Lower NU

10 pz 67.77878 $ End Lower NU, Start Fuel

c

11 pz 156.96878 $ End Fuel, Start Upper NU for Pin element

c

12 pz 187.271248 $ End Upper NU, Start Top Reflector

13 pz 194.877528 $ End Reflector, Start Packing

16 pz 224.877528 $ Assembly upper limit

c

17 cz 94.9

c

21 px -2.5335 $ Nominal half-width of plates

22 px 2.5335 $ and calandria outer half-width

23 py -2.5335

24 py 2.5335

28 px -2.54 $ Radial shield half-width

29 px 2.54

30 py -2.54

31 py 2.54

c

33 px -2.45 $ inner half-width of calandria

34 px 2.45

35 py -2.45

36 py 2.45

c

c

c subdivisions in the plate element axial blanket and core cells

c

c 9 pz 37.60628 $ axial reflector / axial blanket

41 pz 45.228780

42 pz 57.951780

c 10 pz 67.77878 $ axial blanket / core

43 pz 71.209862

44 pz 74.957944

45 pz 78.706026

46 pz 82.454108

47 pz 86.202190

48 pz 89.950272

49 pz 93.698354

50 pz 97.446436

51 pz 101.194518

52 pz 104.942600

53 pz 108.690682

54 pz 112.438764

55 pz 116.186846

56 pz 119.934928

57 pz 123.683010

58 pz 127.431092

59 pz 131.179174

60 pz 134.927256

61 pz 138.675338

62 pz 142.423420

63 pz 146.171502

64 pz 149.919584

65 pz 153.667666

c

66 pz 157.098748 $ core / axial blanket

c in plate elements (this replaces pz=11)

67 pz 166.925748

68 pz 179.648748

c 12 pz 187.271248 $ axial blanket / reflector

c

c differences in the pin elements ?

c 67 pz 166.925748

c 68 pz 179.648748

c 12 pz 187.271248 $ axial blanket / reflector

c

c Grid plate heights

c

71 pz 31.8

72 pz 62.2

73 pz 162.6

74 pz 193.0

c

c 71 c/z 0 0 0.423 $ fuel pin radius

c 71 c/z 0.6125 0.6125 0.423

c 72 c/z 0 0 0.4305 $ fuel can inner radius

c 73 c/z 0 0 0.488 $ calandria tube inner radius

c 74 c/z 0 0 0.513 $ calandria tube outer radius

c 74 c/z 0.6125 0.6125 0.513

c 75 px 0.0

c 76 px 1.225

c 77 py 0.0

c 78 py 1.225

c 79 cz 1.692

c 80 cz 2.052

c

81 pz 67.77878 $ 0.0

82 pz 68.21878 $ 0.44

83 pz 97.39878 $ 29.62

c 84 pz 97.50878 $ 29.73

85 pz 97.94878 $ 0.44

86 pz 127.12878 $ 29.62

87 pz 127.23878 $ 29.73

88 pz 127.67878 $ 0.44

89 pz 156.85878 $ 29.62

90 pz 156.96878 $ 29.73

c

91 c/z -1.785 -1.785 0.423

92 c/z -0.595 -1.785 0.423

93 c/z 0.595 -1.785 0.423

94 c/z 1.785 -1.785 0.423

95 c/z -1.785 -0.595 0.423

96 c/z -0.595 -0.595 0.423

97 c/z 0.595 -0.595 0.423

98 c/z 1.785 -0.595 0.423

99 c/z -1.785 0.595 0.423

100 c/z -0.595 0.595 0.423

101 c/z 0.595 0.595 0.423

102 c/z 1.785 0.595 0.423

103 c/z -1.785 1.785 0.423

104 c/z -0.595 1.785 0.423

105 c/z 0.595 1.785 0.423

106 c/z 1.785 1.785 0.423

c

c

111 c/z -1.785 -1.785 0.513

112 c/z -0.595 -1.785 0.513

113 c/z 0.595 -1.785 0.513

114 c/z 1.785 -1.785 0.513

115 c/z -1.785 -0.595 0.513

116 c/z -0.595 -0.595 0.513

117 c/z 0.595 -0.595 0.513

118 c/z 1.785 -0.595 0.513

119 c/z -1.785 0.595 0.513

120 c/z -0.595 0.595 0.513

121 c/z 0.595 0.595 0.513

122 c/z 1.785 0.595 0.513

123 c/z -1.785 1.785 0.513

124 c/z -0.595 1.785 0.513

125 c/z 0.595 1.785 0.513

126 c/z 1.785 1.785 0.513

c

132 px -2.551 $ sheath inner half-width

133 px 2.551

134 py -2.551

135 py 2.551

136 px -2.6272 $ sheath outer half-width

137 px 2.6272

138 py -2.6272

139 py 2.6272

c

c Widths of plate cores

c \* in plate geometry cores these are 101 to 112

151 px -2.3355 $ Pu plate core width

152 px 2.3355

153 py -2.3355

154 py 2.3355

155 px -2.4255 $ UO2 plate core width

156 px 2.4255

157 py -2.4255

158 py 2.4255

159 px -2.4815 $ Na plate core width

160 px 2.4815

161 py -2.4815

162 py 2.4815

c

c

c coordinates of the elements in 5x5 arrays

c \* in the plate geometry cores these are 81 to 92

181 px -8.05815

182 px 8.05815

183 py -8.05815

184 py 8.05815

185 px -13.43025

186 px 13.43025

187 py -13.43025

188 py 13.43025

189 px -13.5635

190 px 13.5635

191 py -13.5635

192 py 13.5635

c

c

c Cell 2 Axial heights

c

401 pz 153.667666

402 pz 153.704013

403 pz 154.245013

404 pz 154.281360

405 pz 154.318010

406 pz 154.876010

407 pz 154.912660

408 pz 154.958360

409 pz 155.194360

410 pz 155.240060

411 pz 155.276407

412 pz 155.817407

413 pz 155.853754

414 pz 155.890404

415 pz 156.448404

416 pz 156.485054

417 pz 156.521401

418 pz 157.062401

419 pz 157.098748

c

c Cell 12 Axial heights

c

501 pz 67.778780

502 pz 67.815127

503 pz 68.356127

504 pz 68.392474

505 pz 68.429124

506 pz 68.987124

507 pz 69.023774

508 pz 69.060121

509 pz 69.601121

510 pz 69.637468

511 pz 69.683168

512 pz 69.919168

513 pz 69.964868

514 pz 70.001518

515 pz 70.559518

516 pz 70.596168

517 pz 70.632515

518 pz 71.173515

519 pz 71.209862

c

c Basic Cell 1 data

c 701 pz 0.000000

c 702 pz 0.036347 $ Na can

c 703 pz 0.577347 $ Na core

c 704 pz 0.613694

c 705 pz 0.650344 $ UO2 can

c 706 pz 1.208344 $ UO2 core

c 707 pz 1.244994

708 pz 1.561994 $ SS

709 pz 1.607694 $ Pu can

710 pz 1.843694 $ Pu core

711 pz 1.889394

712 pz 1.925741 $ Na can

713 pz 2.466741 $ Na core

c 714 pz 2.503088

c 715 pz 2.539738 $ UO2 can

c 716 pz 3.097738 $ UO2 core

c 717 pz 3.134388

c 718 pz 3.170735 $ Na can

c 719 pz 3.711735 $ Na core

c 720 pz 3.748082 $ Cell 1

c

801 pz 0.000000

802 pz 0.036347

803 pz 0.577347 $ Na

804 pz 0.613694

805 pz 0.650344

806 pz 1.208344 $ UO2

807 pz 1.244994

808 pz 1.281341

809 pz 1.822341 $ Na

810 pz 1.858688

811 pz 1.904388

812 pz 2.140388 $ Pu

813 pz 2.186088

814 pz 2.503088 $ SS

815 pz 2.539738

816 pz 3.097738 $ UO2

817 pz 3.134388

818 pz 3.170735

819 pz 3.711735 $ Na

820 pz 3.748082 $ Cell 11

c

c ----------------------------------------------------------------------

c

c

c

c ------------- TALLY CARDS ---------------------------------------------

c

c --- MATERIALS CARDS ---

c

c

C MATERIAL 1 Pu metal plate core

m1 92238.31c 6.8782E-07

94238.31c 3.0461E-05

94239.31c 2.8920E-02

94240.31c 6.9095E-03

94241.31c 7.3960E-04

94242.31c 1.8699E-04

95241.31c 4.5718E-04

1001.31c 1.2764E-04

6000.31c 4.2260E-04

7014.31c 2.4215E-05

8016.31c 8.8450E-05

13027.31c 2.2973E-05

14028.31c 1.4158E-05

25055.31c 1.4902E-06

24050.31c 1.5637E-07

24052.31c 3.0155E-06

24053.31c 3.4193E-07

24054.31c 8.5114E-08

26054.31c 9.5478E-07

26056.31c 1.4988E-05

26057.31c 3.4614E-07

26058.31c 4.6065E-09

28058.31c 5.8334E-06

28060.31c 2.2470E-06

28061.31c 9.7676E-08

28062.31c 3.1143E-07

28064.31c 7.9313E-08

31000.31c 2.0166E-03

c total 3.9991E-02

c MATERIAL 2 Pu plate canning

m2 1001.31c 1.3760E-05

6000.31c 1.1393E-04

14028.31c 3.6607E-04

15031.31c 1.3731E-05

24050.31c 4.0848E-04

24052.31c 7.8771E-03

24053.31c 8.9320E-04

24054.31c 2.2234E-04

25055.31c 8.5931E-04

26054.31c 2.0774E-03

26056.31c 3.2611E-02

26057.31c 7.5313E-04

26058.31c 1.0023E-05

28058.31c 2.8351E-03

28060.31c 1.0921E-03

28061.31c 4.7472E-05

28062.31c 1.5136E-04

28064.31c 3.8548E-05

29063.31c 1.1629E-02

29065.31c 4.9839E-03

c total 6.6997E-02

C MATERIAL 3 UO2 plate core

m3 1001.31c 3.1773E-05

6000.31c 1.1808E-05

8016.31c 4.6008E-02

13027.31c 3.3911E-06

14028.31c 2.2967E-05

25055.31c 8.3273E-08

26054.31c 7.6610E-08

26056.31c 1.2026E-06

26057.31c 2.7774E-08

26058.31c 3.6962E-10

28058.31c 8.4906E-07

28060.31c 3.2705E-07

28061.31c 1.4217E-08

28062.31c 4.5329E-08

28064.31c 1.1544E-08

42000.66c 3.3379E-07

92235.31c 1.6544E-04

92238.31c 2.2837E-02

c total 6.9083E-02

c MATERIAL 4 UO2 plate canning

m4 1001.31c 1.9035E-05

6000.31c 1.2831E-04

14028.31c 6.4475E-04

15031.31c 3.5078E-04

16032.31c 3.6041E-05

24050.31c 6.0044E-04

24052.31c 1.1579E-02

24053.31c 1.3129E-03

24054.31c 3.2682E-04

25055.31c 8.5559E-04

26054.31c 2.8235E-03

26056.31c 4.4323E-02

26057.31c 1.0236E-03

26058.31c 1.3622E-05

28058.31c 5.7360E-03

28060.31c 2.2095E-03

28061.31c 9.6046E-05

28062.31c 3.0624E-04

28064.31c 7.7989E-05

c total 7.2463E-02

C MATERIAL 5 sodium plate core

m5 1001.31c 1.3900E-05

8016.31c 5.6492E-06

11023.31c 2.3225E-02

20040.31c 3.6083E-06

26054.31c 9.4595E-09

26056.31c 1.4849E-07

26057.31c 3.4294E-09

26058.31c 4.5639E-11

c total 2.324832E-02

c MATERIAL 6 Sodium plate canning

m6 1001.31c 2.1631E-05

6000.31c 2.9290E-04

14028.31c 6.0867E-04

15031.31c 3.2795E-05

16032.31c 3.3219E-05

24050.31c 6.4128E-04

24052.31c 1.2366E-02

24053.31c 1.4023E-03

24054.31c 3.4905E-04

25055.31c 1.3570E-03

26054.31c 3.2179E-03

26056.31c 5.0514E-02

26057.31c 1.1666E-03

26058.31c 1.5525E-05

28058.31c 4.8322E-03

28060.31c 1.8614E-03

28061.31c 8.0912E-05

28062.31c 2.5798E-04

28064.31c 6.5701E-05

41093.31c 3.1147E-04

c total 7.9429E-02

C MATERIAL 7 40% steel plate

c m7 1001.31c 1.8355E-05

c 6000.31c 8.7794E-05

c 13027.31c 1.1862E-04

c 14028.31c 7.9703E-04

c 15031.31c 4.0018E-05

c 16032.31c 1.4422E-05

c 22000.62c 2.4806E-04

c 24050.31c 6.9120E-04

c 24052.31c 1.3329E-02

c 24053.31c 1.5114E-03

c 24054.31c 3.7622E-04

c 25055.31c 1.4972E-03

c 26054.31c 3.2362E-03

c 26056.31c 5.0801E-02

c 26057.31c 1.1732E-03

c 26058.31c 1.5613E-05

c 28058.31c 5.9891E-03

c 28060.31c 2.3070E-03

c 28061.31c 1.0028E-04

c 28062.31c 3.1975E-04

c 28064.31c 8.1431E-05

c 29063.31c 5.0365E-05

c 41093.31c 4.9781E-06

c 42000.66c 8.0988E-05

c

c 40% ss plate smeared over plate region

c

m7 1001.31c 7.3413E-06

6000.31c 3.5114E-05

13027.31c 4.7443E-05

14028.31c 3.1878E-04

15031.31c 1.6006E-05

16032.31c 5.7682E-06

22000.62c 9.9214E-05

24050.31c 2.7645E-04

24052.31c 5.3311E-03

24053.31c 6.0450E-04

24054.31c 1.5047E-04

25055.31c 5.9882E-04

26054.31c 1.2944E-03

26056.31c 2.0318E-02

26057.31c 4.6923E-04

26058.31c 6.2446E-06

28058.31c 2.3954E-03

28060.31c 9.2271E-04

28061.31c 4.0108E-05

28062.31c 1.2789E-04

28064.31c 3.2569E-05

29063.31c 1.4101E-05

29065.31c 6.0432E-06

41093.31c 1.9910E-06

42000.66c 3.2392E-05

c total 3.3152E-02

c

C MATERIAL 8 U8 metal plate

m8 1001.31c 4.4048E-05

6000.31c 4.9283E-04

14028.31c 2.1076E-04

26054.31c 6.1951E-06

26056.31c 9.7250E-05

26057.31c 2.2459E-06

26058.31c 2.9889E-08

92235.31c 3.3369E-04

92238.31c 4.6021E-02

c total 4.7208E-02

C MATERIAL 9 U2 metal plate

m9 1001.31c 4.3899E-05

6000.31c 4.6047E-04

14028.31c 1.9692E-04

26054.31c 5.7884E-06

26056.31c 9.0866E-05

26057.31c 2.0985E-06

26058.31c 2.7927E-08

92235.31c 3.3962E-04

92238.31c 4.6785E-02

c total 4.7925E-02

c

c

c radial shield

m12 1001.31c 4.6306E-05

6000.31c 6.8972E-04

14028.31c 3.1158E-04

15031.31c 4.2944E-05

16032.31c 3.7110E-05

25055.31c 7.1275E-04

26054.31c 4.9065E-03

26056.31c 7.4517E-02

26057.31c 1.7491E-03

26058.31c 2.5903E-04

c total 8.32720E-02

c

c radial shield void surround low density

m13 1001.31c 4.6306E-08

6000.31c 6.8972E-07

14028.31c 3.1158E-07

15031.31c 4.2944E-08

16032.31c 3.7110E-08

25055.31c 7.1275E-07

26054.31c 4.9065E-06

26056.31c 7.4517E-05

26057.31c 1.7491E-06

26058.31c 2.5903E-07

c total 8.32720E-05

c

c Axial shield

m14 1001.31c 2.5700E-05

6000.31c 5.1066E-04

13027.31c 1.3989E-04

22000.62c 3.9416E-05

24050.31c 1.2213E-06

24052.31c 2.2823E-05

24053.31c 2.5531E-06

24054.31c 6.2449E-07

25055.31c 3.2634E-04

26054.31c 5.0496E-03

26056.31c 7.6690E-02

26057.31c 1.8001E-03

26058.31c 2.6658E-04

28058.31c 1.2564E-06

28060.31c 4.6968E-07

28061.31c 2.2000E-08

28062.31c 6.2769E-08

28064.31c 1.6774E-08

29063.31c 3.1184E-05

29065.31c 1.3364E-05

42000.66c 9.8355E-06

c total 8.4932E-02

c

c Natural Uranium Breeder

m15 1001.31c 4.4574E-05

6000.31c 4.7140E-04

14028.31c 2.0160E-04

26054.31c 6.1085E-06

26056.31c 9.2771E-05

26057.31c 2.1776E-06

26058.31c 3.2248E-07

92235.31c 3.4209E-04

92238.31c 4.7156E-02

c Total 4.8317E-02

c

c Element top and bottom packing

m16 1001.31c 3.1777E-05

6000.31c 9.9996E-05

13027.31c 8.3095E-06

24050.31c 6.9087E-08

24052.31c 1.2911E-06

24053.31c 1.4442E-07

24054.31c 3.5326E-08

25055.31c 1.0785E-04

26054.31c 1.9605E-03

26056.31c 2.9775E-02

26057.31c 6.9890E-04

26058.31c 1.0350E-04

28058.31c 1.5636E-07

28060.31c 5.8452E-08

28061.31c 2.7378E-09

28062.31c 7.8115E-09

28064.31c 2.0875E-09

29063.31c 6.5270E-06

29065.31c 2.7973E-06

c Total 3.279692E-02

c

c mild steel wrapper material

m17 1001.31c 7.5725E-05

6000.31c 2.3828E-04

13027.31c 1.9802E-05

24050.31c 1.6463E-07

24052.31c 3.0767E-06

24053.31c 3.4414E-07

24054.31c 8.4182E-08

25055.31c 2.5701E-04

26054.31c 4.6718E-03

26056.31c 7.0954E-02

26057.31c 1.6655E-03

26058.31c 2.4664E-04

28058.31c 3.7260E-07

28060.31c 1.3929E-07

28061.31c 6.5242E-09

28062.31c 1.8615E-08

28064.31c 4.9746E-09

29063.31c 1.5554E-05

29065.31c 6.6660E-06

c Total 7.81552E-02

c

c

C MATERIAL 18 U8 metal plate

m18 1001.31c 4.4048E-05

6000.31c 4.9283E-04

14028.31c 2.1076E-04

26054.31c 6.1951E-06

26056.31c 9.7250E-05

26057.31c 2.2459E-06

26058.31c 2.9889E-08

92235.31c 3.3369E-04

92238.31c 4.6021E-02

c total 4.7208E-02

C MATERIAL 19 U2 metal plate

m19 1001.31c 4.3899E-05

6000.31c 4.6047E-04

14028.31c 1.9692E-04

26054.31c 5.7884E-06

26056.31c 9.0866E-05

26057.31c 2.0985E-06

26058.31c 2.7927E-07

92235.31c 3.3962E-04

92238.31c 4.6785E-02

c total 4.7925E-02

c

c

c Superlattice grid plate

c

m20 1001.31c 2.4442E-04

6000.31c 2.9057E-04

14028.31c 4.3858E-05

15031.31c 1.3256E-05

16032.31c 4.3530E-05

25055.31c 2.5785E-04

26054.31c 4.2756E-03

26056.31c 6.7114E-02

26057.31c 1.5500E-03

26058.31c 2.0627E-04

c Total 20 7.403935E-02

c

c -----------------------------------------------

c

c Element C Pin fuel A and E, Calandria NACLIII

c Pin A

m21 1001.31c 3.2784E-05

8016.31c 4.6606E-02

8017.31c 1.7700E-05

13027.31c 1.1702E-05

20040.31c 7.8782E-06

26054.31c 3.3046E-07

26056.31c 5.1875E-06

26057.31c 1.1980E-07

26058.31c 1.5943E-08

92234.31c 1.3805E-06

92235.31c 1.4114E-04

92236.31c 7.9324E-07

92238.31c 1.9379E-02

94238.31c 3.7786E-06

94239.31c 2.9689E-03

94240.31c 6.7253E-04

94241.31c 7.0350E-05

94242.31c 1.7488E-05

95241.31c 4.7854E-05

c total 21 6.9985E-02

c

c PinB

c

m22 1001.31c 3.2784E-05

8016.31c 4.6976E-02

8017.31c 1.7800E-05

14028.31c 9.0199E-06

28058.31c 3.7050E-06

28060.31c 1.4272E-06

28061.31c 6.2038E-08

28062.31c 1.9780E-07

28064.31c 5.0375E-08

92234.31c 1.3177E-06

92235.31c 1.3457E-04

92236.31c 7.4658E-07

92238.31c 1.8472E-02

94238.31c 5.8915E-06

94239.31c 3.7341E-03

94240.31c 9.5200E-04

94241.31c 1.1199E-04

94242.31c 2.7984E-05

95241.31c 5.5789E-05

c total 22 7.0537E-02 F 26 7.1415E-02

c

c Pin C

c

M23 1001.31c 3.2784E-05

8016.31c 4.7416E-02

8017.31c 1.8000E-05

13027.31c 1.9730E-05

14028.31c 7.9741E-06

26054.31c 4.4958E-07

26056.31c 7.0574E-06

26057.31c 1.6298E-07

26058.31c 2.1690E-08

28058.31c 7.4523E-06

28060.31c 2.8707E-06

28061.31c 1.2478E-07

28062.31c 3.9787E-07

28064.31c 1.0132E-07

92234.31c 1.2863E-06

92235.31c 1.2997E-04

92236.31c 7.3103E-07

92238.31c 1.7843E-02

94238.31c 6.9094E-06

94239.31c 4.4708E-03

94240.31c 1.0602E-03

94241.31c 1.1598E-04

94242.31c 3.0047E-05

95241.31c 5.7784E-05

c total 23 7.1230E-02

c

c Pin D

c

M24 1001.31c 3.2784E-05

8016.31c 4.7296E-02

8017.31c 1.8000E-05

13027.31c 1.8914E-05

14028.31c 2.5099E-05

20040.31c 1.5940E-05

26054.31c 4.0346E-07

26056.31c 6.3335E-06

26057.31c 1.4627E-07

26058.31c 1.9465E-08

28058.31c 9.6247E-06

28060.31c 3.7075E-06

28061.31c 1.6116E-07

28062.31c 5.1385E-07

28064.31c 1.3086E-07

92234.31c 1.4118E-06

92235.31c 1.4266E-04

92236.31c 7.9324E-07

92238.31c 1.9584E-02

94238.31c 4.7348E-06

94239.31c 3.0189E-03

94240.31c 7.5441E-04

94241.31c 8.8443E-05

94242.31c 2.0961E-05

95241.31c 4.0742E-05

c total 24 7.1085E-02

c

c Pin E

m25 1001.31c 3.2784E-05

8016.31c 4.7299E-02

8017.31c 1.7970E-05

13027.31c 9.5250E-06

14028.31c 4.5753E-05

20040.31c 3.2062E-05

26054.31c 6.0326E-07

26056.31c 9.4699E-06

26057.31c 2.1870E-07

26058.31c 2.9105E-08

92234.31c 1.1295E-06

92235.31c 1.1465E-04

92236.31c 6.3771E-07

92238.31c 1.5739E-02

94238.31c 9.4851E-06

94239.31c 6.0438E-03

94240.31c 1.5103E-03

94241.31c 1.7707E-04

94242.31c 4.1953E-05

95241.31c 8.1559E-05

c total 25 7.1167E-02

c

C Pin F

M26 1001.31c 3.2784E-05

8016.31c 4.7464E-02

8017.31c 1.8032E-05

13027.31c 1.4287E-05

20040.31c 6.7514E-05

24050.31c 2.1476E-07

24052.31c 4.1414E-06

24053.31c 4.6961E-07

24054.31c 1.1689E-07

26054.31c 6.7247E-07

26056.31c 1.0556E-05

26057.31c 2.4379E-07

26058.31c 3.2444E-08

28058.31c 1.4905E-06

28060.31c 5.7416E-07

28061.31c 2.4958E-08

28062.31c 7.9577E-08

28064.31c 2.0266E-08

92234.31c 1.1452E-06

92235.31c 1.1526E-04

92236.31c 6.3771E-07

92238.31c 1.5824E-02

94238.31c 9.5005E-06

94239.31c 6.0112E-03

94240.31c 1.5285E-03

94241.31c 1.9723E-04

94242.31c 4.4380E-05

95241.31c 6.8035E-05

C total 26 7.1415E-02

c

c

c Composition of Calandria end plate regions

m27 14028.31c 5.5206E-04

24050.31c 4.3520E-04

24052.31c 8.3923E-03

24053.31c 9.5162E-04

24054.31c 2.3688E-04

25055.31c 7.7198E-04

26054.31c 2.0795E-03

26056.31c 3.2644E-02

26057.31c 7.5390E-04

26058.31c 1.0033E-04

28058.31c 3.0363E-03

28060.31c 1.1696E-03

28061.31c 5.0841E-05

28062.31c 1.6210E-04

28064.31c 4.1283E-05

c total 5.13781E-02

c

c UO2 Pin UO2PINC

c

M28 1001.31c 3.2784E-05

6000.31c 3.2095E-05

8016.31c 4.7501E-02

13027.31c 2.3812E-05

14028.31c 4.0001E-05

20040.31c 1.2825E-05

26054.31c 6.5324E-08

26056.31c 1.0254E-06

26057.31c 2.3682E-08

26058.31c 3.1516E-09

92234.31c 9.7268E-07

92235.31c 1.7084E-04

92238.31c 2.3588E-02

c total 28 7.1400E-02

c

c

c --------------------------------------------------------------------------

c Pin clad plus calandria tube combined

c

C Pin PUPINA clad plus tube (was 23)

c

m31 1001.31c 1.0832E-05

6000.31c 5.3887E-05

14028.31c 6.6291E-04

15031.31c 1.5357E-05

16032.31c 9.9700E-06

25055.31c 1.0382E-03

24050.31c 5.3769E-04

24052.31c 1.0369E-02

24053.31c 1.1757E-03

24054.31c 2.9267E-04

26054.31c 2.4695E-03

26056.31c 3.8766E-02

26057.31c 8.9527E-04

26058.31c 1.1914E-04

28058.31c 3.9651E-03

28060.31c 1.5274E-03

28061.31c 6.6392E-05

28062.31c 2.1169E-04

28064.31c 5.3910E-05

c

C Total 31 6.2241E-02

c

C Pin PUPINB clad plus tube

c

m32 1001.31c 9.2847E-06

6000.31c 9.6091E-05

14028.31c 7.8508E-04

15031.31c 1.6869E-05

16032.31c 9.2404E-06

25055.31c 1.0424E-03

24050.31c 4.8064E-04

24052.31c 9.2687E-03

24053.31c 1.0510E-03

24054.31c 2.6162E-04

26054.31c 2.3154E-03

26056.31c 3.6347E-02

26057.31c 8.3939E-04

26058.31c 1.1171E-04

28058.31c 3.9370E-03

28060.31c 1.5166E-03

28061.31c 6.5922E-05

28062.31c 2.1019E-04

28064.31c 5.3529E-05

41093.31c 1.1919E-04

c

C Total 32 5.8537E-02 F 36 6.0033E-02

c

C Pin PUPINC clad plus tube

c

m33 1001.31c 1.0832E-05

6000.31c 5.5189E-05

14028.31c 6.5458E-04

15031.31c 1.4602E-05

16032.31c 9.9700E-06

25055.31c 1.0254E-03

24050.31c 5.3131E-04

24052.31c 1.0246E-02

24053.31c 1.1618E-03

24054.31c 2.8919E-04

26054.31c 2.4419E-03

26056.31c 3.8333E-02

26057.31c 8.8527E-04

26058.31c 1.1781E-04

28058.31c 3.9199E-03

28060.31c 1.5099E-03

28061.31c 6.5635E-05

28062.31c 2.0927E-04

28064.31c 5.3296E-05

c

C Total 33 6.15349E-02

c

c Pin PUPIND can plus tube

c

m34 1001.31c 1.0058E-05

6000.31c 8.1804E-05

13027.31c 2.6012E-06

14028.31c 6.7957E-04

15031.31c 1.3847E-05

16032.31c 3.6474E-06

22048.31c 1.1726E-05

25055.31c 8.7351E-04

27059.31c 1.7202E-06

24050.31c 4.9702E-04

24052.31c 9.5846E-03

24053.31c 1.0868E-03

24054.31c 2.7053E-04

26054.31c 2.3766E-03

26056.31c 3.7307E-02

26057.31c 8.6158E-04

26058.31c 1.1466E-04

28058.31c 3.6114E-03

28060.31c 1.3911E-03

28061.31c 6.0470E-05

28062.31c 1.9281E-04

28064.31c 4.9102E-05

29063.31c 1.7181E-06

29065.31c 7.3632E-07

42000.66c 8.9408E-07

c

C Total 34 5.9086E-02

c

c Pin PUPINE clad plus tube (Was 24)

m35 1001.31c 1.0058E-05

6000.31c 2.9866E-05

13027.31c 2.6012E-06

14028.31c 7.4068E-04

15031.31c 5.5388E-06

16032.31c 7.0518E-06

22048.31c 1.1726E-05

25055.31c 8.0111E-04

27059.31c 1.7202E-06

24050.31c 5.0041E-04

24052.31c 9.6500E-03

24053.31c 1.0942E-03

24054.31c 2.7238E-04

26054.31c 2.4012E-03

26056.31c 3.7694E-02

26057.31c 8.7052E-04

26058.31c 1.1585E-04

28058.31c 3.7263E-03

28060.31c 1.4354E-03

28061.31c 6.2394E-05

28062.31c 1.9894E-04

28064.31c 5.0664E-05

29063.31c 1.7181E-06

29065.31c 7.3632E-07

42000.66c 8.6970E-06

c

C Total 35 5.96942E-02

c

c

C Pin PUPINF can plus tube

c

m36 1001.31c 1.0058E-05

6000.31c 2.9217E-05

13027.31c 1.7341E-06

14028.31c 7.4343E-04

15031.31c 5.5388E-06

16032.31c 7.2951E-06

22048.31c 8.7948E-06

25055.31c 8.0253E-04

27059.31c 1.3232E-06

24050.31c 5.0363E-04

24052.31c 9.7120E-03

24053.31c 1.1013E-03

24054.31c 2.7413E-04

26054.31c 2.4145E-03

26056.31c 3.7903E-02

26057.31c 8.7533E-04

26058.31c 1.1649E-04

28058.31c 3.7525E-03

28060.31c 1.4455E-03

28061.31c 6.2833E-05

28062.31c 2.0034E-04

28064.31c 5.1021E-05

29063.31c 1.2885E-06

29065.31c 5.5221E-07

42000.66c 8.6159E-06

c

c Total 36 6.0033E-02

c

c

c -------------------------------------------------------------

c

c Calandria sodium contents

c

C sodium NACLI element A and B

m41 1001.31c 5.5075E-06

8016.31c 6.4605E-06

11023.31c 2.4129E-02

20040.31c 1.1080E-07

26056.31c 3.0847E-07

c total 41 2.41414E-02

c

C sodium NACLIIS element E

m42 1001.31c 1.1205E-05

8016.31c 1.0767E-06

11023.31c 2.4379E-02

20040.31c 9.5521E-08

c total 42 2.43914E-02

C sodium NACLIII element C (was 25)

m43 1001.31c 7.5966E-06

8016.31c 3.5892E-06

11023.31c 2.3888E-02

19039.31c 3.4270E-07

20040.31c 6.6865E-07

c total 43 2.3900E-02

C sodium NACLIV Element J

m44 1001.31c 7.5966E-06

8016.31c 3.5892E-06

11023.31c 2.4037E-02

19039.31c 3.4270E-07

20040.31c 6.6865E-07

c total 44 2.4049E-02

C sodium NACLV Element H

m45 1001.31c 7.5966E-06

8016.31c 3.5892E-06

11023.31c 2.3829E-02

19039.31c 3.4270E-07

20040.31c 6.6865E-07

c total 45 2.3841E-02

c

c ------------------------------------------------------------------

c

c

c --------------------------------------------------------

c

C Compositions of Calandria outer walls

c

C Calandria Walls NACLI Element Cell A and B

m51 1001.31c 3.9844E-05

6000.31c 2.8167E-04

14028.31c 6.0229E-04

15031.31c 7.3471E-05

16032.31c 3.6808E-05

25055.31c 1.2214E-03

24050.31c 6.5153E-04

24052.31c 1.2564E-02

24053.31c 1.4247E-03

24054.31c 3.5463E-04

26054.31c 2.8589E-03

26056.31c 4.4878E-02

26057.31c 1.0364E-03

26058.31c 1.3793E-04

28058.31c 4.9315E-03

28060.31c 1.8996E-03

28061.31c 8.2574E-05

28062.31c 2.6328E-04

28064.31c 6.7050E-05

C total 51 7.34056E-02

c

c

C Calandria walls NACLIIS Element Cell E

c

m52 1001.31c 3.8637E-05

6000.31c 6.5351E-04

14028.31c 9.7623E-04

15031.31c 4.7540E-05

16032.31c 3.3014E-05

22048.31c 2.4400E-04

25055.31c 1.1060E-03

27059.31c 1.1151E-05

24050.31c 6.2481E-04

24052.31c 1.2049E-02

24053.31c 1.3662E-03

24054.31c 3.4009E-04

26054.31c 2.7541E-03

26056.31c 4.3233E-02

26057.31c 9.9842E-04

26058.31c 1.3287E-04

28058.31c 5.0735E-03

28060.31c 1.9543E-03

28061.31c 8.4952E-05

28062.31c 2.7086E-04

28064.31c 6.8981E-05

29063.31c 6.9320E-06

29065.31c 3.1020E-06

42000.66c 3.4248E-06

C total 52 7.20749E-02

c

c Calandria NACLIII Element Cell C and D (was m28)

c Error in repeat of Mn in m28

m53 1001.31c 3.9844E-05

6000.31c 1.5948E-04

14028.31c 7.7474E-04

15031.31c 5.2334E-05

16032.31c 2.4551E-05

25055.31c 8.3089E-04

24050.31c 6.1403E-04

24052.31c 1.1841E-02

24053.31c 1.3427E-03

24054.31c 3.3422E-04

26054.31c 2.9672E-03

26056.31c 4.6578E-02

26057.31c 1.0757E-03

26058.31c 1.4315E-04

28058.31c 5.2186E-03

28060.31c 2.0102E-03

28061.31c 8.7382E-05

28062.31c 2.7861E-04

28064.31c 7.0954E-05

42000.66c 2.4862E-05

C total 53 7.44684E-02

c

c

C Calandria NACLIV Element 3J and 3L

m54 1001.31c 3.7430E-05

6000.31c 3.5158E-04

14028.31c 8.2197E-04

15031.31c 6.2274E-05

16032.31c 1.6431E-05

25055.31c 1.0026E-03

24050.31c 5.8931E-04

24052.31c 1.1364E-02

24053.31c 1.2886E-03

24054.31c 3.2077E-04

26054.31c 2.7560E-03

26056.31c 4.3263E-02

26057.31c 9.9912E-04

26058.31c 1.3296E-04

28058.31c 4.3943E-03

28060.31c 1.6927E-03

28061.31c 7.3579E-05

28062.31c 2.3460E-04

28064.31c 5.9746E-05

42000.66c 8.8791E-06

C Total 54 6.94698E-02

c

C Calandria NACLV Element 3H

m55 1001.31c 3.8637E-05

6000.31c 2.6343E-04

14028.31c 6.4389E-04

15031.31c 6.8560E-05

16032.31c 1.7190E-05

25055.31c 9.6934E-04

24050.31c 6.0091E-04

24052.31c 1.1588E-02

24053.31c 1.3140E-03

24054.31c 3.2708E-04

26054.31c 2.8877E-03

26056.31c 4.5330E-02

26057.31c 1.0469E-03

26058.31c 1.3932E-04

28058.31c 4.9377E-03

28060.31c 1.9020E-03

28061.31c 8.2679E-05

28062.31c 2.6362E-04

28064.31c 6.7135E-05

42000.66c 8.8791E-06

C Total 55 7.2497E-02

c

C Calandria VCLVI

m56 1001.31c 3.8637E-05

6000.31c 2.4762E-04

14028.31c 9.5110E-04

15031.31c 4.5654E-05

16032.31c 2.3793E-05

25055.31c 8.6191E-04

24050.31c 6.0122E-04

24052.31c 1.1594E-02

24053.31c 1.3147E-03

24054.31c 3.2725E-04

26054.31c 2.8292E-03

26056.31c 4.4413E-02

26057.31c 1.0257E-03

26058.31c 1.3650E-04

28058.31c 4.6653E-03

28060.31c 1.7971E-03

28061.31c 7.8117E-05

28062.31c 2.4907E-04

28064.31c 6.3431E-05

42000.66c 2.4862E-05

C Total 56 7.12882E-02

c

c --- MODE CARDS ---

mode n

kcode 10000 1.0 100 1500

ksrc 0.0 0.0 77.0 0.0 0.0 87.9 0.0 0.0 107.0

0.0 0.0 117.9 0.0 0.0 137.0 0.0 0.0 147.9

10.74 0.0 77.0 10.74 0.0 87.9 10.74 0.0 107.0

10.74 0.0 117.9 10.74 0.0 137.0 10.74 0.0 147.9

-10.74 0.0 77.0 -10.74 0.0 87.9 -10.74 0.0 107.0

-10.74 0.0 117.9 -10.74 0.0 137.0 -10.74 0.0 147.9

0.0 10.74 77.0 0.0 10.74 87.9 0.0 10.74 107.0

0.0 10.74 117.9 0.0 10.74 137.0 0.0 10.74 147.9

0.0 -10.74 77.0 0.0 -10.74 87.9 -10.74 0.0 107.0

0.0 -10.74 117.9 0.0 -10.74 137.0 0.0 -10.74 147.9

10.74 10.74 77.0 10.74 10.74 87.9 10.74 10.74 107.0

10.74 10.74 117.9 10.74 10.74 137.0 10.74 10.74 147.9

-10.74 10.74 77.0 -10.74 10.74 87.9 -10.74 10.74 107.0

-10.74 10.74 117.9 -10.74 10.74 137.0 -10.74 10.74 147.9

10.74 -10.74 77.0 10.74 -10.74 87.9 10.74 -10.74 107.0

10.74 -10.74 117.9 10.74 -10.74 137.0 10.74 -10.74 147.9

-10.74 -10.74 77.0 -10.74 -10.74 87.9 -10.74 -10.74 107.0

-10.74 -10.74 117.9 -10.74 -10.74 137.0 -10.74 -10.74 147.9

25.335 0.0 77.0 25.335 0.0 87.9 25.335 0.0 107.0

25.335 0.0 117.9 25.335 0.0 137.0 25.335 0.0 147.9

-25.335 0.0 77.0 -25.335 0.0 87.9 -25.335 0.0 107.0

-25.335 0.0 117.9 -25.335 0.0 137.0 -25.335 0.0 147.9

0.0 25.335 77.0 0.0 25.335 87.9 0.0 25.335 107.0

0.0 25.335 117.9 0.0 25.335 137.0 0.0 25.335 147.9

0.0 -25.335 77.0 0.0 -25.335 87.9 -25.335 0.0 107.0

0.0 -25.335 117.9 0.0 -25.335 137.0 0.0 -25.335 147.9

25.335 25.335 77.0 25.335 25.335 87.9 25.335 25.335 107.0

25.335 25.335 117.9 25.335 25.335 137.0 25.335 25.335 147.9

-25.335 25.335 77.0 -25.335 25.335 87.9 -25.335 25.335 107.0

-25.335 25.335 117.9 -25.335 25.335 137.0 -25.335 25.335 147.9

25.335 -25.335 77.0 25.335 -25.335 87.9 25.335 -25.335 107.0

25.335 -25.335 117.9 25.335 -25.335 137.0 25.335 -25.335 147.9

-25.335 -25.335 77.0 -25.335 -25.335 87.9 -25.335 -25.335 107.0

37.6 0.0 77.0 37.6 0.0 87.9 37.6 0.0 107.0

37.6 0.0 117.9 37.6 0.0 137.0 37.6 0.0 147.9

-37.6 0.0 77.0 -37.6 0.0 87.9 -37.6 0.0 107.0

-37.6 0.0 117.9 -37.6 0.0 137.0 -37.6 0.0 147.9

0.0 37.6 77.0 0.0 37.6 87.9 0.0 37.6 107.0

0.0 37.6 117.9 0.0 37.6 137.0 0.0 37.6 147.9

0.0 -37.6 77.0 0.0 -37.6 87.9 -37.6 0.0 107.0

0.0 -37.6 117.9 0.0 -37.6 137.0 0.0 -37.6 147.9

Print

### A4.6 MCNP-JEFF-3.1 Zebra25 Model with Central Plate Zone

Z25 with central plate array. Superlattice and void gaps. JEFF-3.1

c Pin Elements C, E, B, A and J are represented and the equivalent pin cells

c for Pin Elements D, H and L

c The experimental value of k-effective to be used with this model is

c 1.0014 +/- 0.0013

c See www.zebra.webnik.org for details.

c c Na dummy region for honeycomb (Z element).

c 11 1.216928E-02 10 -504 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c

c ------------- CELL CARDS ----------------------------------------------

c

c --- Core Pin Geometry Element C Calandria NACLIII Pins 8xA and 8xE

c Fuel m21 and m25, can + tube m31 and m35

c Lower padding

1 16 3.279692E-02 -8 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Lower Reflector

2 14 8.4932E-02 8 -9 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

3 15 4.8317E-02 9 -41 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

4 9 4.7925E-02 41 -42 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

5 8 4.7208E-02 42 -10 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

9 27 0.0513781 33 -34 35 -36 10 -82 u=1 imp:n=1 TMP=2.5301E-08

c

c

10 25 7.1167E-02 -91 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

11 21 0.069985 -92 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

12 25 7.1167E-02 -93 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

13 21 0.069985 -94 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

14 21 0.069985 -95 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

15 25 7.1167E-02 -96 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

16 21 0.069985 -97 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

17 25 7.1167E-02 -98 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

18 25 7.1167E-02 -99 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

19 21 0.069985 -100 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

20 25 7.1167E-02 -101 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

21 21 0.069985 -102 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

22 21 0.069985 -103 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

23 25 7.1167E-02 -104 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

24 21 0.069985 -105 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

25 25 7.1167E-02 -106 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

c

30 35 0.0596942 -111 91 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

31 31 0.062241 -112 92 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

32 35 0.0596942 -113 93 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

33 31 0.062241 -114 94 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

34 31 0.062241 -115 95 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

35 35 0.0596942 -116 96 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

36 31 0.062241 -117 97 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

37 35 0.0596942 -118 98 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

38 35 0.0596942 -119 99 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

39 31 0.062241 -120 100 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

40 35 0.0596942 -121 101 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

41 31 0.062241 -122 102 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

42 31 0.062241 -123 103 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

43 35 0.0596942 -124 104 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

44 31 0.062241 -125 105 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

45 35 0.0596942 -126 106 82 -83 u=1 imp:n=1 TMP=2.5301E-08

c

46 0 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=1 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

48 27 0.0513781 33 -34 35 -36 83 -85 u=1 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

50 25 7.1167E-02 -91 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

51 21 0.069985 -92 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

52 25 7.1167E-02 -93 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

53 21 0.069985 -94 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

54 21 0.069985 -95 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

55 25 7.1167E-02 -96 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

56 21 0.069985 -97 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

57 25 7.1167E-02 -98 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

58 25 7.1167E-02 -99 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

59 21 0.069985 -100 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

60 25 7.1167E-02 -101 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

61 21 0.069985 -102 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

62 21 0.069985 -103 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

63 25 7.1167E-02 -104 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

64 21 0.069985 -105 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

65 25 7.1167E-02 -106 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

c

c

70 35 0.0596942 -111 91 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

71 31 0.062241 -112 92 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

72 35 0.0596942 -113 93 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

73 31 0.062241 -114 94 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

74 31 0.062241 -115 95 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

75 35 0.0596942 -116 96 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

76 31 0.062241 -117 97 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

77 35 0.0596942 -118 98 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

78 35 0.0596942 -119 99 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

79 31 0.062241 -120 100 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

80 35 0.0596942 -121 101 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

81 31 0.062241 -122 102 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

82 31 0.062241 -123 103 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

83 35 0.0596942 -124 104 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

84 31 0.062241 -125 105 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

85 35 0.0596942 -126 106 85 -86 u=1 imp:n=1 TMP=2.5301E-08

c

86 0 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=1 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

88 27 0.0513781 33 -34 35 -36 86 -88 u=1 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

90 25 7.1167E-02 -91 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

91 21 0.069985 -92 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

92 25 7.1167E-02 -93 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

93 21 0.069985 -94 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

94 21 0.069985 -95 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

95 25 7.1167E-02 -96 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

96 21 0.069985 -97 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

97 25 7.1167E-02 -98 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

98 25 7.1167E-02 -99 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

99 21 0.069985 -100 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

100 25 7.1167E-02 -101 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

101 21 0.069985 -102 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

102 21 0.069985 -103 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

103 25 7.1167E-02 -104 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

104 21 0.069985 -105 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

105 25 7.1167E-02 -106 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

c

c

110 35 0.0596942 -111 91 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

111 31 0.062241 -112 92 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

112 35 0.0596942 -113 93 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

113 31 0.062241 -114 94 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

114 31 0.062241 -115 95 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

115 35 0.0596942 -116 96 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

116 31 0.062241 -117 97 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

117 35 0.0596942 -118 98 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

118 35 0.0596942 -119 99 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

119 31 0.062241 -120 100 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

120 35 0.0596942 -121 101 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

121 31 0.062241 -122 102 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

122 31 0.062241 -123 103 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

123 35 0.0596942 -124 104 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

124 31 0.062241 -125 105 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

125 35 0.0596942 -126 106 88 -89 u=1 imp:n=1 TMP=2.5301E-08

c

126 0 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=1 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

128 27 0.0513781 33 -34 35 -36 89 -11 u=1 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

129 53 7.44684E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=1 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

131 8 4.7208E-02 11 -67 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

132 9 4.7925E-02 67 -68 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

133 15 4.8317E-02 68 -12 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Upper Reflector

134 14 8.4932E-02 12 -13 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c Upper padding

135 16 3.279692E-02 13 21 -22 23 -24 u=1 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

136 0 132 -133 134 -135 (-21:22:-23:24) u=1 imp:n=1

c Wrapper

137 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=1 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

138 0 1 -2 3 -4 (-136:137:-138:139) u=1 imp:n=1

c

c End of Core Pin Geometry Element C

c

c

c --- Core Pin geometry Element E (& D) NACLIIS Pins 8xD and 8xF

c D 24 7.1085E-02 F 26 7.1415E-02 clad D 34 5.9086E-02 F 36 6.0033E-02

c Lower padding

201 16 3.279692E-02 -8 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Lower Reflector

202 14 8.4932E-02 8 -9 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

203 15 4.8317E-02 9 -41 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

204 9 4.7925E-02 41 -42 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

205 8 4.7208E-02 42 -10 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

209 27 0.0513781 33 -34 35 -36 10 -82 u=2 imp:n=1 TMP=2.5301E-08

c

c

210 26 7.1415E-02 -91 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

211 24 7.1085E-02 -92 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

212 26 7.1415E-02 -93 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

213 24 7.1085E-02 -94 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

214 24 7.1085E-02 -95 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

215 26 7.1415E-02 -96 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

216 24 7.1085E-02 -97 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

217 26 7.1415E-02 -98 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

218 26 7.1415E-02 -99 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

219 24 7.1085E-02 -100 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

220 26 7.1415E-02 -101 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

221 24 7.1085E-02 -102 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

222 24 7.1085E-02 -103 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

223 26 7.1415E-02 -104 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

224 24 7.1085E-02 -105 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

225 26 7.1415E-02 -106 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

c

230 36 6.0033E-02 -111 91 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

231 34 5.9086E-02 -112 92 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

232 36 6.0033E-02 -113 93 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

233 34 5.9086E-02 -114 94 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

234 34 5.9086E-02 -115 95 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

235 36 6.0033E-02 -116 96 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

236 34 5.9086E-02 -117 97 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

237 36 6.0033E-02 -118 98 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

238 36 6.0033E-02 -119 99 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

239 34 5.9086E-02 -120 100 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

240 36 6.0033E-02 -121 101 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

241 34 5.9086E-02 -122 102 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

242 34 5.9086E-02 -123 103 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

243 36 6.0033E-02 -124 104 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

244 34 5.9086E-02 -125 105 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

245 36 6.0033E-02 -126 106 82 -83 u=2 imp:n=1 TMP=2.5301E-08

c

246 0 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=2 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

248 27 0.0513781 33 -34 35 -36 83 -85 u=2 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

250 26 7.1415E-02 -91 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

251 24 7.1085E-02 -92 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

252 26 7.1415E-02 -93 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

253 24 7.1085E-02 -94 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

254 24 7.1085E-02 -95 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

255 26 7.1415E-02 -96 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

256 24 7.1085E-02 -97 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

257 26 7.1415E-02 -98 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

258 26 7.1415E-02 -99 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

259 24 7.1085E-02 -100 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

260 26 7.1415E-02 -101 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

261 24 7.1085E-02 -102 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

262 24 7.1085E-02 -103 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

263 26 7.1415E-02 -104 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

264 24 7.1085E-02 -105 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

265 26 7.1415E-02 -106 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

c

c

270 36 6.0033E-02 -111 91 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

271 34 5.9086E-02 -112 92 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

272 36 6.0033E-02 -113 93 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

273 34 5.9086E-02 -114 94 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

274 34 5.9086E-02 -115 95 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

275 36 6.0033E-02 -116 96 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

276 34 5.9086E-02 -117 97 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

277 36 6.0033E-02 -118 98 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

278 36 6.0033E-02 -119 99 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

279 34 5.9086E-02 -120 100 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

280 36 6.0033E-02 -121 101 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

281 34 5.9086E-02 -122 102 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

282 34 5.9086E-02 -123 103 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

283 36 6.0033E-02 -124 104 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

284 34 5.9086E-02 -125 105 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

285 36 6.0033E-02 -126 106 85 -86 u=2 imp:n=1 TMP=2.5301E-08

c

286 0 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=2 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

288 27 0.0513781 33 -34 35 -36 86 -88 u=2 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

290 26 7.1415E-02 -91 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

291 24 7.1085E-02 -92 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

292 26 7.1415E-02 -93 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

293 24 7.1085E-02 -94 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

294 24 7.1085E-02 -95 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

295 26 7.1415E-02 -96 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

296 24 7.1085E-02 -97 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

297 26 7.1415E-02 -98 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

298 26 7.1415E-02 -99 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

299 24 7.1085E-02 -100 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

300 26 7.1415E-02 -101 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

301 24 7.1085E-02 -102 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

302 24 7.1085E-02 -103 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

303 26 7.1415E-02 -104 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

304 24 7.1085E-02 -105 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

305 26 7.1415E-02 -106 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

c

c

310 36 6.0033E-02 -111 91 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

311 34 5.9086E-02 -112 92 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

312 36 6.0033E-02 -113 93 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

313 34 5.9086E-02 -114 94 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

314 34 5.9086E-02 -115 95 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

315 36 6.0033E-02 -116 96 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

316 34 5.9086E-02 -117 97 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

317 36 6.0033E-02 -118 98 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

318 36 6.0033E-02 -119 99 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

319 34 5.9086E-02 -120 100 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

320 36 6.0033E-02 -121 101 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

321 34 5.9086E-02 -122 102 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

322 34 5.9086E-02 -123 103 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

323 36 6.0033E-02 -124 104 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

324 34 5.9086E-02 -125 105 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

325 36 6.0033E-02 -126 106 88 -89 u=2 imp:n=1 TMP=2.5301E-08

c

326 0 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=2 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

328 27 0.0513781 33 -34 35 -36 89 -11 u=2 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

329 52 7.20749E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=2 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

331 8 4.7208E-02 11 -67 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

332 9 4.7925E-02 67 -68 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

333 15 4.8317E-02 68 -12 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Upper Reflector

334 14 8.4932E-02 12 -13 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c Upper padding

335 16 3.279692E-02 13 21 -22 23 -24 u=2 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

336 0 132 -133 134 -135 (-21:22:-23:24) u=2 imp:n=1

c Wrapper

337 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=2 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

338 0 1 -2 3 -4 (-136:137:-138:139) u=2 imp:n=1

c

c End of Core Pin Geometry Element E (D)

c

c

c --- Core Pin Geometry Element B (H, L) Calandria NACLI Pins 11xB and 5xF

c B 22 7.0537E-02 F 26 7.1415E-02 clad 32 5.8537E-02 F 36 6.0033E-02

c Pin F is in circles 93 98 99 101 and 104

c

c Lower padding

401 16 3.279692E-02 -8 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Lower Reflector

402 14 8.4932E-02 8 -9 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

403 15 4.8317E-02 9 -41 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

404 9 4.7925E-02 41 -42 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

405 8 4.7208E-02 42 -10 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

409 27 0.0513781 33 -34 35 -36 10 -82 u=3 imp:n=1 TMP=2.5301E-08

c

c

410 22 7.0537E-02 -91 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

411 22 7.0537E-02 -92 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

412 26 7.1415E-02 -93 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

413 22 7.0537E-02 -94 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

414 22 7.0537E-02 -95 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

415 22 7.0537E-02 -96 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

416 22 7.0537E-02 -97 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

417 26 7.1415E-02 -98 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

418 26 7.1415E-02 -99 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

419 22 7.0537E-02 -100 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

420 26 7.1415E-02 -101 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

421 22 7.0537E-02 -102 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

422 22 7.0537E-02 -103 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

423 26 7.1415E-02 -104 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

424 22 7.0537E-02 -105 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

425 22 7.0537E-02 -106 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

c

430 32 5.8537E-02 -111 91 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

431 32 5.8537E-02 -112 92 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

432 36 6.0033E-02 -113 93 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

433 32 5.8537E-02 -114 94 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

434 32 5.8537E-02 -115 95 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

435 32 5.8537E-02 -116 96 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

436 32 5.8537E-02 -117 97 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

437 36 6.0033E-02 -118 98 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

438 36 6.0033E-02 -119 99 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

439 32 5.8537E-02 -120 100 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

440 36 6.0033E-02 -121 101 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

441 32 5.8537E-02 -122 102 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

442 32 5.8537E-02 -123 103 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

443 36 6.0033E-02 -124 104 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

444 32 5.8537E-02 -125 105 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

445 32 5.8537E-02 -126 106 82 -83 u=3 imp:n=1 TMP=2.5301E-08

c

446 0 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=3 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

448 27 0.0513781 33 -34 35 -36 83 -85 u=3 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

450 22 7.0537E-02 -91 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

451 22 7.0537E-02 -92 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

452 26 7.1415E-02 -93 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

453 22 7.0537E-02 -94 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

454 22 7.0537E-02 -95 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

455 22 7.0537E-02 -96 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

456 22 7.0537E-02 -97 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

457 26 7.1415E-02 -98 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

458 26 7.1415E-02 -99 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

459 22 7.0537E-02 -100 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

460 26 7.1415E-02 -101 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

461 22 7.0537E-02 -102 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

462 22 7.0537E-02 -103 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

463 26 7.1415E-02 -104 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

464 22 7.0537E-02 -105 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

465 22 7.0537E-02 -106 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

c

c

470 32 5.8537E-02 -111 91 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

471 32 5.8537E-02 -112 92 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

472 36 6.0033E-02 -113 93 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

473 32 5.8537E-02 -114 94 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

474 32 5.8537E-02 -115 95 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

475 32 5.8537E-02 -116 96 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

476 32 5.8537E-02 -117 97 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

477 36 6.0033E-02 -118 98 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

478 36 6.0033E-02 -119 99 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

479 32 5.8537E-02 -120 100 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

480 36 6.0033E-02 -121 101 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

481 32 5.8537E-02 -122 102 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

482 32 5.8537E-02 -123 103 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

483 36 6.0033E-02 -124 104 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

484 32 5.8537E-02 -125 105 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

485 32 5.8537E-02 -126 106 85 -86 u=3 imp:n=1 TMP=2.5301E-08

c

486 0 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=3 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

488 27 0.0513781 33 -34 35 -36 86 -88 u=3 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

490 22 7.0537E-02 -91 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

491 22 7.0537E-02 -92 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

492 26 7.1415E-02 -93 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

493 22 7.0537E-02 -94 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

494 22 7.0537E-02 -95 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

495 22 7.0537E-02 -96 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

496 22 7.0537E-02 -97 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

497 26 7.1415E-02 -98 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

498 26 7.1415E-02 -99 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

499 22 7.0537E-02 -100 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

500 26 7.1415E-02 -101 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

501 22 7.0537E-02 -102 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

502 22 7.0537E-02 -103 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

503 26 7.1415E-02 -104 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

504 22 7.0537E-02 -105 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

505 22 7.0537E-02 -106 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

c

c

510 32 5.8537E-02 -111 91 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

511 32 5.8537E-02 -112 92 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

512 36 6.0033E-02 -113 93 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

513 32 5.8537E-02 -114 94 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

514 32 5.8537E-02 -115 95 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

515 32 5.8537E-02 -116 96 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

516 32 5.8537E-02 -117 97 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

517 36 6.0033E-02 -118 98 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

518 36 6.0033E-02 -119 99 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

519 32 5.8537E-02 -120 100 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

520 36 6.0033E-02 -121 101 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

521 32 5.8537E-02 -122 102 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

522 32 5.8537E-02 -123 103 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

523 36 6.0033E-02 -124 104 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

524 32 5.8537E-02 -125 105 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

525 32 5.8537E-02 -126 106 88 -89 u=3 imp:n=1 TMP=2.5301E-08

c

526 0 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=3 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

528 27 0.0513781 33 -34 35 -36 89 -11 u=3 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

529 51 7.34056E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=3 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

531 8 4.7208E-02 11 -67 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

532 9 4.7925E-02 67 -68 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

533 15 4.8317E-02 68 -12 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Upper Reflector

534 14 8.4932E-02 12 -13 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c Upper padding

535 16 3.279692E-02 13 21 -22 23 -24 u=3 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

536 0 132 -133 134 -135 (-21:22:-23:24) u=3 imp:n=1

c Wrapper

537 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=3 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

538 0 1 -2 3 -4 (-136:137:-138:139) u=3 imp:n=1

c

c End of Core Pin Geometry Element B (H, L)

c

c

c --- Core Pin Geometry Element A Calandria NACLI Pins 16xC

c c 23 7.1230E-02 clad 33 6.15349E-02

c

c Lower padding

601 16 3.279692E-02 -8 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Lower Reflector

602 14 8.4932E-02 8 -9 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

603 15 4.8317E-02 9 -41 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

604 9 4.7925E-02 41 -42 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

605 8 4.7208E-02 42 -10 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

609 27 0.0513781 33 -34 35 -36 10 -82 u=4 imp:n=1 TMP=2.5301E-08

c

c

610 23 7.1230E-02 -91 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

611 23 7.1230E-02 -92 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

612 23 7.1230E-02 -93 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

613 23 7.1230E-02 -94 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

614 23 7.1230E-02 -95 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

615 23 7.1230E-02 -96 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

616 23 7.1230E-02 -97 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

617 23 7.1230E-02 -98 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

618 23 7.1230E-02 -99 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

619 23 7.1230E-02 -100 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

620 23 7.1230E-02 -101 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

621 23 7.1230E-02 -102 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

622 23 7.1230E-02 -103 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

623 23 7.1230E-02 -104 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

624 23 7.1230E-02 -105 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

625 23 7.1230E-02 -106 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

c

630 33 6.15349E-02 -111 91 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

631 33 6.15349E-02 -112 92 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

632 33 6.15349E-02 -113 93 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

633 33 6.15349E-02 -114 94 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

634 33 6.15349E-02 -115 95 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

635 33 6.15349E-02 -116 96 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

636 33 6.15349E-02 -117 97 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

637 33 6.15349E-02 -118 98 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

638 33 6.15349E-02 -119 99 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

639 33 6.15349E-02 -120 100 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

640 33 6.15349E-02 -121 101 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

641 33 6.15349E-02 -122 102 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

642 33 6.15349E-02 -123 103 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

643 33 6.15349E-02 -124 104 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

644 33 6.15349E-02 -125 105 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

645 33 6.15349E-02 -126 106 82 -83 u=4 imp:n=1 TMP=2.5301E-08

c

646 0 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=4 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

648 27 0.0513781 33 -34 35 -36 83 -85 u=4 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

650 23 7.1230E-02 -91 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

651 23 7.1230E-02 -92 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

652 23 7.1230E-02 -93 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

653 23 7.1230E-02 -94 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

654 23 7.1230E-02 -95 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

655 23 7.1230E-02 -96 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

656 23 7.1230E-02 -97 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

657 23 7.1230E-02 -98 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

658 23 7.1230E-02 -99 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

659 23 7.1230E-02 -100 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

660 23 7.1230E-02 -101 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

661 23 7.1230E-02 -102 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

662 23 7.1230E-02 -103 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

663 23 7.1230E-02 -104 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

664 23 7.1230E-02 -105 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

665 23 7.1230E-02 -106 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

c

c

670 33 6.15349E-02 -111 91 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

671 33 6.15349E-02 -112 92 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

672 33 6.15349E-02 -113 93 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

673 33 6.15349E-02 -114 94 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

674 33 6.15349E-02 -115 95 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

675 33 6.15349E-02 -116 96 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

676 33 6.15349E-02 -117 97 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

677 33 6.15349E-02 -118 98 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

678 33 6.15349E-02 -119 99 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

679 33 6.15349E-02 -120 100 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

680 33 6.15349E-02 -121 101 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

681 33 6.15349E-02 -122 102 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

682 33 6.15349E-02 -123 103 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

683 33 6.15349E-02 -124 104 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

684 33 6.15349E-02 -125 105 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

685 33 6.15349E-02 -126 106 85 -86 u=4 imp:n=1 TMP=2.5301E-08

c

686 0 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=4 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

688 27 0.0513781 33 -34 35 -36 86 -88 u=4 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

690 23 7.1230E-02 -91 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

691 23 7.1230E-02 -92 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

692 23 7.1230E-02 -93 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

693 23 7.1230E-02 -94 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

694 23 7.1230E-02 -95 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

695 23 7.1230E-02 -96 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

696 23 7.1230E-02 -97 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

697 23 7.1230E-02 -98 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

698 23 7.1230E-02 -99 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

699 23 7.1230E-02 -100 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

700 23 7.1230E-02 -101 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

701 23 7.1230E-02 -102 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

702 23 7.1230E-02 -103 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

703 23 7.1230E-02 -104 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

704 23 7.1230E-02 -105 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

705 23 7.1230E-02 -106 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

c

c

710 33 6.15349E-02 -111 91 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

711 33 6.15349E-02 -112 92 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

712 33 6.15349E-02 -113 93 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

713 33 6.15349E-02 -114 94 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

714 33 6.15349E-02 -115 95 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

715 33 6.15349E-02 -116 96 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

716 33 6.15349E-02 -117 97 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

717 33 6.15349E-02 -118 98 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

718 33 6.15349E-02 -119 99 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

719 33 6.15349E-02 -120 100 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

720 33 6.15349E-02 -121 101 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

721 33 6.15349E-02 -122 102 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

722 33 6.15349E-02 -123 103 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

723 33 6.15349E-02 -124 104 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

724 33 6.15349E-02 -125 105 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

725 33 6.15349E-02 -126 106 88 -89 u=4 imp:n=1 TMP=2.5301E-08

c

726 0 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=4 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

728 27 0.0513781 33 -34 35 -36 89 -11 u=4 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

729 51 7.34056E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=4 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

731 8 4.7208E-02 11 -67 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

732 9 4.7925E-02 67 -68 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

733 15 4.8317E-02 68 -12 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Upper Reflector

734 14 8.4932E-02 12 -13 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c Upper padding

735 16 3.279692E-02 13 21 -22 23 -24 u=4 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

736 0 132 -133 134 -135 (-21:22:-23:24) u=4 imp:n=1

c Wrapper

737 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=4 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

738 0 1 -2 3 -4 (-136:137:-138:139) u=4 imp:n=1

c

c End of Core Pin Geometry Element A

c

c

c --- Core Pin Geometry Element J Calandria NACLIV Pins 12xE and 4xUO2

c E 25 7.1167E-02 28 7.1400E-02 35 5.96942E-02

c The positions of pin UO2 are the circles 94, 96, 102 and 104

c Lower padding

801 16 3.279692E-02 -8 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Lower Reflector

802 14 8.4932E-02 8 -9 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Lower NatU Breeder bottom section

803 15 4.8317E-02 9 -41 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

804 9 4.7925E-02 41 -42 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

805 8 4.7208E-02 42 -10 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Minicalandria

c

c Bottom plate

809 27 0.0513781 33 -34 35 -36 10 -82 u=5 imp:n=1 TMP=2.5301E-08

c

c

810 25 7.1167E-02 -91 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

811 25 7.1167E-02 -92 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

812 25 7.1167E-02 -93 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

813 28 7.1400E-02 -94 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

814 25 7.1167E-02 -95 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

815 28 7.1400E-02 -96 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

816 25 7.1167E-02 -97 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

817 25 7.1167E-02 -98 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

818 25 7.1167E-02 -99 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

819 25 7.1167E-02 -100 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

820 25 7.1167E-02 -101 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

821 28 7.1400E-02 -102 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

822 25 7.1167E-02 -103 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

823 28 7.1400E-02 -104 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

824 25 7.1167E-02 -105 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

825 25 7.1167E-02 -106 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

c

830 35 5.96942E-02 -111 91 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

831 35 5.96942E-02 -112 92 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

832 35 5.96942E-02 -113 93 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

833 35 5.96942E-02 -114 94 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

834 35 5.96942E-02 -115 95 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

835 35 5.96942E-02 -116 96 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

836 35 5.96942E-02 -117 97 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

837 35 5.96942E-02 -118 98 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

838 35 5.96942E-02 -119 99 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

839 35 5.96942E-02 -120 100 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

840 35 5.96942E-02 -121 101 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

841 35 5.96942E-02 -122 102 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

842 35 5.96942E-02 -123 103 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

843 35 5.96942E-02 -124 104 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

844 35 5.96942E-02 -125 105 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

845 35 5.96942E-02 -126 106 82 -83 u=5 imp:n=1 TMP=2.5301E-08

c

846 0 33 -34 35 -36 82 -83 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=5 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

848 27 0.0513781 33 -34 35 -36 83 -85 u=5 imp:n=1 TMP=2.5301E-08

c

c Middle calandria

c

850 25 7.1167E-02 -91 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

851 25 7.1167E-02 -92 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

852 25 7.1167E-02 -93 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

853 28 7.1400E-02 -94 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

854 25 7.1167E-02 -95 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

855 28 7.1400E-02 -96 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

856 25 7.1167E-02 -97 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

857 25 7.1167E-02 -98 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

858 25 7.1167E-02 -99 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

859 25 7.1167E-02 -100 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

860 25 7.1167E-02 -101 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

861 28 7.1400E-02 -102 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

862 25 7.1167E-02 -103 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

863 28 7.1400E-02 -104 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

864 25 7.1167E-02 -105 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

865 25 7.1167E-02 -106 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

c

c

870 35 5.96942E-02 -111 91 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

871 35 5.96942E-02 -112 92 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

872 35 5.96942E-02 -113 93 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

873 35 5.96942E-02 -114 94 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

874 35 5.96942E-02 -115 95 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

875 35 5.96942E-02 -116 96 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

876 35 5.96942E-02 -117 97 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

877 35 5.96942E-02 -118 98 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

878 35 5.96942E-02 -119 99 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

879 35 5.96942E-02 -120 100 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

880 35 5.96942E-02 -121 101 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

881 35 5.96942E-02 -122 102 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

882 35 5.96942E-02 -123 103 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

883 35 5.96942E-02 -124 104 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

884 35 5.96942E-02 -125 105 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

885 35 5.96942E-02 -126 106 85 -86 u=5 imp:n=1 TMP=2.5301E-08

c

886 0 33 -34 35 -36 85 -86 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=5 imp:n=1 TMP=2.5301E-08

c

c Top and bottom calandria plates

c

888 27 0.0513781 33 -34 35 -36 86 -88 u=5 imp:n=1 TMP=2.5301E-08

c

c Top calandria

c

890 25 7.1167E-02 -91 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

891 25 7.1167E-02 -92 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

892 25 7.1167E-02 -93 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

893 28 7.1400E-02 -94 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

894 25 7.1167E-02 -95 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

895 28 7.1400E-02 -96 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

896 25 7.1167E-02 -97 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

897 25 7.1167E-02 -98 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

898 25 7.1167E-02 -99 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

899 25 7.1167E-02 -100 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

900 25 7.1167E-02 -101 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

901 28 7.1400E-02 -102 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

902 25 7.1167E-02 -103 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

903 28 7.1400E-02 -104 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

904 25 7.1167E-02 -105 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

905 25 7.1167E-02 -106 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

c

c

910 35 5.96942E-02 -111 91 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

911 35 5.96942E-02 -112 92 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

912 35 5.96942E-02 -113 93 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

913 35 5.96942E-02 -114 94 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

914 35 5.96942E-02 -115 95 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

915 35 5.96942E-02 -116 96 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

916 35 5.96942E-02 -117 97 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

917 35 5.96942E-02 -118 98 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

918 35 5.96942E-02 -119 99 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

919 35 5.96942E-02 -120 100 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

920 35 5.96942E-02 -121 101 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

921 35 5.96942E-02 -122 102 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

922 35 5.96942E-02 -123 103 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

923 35 5.96942E-02 -124 104 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

924 35 5.96942E-02 -125 105 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

925 35 5.96942E-02 -126 106 88 -89 u=5 imp:n=1 TMP=2.5301E-08

c

926 0 33 -34 35 -36 88 -89 &

111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 &

u=5 imp:n=1 TMP=2.5301E-08

c

c Top plate of top calandria

c

928 27 0.0513781 33 -34 35 -36 89 -11 u=5 imp:n=1 TMP=2.5301E-08

c

c Calandria outer wall

c

929 54 6.94698E-02 21 -22 23 -24 10 -11 (-33 :34 :-35 :36 :-10 :11) u=5 &

imp:n=1 TMP=2.5301E-08

c

c Upper NatU Blanket

931 8 4.7208E-02 11 -67 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

932 9 4.7925E-02 67 -68 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

933 15 4.8317E-02 68 -12 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Upper Reflector

934 14 8.4932E-02 12 -13 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c Upper padding

935 16 3.279692E-02 13 21 -22 23 -24 u=5 imp:n=1 TMP=2.5301E-08

c gap between plates and wrapper

936 0 132 -133 134 -135 (-21:22:-23:24) u=5 imp:n=1

c Wrapper

937 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=5 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

938 0 1 -2 3 -4 (-136:137:-138:139) u=5 imp:n=1

c

c End of Core Pin Geometry Element J

c

c

c

c --- Core Plate Geometry Element with sodium dummy Z plate

c Lower padding

1011 16 3.279692E-02 -8 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Lower Reflector

1012 14 8.4932E-02 8 -9 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Lower section of the NatU Blanket

1013 15 4.8317E-02 9 -41 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

1014 9 4.7925E-02 41 -42 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

1015 8 4.7208E-02 42 -10 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c Fuelled section

c

c Lowest core Cell, Cell 12

c

c Na dummy

1022 11 1.216928E-02 10 -504 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1027 3 6.9083E-02 505 -506 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1028 4 7.2463E-02 504 -507 21 -22 23 -24 &

(-155:156:-157:158:-505:506) u=6 imp:n=1 TMP=2.5301E-08

c

c Na dummy

1032 11 1.216928E-02 507 -510 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

1035 1 3.9991E-02 151 -152 153 -154 511 -512 u=6 imp:n=1 TMP=2.5301E-08

C Pu canning

1036 2 6.6997E-02 510 -513 21 -22 23 -24 &

(-151:152:-153:154:-511:512) u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1039 3 6.9083E-02 514 -515 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1040 4 7.2463E-02 513 -516 21 -22 23 -24 &

(-155:156:-157:158:-514:515) u=6 imp:n=1 TMP=2.5301E-08

c

c Na dummy

1042 11 1.216928E-02 516 -43 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c Insert the 22 central region core cells

c

1051 0 43 -44 21 -22 23 -24 fill=13 (0 0 71.209862) u=6 imp:n=1

c

1052 0 44 -45 21 -22 23 -24 fill=14 (0 0 74.957944) u=6 imp:n=1

c

c

1053 0 45 -46 21 -22 23 -24 fill=13 (0 0 78.706026) u=6 imp:n=1

c

1054 0 46 -47 21 -22 23 -24 fill=14 (0 0 82.454108) u=6 imp:n=1

c

c

1055 0 47 -48 21 -22 23 -24 fill=13 (0 0 86.202190) u=6 imp:n=1

c

1056 0 48 -49 21 -22 23 -24 fill=14 (0 0 89.950272) u=6 imp:n=1

c

c

1057 0 49 -50 21 -22 23 -24 fill=13 (0 0 93.698354) u=6 imp:n=1

c

1058 0 50 -51 21 -22 23 -24 fill=14 (0 0 97.446436) u=6 imp:n=1

c

c

1059 0 51 -52 21 -22 23 -24 fill=13 (0 0 101.194518) u=6 imp:n=1

c

1060 0 52 -53 21 -22 23 -24 fill=14 (0 0 104.942600) u=6 imp:n=1

c

c

1061 0 53 -54 21 -22 23 -24 fill=13 (0 0 108.690682) u=6 imp:n=1

c

1062 0 54 -55 21 -22 23 -24 fill=14 (0 0 112.438764) u=6 imp:n=1

c

c

1063 0 55 -56 21 -22 23 -24 fill=13 (0 0 116.186846) u=6 imp:n=1

c

1064 0 56 -57 21 -22 23 -24 fill=14 (0 0 119.934928) u=6 imp:n=1

c

c

1065 0 57 -58 21 -22 23 -24 fill=13 (0 0 123.683010) u=6 imp:n=1

c

1066 0 58 -59 21 -22 23 -24 fill=14 (0 0 127.431092) u=6 imp:n=1

c

c

1067 0 59 -60 21 -22 23 -24 fill=13 (0 0 131.179174) u=6 imp:n=1

c

1068 0 60 -61 21 -22 23 -24 fill=14 (0 0 134.927256) u=6 imp:n=1

c

c

1069 0 61 -62 21 -22 23 -24 fill=13 (0 0 138.675338) u=6 imp:n=1

c

1070 0 62 -63 21 -22 23 -24 fill=14 (0 0 142.423420) u=6 imp:n=1

c

c

1071 0 63 -64 21 -22 23 -24 fill=13 (0 0 146.171502) u=6 imp:n=1

c

1072 0 64 -65 21 -22 23 -24 fill=14 (0 0 149.919584) u=6 imp:n=1

c

c

c The top core cell, Cell 2

c

c Na dummy

1082 11 1.216928E-02 65 -404 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1087 3 6.9083E-02 405 -406 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1088 4 7.2463E-02 404 -407 21 -22 23 -24 &

(-155:156:-157:158:-405:406) u=6 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

1092 1 3.9991E-02 151 -152 153 -154 408 -409 u=6 imp:n=1 &

TMP=2.5301E-08

C Pu canning

1093 2 6.6997E-02 407 -410 21 -22 23 -24 &

(-151:152:-153:154:-408:409) u=6 imp:n=1 TMP=2.5301E-08

c

c Na dummy

1102 11 1.216928E-02 410 -413 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1107 3 6.9083E-02 414 -415 155 -156 157 -158 u=6 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1108 4 7.2463E-02 413 -416 21 -22 23 -24 &

(-155:156:-157:158:-414:415) u=6 imp:n=1 TMP=2.5301E-08

c

c Na dummy

1112 11 1.216928E-02 416 -66 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c

c Upper Axial blanket.

c

1121 8 4.7208E-02 66 -67 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

1122 9 4.7925E-02 67 -68 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

1123 15 4.8317E-02 68 -12 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c Upper Reflector

1126 14 8.4932E-02 12 -13 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c Upper padding

1127 16 3.279692E-02 13 21 -22 23 -24 u=6 imp:n=1 TMP=2.5301E-08

c

c Wrapper region

c gap between plates and wrapper

1131 0 132 -133 134 -135 (-21:22:-23:24) u=6 imp:n=1

c Wrapper

1132 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=6 &

imp:n=1 TMP=2.5301E-08

c gap outside wrapper

1133 0 1 -2 3 -4 (-136:137:-138:139) u=6 imp:n=1

c

c End of Z plate element

c

c Y plate element

c

c

c --- Core Plate Geometry Element with sodium dummy Y plate

c Lower padding

1211 16 3.279692E-02 -8 21 -22 23 -24 u=12 imp:n=1 TMP=2.5301E-08

c Lower Reflector

1212 14 8.4932E-02 8 -9 21 -22 23 -24 u=12 imp:n=1 TMP=2.5301E-08

c Lower section of the NatU Blanket

1213 15 4.8317E-02 9 -41 21 -22 23 -24 u=12 imp:n=1 TMP=2.5301E-08

c Middle section of Lower Blanket

1214 9 4.7925E-02 41 -42 21 -22 23 -24 u=12 imp:n=1 TMP=2.5301E-08

c Top section of lower blanket

1215 8 4.7208E-02 42 -10 21 -22 23 -24 u=12 imp:n=1 TMP=2.5301E-08

c

c Fuelled section

c

c Lowest core Cell, Cell 12

c

c Na dummy region. The Y ring

1221 0 10 -504 -109 u=12 imp:n=1

C Steel region

1222 10 8.84614E-02 10 -504 109 -110 u=12 imp:n=1 TMP=2.5301E-08

c

1223 0 10 -504 21 -22 23 -24 110 u=12 imp:n=1

c

c UO2 core

1227 3 6.9083E-02 505 -506 155 -156 157 -158 u=12 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1228 4 7.2463E-02 504 -507 21 -22 23 -24 &

(-155:156:-157:158:-505:506) u=12 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

1231 0 507 -510 -109 u=12 imp:n=1

C Steel region

1232 10 8.84614E-02 507 -510 109 -110 u=12 imp:n=1 TMP=2.5301E-08

c

1233 0 507 -510 21 -22 23 -24 110 u=12 imp:n=1

c

C Pu Plate core

1235 1 3.9991E-02 151 -152 153 -154 511 -512 u=12 imp:n=1 TMP=2.5301E-08

C Pu canning

1236 2 6.6997E-02 510 -513 21 -22 23 -24 &

(-151:152:-153:154:-511:512) u=12 imp:n=1 TMP=2.5301E-08

c

c UO2 core

1239 3 6.9083E-02 514 -515 155 -156 157 -158 u=12 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1240 4 7.2463E-02 513 -516 21 -22 23 -24 &

(-155:156:-157:158:-514:515) u=12 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

1243 0 516 -43 -109 u=12 imp:n=1

C Steel region

1244 10 8.84614E-02 516 -43 109 -110 u=12 imp:n=1 TMP=2.5301E-08

c

1245 0 516 -43 21 -22 23 -24 110 u=12 imp:n=1

c

c Insert the 22 central region core cells

c

1251 0 43 -44 21 -22 23 -24 fill=15 (0 0 71.21678) u=12 imp:n=1

c

1252 0 44 -45 21 -22 23 -24 fill=16 (0 0 74.97178) u=12 imp:n=1

c

c

1253 0 45 -46 21 -22 23 -24 fill=15 (0 0 78.72678) u=12 imp:n=1

c

1254 0 46 -47 21 -22 23 -24 fill=16 (0 0 82.48178) u=12 imp:n=1

c

c

1255 0 47 -48 21 -22 23 -24 fill=15 (0 0 86.23678) u=12 imp:n=1

c

1256 0 48 -49 21 -22 23 -24 fill=16 (0 0 89.99178) u=12 imp:n=1

c

c

1257 0 49 -50 21 -22 23 -24 fill=15 (0 0 93.74678) u=12 imp:n=1

c

1258 0 50 -51 21 -22 23 -24 fill=16 (0 0 97.50178) u=12 imp:n=1

c

c

1259 0 51 -52 21 -22 23 -24 fill=15 (0 0 101.25678) u=12 imp:n=1

c

1260 0 52 -53 21 -22 23 -24 fill=16 (0 0 105.01178) u=12 imp:n=1

c

c

1261 0 53 -54 21 -22 23 -24 fill=15 (0 0 108.76678) u=12 imp:n=1

c

1262 0 54 -55 21 -22 23 -24 fill=16 (0 0 112.52178) u=12 imp:n=1

c

c

1263 0 55 -56 21 -22 23 -24 fill=15 (0 0 116.27678) u=12 imp:n=1

c

1264 0 56 -57 21 -22 23 -24 fill=16 (0 0 120.03178) u=12 imp:n=1

c

c

1265 0 57 -58 21 -22 23 -24 fill=15 (0 0 123.78678) u=12 imp:n=1

c

1266 0 58 -59 21 -22 23 -24 fill=16 (0 0 127.54178) u=12 imp:n=1

c

c

1267 0 59 -60 21 -22 23 -24 fill=15 (0 0 131.29678) u=12 imp:n=1

c

1268 0 60 -61 21 -22 23 -24 fill=16 (0 0 135.05178) u=12 imp:n=1

c

c

1269 0 61 -62 21 -22 23 -24 fill=15 (0 0 138.80678) u=12 imp:n=1

c

1270 0 62 -63 21 -22 23 -24 fill=16 (0 0 142.56178) u=12 imp:n=1

c

c

1271 0 63 -64 21 -22 23 -24 fill=15 (0 0 146.31678) u=12 imp:n=1

c

1272 0 64 -65 21 -22 23 -24 fill=16 (0 0 150.07178) u=12 imp:n=1

c

c

c The top core cell, Cell 2

c

c Na dummy region. The Y ring

1275 0 65 -404 -109 u=12 imp:n=1

C Steel region

1276 10 8.84614E-02 65 -404 109 -110 u=12 imp:n=1 TMP=2.5301E-08

c

1277 0 65 -404 21 -22 23 -24 110 u=12 imp:n=1

c

c UO2 core

1278 3 6.9083E-02 405 -406 155 -156 157 -158 u=12 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1279 4 7.2463E-02 404 -407 21 -22 23 -24 &

(-155:156:-157:158:-405:406) u=12 imp:n=1 TMP=2.5301E-08

c

C Pu Plate core

1280 1 3.9991E-02 151 -152 153 -154 408 -409 u=12 imp:n=1 &

TMP=2.5301E-08

C Pu canning

1281 2 6.6997E-02 407 -410 21 -22 23 -24 &

(-151:152:-153:154:-408:409) u=12 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

1282 0 410 -413 -109 u=12 imp:n=1

C Steel region

1283 10 8.84614E-02 410 -413 109 -110 u=12 imp:n=1 TMP=2.5301E-08

c

1284 0 410 -413 21 -22 23 -24 110 u=12 imp:n=1

c

c UO2 core

1285 3 6.9083E-02 414 -415 155 -156 157 -158 u=12 imp:n=1 TMP=2.5301E-08

c UO2 plate can

1286 4 7.2463E-02 413 -416 21 -22 23 -24 &

(-155:156:-157:158:-414:415) u=12 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

1287 0 416 -11 -109 u=12 imp:n=1

C Steel region

1288 10 8.84614E-02 416 -11 109 -110 u=12 imp:n=1 TMP=2.5301E-08

c

1289 0 416 -11 21 -22 23 -24 110 u=12 imp:n=1

c

c

c Upper Axial blanket.

c

1321 8 4.7208E-02 11 -67 21 -22 23 -24 u=12 imp:n=1 TMP=2.5301E-08

1322 9 4.7925E-02 67 -68 21 -22 23 -24 u=12 imp:n=1 TMP=2.5301E-08

1323 15 4.8317E-02 68 -12 21 -22 23 -24 u=12 imp:n=1 TMP=2.5301E-08

c

c Upper Reflector

1326 14 8.4932E-02 12 -13 21 -22 23 -24 u=12 imp:n=1 TMP=2.5301E-08

c Upper padding

1327 16 3.279692E-02 13 21 -22 23 -24 u=12 imp:n=1 TMP=2.5301E-08

c

c Wrapper region

c gap between plates and wrapper

1331 0 132 -133 134 -135 (-21:22:-23:24) u=12 imp:n=1

c Wrapper

1332 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=12 &

imp:n=1 TMP=2.5301E-08

c gap outside wrapper

1333 0 1 -2 3 -4 (-136:137:-138:139) u=12 imp:n=1

c

c End of Y element

c

c --- Radial Breeder Element

c Lower padding

1441 16 3.279692E-02 -8 21 -22 23 -24 u=7 imp:n=1 TMP=2.5301E-08

c Lower Reflector

1442 14 8.4932E-02 8 -9 21 -22 23 -24 u=7 imp:n=1 TMP=2.5301E-08

c Radial blanket

1444 15 4.8317E-02 9 -12 21 -22 23 -24 u=7 imp:n=1 TMP=2.5301E-08

c Upper reflector

1446 like 134 but u=7 imp:n=1 TMP=2.5301E-08

c Upper padding

1447 like 135 but u=7 imp:n=1 TMP=2.5301E-08

c Wrapper region

c gap between plates and wrapper

1448 0 132 -133 134 -135 (-21:22:-23:24) u=7 imp:n=1

c Wrapper

1449 17 7.81552E-02 136 -137 138 -139 (-132:133:-134:135) u=7 imp:n=1 &

TMP=2.5301E-08

c gap outside wrapper

1450 0 1 -2 3 -4 (-136:137:-138:139) u=7 imp:n=1

c

c

c

c --- Radial shield

c

1466 12 8.32720E-02 28 -29 30 -31 u=8 imp:n=1 TMP=2.5301E-08

c

1467 13 8.32720E-05 1 -2 3 -4 (-28:29:-30:31) u=8 imp:n=1 &

TMP=2.5301E-08

c

c

1468 13 8.32720E-05 1 -2 3 -4 u=9 imp:n=1 TMP=2.5301E-08

c

c --- Assembly

c

1471 0 189 -190 191 -192 u=10 lat=1

fill=-3:3 -3:3 0:0

199 164 162 161 163 165 199

146 144 142 141 143 145 147

126 124 122 121 123 125 127

106 104 102 101 103 105 107

116 114 112 111 113 115 117

136 134 132 131 133 135 137

199 154 152 151 153 155 199

imp:n=1

c

c --- Fuel Region

c

1472 0 7 -16 -17 fill=10 imp:n=1

c --- Universe

1473 0 -7:16:17 imp:n=0

c

c Cell A

c 501 1 6.9985E-02 -71 u=3 imp:n=1 TMP=2.5301E-08

c

c 502 23 0.062241 -74 71 u=3 imp:n=1 TMP=2.5301E-08

c

c 503 5 2.3900E-02 74 u=3 imp:n=1 TMP=2.5301E-08

c

c 504 0 75 -76 77 -78 u=3 fill=1 imp:n=1

c

c Cell E Modified compositions

c

c 506 2 7.1167E-02 -71 u=4 imp:n=1 TMP=2.5301E-08

c

c 507 24 0.0596942 -74 71 u=4 imp:n=1 TMP=2.5301E-08

c

c 508 5 2.3900E-02 74 u=4 imp:n=1 TMP=2.5301E-08

c

c 509 0 75 -76 77 -78 u=4 fill=2 imp:n=1

c

c 511 0 75 -76 77 -78 lat=1 &

c fill -2:1 -2:1 0:0 &

c 3 4 3 4 4 3 4 3 3 4 3 4 4 3 4 3 &

c u=11 imp:n=1

c

c

c ------------- PLATE ELEMENT CELL CARDS ----------------------------------

c

c The First Regular cell. Cell 1

c

c Na dummy

c

c 2162 11 1.216928E-02 801 -804 21 -22 23 -24 u=13 imp:n=1 TMP=2.5301E-08

2162 11 1.216928E-02 -804 21 -22 23 -24 u=13 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2167 3 6.9083E-02 805 -806 155 -156 157 -158 u=13 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2168 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-155:156:-157:158:-805:806) u=13 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2170 7 3.3152E-02 807 -708 21 -22 23 -24 u=13 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2172 1 3.9991E-02 151 -152 153 -154 709 -710 u=13 imp:n=1 TMP=2.5301E-08

C Pu canning

2173 2 6.6997E-02 708 -711 21 -22 23 -24 &

(-151:152:-153:154:-709:710) u=13 imp:n=1 TMP=2.5301E-08

c

c

c Na dummy

c

2182 11 1.216928E-02 711 -814 21 -22 23 -24 u=13 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2187 3 6.9083E-02 815 -816 155 -156 157 -158 u=13 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2188 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-155:156:-157:158:-815:816) u=13 imp:n=1 TMP=2.5301E-08

c

c Na dummy

c

c 2192 11 1.216928E-02 817 -820 21 -22 23 -24 u=13 imp:n=1 TMP=2.5301E-08

2192 11 1.216928E-02 817 21 -22 23 -24 u=13 imp:n=1 TMP=2.5301E-08

c

c End of Cell 1 beginning of Cell 2

c

c Na dummy

c

c 2202 11 1.216928E-02 801 -804 21 -22 23 -24 u=14 imp:n=1 TMP=2.5301E-08

2202 11 1.216928E-02 -804 21 -22 23 -24 u=14 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2207 3 6.9083E-02 805 -806 155 -156 157 -158 u=14 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2208 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-155:156:-157:158:-805:806) u=14 imp:n=1 TMP=2.5301E-08

c

c Na dummy

c

2211 11 1.216928E-02 807 -810 21 -22 23 -24 u=14 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2214 1 3.9991E-02 151 -152 153 -154 811 -812 u=14 imp:n=1 TMP=2.5301E-08

C Pu canning

2215 2 6.6997E-02 810 -813 21 -22 23 -24 &

(-151:152:-153:154:-811:812) u=14 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2217 7 3.3152E-02 813 -814 21 -22 23 -24 u=14 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2219 3 6.9083E-02 815 -816 155 -156 157 -158 u=14 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2220 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-155:156:-157:158:-815:816) u=14 imp:n=1 TMP=2.5301E-08

c

c Na dummy

c

c 2222 11 1.216928E-02 817 -820 21 -22 23 -24 u=14 imp:n=1 TMP=2.5301E-08

2222 11 1.216928E-02 817 21 -22 23 -24 u=14 imp:n=1 TMP=2.5301E-08

c

c End of plate element cell data for Z plate

c

c Cell data for Y plate

c

c

c The First Regular cell. Cell 1 with the Y ring

c

c Na dummy region. The Y ring

c 2361 0 801 -804 -109 u=15 imp:n=1

2361 0 -804 -109 u=15 imp:n=1

C Steel region

c 2362 10 8.84614E-02 801 -804 109 -110 u=15 imp:n=1 TMP=2.5301E-08

2362 10 8.84614E-02 -804 109 -110 u=15 imp:n=1 TMP=2.5301E-08

c

c 2363 0 801 -804 21 -22 23 -24 110 u=15 imp:n=1

2363 0 -804 21 -22 23 -24 110 u=15 imp:n=1

c

c UO2 plate

c UO2 core

2367 3 6.9083E-02 805 -806 155 -156 157 -158 u=15 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2368 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-155:156:-157:158:-805:806) u=15 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2370 7 3.3152E-02 807 -708 21 -22 23 -24 u=15 imp:n=1 TMP=2.5301E-08

c

c Pu plate

C Plate core

2372 1 3.9991E-02 151 -152 153 -154 709 -710 u=15 imp:n=1 TMP=2.5301E-08

C Pu canning

2373 2 6.6997E-02 708 -711 21 -22 23 -24 &

(-151:152:-153:154:-709:710) u=15 imp:n=1 TMP=2.5301E-08

c

c

c Na dummy region. The Y ring

2381 0 711 -814 -109 u=15 imp:n=1

C Steel region

2382 10 8.84614E-02 711 -814 109 -110 u=15 imp:n=1 TMP=2.5301E-08

c

2383 0 711 -814 21 -22 23 -24 110 u=15 imp:n=1

c

c UO2 plate

c UO2 core

2387 3 6.9083E-02 815 -816 155 -156 157 -158 u=15 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2388 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-155:156:-157:158:-815:816) u=15 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

c 2391 0 817 -820 -109 u=15 imp:n=1

2391 0 817 -109 u=15 imp:n=1

C Steel region

c 2392 10 8.84614E-02 817 -820 109 -110 u=15 imp:n=1 TMP=2.5301E-08

2392 10 8.84614E-02 817 109 -110 u=15 imp:n=1 TMP=2.5301E-08

c

c 2393 0 817 -820 21 -22 23 -24 110 u=15 imp:n=1

2393 0 817 21 -22 23 -24 110 u=15 imp:n=1

c

c End of Cell 1 beginning of Cell 2

c

c Na dummy region. The Y ring

c 2401 0 801 -804 -109 u=16 imp:n=1

2401 0 -804 -109 u=16 imp:n=1

C Steel region

c 2402 10 8.84614E-02 801 -804 109 -110 u=16 imp:n=1 TMP=2.5301E-08

2402 10 8.84614E-02 -804 109 -110 u=16 imp:n=1 TMP=2.5301E-08

c

c 2403 0 801 -804 21 -22 23 -24 110 u=16 imp:n=1

2403 0 -804 21 -22 23 -24 110 u=16 imp:n=1

c UO2 plate

c UO2 core

2407 3 6.9083E-02 805 -806 155 -156 157 -158 u=16 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2408 4 7.2463E-02 804 -807 21 -22 23 -24 &

(-155:156:-157:158:-805:806) u=16 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

2410 0 807 -810 -109 u=16 imp:n=1

C Steel region

2411 10 8.84614E-02 807 -810 109 -110 u=16 imp:n=1 TMP=2.5301E-08

c

2412 0 807 -810 21 -22 23 -24 110 u=16 imp:n=1

c

c Pu plate

C Plate core

2414 1 3.9991E-02 151 -152 153 -154 811 -812 u=16 imp:n=1 TMP=2.5301E-08

C Pu canning

2415 2 6.6997E-02 810 -813 21 -22 23 -24 &

(-151:152:-153:154:-811:812) u=16 imp:n=1 TMP=2.5301E-08

c

c Steel plate

2417 7 3.3152E-02 813 -814 21 -22 23 -24 u=16 imp:n=1 TMP=2.5301E-08

c

c UO2 plate

c UO2 core

2419 3 6.9083E-02 815 -816 155 -156 157 -158 u=16 imp:n=1 TMP=2.5301E-08

c UO2 plate can

2420 4 7.2463E-02 814 -817 21 -22 23 -24 &

(-155:156:-157:158:-815:816) u=16 imp:n=1 TMP=2.5301E-08

c

c Na dummy region. The Y ring

c 2422 0 817 -820 -109 u=16 imp:n=1

2422 0 817 -109 u=16 imp:n=1

C Steel region

c 2423 10 8.84614E-02 817 -820 109 -110 u=16 imp:n=1 TMP=2.5301E-08

2423 10 8.84614E-02 817 109 -110 u=16 imp:n=1 TMP=2.5301E-08

c

c 2424 0 817 -820 21 -22 23 -24 110 u=16 imp:n=1

2424 0 817 21 -22 23 -24 110 u=16 imp:n=1

c

c

c --------------------------------------------------------------------

c

c Form the region surrounding groups of 5x5 elements, containing grids

c

c

3001 0 189 -190 191 -192 (-185:186:-187:188) -71 u=100 imp:n=1

c

3002 20 7.403935E-02 189 -190 191 -192 (-185:186:-187:188) 71 -72 &

u=100 imp:n=1

c

3003 0 189 -190 191 -192 (-185:186:-187:188) 72 -73 u=100 imp:n=1

c

3004 20 7.403935E-02 189 -190 191 -192 (-185:186:-187:188) 73 -74 &

u=100 imp:n=1

c

3005 0 189 -190 191 -192 (-185:186:-187:188) 74 u=100 imp:n=1

c

c

c ------------------------------------------------------------------

c

c Form arrays of 5x5 elements

c

c Central row

c

c Central array of 5x5 core elements

c

c

3011 0 1 -2 3 -4 u=201 lat=1

fill=-2:2 -2:2 0:0

12 12 12 12 12

6 12 12 12 12

12 12 12 12 12

12 12 12 12 12

12 12 12 12 6

imp:n=1

c

3012 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=101 imp:n=1

c

3013 0 7 -16 185 -186 187 -188 fill=201 u=101 imp:n=1

c

c

c Middle Left array of 5x5 core elements in row 4

c

3014 0 1 -2 3 -4 u=202 lat=1

fill=-2:2 -2:2 0:0

4 5 4 6 6

4 2 4 6 6

3 2 2 12 12

4 2 2 12 12

4 5 2 6 6

imp:n=1

c

c

c Surround material

c

3015 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=102 imp:n=1

c

c

3016 0 7 -16 185 -186 187 -188 fill=202 u=102 imp:n=1

c

c

c Middle Right array of 5x5 core elements in row 4

c

3017 0 1 -2 3 -4 u=203 lat=1

fill=-2:2 -2:2 0:0

6 6 4 5 4

6 6 4 2 4

12 6 2 2 3

6 6 2 2 4

6 12 3 5 4

imp:n=1

c

c

c Surround material

c

3018 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=103 imp:n=1

c

c

3019 0 7 -16 185 -186 187 -188 fill=203 u=103 imp:n=1

c

c

c

c Left core edge array of 5x5 elements in row 4

c

3021 0 1 -2 3 -4 u=204 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 1

7 7 7 7 1

7 7 7 7 1

7 7 7 7 1

7 7 7 7 1

imp:n=1

c

c

c Surround material

c

3022 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=104 imp:n=1

c

c

3023 0 7 -16 185 -186 187 -188 fill=204 u=104 imp:n=1

c

c

c Right core edge array of 5x5 elements in row 4

c

3024 0 1 -2 3 -4 u=205 lat=1

fill=-2:2 -2:2 0:0

1 7 7 7 7

1 7 7 7 7

1 7 7 7 7

1 7 7 7 7

1 7 7 7 7

imp:n=1

c

c

c Surround material

c

3025 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=105 imp:n=1

c

c

3026 0 7 -16 185 -186 187 -188 fill=205 u=105 imp:n=1

c

c

c ROW 3 The row below the central line

c

c

c Middle array of 5x5 core elements in Row 3

c

c

3031 0 1 -2 3 -4 u=211 lat=1

fill=-2:2 -2:2 0:0

6 12 6 6 6

6 12 6 6 6

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

imp:n=1

c

c Surround material

c

3032 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=111 imp:n=1

c

3033 0 7 -16 185 -186 187 -188 fill=211 u=111 imp:n=1

c

c Lower left array of 5x5 core elements in Row 3

c

c

3034 0 1 -2 3 -4 u=212 lat=1

fill=-2:2 -2:2 0:0

1 2 2 1 12

1 2 2 1 2

1 1 4 2 3

7 1 2 3 3

7 7 2 1 1

imp:n=1

c

c Surround material

c

3035 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=112 imp:n=1

c

3036 0 7 -16 185 -186 187 -188 fill=212 u=112 imp:n=1

c

c

c Lower right array of 5x5 core elements in Row 3

c

3037 0 1 -2 3 -4 u=213 lat=1

fill=-2:2 -2:2 0:0

6 1 2 2 1

2 1 2 2 1

3 3 4 1 1

3 3 2 1 7

1 1 2 7 7

imp:n=1

c

c

c Surround material

c

3038 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=113 imp:n=1

c

c

3039 0 7 -16 185 -186 187 -188 fill=213 u=113 imp:n=1

c

c

c

c left array of blanket elements with a single core element

c

c

3041 0 1 -2 3 -4 u=214 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3042 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=114 imp:n=1

c

3043 0 7 -16 185 -186 187 -188 fill=214 u=114 imp:n=1

c

c

c right array of blanket elements with two core elements

c

c

3045 0 1 -2 3 -4 u=215 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3046 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=115 imp:n=1

c

3047 0 7 -16 185 -186 187 -188 fill=215 u=115 imp:n=1

c

c

c ROW 5 the row above the central line

c

c Central array of 5x5 core elements in Row 5

c

3051 0 1 -2 3 -4 u=221 lat=1

fill=-2:2 -2:2 0:0

3 3 3 3 3

3 3 3 3 3

3 3 3 3 3

6 6 6 12 6

6 6 6 12 6

imp:n=1

c

c

c Surround material

c

3052 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=121 imp:n=1

c

c

3053 0 7 -16 185 -186 187 -188 fill=221 u=121 imp:n=1

c

c

c Top left array of 5x5 core elements in Row 5

c

3054 0 1 -2 3 -4 u=222 lat=1

fill=-2:2 -2:2 0:0

7 7 2 1 1

7 1 2 3 3

1 1 4 2 2

1 3 2 1 2

1 2 2 1 6

imp:n=1

c

c

c Surround material

c

3055 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=122 imp:n=1

c

c

3056 0 7 -16 185 -186 187 -188 fill=222 u=122 imp:n=1

c

c

c Top right array of 5x5 core elements in Row 5

c

3057 0 1 -2 3 -4 u=223 lat=1

fill=-2:2 -2:2 0:0

1 1 2 7 7

3 3 2 1 7

2 2 4 2 2

2 1 2 3 1

6 1 2 2 1

imp:n=1

c

c

c Surround material

c

3058 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=123 imp:n=1

c

c

3059 0 7 -16 185 -186 187 -188 fill=223 u=123 imp:n=1

c

c

c

c left array of blanket elements with two core plate elements

c

c

3061 0 1 -2 3 -4 u=224 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3062 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=124 imp:n=1

c

3063 0 7 -16 185 -186 187 -188 fill=224 u=124 imp:n=1

c

c

c Right array of blanket elements with one core plate element

c

c

3064 0 1 -2 3 -4 u=225 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3065 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=125 imp:n=1

c

3066 0 7 -16 185 -186 187 -188 fill=225 u=125 imp:n=1

c

c

c ROW 2 The row two down from the central row

c

c Lower central group

c

c

3071 0 1 -2 3 -4 u=231 lat=1

fill=-2:2 -2:2 0:0

1 1 1 1 1

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3072 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=131 imp:n=1

c

3073 0 7 -16 185 -186 187 -188 fill=231 u=131 imp:n=1

c

c

c Array of blanket elements

c

c

3074 0 1 -2 3 -4 u=232 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3075 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=132 imp:n=1

c

3076 0 7 -16 185 -186 187 -188 fill=232 u=132 imp:n=1

c

c

c

c Right array of blanket elements with one core element

c

c

3077 0 1 -2 3 -4 u=233 lat=1

fill=-2:2 -2:2 0:0

2 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3078 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=133 imp:n=1

c

3079 0 7 -16 185 -186 187 -188 fill=233 u=133 imp:n=1

c

c

c

c ROW 6

c

c Top central array of 5x5 core elements in row 6

c

3081 0 1 -2 3 -4 u=241 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

1 1 1 1 1

imp:n=1

c

c Surround material

c

3082 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=141 imp:n=1

c

3083 0 7 -16 185 -186 187 -188 fill=241 u=141 imp:n=1

c

c

c

c Left array of blanket elements with one core element

c

c

3085 0 1 -2 3 -4 u=242 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 3

imp:n=1

c

c

c Surround material

c

3086 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=142 imp:n=1

c

3087 0 7 -16 185 -186 187 -188 fill=242 u=142 imp:n=1

c

c

c Right central array in Row 6

c

c

3088 0 1 -2 3 -4 u=243 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

7 7 7 7 7

imp:n=1

c

c Surround material

c

3089 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=143 imp:n=1

c

3090 0 7 -16 185 -186 187 -188 fill=243 u=143 imp:n=1

c

c

c

c

c \*\*\* Blanket-Reflector Arrays \*\*\*

c

c ROW 2

c

c Bottom Left

c

c

3111 0 1 -2 3 -4 u=234 lat=1

fill=-2:2 -2:2 0:0

8 7 7 7 7

8 8 7 7 7

8 8 8 7 7

8 8 8 8 7

9 8 8 8 8

imp:n=1

c

c

c Surround material

c

3112 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=134 imp:n=1

c

3113 0 7 -16 185 -186 187 -188 fill=234 u=134 imp:n=1

c

c

c Row 2 Bottom Right Blanket Reflector Array

c

c

3121 0 1 -2 3 -4 u=235 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 8

7 7 7 8 8

7 7 8 8 8

7 8 8 8 8

8 8 8 8 9

imp:n=1

c

c

c Surround material

c

3122 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=135 imp:n=1

c

3123 0 7 -16 185 -186 187 -188 fill=235 u=135 imp:n=1

c

c

c ROW 6

c

c Top Left Blanket-Reflector Array

c

c

3131 0 1 -2 3 -4 u=244 lat=1

fill=-2:2 -2:2 0:0

9 8 8 8 8

8 8 8 8 7

8 8 8 7 7

8 8 7 7 7

8 7 7 7 7

imp:n=1

c

c

c Surround material

c

3132 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=144 imp:n=1

c

3133 0 7 -16 185 -186 187 -188 fill=244 u=144 imp:n=1

c

c Row 6 Top Right Blanket Reflector Array

c

c

3141 0 1 -2 3 -4 u=245 lat=1

fill=-2:2 -2:2 0:0

8 8 8 8 9

7 8 8 8 8

7 7 8 8 8

7 7 7 8 8

7 7 7 7 8

imp:n=1

c

c

c Surround material

c

3142 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=145 imp:n=1

c

3143 0 7 -16 185 -186 187 -188 fill=245 u=145 imp:n=1

c

c

c Row 1 Blanket - Reflector arrays

c

c Row 1 First Left array

c

c

3151 0 1 -2 3 -4 u=254 lat=1

fill=-2:2 -2:2 0:0

9 9 8 8 8

9 9 9 8 8

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3152 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=154 imp:n=1

c

3153 0 7 -16 185 -186 187 -188 fill=254 u=154 imp:n=1

c

c Row 1 Mid-Left

c

c

3161 0 1 -2 3 -4 u=252 lat=1

fill=-2:2 -2:2 0:0

8 8 8 7 7

8 8 8 8 8

8 8 8 8 8

9 9 9 8 8

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3162 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=152 imp:n=1

c

3163 0 7 -16 185 -186 187 -188 fill=252 u=152 imp:n=1

c

c Row 1 Central Array

c

3171 0 1 -2 3 -4 u=251 lat=1

fill=-2:2 -2:2 0:0

7 7 7 7 7

8 8 8 8 8

8 8 8 8 8

8 8 8 8 8

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3172 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=151 imp:n=1

c

3173 0 7 -16 185 -186 187 -188 fill=251 u=151 imp:n=1

c

c Row 1 First Right array

c

c

3181 0 1 -2 3 -4 u=253 lat=1

fill=-2:2 -2:2 0:0

7 7 8 8 8

8 8 8 8 8

8 8 8 8 8

8 8 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3182 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=153 imp:n=1

c

3183 0 7 -16 185 -186 187 -188 fill=253 u=153 imp:n=1

c

c Row 1 Far Right

c

c

3191 0 1 -2 3 -4 u=255 lat=1

fill=-2:2 -2:2 0:0

8 8 8 9 9

8 8 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3192 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=155 imp:n=1

c

3193 0 7 -16 185 -186 187 -188 fill=255 u=155 imp:n=1

c

c

c Row 2 Blanket reflector arrays

c

c Row 2 First Left array

c

c

3201 0 1 -2 3 -4 u=236 lat=1

fill=-2:2 -2:2 0:0

9 9 9 8 8

9 9 9 8 8

9 9 9 9 8

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3202 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=136 imp:n=1

c

3203 0 7 -16 185 -186 187 -188 fill=236 u=136 imp:n=1

c

c Row 2 Far Right

c

c

3211 0 1 -2 3 -4 u=237 lat=1

fill=-2:2 -2:2 0:0

8 8 9 9 9

8 8 9 9 9

8 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3212 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=137 imp:n=1

c

3213 0 7 -16 185 -186 187 -188 fill=237 u=137 imp:n=1

c

c Row 4 Blanket- Reflector arrays

c

c

c Row 4 First Left array

c

c

3221 0 1 -2 3 -4 u=206 lat=1

fill=-2:2 -2:2 0:0

9 8 8 8 7

9 8 8 8 7

9 8 8 8 7

9 8 8 8 7

9 8 8 8 7

imp:n=1

c

c

c Surround material

c

3222 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=106 imp:n=1

c

3223 0 7 -16 185 -186 187 -188 fill=206 u=106 imp:n=1

c

c

c Row 4 Far Right

c

c

3231 0 1 -2 3 -4 u=207 lat=1

fill=-2:2 -2:2 0:0

7 8 8 8 9

7 8 8 8 9

7 8 8 8 9

7 8 8 8 9

7 8 8 8 9

imp:n=1

c

c

c Surround material

c

3232 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=107 imp:n=1

c

3233 0 7 -16 185 -186 187 -188 fill=207 u=107 imp:n=1

c

c Row 6 Blanket- Reflector arrays

c

c

c Row 6 First Left array

c

3241 0 1 -2 3 -4 u=246 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 8

9 9 9 8 8

9 9 9 8 8

imp:n=1

c

c

c Surround material

c

3242 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=146 imp:n=1

c

3243 0 7 -16 185 -186 187 -188 fill=246 u=146 imp:n=1

c

c Row 6 Far Right

c

3251 0 1 -2 3 -4 u=247 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

8 9 9 9 9

8 8 9 9 9

8 8 9 9 9

imp:n=1

c

c

c Surround material

c

3252 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=147 imp:n=1

c

3253 0 7 -16 185 -186 187 -188 fill=247 u=147 imp:n=1

c

c

c Row 5 Blanket- Reflector arrays

c

c

c Row 5 First Left array

c

c

3261 0 1 -2 3 -4 u=226 lat=1

fill=-2:2 -2:2 0:0

9 9 8 8 8

9 9 8 8 8

9 9 8 8 8

9 8 8 8 7

9 8 8 8 7

imp:n=1

c

c

c Surround material

c

3262 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=126 imp:n=1

c

3263 0 7 -16 185 -186 187 -188 fill=226 u=126 imp:n=1

c

c Row 4 Far Right

c

3271 0 1 -2 3 -4 u=227 lat=1

fill=-2:2 -2:2 0:0

8 8 8 9 9

8 8 8 9 9

8 8 8 9 9

7 8 8 8 9

7 8 8 8 9

imp:n=1

c

c

c Surround material

c

3272 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=127 imp:n=1

c

3273 0 7 -16 185 -186 187 -188 fill=227 u=127 imp:n=1

c

c

c Row 3 Blanket- Reflector arrays

c

c Row 3 First Left array

c

3281 0 1 -2 3 -4 u=216 lat=1

fill=-2:2 -2:2 0:0

9 8 8 8 7

9 8 8 8 7

9 9 8 8 8

9 9 8 8 8

9 9 8 8 8

imp:n=1

c

c

c Surround material

c

3282 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=116 imp:n=1

c

3283 0 7 -16 185 -186 187 -188 fill=216 u=116 imp:n=1

c

c Row 3 Far Right

c

3291 0 1 -2 3 -4 u=217 lat=1

fill=-2:2 -2:2 0:0

7 8 8 8 9

7 8 8 8 9

8 8 8 9 9

8 8 8 9 9

8 8 8 9 9

imp:n=1

c

c

c Surround material

c

3292 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=117 imp:n=1

c

3293 0 7 -16 185 -186 187 -188 fill=217 u=117 imp:n=1

c

c Row 7 Blanket - Reflector arrays

c

c Row 7 First Left array

c

c

3301 0 1 -2 3 -4 u=264 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 8 8

9 9 8 8 8

imp:n=1

c

c

c Surround material

c

3302 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=164 imp:n=1

c

3303 0 7 -16 185 -186 187 -188 fill=264 u=164 imp:n=1

c

c Row 7 Mid-Left

c

3311 0 1 -2 3 -4 u=262 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 8 8

8 8 8 8 8

8 8 8 8 8

8 8 8 7 7

imp:n=1

c

c

c Surround material

c

3312 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=162 imp:n=1

c

3313 0 7 -16 185 -186 187 -188 fill=262 u=162 imp:n=1

c

c Row 7 Central Array

c

3321 0 1 -2 3 -4 u=261 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

8 8 8 8 8

8 8 8 8 8

8 8 8 8 8

7 7 7 7 7

imp:n=1

c

c

c Surround material

c

3322 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=161 imp:n=1

c

3323 0 7 -16 185 -186 187 -188 fill=261 u=161 imp:n=1

c

c Row 7 First Right array

c

3331 0 1 -2 3 -4 u=263 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

8 8 9 9 9

8 8 8 8 8

8 8 8 8 8

7 7 8 8 8

imp:n=1

c

c

c Surround material

c

3332 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=163 imp:n=1

c

3333 0 7 -16 185 -186 187 -188 fill=263 u=163 imp:n=1

c

c Row 7 Far Right

c

3341 0 1 -2 3 -4 u=265 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

8 8 9 9 9

8 8 8 9 9

imp:n=1

c

c

c Surround material

c

3342 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=165 imp:n=1

c

3343 0 7 -16 185 -186 187 -188 fill=265 u=165 imp:n=1

c

c Beyond the reflector 5x5 Region 9

c

3351 0 1 -2 3 -4 u=299 lat=1

fill=-2:2 -2:2 0:0

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

9 9 9 9 9

imp:n=1

c

c

c Surround material

c

3352 0 189 -190 191 -192 (-185:186:-187:188) fill=100 u=199 imp:n=1

c

c

3353 0 7 -16 185 -186 187 -188 fill=299 u=199 imp:n=1

c

c

c

c -----------------------------------------------------------------------

c

c

c ------------- SURFACE CARDS -------------------------------------------

c

c Lattice 2 (Assembly) Elementary cell surfaces

1 px -2.68605

2 px 2.68605

3 py -2.68605

4 py 2.68605

7 pz 0.0 $ Assembly lower limit

8 pz 30.0 $ End Packing, Start Reflector

9 pz 37.60628 $ End Plenum, Start Lower NU

10 pz 67.77878 $ End Lower NU, Start Fuel

c

11 pz 156.96878 $ End Fuel, Start Upper NU for Pin element

c

12 pz 187.271248 $ End Upper NU, Start Top Reflector

13 pz 194.877528 $ End Reflector, Start Packing

16 pz 224.877528 $ Assembly upper limit

c

c 17 cz 94.9

17 cz 89.5

21 px -2.5335 $ Nominal half-width of plates

22 px 2.5335 $ and calandria outer half-width

23 py -2.5335

24 py 2.5335

28 px -2.54 $ Radial shield half-width

29 px 2.54

30 py -2.54

31 py 2.54

c

33 px -2.45 $ inner half-width of calandria

34 px 2.45

35 py -2.45

36 py 2.45

c

c

c subdivisions in the plate element axial blanket and core cells

c

c 9 pz 37.60628 $ axial reflector / axial blanket

41 pz 45.228780

42 pz 57.951780

c 10 pz 67.77878 $ axial blanket / core

43 pz 71.209862

44 pz 74.957944

45 pz 78.706026

46 pz 82.454108

47 pz 86.202190

48 pz 89.950272

49 pz 93.698354

50 pz 97.446436

51 pz 101.194518

52 pz 104.942600

53 pz 108.690682

54 pz 112.438764

55 pz 116.186846

56 pz 119.934928

57 pz 123.683010

58 pz 127.431092

59 pz 131.179174

60 pz 134.927256

61 pz 138.675338

62 pz 142.423420

63 pz 146.171502

64 pz 149.919584

65 pz 153.667666

c

66 pz 157.098748 $ core / axial blanket

c in plate elements (this replaces pz=11)

67 pz 166.925748

68 pz 179.648748

c 12 pz 187.271248 $ axial blanket / reflector

c

c differences in the pin elements ?

c 67 pz 166.925748

c 68 pz 179.648748

c 12 pz 187.271248 $ axial blanket / reflector

c

c Grid plate heights

c

71 pz 31.8

72 pz 62.2

73 pz 162.6

74 pz 193.0

c

c 71 c/z 0 0 0.423 $ fuel pin radius

c 71 c/z 0.6125 0.6125 0.423

c 72 c/z 0 0 0.4305 $ fuel can inner radius

c 73 c/z 0 0 0.488 $ calandria tube inner radius

c 74 c/z 0 0 0.513 $ calandria tube outer radius

c 74 c/z 0.6125 0.6125 0.513

c 75 px 0.0

c 76 px 1.225

c 77 py 0.0

c 78 py 1.225

c 79 cz 1.692

c 80 cz 2.052

c

81 pz 67.77878 $ 0.0

82 pz 68.21878 $ 0.44

83 pz 97.39878 $ 29.62

c 84 pz 97.50878 $ 29.73

85 pz 97.94878 $ 0.44

86 pz 127.12878 $ 29.62

87 pz 127.23878 $ 29.73

88 pz 127.67878 $ 0.44

89 pz 156.85878 $ 29.62

90 pz 156.96878 $ 29.73

c

91 c/z -1.785 -1.785 0.423

92 c/z -0.595 -1.785 0.423

93 c/z 0.595 -1.785 0.423

94 c/z 1.785 -1.785 0.423

95 c/z -1.785 -0.595 0.423

96 c/z -0.595 -0.595 0.423

97 c/z 0.595 -0.595 0.423

98 c/z 1.785 -0.595 0.423

99 c/z -1.785 0.595 0.423

100 c/z -0.595 0.595 0.423

101 c/z 0.595 0.595 0.423

102 c/z 1.785 0.595 0.423

103 c/z -1.785 1.785 0.423

104 c/z -0.595 1.785 0.423

105 c/z 0.595 1.785 0.423

106 c/z 1.785 1.785 0.423

c

c the sodium dummy plate type X and Y (ring shaped)

109 cz 2.3

c

110 cz 2.5334

c

111 c/z -1.785 -1.785 0.513

112 c/z -0.595 -1.785 0.513

113 c/z 0.595 -1.785 0.513

114 c/z 1.785 -1.785 0.513

115 c/z -1.785 -0.595 0.513

116 c/z -0.595 -0.595 0.513

117 c/z 0.595 -0.595 0.513

118 c/z 1.785 -0.595 0.513

119 c/z -1.785 0.595 0.513

120 c/z -0.595 0.595 0.513

121 c/z 0.595 0.595 0.513

122 c/z 1.785 0.595 0.513

123 c/z -1.785 1.785 0.513

124 c/z -0.595 1.785 0.513

125 c/z 0.595 1.785 0.513

126 c/z 1.785 1.785 0.513

c

132 px -2.551 $ sheath inner half-width

133 px 2.551

134 py -2.551

135 py 2.551

136 px -2.6272 $ sheath outer half-width

137 px 2.6272

138 py -2.6272

139 py 2.6272

c

c Widths of plate cores

c \* in plate geometry cores these are 101 to 112

151 px -2.3355 $ Pu plate core width

152 px 2.3355

153 py -2.3355

154 py 2.3355

155 px -2.4255 $ UO2 plate core width

156 px 2.4255

157 py -2.4255

158 py 2.4255

159 px -2.4815 $ Na plate core width

160 px 2.4815

161 py -2.4815

162 py 2.4815

c

c

c coordinates of the elements in 5x5 arrays

c \* in the plate geometry cores these are 81 to 92

181 px -8.05815

182 px 8.05815

183 py -8.05815

184 py 8.05815

185 px -13.43025

186 px 13.43025

187 py -13.43025

188 py 13.43025

189 px -13.5635

190 px 13.5635

191 py -13.5635

192 py 13.5635

c

c

c Cell 2 Axial heights

c

401 pz 153.667666

402 pz 153.704013

403 pz 154.245013

404 pz 154.281360

405 pz 154.318010

406 pz 154.876010

407 pz 154.912660

408 pz 154.958360

409 pz 155.194360

410 pz 155.240060

411 pz 155.276407

412 pz 155.817407

413 pz 155.853754

414 pz 155.890404

415 pz 156.448404

416 pz 156.485054

417 pz 156.521401

418 pz 157.062401

419 pz 157.098748

c

c Cell 12 Axial heights

c

501 pz 67.778780

502 pz 67.815127

503 pz 68.356127

504 pz 68.392474

505 pz 68.429124

506 pz 68.987124

507 pz 69.023774

508 pz 69.060121

509 pz 69.601121

510 pz 69.637468

511 pz 69.683168

512 pz 69.919168

513 pz 69.964868

514 pz 70.001518

515 pz 70.559518

516 pz 70.596168

517 pz 70.632515

518 pz 71.173515

519 pz 71.209862

c

c Basic Cell 1 data

c 701 pz 0.000000

c 702 pz 0.037500

c 703 pz 0.578500 $ Na

c 704 pz 0.616000

c 705 pz 0.652650

c 706 pz 1.210650 $ UO2

c 707 pz 1.247300

708 pz 1.564300 $ SS

709 pz 1.610000 $ Pu can

710 pz 1.846000 $ Pu core

711 pz 1.891700

712 pz 1.929200 $ Na can

713 pz 2.470200 $ Na core

c 714 pz 2.507700 $ SS

c 715 pz 2.544350

c 716 pz 3.102350 $ UO2

c 717 pz 3.139000

c 718 pz 3.176500

c 719 pz 3.717500 $ Na

c 720 pz 3.755000 $ Cell 1

c

801 pz 0.000000

802 pz 0.037500

803 pz 0.578500 $ Na

804 pz 0.616000

805 pz 0.652650

806 pz 1.210650 $ UO2

807 pz 1.247300

808 pz 1.284800

809 pz 1.825800 $ Na

810 pz 1.863300

811 pz 1.909000

812 pz 2.145000 $ Pu

813 pz 2.190700

814 pz 2.507700 $ SS

815 pz 2.544350

816 pz 3.102350 $ UO2

817 pz 3.139000

818 pz 3.176500

819 pz 3.717500 $ Na

820 pz 3.755000 $ Cell 11

c

c

c ----------------------------------------------------------------------

c

c

c

c ------------- TALLY CARDS ---------------------------------------------

c

c --- MATERIALS CARDS ---

c

c

C MATERIAL 1 Pu metal plate core

m1 92238.31c 6.8782E-07

94238.31c 3.0461E-05

94239.31c 2.8920E-02

94240.31c 6.9095E-03

94241.31c 7.3960E-04

94242.31c 1.8699E-04

95241.31c 4.5718E-04

1001.31c 1.2764E-04

6000.31c 4.2260E-04

7014.31c 2.4215E-05

8016.31c 8.8450E-05

13027.31c 2.2973E-05

14028.31c 1.4158E-05

25055.31c 1.4902E-06

24050.31c 1.5637E-07

24052.31c 3.0155E-06

24053.31c 3.4193E-07

24054.31c 8.5114E-08

26054.31c 9.5478E-07

26056.31c 1.4988E-05

26057.31c 3.4614E-07

26058.31c 4.6065E-09

28058.31c 5.8334E-06

28060.31c 2.2470E-06

28061.31c 9.7676E-08

28062.31c 3.1143E-07

28064.31c 7.9313E-08

31000.31c 2.0166E-03

c total 3.9991E-02

c MATERIAL 2 Pu plate canning

m2 1001.31c 1.3760E-05

6000.31c 1.1393E-04

14028.31c 3.6607E-04

15031.31c 1.3731E-05

24050.31c 4.0848E-04

24052.31c 7.8771E-03

24053.31c 8.9320E-04

24054.31c 2.2234E-04

25055.31c 8.5931E-04

26054.31c 2.0774E-03

26056.31c 3.2611E-02

26057.31c 7.5313E-04

26058.31c 1.0023E-05

28058.31c 2.8351E-03

28060.31c 1.0921E-03

28061.31c 4.7472E-05

28062.31c 1.5136E-04

28064.31c 3.8548E-05

29063.31c 1.1629E-02

29065.31c 4.9839E-03

c total 6.6997E-02

C MATERIAL 3 UO2 plate core

m3 1001.31c 3.1773E-05

6000.31c 1.1808E-05

8016.31c 4.6008E-02

13027.31c 3.3911E-06

14028.31c 2.2967E-05

25055.31c 8.3273E-08

26054.31c 7.6610E-08

26056.31c 1.2026E-06

26057.31c 2.7774E-08

26058.31c 3.6962E-10

28058.31c 8.4906E-07

28060.31c 3.2705E-07

28061.31c 1.4217E-08

28062.31c 4.5329E-08

28064.31c 1.1544E-08

42000.66c 3.3379E-07

92235.31c 1.6544E-04

92238.31c 2.2837E-02

c total 6.9083E-02

c MATERIAL 4 UO2 plate canning

m4 1001.31c 1.9035E-05

6000.31c 1.2831E-04

14028.31c 6.4475E-04

15031.31c 3.5078E-04

16032.31c 3.6041E-05

24050.31c 6.0044E-04

24052.31c 1.1579E-02

24053.31c 1.3129E-03

24054.31c 3.2682E-04

25055.31c 8.5559E-04

26054.31c 2.8235E-03

26056.31c 4.4323E-02

26057.31c 1.0236E-03

26058.31c 1.3622E-05

28058.31c 5.7360E-03

28060.31c 2.2095E-03

28061.31c 9.6046E-05

28062.31c 3.0624E-04

28064.31c 7.7989E-05

c total 7.2463E-02

C MATERIAL 5 sodium plate core

m5 1001.31c 1.3900E-05

8016.31c 5.6492E-06

11023.31c 2.3225E-02

20040.31c 3.6083E-06

26054.31c 9.4595E-09

26056.31c 1.4849E-07

26057.31c 3.4294E-09

26058.31c 4.5639E-11

c total 2.324832E-02

c MATERIAL 6 Sodium plate canning

m6 1001.31c 2.1631E-05

6000.31c 2.9290E-04

14028.31c 6.0867E-04

15031.31c 3.2795E-05

16032.31c 3.3219E-05

24050.31c 6.4128E-04

24052.31c 1.2366E-02

24053.31c 1.4023E-03

24054.31c 3.4905E-04

25055.31c 1.3570E-03

26054.31c 3.2179E-03

26056.31c 5.0514E-02

26057.31c 1.1666E-03

26058.31c 1.5525E-05

28058.31c 4.8322E-03

28060.31c 1.8614E-03

28061.31c 8.0912E-05

28062.31c 2.5798E-04

28064.31c 6.5701E-05

41093.31c 3.1147E-04

c total 7.9429E-02

C MATERIAL 7 40% steel plate

c m7 1001.31c 1.8355E-05

c 6000.31c 8.7794E-05

c 13027.31c 1.1862E-04

c 14028.31c 7.9703E-04

c 15031.31c 4.0018E-05

c 16032.31c 1.4422E-05

c 22000.62c 2.4806E-04

c 24050.31c 6.9120E-04

c 24052.31c 1.3329E-02

c 24053.31c 1.5114E-03

c 24054.31c 3.7622E-04

c 25055.31c 1.4972E-03

c 26054.31c 3.2362E-03

c 26056.31c 5.0801E-02

c 26057.31c 1.1732E-03

c 26058.31c 1.5613E-05

c 28058.31c 5.9891E-03

c 28060.31c 2.3070E-03

c 28061.31c 1.0028E-04

c 28062.31c 3.1975E-04

c 28064.31c 8.1431E-05

c 29063.31c 5.0365E-05

c 41093.31c 4.9781E-06

c 42000.66c 8.0988E-05

c

c 40% ss plate smeared over plate region

c

m7 1001.31c 7.3413E-06

6000.31c 3.5114E-05

13027.31c 4.7443E-05

14028.31c 3.1878E-04

15031.31c 1.6006E-05

16032.31c 5.7682E-06

22000.62c 9.9214E-05

24050.31c 2.7645E-04

24052.31c 5.3311E-03

24053.31c 6.0450E-04

24054.31c 1.5047E-04

25055.31c 5.9882E-04

26054.31c 1.2944E-03

26056.31c 2.0318E-02

26057.31c 4.6923E-04

26058.31c 6.2446E-06

28058.31c 2.3954E-03

28060.31c 9.2271E-04

28061.31c 4.0108E-05

28062.31c 1.2789E-04

28064.31c 3.2569E-05

29063.31c 1.4101E-05

29065.31c 6.0432E-06

41093.31c 1.9910E-06

42000.66c 3.2392E-05

c total 3.3152E-02

c

C MATERIAL 8 U8 metal plate

m8 1001.31c 4.4048E-05

6000.31c 4.9283E-04

14028.31c 2.1076E-04

26054.31c 6.1951E-06

26056.31c 9.7250E-05

26057.31c 2.2459E-06

26058.31c 2.9889E-08

92235.31c 3.3369E-04

92238.31c 4.6021E-02

c total 4.7208E-02

C MATERIAL 9 U2 metal plate

m9 1001.31c 4.3899E-05

6000.31c 4.6047E-04

14028.31c 1.9692E-04

26054.31c 5.7884E-06

26056.31c 9.0866E-05

26057.31c 2.0985E-06

26058.31c 2.7927E-08

92235.31c 3.3962E-04

92238.31c 4.6785E-02

c total 4.7925E-02

c

c

c MATERIAL 10 Dummy plate Y

c

m10 1001.31c 2.4073E-05

6000.31c 2.5251E-04

14028.31c 7.4610E-04

15031.31c 1.7803E-05

16032.31c 1.7195E-05

25055.31c 1.5006E-03

24050.31c 7.0597E-04

24052.31c 1.3614E-02

24053.31c 1.5437E-03

24054.31c 3.8427E-04

26054.31c 3.5001E-03

26056.31c 5.4943E-02

26057.31c 1.2689E-03

26058.31c 1.6886E-04

28058.31c 6.3995E-03

28060.31c 2.4651E-03

28061.31c 1.0716E-04

28062.31c 3.4166E-04

28064.31c 8.7011E-05

41093.31c 3.7393E-04

c total 8.84614E-02

c

c MATERIAL 11 Honeycomb dummy plate

c

m11 1001.31c 3.3245E-06

6000.31c 3.3477E-05

14028.31c 1.2169E-04

15031.31c 4.9764E-06

16032.31c 2.5076E-06

25055.31c 1.9518E-04

24050.31c 1.0707E-04

24052.31c 2.0648E-03

24053.31c 2.3413E-04

24054.31c 5.8281E-05

26054.31c 4.7179E-04

26056.31c 7.4061E-03

26057.31c 1.7104E-04

26058.31c 2.2762E-05

28058.31c 8.3019E-04

28060.31c 3.1979E-04

28061.31c 1.3901E-05

28062.31c 4.4323E-05

28064.31c 1.1288E-05

41093.31c 5.2657E-05

c total 1.216928E-02

c

c

c radial shield

m12 1001.31c 4.6306E-05

6000.31c 6.8972E-04

14028.31c 3.1158E-04

15031.31c 4.2944E-05

16032.31c 3.7110E-05

25055.31c 7.1275E-04

26054.31c 4.9065E-03

26056.31c 7.4517E-02

26057.31c 1.7491E-03

26058.31c 2.5903E-04

c total 8.32720E-02

c

c radial shield void surround low density

m13 1001.31c 4.6306E-08

6000.31c 6.8972E-07

14028.31c 3.1158E-07

15031.31c 4.2944E-08

16032.31c 3.7110E-08

25055.31c 7.1275E-07

26054.31c 4.9065E-06

26056.31c 7.4517E-05

26057.31c 1.7491E-06

26058.31c 2.5903E-07

c total 8.32720E-05

c

c Axial shield

m14 1001.31c 2.5700E-05

6000.31c 5.1066E-04

13027.31c 1.3989E-04

22000.62c 3.9416E-05

24050.31c 1.2213E-06

24052.31c 2.2823E-05

24053.31c 2.5531E-06

24054.31c 6.2449E-07

25055.31c 3.2634E-04

26054.31c 5.0496E-03

26056.31c 7.6690E-02

26057.31c 1.8001E-03

26058.31c 2.6658E-04

28058.31c 1.2564E-06

28060.31c 4.6968E-07

28061.31c 2.2000E-08

28062.31c 6.2769E-08

28064.31c 1.6774E-08

29063.31c 3.1184E-05

29065.31c 1.3364E-05

42000.66c 9.8355E-06

c total 8.4932E-02

c

c Natural Uranium Breeder

m15 1001.31c 4.4574E-05

6000.31c 4.7140E-04

14028.31c 2.0160E-04

26054.31c 6.1085E-06

26056.31c 9.2771E-05

26057.31c 2.1776E-06

26058.31c 3.2248E-07

92235.31c 3.4209E-04

92238.31c 4.7156E-02

c Total 4.8317E-02

c

c Element top and bottom packing

m16 1001.31c 3.1777E-05

6000.31c 9.9996E-05

13027.31c 8.3095E-06

24050.31c 6.9087E-08

24052.31c 1.2911E-06

24053.31c 1.4442E-07

24054.31c 3.5326E-08

25055.31c 1.0785E-04

26054.31c 1.9605E-03

26056.31c 2.9775E-02

26057.31c 6.9890E-04

26058.31c 1.0350E-04

28058.31c 1.5636E-07

28060.31c 5.8452E-08

28061.31c 2.7378E-09

28062.31c 7.8115E-09

28064.31c 2.0875E-09

29063.31c 6.5270E-06

29065.31c 2.7973E-06

c Total 3.279692E-02

c

c mild steel wrapper material

m17 1001.31c 7.5725E-05

6000.31c 2.3828E-04

13027.31c 1.9802E-05

24050.31c 1.6463E-07

24052.31c 3.0767E-06

24053.31c 3.4414E-07

24054.31c 8.4182E-08

25055.31c 2.5701E-04

26054.31c 4.6718E-03

26056.31c 7.0954E-02

26057.31c 1.6655E-03

26058.31c 2.4664E-04

28058.31c 3.7260E-07

28060.31c 1.3929E-07

28061.31c 6.5242E-09

28062.31c 1.8615E-08

28064.31c 4.9746E-09

29063.31c 1.5554E-05

29065.31c 6.6660E-06

c Total 7.81552E-02

c

c

C MATERIAL 18 U8 metal plate

m18 1001.31c 4.4048E-05

6000.31c 4.9283E-04

14028.31c 2.1076E-04

26054.31c 6.1951E-06

26056.31c 9.7250E-05

26057.31c 2.2459E-06

26058.31c 2.9889E-08

92235.31c 3.3369E-04

92238.31c 4.6021E-02

c total 4.7208E-02

C MATERIAL 19 U2 metal plate

m19 1001.31c 4.3899E-05

6000.31c 4.6047E-04

14028.31c 1.9692E-04

26054.31c 5.7884E-06

26056.31c 9.0866E-05

26057.31c 2.0985E-06

26058.31c 2.7927E-07

92235.31c 3.3962E-04

92238.31c 4.6785E-02

c total 4.7925E-02

c

c

c Superlattice grid plate

c

m20 1001.31c 2.4442E-04

6000.31c 2.9057E-04

14028.31c 4.3858E-05

15031.31c 1.3256E-05

16032.31c 4.3530E-05

25055.31c 2.5785E-04

26054.31c 4.2756E-03

26056.31c 6.7114E-02

26057.31c 1.5500E-03

26058.31c 2.0627E-04

c Total 19 7.403935E-02

c

c -----------------------------------------------

c

c Element C Pin fuel A and E, Calandria NACLIII

c Pin A

m21 1001.31c 3.2784E-05

8016.31c 4.6606E-02

8017.31c 1.7700E-05

13027.31c 1.1702E-05

20040.31c 7.8782E-06

26054.31c 3.3046E-07

26056.31c 5.1875E-06

26057.31c 1.1980E-07

26058.31c 1.5943E-08

92234.31c 1.3805E-06

92235.31c 1.4114E-04

92236.31c 7.9324E-07

92238.31c 1.9379E-02

94238.31c 3.7786E-06

94239.31c 2.9689E-03

94240.31c 6.7253E-04

94241.31c 7.0350E-05

94242.31c 1.7488E-05

95241.31c 4.7854E-05

c total 21 6.9985E-02

c

c PinB

c

m22 1001.31c 3.2784E-05

8016.31c 4.6976E-02

8017.31c 1.7800E-05

14028.31c 9.0199E-06

28058.31c 3.7050E-06

28060.31c 1.4272E-06

28061.31c 6.2038E-08

28062.31c 1.9780E-07

28064.31c 5.0375E-08

92234.31c 1.3177E-06

92235.31c 1.3457E-04

92236.31c 7.4658E-07

92238.31c 1.8472E-02

94238.31c 5.8915E-06

94239.31c 3.7341E-03

94240.31c 9.5200E-04

94241.31c 1.1199E-04

94242.31c 2.7984E-05

95241.31c 5.5789E-05

c total 22 7.0537E-02 F 26 7.1415E-02

c

c Pin C

c

M23 1001.31c 3.2784E-05

8016.31c 4.7416E-02

8017.31c 1.8000E-05

13027.31c 1.9730E-05

14028.31c 7.9741E-06

26054.31c 4.4958E-07

26056.31c 7.0574E-06

26057.31c 1.6298E-07

26058.31c 2.1690E-08

28058.31c 7.4523E-06

28060.31c 2.8707E-06

28061.31c 1.2478E-07

28062.31c 3.9787E-07

28064.31c 1.0132E-07

92234.31c 1.2863E-06

92235.31c 1.2997E-04

92236.31c 7.3103E-07

92238.31c 1.7843E-02

94238.31c 6.9094E-06

94239.31c 4.4708E-03

94240.31c 1.0602E-03

94241.31c 1.1598E-04

94242.31c 3.0047E-05

95241.31c 5.7784E-05

c total 23 7.1230E-02

c

c Pin D

c

M24 1001.31c 3.2784E-05

8016.31c 4.7296E-02

8017.31c 1.8000E-05

13027.31c 1.8914E-05

14028.31c 2.5099E-05

20040.31c 1.5940E-05

26054.31c 4.0346E-07

26056.31c 6.3335E-06

26057.31c 1.4627E-07

26058.31c 1.9465E-08

28058.31c 9.6247E-06

28060.31c 3.7075E-06

28061.31c 1.6116E-07

28062.31c 5.1385E-07

28064.31c 1.3086E-07

92234.31c 1.4118E-06

92235.31c 1.4266E-04

92236.31c 7.9324E-07

92238.31c 1.9584E-02

94238.31c 4.7348E-06

94239.31c 3.0189E-03

94240.31c 7.5441E-04

94241.31c 8.8443E-05

94242.31c 2.0961E-05

95241.31c 4.0742E-05

c total 24 7.1085E-02

c

c Pin E

m25 1001.31c 3.2784E-05

8016.31c 4.7299E-02

8017.31c 1.7970E-05

13027.31c 9.5250E-06

14028.31c 4.5753E-05

20040.31c 3.2062E-05

26054.31c 6.0326E-07

26056.31c 9.4699E-06

26057.31c 2.1870E-07

26058.31c 2.9105E-08

92234.31c 1.1295E-06

92235.31c 1.1465E-04

92236.31c 6.3771E-07

92238.31c 1.5739E-02

94238.31c 9.4851E-06

94239.31c 6.0438E-03

94240.31c 1.5103E-03

94241.31c 1.7707E-04

94242.31c 4.1953E-05

95241.31c 8.1559E-05

c total 25 7.1167E-02

c

C Pin F

M26 1001.31c 3.2784E-05

8016.31c 4.7464E-02

8017.31c 1.8032E-05

13027.31c 1.4287E-05

20040.31c 6.7514E-05

24050.31c 2.1476E-07

24052.31c 4.1414E-06

24053.31c 4.6961E-07

24054.31c 1.1689E-07

26054.31c 6.7247E-07

26056.31c 1.0556E-05

26057.31c 2.4379E-07

26058.31c 3.2444E-08

28058.31c 1.4905E-06

28060.31c 5.7416E-07

28061.31c 2.4958E-08

28062.31c 7.9577E-08

28064.31c 2.0266E-08

92234.31c 1.1452E-06

92235.31c 1.1526E-04

92236.31c 6.3771E-07

92238.31c 1.5824E-02

94238.31c 9.5005E-06

94239.31c 6.0112E-03

94240.31c 1.5285E-03

94241.31c 1.9723E-04

94242.31c 4.4380E-05

95241.31c 6.8035E-05

C total 26 7.1415E-02

c

c

c Composition of Calandria end plate regions

m27 14028.31c 5.5206E-04

24050.31c 4.3520E-04

24052.31c 8.3923E-03

24053.31c 9.5162E-04

24054.31c 2.3688E-04

25055.31c 7.7198E-04

26054.31c 2.0795E-03

26056.31c 3.2644E-02

26057.31c 7.5390E-04

26058.31c 1.0033E-04

28058.31c 3.0363E-03

28060.31c 1.1696E-03

28061.31c 5.0841E-05

28062.31c 1.6210E-04

28064.31c 4.1283E-05

c total 5.13781E-02

c

c UO2 Pin UO2PINC

c

M28 1001.31c 3.2784E-05

8016.31c 3.2095E-05

8017.31c 4.7483E-02

13027.31c 1.8000E-05

14028.31c 2.3812E-05

20040.31c 4.0001E-05

26054.31c 1.2825E-05

26056.31c 6.5324E-08

26057.31c 1.0254E-06

26058.31c 2.3682E-08

92234.31c 9.7268E-07

92235.31c 1.7604E-04

92238.31c 2.3580E-02

c total 28 7.1400E-02

c

c

c --------------------------------------------------------------------------

c Pin clad plus calandria tube combined

c

C Pin PUPINA clad plus tube (was 23)

c

m31 1001.31c 1.0832E-05

6000.31c 5.3887E-05

14028.31c 6.6291E-04

15031.31c 1.5357E-05

16032.31c 9.9700E-06

25055.31c 1.0382E-03

24050.31c 5.3769E-04

24052.31c 1.0369E-02

24053.31c 1.1757E-03

24054.31c 2.9267E-04

26054.31c 2.4695E-03

26056.31c 3.8766E-02

26057.31c 8.9527E-04

26058.31c 1.1914E-04

28058.31c 3.9651E-03

28060.31c 1.5274E-03

28061.31c 6.6392E-05

28062.31c 2.1169E-04

28064.31c 5.3910E-05

c

C Total 31 6.2241E-02

c

C Pin PUPINB clad plus tube

c

m32 1001.31c 9.2847E-06

6000.31c 9.6091E-05

14028.31c 7.8508E-04

15031.31c 1.6869E-05

16032.31c 9.2404E-06

25055.31c 1.0424E-03

24050.31c 4.8064E-04

24052.31c 9.2687E-03

24053.31c 1.0510E-03

24054.31c 2.6162E-04

26054.31c 2.3154E-03

26056.31c 3.6347E-02

26057.31c 8.3939E-04

26058.31c 1.1171E-04

28058.31c 3.9370E-03

28060.31c 1.5166E-03

28061.31c 6.5922E-05

28062.31c 2.1019E-04

28064.31c 5.3529E-05

41093.31c 1.1919E-04

c

C Total 32 5.8537E-02 F 36 6.0033E-02

c

C Pin PUPINC clad plus tube

c

m33 1001.31c 1.0832E-05

6000.31c 5.5189E-05

14028.31c 6.5458E-04

15031.31c 1.4602E-05

16032.31c 9.9700E-06

25055.31c 1.0254E-03

24050.31c 5.3131E-04

24052.31c 1.0246E-02

24053.31c 1.1618E-03

24054.31c 2.8919E-04

26054.31c 2.4419E-03

26056.31c 3.8333E-02

26057.31c 8.8527E-04

26058.31c 1.1781E-04

28058.31c 3.9199E-03

28060.31c 1.5099E-03

28061.31c 6.5635E-05

28062.31c 2.0927E-04

28064.31c 5.3296E-05

c

C Total 33 6.15349E-02

c

c Pin PUPIND can plus tube

c

m34 1001.31c 1.0058E-05

6000.31c 8.1804E-05

13027.31c 2.6012E-06

14028.31c 6.7957E-04

15031.31c 1.3847E-05

16032.31c 3.6474E-06

22048.31c 1.1726E-05

25055.31c 8.7351E-04

27059.31c 1.7202E-06

24050.31c 4.9702E-04

24052.31c 9.5846E-03

24053.31c 1.0868E-03

24054.31c 2.7053E-04

26054.31c 2.3766E-03

26056.31c 3.7307E-02

26057.31c 8.6158E-04

26058.31c 1.1466E-04

28058.31c 3.6114E-03

28060.31c 1.3911E-03

28061.31c 6.0470E-05

28062.31c 1.9281E-04

28064.31c 4.9102E-05

29063.31c 1.7181E-06

29065.31c 7.3632E-07

42000.66c 8.9408E-07

c

C Total 34 5.9086E-02

c

c Pin PUPINE clad plus tube (Was 24)

m35 1001.31c 1.0058E-05

6000.31c 2.9866E-05

13027.31c 2.6012E-06

14028.31c 7.4068E-04

15031.31c 5.5388E-06

16032.31c 7.0518E-06

22048.31c 1.1726E-05

25055.31c 8.0111E-04

27059.31c 1.7202E-06

24050.31c 5.0041E-04

24052.31c 9.6500E-03

24053.31c 1.0942E-03

24054.31c 2.7238E-04

26054.31c 2.4012E-03

26056.31c 3.7694E-02

26057.31c 8.7052E-04

26058.31c 1.1585E-04

28058.31c 3.7263E-03

28060.31c 1.4354E-03

28061.31c 6.2394E-05

28062.31c 1.9894E-04

28064.31c 5.0664E-05

29063.31c 1.7181E-06

29065.31c 7.3632E-07

42000.66c 8.6970E-06

c

C Total 35 5.96942E-02

c

c

C Pin PUPINF can plus tube

c

m36 1001.31c 1.0058E-05

6000.31c 2.9217E-05

13027.31c 1.7341E-06

14028.31c 7.4343E-04

15031.31c 5.5388E-06

16032.31c 7.2951E-06

22048.31c 8.7948E-06

25055.31c 8.0253E-04

27059.31c 1.3232E-06

24050.31c 5.0363E-04

24052.31c 9.7120E-03

24053.31c 1.1013E-03

24054.31c 2.7413E-04

26054.31c 2.4145E-03

26056.31c 3.7903E-02

26057.31c 8.7533E-04

26058.31c 1.1649E-04

28058.31c 3.7525E-03

28060.31c 1.4455E-03

28061.31c 6.2833E-05

28062.31c 2.0034E-04

28064.31c 5.1021E-05

29063.31c 1.2885E-06

29065.31c 5.5221E-07

42000.66c 8.6159E-06

c

c Total 36 6.0033E-02

c

c

c -------------------------------------------------------------

c

c Calandria sodium contents

c

C sodium NACLI element A and B

m41 1001.31c 5.5075E-06

8016.31c 6.4605E-06

11023.31c 2.4129E-02

20040.31c 1.1080E-07

26056.31c 3.0847E-07

c total 41 2.41414E-02

c

C sodium NACLIIS element E

m42 1001.31c 1.1205E-05

8016.31c 1.0767E-06

11023.31c 2.4379E-02

20040.31c 9.5521E-08

c total 42 2.43914E-02

C sodium NACLIII element C (was 25)

m43 1001.31c 7.5966E-06

8016.31c 3.5892E-06

11023.31c 2.3888E-02

19039.31c 3.4270E-07

20040.31c 6.6865E-07

c total 43 2.3900E-02

C sodium NACLIV Element J

m44 1001.31c 7.5966E-06

8016.31c 3.5892E-06

11023.31c 2.4037E-02

19039.31c 3.4270E-07

20040.31c 6.6865E-07

c total 44 2.4049E-02

C sodium NACLV Element H

m45 1001.31c 7.5966E-06

8016.31c 3.5892E-06

11023.31c 2.3829E-02

19039.31c 3.4270E-07

20040.31c 6.6865E-07

c total 45 2.3841E-02

c

c ------------------------------------------------------------------

c

c

c --------------------------------------------------------

c

C Compositions of Calandria outer walls

c

C Calandria Walls NACLI Element Cell A and B

m51 1001.31c 3.9844E-05

6000.31c 2.8167E-04

14028.31c 6.0229E-04

15031.31c 7.3471E-05

16032.31c 3.6808E-05

25055.31c 1.2214E-03

24050.31c 6.5153E-04

24052.31c 1.2564E-02

24053.31c 1.4247E-03

24054.31c 3.5463E-04

26054.31c 2.8589E-03

26056.31c 4.4878E-02

26057.31c 1.0364E-03

26058.31c 1.3793E-04

28058.31c 4.9315E-03

28060.31c 1.8996E-03

28061.31c 8.2574E-05

28062.31c 2.6328E-04

28064.31c 6.7050E-05

C total 51 7.34056E-02

c

c

C Calandria walls NACLIIS Element Cell E

c

m52 1001.31c 3.8637E-05

6000.31c 6.5351E-04

14028.31c 9.7623E-04

15031.31c 4.7540E-05

16032.31c 3.3014E-05

22048.31c 2.4400E-04

25055.31c 1.1060E-03

27059.31c 1.1151E-05

24050.31c 6.2481E-04

24052.31c 1.2049E-02

24053.31c 1.3662E-03

24054.31c 3.4009E-04

26054.31c 2.7541E-03

26056.31c 4.3233E-02

26057.31c 9.9842E-04

26058.31c 1.3287E-04

28058.31c 5.0735E-03

28060.31c 1.9543E-03

28061.31c 8.4952E-05

28062.31c 2.7086E-04

28064.31c 6.8981E-05

29063.31c 6.9320E-06

29065.31c 3.1020E-06

42000.66c 3.4248E-06

C total 52 7.20749E-02

c

c Calandria NACLIII Element Cell C and D (was m28)

c Error in repeat of Mn in m28

m53 1001.31c 3.9844E-05

6000.31c 1.5948E-04

14028.31c 7.7474E-04

15031.31c 5.2334E-05

16032.31c 2.4551E-05

25055.31c 8.3089E-04

24050.31c 6.1403E-04

24052.31c 1.1841E-02

24053.31c 1.3427E-03

24054.31c 3.3422E-04

26054.31c 2.9672E-03

26056.31c 4.6578E-02

26057.31c 1.0757E-03

26058.31c 1.4315E-04

28058.31c 5.2186E-03

28060.31c 2.0102E-03

28061.31c 8.7382E-05

28062.31c 2.7861E-04

28064.31c 7.0954E-05

42000.66c 2.4862E-05

C total 53 7.44684E-02

c

c

C Calandria NACLIV Element 3J and 3L

m54 1001.31c 3.7430E-05

6000.31c 3.5158E-04

14028.31c 8.2197E-04

15031.31c 6.2274E-05

16032.31c 1.6431E-05

25055.31c 1.0026E-03

24050.31c 5.8931E-04

24052.31c 1.1364E-02

24053.31c 1.2886E-03

24054.31c 3.2077E-04

26054.31c 2.7560E-03

26056.31c 4.3263E-02

26057.31c 9.9912E-04

26058.31c 1.3296E-04

28058.31c 4.3943E-03

28060.31c 1.6927E-03

28061.31c 7.3579E-05

28062.31c 2.3460E-04

28064.31c 5.9746E-05

42000.66c 8.8791E-06

C Total 54 6.94698E-02

c

C Calandria NACLV Element 3H

m55 1001.31c 3.8637E-05

6000.31c 2.6343E-04

14028.31c 6.4389E-04

15031.31c 6.8560E-05

16032.31c 1.7190E-05

25055.31c 9.6934E-04

24050.31c 6.0091E-04

24052.31c 1.1588E-02

24053.31c 1.3140E-03

24054.31c 3.2708E-04

26054.31c 2.8877E-03

26056.31c 4.5330E-02

26057.31c 1.0469E-03

26058.31c 1.3932E-04

28058.31c 4.9377E-03

28060.31c 1.9020E-03

28061.31c 8.2679E-05

28062.31c 2.6362E-04

28064.31c 6.7135E-05

42000.66c 8.8791E-06

C Total 55 7.2497E-02

c

C Calandria VCLVI

m56 1001.31c 3.8637E-05

6000.31c 2.4762E-04

14028.31c 9.5110E-04

15031.31c 4.5654E-05

16032.31c 2.3793E-05

25055.31c 8.6191E-04

24050.31c 6.0122E-04

24052.31c 1.1594E-02

24053.31c 1.3147E-03

24054.31c 3.2725E-04

26054.31c 2.8292E-03

26056.31c 4.4413E-02

26057.31c 1.0257E-03

26058.31c 1.3650E-04

28058.31c 4.6653E-03

28060.31c 1.7971E-03

28061.31c 7.8117E-05

28062.31c 2.4907E-04

28064.31c 6.3431E-05

42000.66c 2.4862E-05

C Total 56 7.12882E-02

c

c

c

c --- MODE CARDS ---

mode n

kcode 10000 1.0 100 1500

ksrc 0.0 0.0 77.0 0.0 0.0 87.9 0.0 0.0 107.0

0.0 0.0 117.9 0.0 0.0 137.0 0.0 0.0 147.9

10.74 0.0 77.0 10.74 0.0 87.9 10.74 0.0 107.0

10.74 0.0 117.9 10.74 0.0 137.0 10.74 0.0 147.9

-10.74 0.0 77.0 -10.74 0.0 87.9 -10.74 0.0 107.0

-10.74 0.0 117.9 -10.74 0.0 137.0 -10.74 0.0 147.9

0.0 10.74 77.0 0.0 10.74 87.9 0.0 10.74 107.0

0.0 10.74 117.9 0.0 10.74 137.0 0.0 10.74 147.9

0.0 -10.74 77.0 0.0 -10.74 87.9 -10.74 0.0 107.0

0.0 -10.74 117.9 0.0 -10.74 137.0 0.0 -10.74 147.9

10.74 10.74 77.0 10.74 10.74 87.9 10.74 10.74 107.0

10.74 10.74 117.9 10.74 10.74 137.0 10.74 10.74 147.9

-10.74 10.74 77.0 -10.74 10.74 87.9 -10.74 10.74 107.0

-10.74 10.74 117.9 -10.74 10.74 137.0 -10.74 10.74 147.9

10.74 -10.74 77.0 10.74 -10.74 87.9 10.74 -10.74 107.0

10.74 -10.74 117.9 10.74 -10.74 137.0 10.74 -10.74 147.9

-10.74 -10.74 77.0 -10.74 -10.74 87.9 -10.74 -10.74 107.0

-10.74 -10.74 117.9 -10.74 -10.74 137.0 -10.74 -10.74 147.9

25.335 0.0 77.0 25.335 0.0 87.9 25.335 0.0 107.0

25.335 0.0 117.9 25.335 0.0 137.0 25.335 0.0 147.9

-25.335 0.0 77.0 -25.335 0.0 87.9 -25.335 0.0 107.0

-25.335 0.0 117.9 -25.335 0.0 137.0 -25.335 0.0 147.9

0.0 25.335 77.0 0.0 25.335 87.9 0.0 25.335 107.0

0.0 25.335 117.9 0.0 25.335 137.0 0.0 25.335 147.9

0.0 -25.335 77.0 0.0 -25.335 87.9 -25.335 0.0 107.0

0.0 -25.335 117.9 0.0 -25.335 137.0 0.0 -25.335 147.9

25.335 25.335 77.0 25.335 25.335 87.9 25.335 25.335 107.0

25.335 25.335 117.9 25.335 25.335 137.0 25.335 25.335 147.9

-25.335 25.335 77.0 -25.335 25.335 87.9 -25.335 25.335 107.0

-25.335 25.335 117.9 -25.335 25.335 137.0 -25.335 25.335 147.9

25.335 -25.335 77.0 25.335 -25.335 87.9 25.335 -25.335 107.0

25.335 -25.335 117.9 25.335 -25.335 137.0 25.335 -25.335 147.9

-25.335 -25.335 77.0 -25.335 -25.335 87.9 -25.335 -25.335 107.0

37.6 0.0 77.0 37.6 0.0 87.9 37.6 0.0 107.0

37.6 0.0 117.9 37.6 0.0 137.0 37.6 0.0 147.9

-37.6 0.0 77.0 -37.6 0.0 87.9 -37.6 0.0 107.0

-37.6 0.0 117.9 -37.6 0.0 137.0 -37.6 0.0 147.9

0.0 37.6 77.0 0.0 37.6 87.9 0.0 37.6 107.0

0.0 37.6 117.9 0.0 37.6 137.0 0.0 37.6 147.9

0.0 -37.6 77.0 0.0 -37.6 87.9 -37.6 0.0 107.0

0.0 -37.6 117.9 0.0 -37.6 137.0 0.0 -37.6 147.9

Print

## LIST OF TABLES

[Table 1.1 Summary of Assemblies and Measurements 11](#_Toc254000872)

[Table 1.2 Standard Plate Geometry Cells 14](#_Toc254000873)

[Table 1.D1 Dimensions of the Core Region Plates. (cm) 22](#_Toc254000874)

[Table 1.D2 Dimensions of the Axial Blanket Region Natural Uranium Plates and Shield Region 23](#_Toc254000875)

[Table 1.D3 Dimensions of a Radial Blanket (or Radial Breeder) Element 31](#_Toc254000876)

[Table 1.D4 Radial Shield Element, MST9F10 31](#_Toc254000877)

[Table 1.D5 The Element Sheaths, Superlattice Grid Plate and the Lattice Spacings 31](#_Toc254000878)

[Table 1.3 Contents of the 168 Mini-calandria Elements used in Assembly 23. 32](#_Toc254000879)

[Table 1.D6 Dimensions of the Components used in the Pin-geometry Elements 40](#_Toc254000880)

[Table 1.D7 Dimensions of the Alternative Plutonium and Uranium Plates (in cm) 41](#_Toc254000881)

[Table 1.D8 Control Rod Plate Identifiers and Dimensions 42](#_Toc254000882)

[Table 1.4 The Experimental keff Values Corrected to the Reference Temperature of 300K and the Reference Date, June 1981, with Control Rods Withdrawn. 47](#_Toc254000883)

[Table 1.6 Uncertainties affecting the Comparison of keff Values for Pin versus Plate Geometry Cores 52](#_Toc254000884)

[Table 1.7 Uncertainties affecting the Comparison of keff Values for Sodium Filled versus Sodium Voided Cores 53](#_Toc254000885)

[Table 1.M1 The Plutonium Metal Plate, PUVIII8. 55](#_Toc254000886)

[Table 1.M2 The Natural Uranium Oxide Plate, UO23R4. 56](#_Toc254000887)

[Table 1.M3 The Sodium Plate, NASTDL4. 57](#_Toc254000888)

[Table 1.M4 Sodium Dummy Plates. 58](#_Toc254000889)

[Table 1.M5 The 40% Stainless Steel Plate, STSTF8. 59](#_Toc254000890)

[Table 1.M6 Blanket Region Natural Uranium Components 61](#_Toc254000891)

[Table 1.M7 Axial Reflector Mild Steel Block. 62](#_Toc254000892)

[Table 1.M8 The Radial Steel Reflector Region. 62](#_Toc254000893)

[Table 1.M.9 Mild Steel Sheath and Superlattice Grid Plates. 63](#_Toc254000894)

[Table 1.M10 Mild Steel Cylindrical Spacer Material, MSTST3 and MSTST12 used above and below the Steel Reflector or Shield Region. 63](#_Toc254000895)

[Table 1.M11 Multiscan Fission Chambers 64](#_Toc254000896)

[Table 1.M12 Compositions of the Fuel Pins. 66](#_Toc254000897)

[Table 1.M12 continued. Percentage Compositions by Weight of the Fuel 67](#_Toc254000898)

[Table 1.M13 Details of the UO2 Pins 68](#_Toc254000899)

[Table 1.M14 Compositions of the Fuel Pin Cans and End Regions 69](#_Toc254000900)

[Table 1.M15 Compositions of the Cans of the UO2 Pins (g) 69](#_Toc254000901)

[Table 1.M16 Details of the Mini-calandria - Weights of Steel and Sodium. 70](#_Toc254000902)

[Table 1.M17 Element Contents of the Sodium Regions of the Mini-calandria (g) 73](#_Toc254000903)

[Table 1.M18 Weights of the Alternative Plutonium Plates 74](#_Toc254000904)

[Table 1.M18B. The Alternative Natural Uranium Oxide Plate, UO24R4. 76](#_Toc254000905)

[This is the uranium oxide plate with “4 radiused corners” used in the core cells of the mixed oxide element, C22±04A. The core section of the element contains 11 cells CC22-06A. This plate includes silver-copper braze material. 76](#_Toc254000906)

[Table 1.M18C. The Stainless Steel Plate STSTDL8 (dull steel). 77](#_Toc254000907)

[This is used in the core cells of the mixed oxide element, C22±04A. 77](#_Toc254000908)

[Zebra Control Rods 78](#_Toc254000909)

[Table 1.M19 Control Rod Plutonium Metal Plate, PUXIVC8 79](#_Toc254000910)

[Table 1.M20 Control Rod Uranium Oxide Plate , UO2C4R4 81](#_Toc254000911)

[Table 1.M21 Control Rod Uranium Metal Plate, UC8 82](#_Toc254000912)

[Table 1.M22 Control Rod Stainless Steel Plate, STSTCF8 82](#_Toc254000913)

[Table 1.M23 Control Rod Sodium Plate, NASTMC4 83](#_Toc254000914)

[Table 1.M24 Control Rod Aluminium Plate, ALCG8 84](#_Toc254000915)

[Table 1.M25 Control Rod Boron Absorber Plate, B10C2 85](#_Toc254000916)

[Table 1.M26 The Control Rod Sheath. 86](#_Toc254000917)

[Table 1.8A Location of Foils 93](#_Toc254000918)

[Table 1.8B Axial Variations of the U238 Fission and Capture Rates Measured on the Mid-planes of UO2 Plates using 25.3 mm diameter Foils. 94](#_Toc254000919)

[Table 1.9 U238/U235 Fission Ratios in the Central Region of the Element located at (50,45). 94](#_Toc254000920)

[Table 1.10 Sources of Uncertainty in the Cell Averaged Fission Ratio Measurements. 95](#_Toc254000921)

[Table 1.11 The Sources of Uncertainty for the Cell-averaged value of C28/F49. 96](#_Toc254000922)

[Table 1.12 Reaction Rate Ratio Measurements in Assembly 22 97](#_Toc254000923)

[Table 1.13 Delayed Neutron Fractions and Total Yields used in the Inverse Kinetics Analyses 102](#_Toc254000924)

[Table 1.14 Delayed Neutron 6 Time Group Decay Constants (sec-1) used in the Analyses 102](#_Toc254000925)

[Table 1.15 Delayed Neutron Energy Spectra used in the Inverse Kinetics Analyses 102](#_Toc254000926)

[Table 1.15B Total Beta-effective Values Calculated for the CADENZA Cores (ZTN22/13) 103](#_Toc254000927)

[Table 1.15A Delayed Neutron Parameters Calculated for the CADENZA Cores (ZTN22/13) 104](#_Toc254000928)

[Table 1.16 Uncertainties arising from Reproducibility and Drift 105](#_Toc254000929)

[Table 1.17 Measured values of the Reactivity Effects of Replacing Standard Plate Elements C22±01C (PUVIII8 plates) by Alternative Plate and by Pin Elements in Core 22 (x10-4 dk/k) 108](#_Toc254000930)

[Table 1.18 Measured values of the Reactivity Effects of Replacing 9 Standard Plate Elements, or a Single Element (C24±20CY), by Pin or Alternative Plate Elements in Core 24 109](#_Toc254000931)

[Table 1.19 Measured values of the Reactivity Effects of Replacing Standard Pin Elements (C25+03A1) by Plate Elements (C24+20CY) in Core 25 109](#_Toc254000932)

[Table 1.20 Reactivity change resulting from Replacing 9 (C22-03C) Elements at the Centre of Core 23 by the Element Named in Column 1 109](#_Toc254000933)

[Table 1.21 Reactivity Changes resulting from the Enrichment Changes 110](#_Toc254000934)

[Table 1.22 Reactivity Effects of Changes in Heterogeneity 111](#_Toc254000935)

[Table 1.23 Changes in Reactivity for Plate Replacements in Position (50,45) in Core 22B 114](#_Toc254000936)

[Table 1.24 Changes in Reactivity for Plate Replacements in Position (50,42) in Core 22B 115](#_Toc254000937)

[Table 1.25 Changes in Reactivity for Plate Replacements in Position (50,39) and (50,51) in Core 22B 116](#_Toc254000938)

[Table 1.26 Changes in Reactivity for Plate Replacements in Position (50,45) in Core 24 116](#_Toc254000939)

[Table 1.27 Reactivities of Material Perturbations in Elements in Off-central Positions in Core 24 117](#_Toc254000940)

[Table 1.28 Material Worth Measurements in Position (50,45) in Cores 23 and 25. 117](#_Toc254000941)

[Table 1.29 Material Worth Measurements in Positions (50,39) plus (50,51) in Cores 23 and 25 118](#_Toc254000942)

[Table 1.30 Comparison of Steel Weights in Sodium Plates and Dummy Rings 121](#_Toc254000943)

[Table 1.31 Comparison of Axially Symmetric Void Worths in Cores 22A and 22B (10-4 dk/k) 122](#_Toc254000944)

[Table 1.32 Reactivity Changes resulting from Sodium Voiding in Core 23 and Sodium Flooding in Core 25 122](#_Toc254000945)

[Table 1.33 Reactivity Changes, Replacing Pin Elements by Plate Elements in Core 23 124](#_Toc254000946)

[Table 1.34 Reactivity Changes, Replacing Pin Elements by Plate Elements in Core 25 126](#_Toc254000947)

[Table 1.M27 The Half-thickness Plutonium Plate, PUJ16 131](#_Toc254000948)

[Table 1.M28 The Mixed Oxide Plate, PUIV4. 132](#_Toc254000949)

[This is used in the Plutonium Enrichment Measurements and in the plutonium oxide element C22 04A 132](#_Toc254000950)

[Table 1.M29 The Plutonium Plate PUII8 133](#_Toc254000951)

[Table 1.M30 Plates used in the Reactivity Worth Measurements 134](#_Toc254000952)

[Table 1.M.31 The Pins used in the Reactivity Worth Measurements 136](#_Toc254000953)

[Table 2.1 K-effective values and Uncertainties based on the Analyses made by the Measurers 153](#_Toc254000954)

[Table 2.2 Sensitivity of k-effective values to Changes in Composition. 154](#_Toc254000955)

[Table 2.3 Uncertainties affecting the values of the Differences between the keff values for Pin versus Plate Geometry Cores 156](#_Toc254000956)

[Table 2.4 Uncertainties affecting the values of the Differences between the keff values for Sodium Filled versus Sodium Voided Cores 156](#_Toc254000957)

[Table 2.5 The Reactivity Differences between the Reference Assemblies and the Versions with the central Plate Geometry Zones. 157](#_Toc254000958)

[Table 2.6 Comparison of Fission Chamber Measurements made in Core 22 and the cores BZD/1 and BZD/3 which used the Same Core Cell as Core 22 but in a Radially Heterogeneous Core Arrangement (central blanket zone). 159](#_Toc254000959)

[Table 2.7 Reaction Rate Ratio Measurements in Assembly 22 160](#_Toc254000960)

[Table 2.8 Comparison of the Reaction Rate Ratio Measurements made in MASURCA by different Participants in the IRMA Intercomparisons. 161](#_Toc254000961)

[Table 2.9 Intercomparisons made in the ZEBRA Bizet Programme. Differences relative to the Winfrith Measurements (in percent). 161](#_Toc254000962)

[Table 2.10 Summary of Differences Relative to AEEW/ZEBRA Measurements. 162](#_Toc254000963)

[Table 2.11 Effects of Changes from the Standard Loading of the Inner Core Cell in BZD 162](#_Toc254000964)

[Table 3.D1 Dimensions of the Core Region Plates. 186](#_Toc254000965)

[Table 3.D2 Dimensions of the Axial Blanket Region Natural Uranium Plates 190](#_Toc254000966)

[Table 3.D3 Dimensions of the Axial Shielding Region Mild Steel Blocks 191](#_Toc254000967)

[Table 3.D4 Dimensions of the Element Sheaths and the Lattice Spacings 192](#_Toc254000968)

[Table 3.D5 Model of Cell 1 in Assembly 22. 194](#_Toc254000969)

[Table 3.D6 Dimensions which Differ in Cell 2 194](#_Toc254000970)

[Table 3.D7 Model of Cell 11 in Assembly 22. 195](#_Toc254000971)

[Table 3.D8 Dimensions which Differ in Cell 12 195](#_Toc254000972)

[Table 3.D9 Model of Cell CC-24-1 in Assembly 24. 200](#_Toc254000973)

[Table 3.D10 Dimensions which differ in Cell CC-24-2 200](#_Toc254000974)

[Table 3.D11 Model of Cell CC-24-11 in Assembly 24. 201](#_Toc254000975)

[Table 3.D12 Dimensions which differ in Cell CC-24-12 201](#_Toc254000976)

[Table 3.D13 Axial Dimensions of a Core Element in Assembly 22 207](#_Toc254000977)

[Table 3.D14 Axial Dimensions of Assembly 24 Core Elements containing the Sodium Dummy Plates (thickness 0.616 cm) 207](#_Toc254000978)

[Table 3.D15 Axial Dimensions of a Radial Blanket Element 207](#_Toc254000979)

[Table 3.D16 Dimensions of the Radial Shield Element 208](#_Toc254000980)

[Table 3.D17 Dimensions of the Mini-calandria Components. 209](#_Toc254000981)

[Table 3.M1 The Plutonium Metal Plate, PUVIII8. 213](#_Toc254000982)

[Table 3.M2 The Natural Uranium Oxide Plate, UO23R4. 214](#_Toc254000983)

[Table 3.M3 The Sodium Plate, NASTDL4. 215](#_Toc254000984)

[Table 3.M4 Sodium Dummy Plates. 216](#_Toc254000985)

[Table 3.M5 The 40% Stainless Steel Plate, STSTF8. 217](#_Toc254000986)

[Table 3.D18 Blanket Region Natural Uranium Components, U8, U2 and U3 218](#_Toc254000987)

[Table 3.D19 Axial Reflector Mild Steel Block. 219](#_Toc254000988)

[Table 3.D20 Mild Steel Block, MST3. 219](#_Toc254000989)

[Table 3.M6 The Steel Bar MST9F10. Total length ~3 m 220](#_Toc254000990)

[Table 3.M7 The Mild Steel Sheath. 221](#_Toc254000991)

[Table 3.M8 Compositions of the Fuel. 222](#_Toc254000992)

[Table 3.M9 Compositions of the Fuel Pin Cans and End Regions. 223](#_Toc254000993)

[Table 3.M10 Atomic Densities of the UO2 Pins 224](#_Toc254000994)

[Table 3.M11 The Masses adopted for the Calandria Tubes and End Regions and the Corresponding Atomic Densities. 225](#_Toc254000995)

[Table 3.M12 Atomic Densities of the Outer Mini-calandria Walls 226](#_Toc254000996)

[Table 3.M13 Atomic Densities of the Sodium Region 226](#_Toc254000997)

[Table 3.D21A Plate Cell Volume Fractions. 227](#_Toc254000998)

[Table 3.D21B Pin Cell Volume Fractions. 227](#_Toc254000999)

[Table 3.M14 Average Compositions of the Chosen Plate and Pin Cells 228](#_Toc254001000)

[Table 3.M15 Sheath Material Smeared over the area between the Plates, or Calandria, and the Lattice Cell Boundary, based on a Lattice Spacing of 5.3721 cm or 5.4254 cm 231](#_Toc254001001)

[Table 3.M16 Smeared Atomic Densities for the Natural Uranium Plate, U8, plus Sheath. 233](#_Toc254001002)

[Table 3.M17 Smeared Atomic Densities for the Natural Uranium Plate, U2, plus Sheath. 234](#_Toc254001003)

[Table 3.M18 Smeared Atomic Densities for the Natural Uranium Plate, U3, plus Sheath. 235](#_Toc254001004)

[Table 3.M19 Smeared Atomic Densities for the Mild Steel Axial Reflector Block, 236](#_Toc254001005)

[MST3, plus Sheath, averaged over the lattice spacing of 5.4254 cm. 236](#_Toc254001006)

[Table 3.M20 The Edge Region of the Plutonium Plate Combined with the Sheath and averaged over the space between the plate core and the lattice square of side 5.4254 cm. (Atoms/barn.cm) 237](#_Toc254001007)

[Table 3.M21 Smeared Atomic Densities for the Upper and Lower Canning Region of the Plutonium Plate averaged with the sheath over the lattice square of side 5.4254 cm. 238](#_Toc254001008)

[Table 3.M22 Smeared Atomic Densities. Smearing the UO2 Plate Edge Region with the Sheath over the space between the plate core and the lattice square of side 5.4254 cm 239](#_Toc254001009)

[(atomic densities in Atoms/barn.cm). 239](#_Toc254001010)

[Table 3.M23 Smeared Atomic Densities. Smearing the Upper and Lower Canning Region of the UO2 plate with the Sheath over the lattice square of side 5.4254 cm. 240](#_Toc254001011)

[Table 3.M24 Smeared Atomic Densities. Smearing the Sodium Plate Edge Region with the Sheath over the space between the plate core and the lattice square of side 5.4254 cm. 241](#_Toc254001012)

[Table 3.M25 Smeared Atomic Densities. Smearing the Upper and Lower Canning Region of the Sodium Plate with the Sheath over the lattice square of side 5.4254 cm. 242](#_Toc254001013)

[Table 3.M26 Smeared Atomic Densities. The 40%Steel Plate Smeared with the Sheath over the lattice square of side 5.4254 cm. (Atoms/barn.cm) 243](#_Toc254001014)

[Table 3.M27 Smeared Atomic Densities. Smearing the Sodium Dummy Plates over the Plate Area 244](#_Toc254001015)

[Table 3.M28 The Reduced Atomic Densities of the Dummy Plates before combining with the Sheath, based on the area 5.42542 cm2. 246](#_Toc254001016)

[Table 3.M29 Atomic Densities of the Smeared Dummy Plates combined with the Sheath Material 247](#_Toc254001017)

[Table 3.M30 Atomic Densities of the Smeared Dummy Plates combined with the Sheath Material when there is a Central Square Hole of Side 4.6 cm. 248](#_Toc254001018)

[Table 3.D22 The Dimensions of the Pin Cell, Pellet Column, Canning and Calandria Tubes. 250](#_Toc254001019)

[Table 3.M31 Atomic Densities of the Tubes and the Scaled Atomic Densities. 251](#_Toc254001020)

[Table 3.M32 Atomic Densities of the Cans 251](#_Toc254001021)

[Table 3.M33 Scaled Atomic Densities of the Cans (x 0.4055318) 252](#_Toc254001022)

[Table 3.M34 Combined Can Plus Tube Homogenised Atomic Number Densities 253](#_Toc254001023)

[Table 3.D23 Dimensions of the Calandria Walls 254](#_Toc254001024)

[Table 3.M35 Atomic Density Contributed by the Smeared Sheath 254](#_Toc254001025)

[Table 3.M36 Atomic Densities of the Calandria Walls 255](#_Toc254001026)

[Table 3.M37 Atomic Densities of the Walls Scaled by the Factor 0.30682 255](#_Toc254001027)

[Table 3.M38 Atomic Density of the Calandria Walls and Sheath Combined 256](#_Toc254001028)

[Table 3.M39 Atomic Densities for the UO2 Fuel Pin Canning Plus the Tube 258](#_Toc254001029)

[Table 3.2 Keff  values and Uncertainties 259](#_Toc254001030)

[Table 3.3 Uncertainties affecting the Comparison of keff values for Pin versus Plate Geometry Cores 260](#_Toc254001031)

[Table 3.4 Uncertainties affecting the Comparison of keff values for Sodium Filled versus Sodium Voided Cores 260](#_Toc254001032)

[Table 3. 5 Uncertainties affecting the Comparison of keff values for the central plate zones in the pin geometry cores, Assembly 23 and 25 260](#_Toc254001033)

[Table 3.8 Recommended Reaction Rate Ratio Measurements in the Central Region of Assembly 22 264](#_Toc254001034)

[Table 3.9 Possible systematic uncertainties associated with the Zebra techniques 264](#_Toc254001035)

[Table 3.M40 Atomic Densities for the Alternative Core Region Plutonium Plates 266](#_Toc254001036)

[Table 3.M41 Atomic Densities for the Half-thickness Plutonium Plate, PUJ16 268](#_Toc254001037)

[Table 3.M42 Atomic Densities for the Mixed Oxide Plate used in the Plutonium Enrichment and Element Replacement Measurements, PUIV4. 269](#_Toc254001038)

[Table 3.M43 Atomic Densities for the Plutonium Plate PUII8 270](#_Toc254001039)

[Table 3.M43B Atomic Densities for the Uranium Oxide Plate UO24R4 a component in the Mixed Oxide Plate Element C22±04A used in the Element Replacement Measurements. 271](#_Toc254001040)

[This plate contains silver-copper braze material, which can have a significant effect on reactivity. However there are only 11 of these plates in a C22±04A element (one per cell, CC22-06A). 271](#_Toc254001041)

[Table 3.M44 Stainless Steel Plates STSTBR8 (bright) and STSTDL8 (dull) used in the Reactivity Worth Measurements 272](#_Toc254001042)

[Table 3.M45 GII8 Graphite Plate used in the Reactivity Worth Measurements 272](#_Toc254001043)

[Table 3.M46 AL2O34 Aluminium Oxide Plate used in the Reactivity Worth Measurements 273](#_Toc254001044)

[Table 3.M47 ALG8 Aluminium Plate used in the Reactivity Worth Measurements 273](#_Toc254001045)

[Table 3.M48 MSTPINA The Mild Steel Pin 274](#_Toc254001046)

[Table 3.M49 The Pins, 2ALPINA, 2ALOPINA and 2CPINA 274](#_Toc254001047)

[Table 3.D24 Control Rod Components and Dimensions 277](#_Toc254001048)

[Table 3.M50 Control Rod Plate PUXIVC8 279](#_Toc254001049)

[Table 3.M51 Control Rod Plate UO2C4R4 281](#_Toc254001050)

[Table 3.M52 Control Rod Plate UC8 282](#_Toc254001051)

[Table 3.M53 Control Rod Plate STSTCF8 ("Reduced density" steel plate) 282](#_Toc254001052)

[Table 3.M54 Control Rod Plate NASTMC4 283](#_Toc254001053)

[Table 3.M55 Control Rod Plate ALCG8 284](#_Toc254001054)

[Table 3.M56 Control Rod Plate B10C2 284](#_Toc254001055)

[Table 3.M57 Control Rod Sheath CRSHEATH 285](#_Toc254001056)

[Table 4.1A. MONK/Dice-JEF-2.2 k-effective Results 287](#_Toc254001057)

[Table 4.1B. Calculations using the Bingo-JEF-2.2 Library in MONK 287](#_Toc254001058)

[Table 4.1C MONK9A/Dice-JENDL-3.2 k-effective Results 288](#_Toc254001059)

[Table 4.2 KENO5a+CONSYST+ABBN-93 k-effective Results 288](#_Toc254001060)

[Table 4.3A MCNP/JENDL-3.3 k-effective Results 289](#_Toc254001061)

[Table 4.3B MCNP/JEFF-3.1 k-effective Results 289](#_Toc254001062)

[Table 4.4A MONK/Dice JEF-2.2 Results for Δ(C-E) (x10-4) 290](#_Toc254001063)

[Table 4.4B MONK/Bingo JEF-2.2 Results for Δ(C-E) (x10-4) 290](#_Toc254001064)

[Table 4.4C MONK9A/JENDL-3.2 Results for Δ(C-E) (x10-4) 291](#_Toc254001065)

[Table 4.4D MONK/ENDF/B-VI-v4 Results for Δ(C-E) (x10-4) 291](#_Toc254001066)

[Table 4.5 KENO5a+CONSYST+ABBN-93 Results for Δ(C-E) (x10-4) 291](#_Toc254001067)

[Table 4.6A MCNP/JENDL-3.3 Results for Δ(C-E) (x10-4) 292](#_Toc254001068)

[Table 4.6B MCNP/JEFF-3.1 Results for Δ(C-E) (x10-4) 292](#_Toc254001069)

[Table 4.8 Cell Averaged Reaction Rate Ratio Calculations using MONK/JEF-2.2 294](#_Toc254001070)

[Table 4.9 Cell Averaged Reaction Rate Ratio Calculations using MONK/JENDL-3.2 295](#_Toc254001071)

[Table 4.10 Cell Averaged Reaction Rate Ratio Calculations using MONK/ ENDF/B-VI-v4 296](#_Toc254001072)

[Table 4.11 FOP and Exact Perturbation Calculations for Element Replacements in Core 22 and Comparison with Experiment (from ZTN22-13) (Units 10-4 dk/k) 298](#_Toc254001073)

[Table 4.12 FOP Calculations for Element Replacements in Core 24 and Comparison with Experiment (from ZTN22-13) (Units 10-4 dk/k) 299](#_Toc254001074)

[Table 4.13 Comparison of Calculated and Experimental Enrichment Worths 300](#_Toc254001075)

[Table 4.14 Comparison of Measured and Calculated values of the Effects of Changes in the Plate Loading of Cells in Cores 22 and 24. (Units 10-4 dk/k) 301](#_Toc254001076)

[Table 4.15 Comparison of Measured and Calculated Effects of Changes in the Pin Loading of Cells in Cores 23 and 25. (Units 10-4 dk/k) 302](#_Toc254001077)

[Table 4.16 Comparison of Calculation and Experiment for the Small-Zone Sodium Worths in the Plate and Pin Geometry Cores (From ZTN22-13) (Units 10-6 dk/k) 303](#_Toc254001078)

**LIST OF FIGURES**

[Figure 1.1 A Perspective View of the ZEBRA Critical Assembly Facility. 4](#_Toc254000798)

[Figure 1.2 View of an Element being Loaded into a ZEBRA Assembly. 5](#_Toc254000799)

[Figure 1.3 Vertical Sectional View of the ZEBRA Facility 6](#_Toc254000800)

[Figure 1.4 Diagram of a Fuel Element Containing Materials in Plate Form 7](#_Toc254000801)

[Figure 1.5 Core Cells of Assembly 22B. 15](#_Toc254000802)

[Figure 1.6 Plate Arrangement in the Single and Double Elements. 16](#_Toc254000803)

[Figure 1.7A Plan of Assembly 22. 17](#_Toc254000804)

[Figure 1.7B Positions of the Pu239 Fission Chambers in Core Cells of Assembly 22B which Replace Cell 13. 19](#_Toc254000805)

[Figure 1.8A Assembly 22 Reference Core Loading (Fissile Elements) 20](#_Toc254000806)

[Figure 1.8B Assembly 24 Reference Core Loading (Fissile Elements) 21](#_Toc254000807)

[Figure 1.9 Core of the Plutonium Metal Fuel Plate, PuVIII8. 25](#_Toc254000808)

[Figure 1.10 Core and Copper Clad of the Plutonium Metal Fuel Plate. 25](#_Toc254000809)

[Figure 1.11 Core, Copper and Steel Clad of the Plutonium Metal Fuel Plate, PuVIII8. 26](#_Toc254000810)

[Figure 1.12 Core Region of the Uranium Oxide Plate. 27](#_Toc254000811)

[Figure 1.13 Core and Can Regions of the Uranium Oxide Plate. 28](#_Toc254000812)

[Figure 1.14 Core Plus Can Regions of the Sodium Plate. 29](#_Toc254000813)

[Figure 1.15 The 40% Steel Plate. 30](#_Toc254000814)

[Figure 1.16 Assembly 23 Reference Core Loading (Fissile Elements) 35](#_Toc254000815)

[Figure 1.17 Diagram of a Mini-calandria 36](#_Toc254000816)

[Figure 1.18 Mini-calandria Components 37](#_Toc254000817)

[Figure 1.19 Assembly 25. Fissile Elements 38](#_Toc254000818)

[Figure 1.20 Dimensions of an Oxide Fuel Pin 39](#_Toc254000819)

[Figure 1.21A The Zebra Parallel Plate Fission Chamber. 89](#_Toc254000820)

[Figure 1.21B Fission Chamber Location on the Mid-plane of a Central Element. 90](#_Toc254000821)

[Figure 1.21C Location of Foils in the UO2 plates 91](#_Toc254000822)

[Figure 1.22 Central Plate Zone in Assembly 23A 128](#_Toc254000823)

[Figure 1.23 Central Plate Zone in Assembly 25 129](#_Toc254000824)

[Figure 1.24 Sequence of Element Changes in Assembly 25 130](#_Toc254000825)

[Figure 1.25A The Plutonium Fission Rate Distribution, Assembly 22B Level 1 (z = -38.03 cm) 142](#_Toc254000826)

[Figure 1.25B The Plutonium Fission Rate Distribution, Assembly 22B Level 2 (z = -19.23 cm) 143](#_Toc254000827)

[Figure 1.25C The Plutonium Fission Rate Distribution, Assembly 22B Level 3 (z = -0.52 cm) 144](#_Toc254000828)

[Figure 1.25D The Plutonium Fission Rate Distribution, Assembly 22B Level 4 (z = +18.31 cm) 145](#_Toc254000829)

[Figure 1.25E The Plutonium Fission Rate Distribution, Assembly 22B Level 1 (z = +37.06 cm) 146](#_Toc254000830)

[Figure 1.26A The Plutonium Fission Rate Distribution in Core 24 relative to that in Core 22. 147](#_Toc254000831)

[Figure 1.26B The Plutonium Fission Rate Distribution in Core 24 relative to that in Core 22. 148](#_Toc254000832)

[Figure 1.26C The Plutonium Fission Rate Distribution in Core 24 relative to that in Core 22. 149](#_Toc254000833)

[Figure 1.26D The Plutonium Fission Rate Distribution in Core 24 relative to that in Core 22. 150](#_Toc254000834)

[Figure 1.26E The Plutonium Fission Rate Distribution in Core 24 relative to that in Core 22. 151](#_Toc254000835)

[Figure 1.27 The Chambers of the Multi-chamber Scanning System being Loaded into a Double Element. 152](#_Toc254000836)

[Figure 2.1 The Measured Relative Reactivity Worth Profile of FR9 and the Fitted Straight Line giving the "Standard cm" Equivalence. 165](#_Toc254000837)

[Figure 3.1 Diagram of a Plate within an Element Sheath (Drawing not to scale) 175](#_Toc254000838)

[Figure 3.2 Diagram of Simplified Models in which the Gaps between the Plates (or Mini-calandria), the Element Sheath and the Superlattice Grid are Eliminated. 175](#_Toc254000839)

[Figure 3.3 Calculational Model of the Assembly 22 Core (Fissile Elements) 179](#_Toc254000840)

[Figure 3.4 Calculational Model of the Assembly 24 Core (Fissile Elements) 180](#_Toc254000841)

[Figure 3.5A Assembly 23 Model (Fissile Elements) 181](#_Toc254000842)

[Figure 3.5B Assembly 25 Model (Fissile Elements) 182](#_Toc254000843)

[Figure 3.6A Calculational Model of the Central Plate Zone in Assembly 23 183](#_Toc254000844)

[Figure 3.6B Calculational Model of the Central Plate Zone in Assembly 25 184](#_Toc254000845)

[Figure 3.7 The Lattice Dimensions of Model A and of a Model with a Uniform Array of Elements 185](#_Toc254000846)

[Figure 3.8 Dimensions of the Plutonium Metal and Uranium Oxide Plates 187](#_Toc254000847)

[Figure 3.9 Dimensions of the Sodium and 40% Steel Plates 188](#_Toc254000848)

[Figure 3.10 Dimensions of the two types of "Sodium Dummy" Plate, the Ring and "Honeycomb" Plates. 189](#_Toc254000849)

[Figure 3.11 Dimensions of the Uranium Metal Plates. 190](#_Toc254000850)

[Figure 3.12 Dimensions of the Mild Steel Blocks used in the Axial Shielding Region. 191](#_Toc254000851)

[Figure 3.13 Radial Dimensions of the Element in a Model with a Uniform Lattice Spacing 192](#_Toc254000852)

[Figure 3.14A Model A Dimensions of the Cells in Assembly 22. Cell 1. 196](#_Toc254000853)

[Figure 3.14B Model A Dimensions of the Cells in Assembly 22. Cell 2. 197](#_Toc254000854)

[Figure 3.14C Model A Dimensions of the Cells in Assembly 22. Cell 11. 198](#_Toc254000855)

[Figure 3.14D Model A Dimensions of the Cells in Assembly 22. Cell 12. 199](#_Toc254000856)

[Figure 3.15A Model A Dimensions of the Cells in Assembly 24. Cell CC-24-1. 202](#_Toc254000857)

[Figure 3.15B Model A Dimensions of the Cells in Assembly 24. Cell CC-24-2. 203](#_Toc254000858)

[Figure 3.15C Model A Dimensions of the Cells in Assembly 24. Cell CC-24-11. 204](#_Toc254000859)

[Figure 3.15D Model A Dimensions of the Cells in Assembly 24. Cell CC-24-12. 205](#_Toc254000860)

[Figure 3.16 Dimensions of the Core Elements 206](#_Toc254000861)

[Figure 3.17 Dimensions of the Pin Geometry Cells. 210](#_Toc254000862)

[Figure 3.18 Simplified Models of Cells 230](#_Toc254000863)

[Table 3.6A Comparison of MCNP/JEFF-3.1 k-eff values Calculated using Different Models 261](#_Toc254000864)

[Table 3.6B Comparison of MONK/JEF-2.2 k-effective values Calculated using Different Models 262](#_Toc254000865)

[Table 4.1D MONK/ENDF/B-VI-v4 k-effective Results 288](#_Toc254000866)

[Table 4.17. continued 305](#_Toc254000867)