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Detailed Computational Models for Nuclear Criticality Analyses on the First Startup Cores of NSRR: A TRIGA Annular Core Pulse Reactor

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Nuclear Science Research Institute

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The detailed computational models for nuclear criticality analyses on the first startup cores of NSRR (Nuclear Safety Research Reactor), which is categorized as a TRIGA-ACPR (Annular Core Pulse Reactor), were created for the purposes of deeper understandings of safety inspection data on the neutron absorber rod worths of reactivity and improvement of determination technique of the reactivity worths. The uncertainties in effective neutron multiplication factor (k_{eff}) propagated from errors in the geometry, material, and operation data for the present models were evaluated in detail by using the MVP version 3 code with the latest Japanese nuclear data library, JENDL-5, and the previous versions of JENDL libraries. As a result, the overall uncertainties in k_{eff} for the present models were evaluated to be in the range of 0.0027 to 0.0029 Δk_{eff} . It is expected that the present models will be utilized as the benchmark on k_{eff} for TRIGA-ACPR. Moreover, it is confirmed that the overall uncertainties were sufficiently smaller than the values of absorber rod worths determined in NSRR. Thus, it is also considered that the present models are applicable to further analyses on the absorber rod worths in NSRR.

Keywords: Computational Model, Nuclear Criticality Analysis, Benchmark, NSRR, TRIGA-ACPR, Neutron Absorber Rod, Reactivity Worth, Effective Neutron Multiplication Factor, MVP, JENDL-5

TRIGA 環状炉心パルス炉 NSRR の初回起動炉心の臨界解析用詳細計算モデル

日本原子力研究開発機構 原子力科学研究所

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(2025年1月16日受理)

中性子吸収棒の反応度価値に関する安全検査データのより深い理解と反応度価値の測定 技術の向上のために、TRIGA-ACPR(環状炉心パルス炉)に分類されるNSRR(原子炉安全 性研究炉)の初回起動炉心の臨界解析用詳細計算モデルを作成した。本モデルの形状、材 料、運転データの誤差から伝播する中性子実効増倍率(keff)の不確かさを、最新の核データ ライブラリJENDL-5 及び旧版のJENDL ライブラリと MVP 第3版コードを用いて詳細に評 価した。その結果、本モデルにおける keff の全体的な不確かさは、0.0027 から 0.0029 Δkeff の範囲と評価した。本モデルは、TRIGA-ACPR の keff のベンチマークとして利用されることが 期待される。さらに、全体的な不確かさは、NSRR で測定された吸収棒価値よりも十分小さい ことを確認した。よって、本モデルは NSRR における吸収棒反応度価値に関する今後の解析 にも適用できる。

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Contents

| 1. Int | roduction 1 |
|--------|---|
| 2. Ge | ometry Data ······3 |
| 2.1 | Fuel rod ······3 |
| 2.2 | Control and safety rods with fuel followers $\cdots \cdots 5$ |
| 2.3 | Adjustable transient rod ······7 |
| 2.4 | Fast transient rod ······7 |
| 2.5 | Horizontal layout of cores ······10 |
| 2.5. | 1 Minimum core ·····10 |
| 2.5. | 2 Standard core ·····10 |
| 2.5. | 3 Intermediate cores in fuel addition steps |
| 2.6 | Vertical layout of cores |
| 3. Ma | terial Data ·····16 |
| 3.1 | Uranium-zirconium hydride in fuel, control, and safety rods16 |
| 3.2 | Zirconium rod in fuel, control, and safety rods19 |
| 3.3 | Stainless-steel type SUS304 of cladding in fuel rod20 |
| 3.4 | Stainless-steel type SUS304 of top/bottom plugs in fuel rod $\cdots\cdots\cdots 21$ |
| 3.5 | Molybdenum disc in fuel rod $\cdots 23$ |
| 3.6 | Axial graphite reflector in fuel rod $\cdots \cdots 24$ |
| 3.7 | Natural boron carbide absorber in control and safety rods $\cdots 25$ |
| 3.8 | Stainless-steel type SUS304 of cladding, spacer, and top/bottom plugs |
| | in control and safety rods ······26 |
| 3.9 | Aluminum alloy type A6061 of spacer tube in control and safety rods, |
| | and of cladding, spacer, air follower/spacer tubes, and top/bottom |
| | plugs in adjustable and fast transient rods $\cdots \cdots 27$ |
| 3.10 | Enriched boron carbide absorber in adjustable and fast transient rods $\cdots 29$ |
| 3.11 | Water as moderator and reflector |
| 3.12 | Other core structures ···································· |
| 4. Op | eration Data ······32 |
| 4.1 | Minimum and standard cores ·······32 |
| 4.2 | Intermediate cores |
| 5. An | alyses of Effective Neutron Multiplication Factors |
| 5.1 | Calculation method ······37 |
| 5.2 | Calculated results |
| 6. Ev. | aluation of Uncertainties for Detailed Models43 |

| 6.1 U | ncertainties from errors in geometry data43 |
|--|---|
| 6.1.1 | Fuel rod ······45 |
| 6.1.2 | Control and safety rods ······49 |
| 6.1.3 | Adjustable and fast transient rods $\cdots 52$ |
| 6.1.4 | Grid plate ······54 |
| 6.1.5 | Experimental tube |
| 6.1.6 | Shroud |
| 6.1.7 | Guide tube for transient rod |
| 6.1.8 | Summary for geometry data57 |
| 6.2 U | ncertainties from errors in material data59 |
| 6.2.1 | Uranium-zirconium hydride in fuel, control, and safety rods60 |
| 6.2.2 | Zirconium rod in fuel, control, and safety rods ······62 |
| 6.2.3 | Stainless-steel in fuel, control, and safety rods, |
| | and in guide tube for transient rod ······62 |
| 6.2.4 | Molybdenum disc in fuel rod ······64 |
| 6.2.5 | Axial graphite reflector in fuel rod ······64 |
| 6.2.6 | Aluminum alloy in control, safety, and transient rods, |
| | and in other core structures ······65 |
| 6.2.7 | Natural boron carbide absorber in control and safety rods |
| 6.2.8 | Enriched boron carbide absorber in transient rod |
| 6.2.9 | Summary for material data |
| 6.3 U | ncertainties from errors in operation data70 |
| 6.3.1 | Rod position for control, safety, and transient rods70 |
| 6.3.2 | Temperature ······70 |
| 6.3.3 | Criticality judgement |
| 6.3.4 | Summary for operation data71 |
| 6.4 O | verall uncertainties ······73 |
| 7. Sumr | nary |
| Acknowle | edgements ······76 |
| Reference | |
| Appendix | Effect of Transient Rod Positions on Uncertainties |
| Appendix-2 Effect of Replacement of Experimental Tube with Water | |
| | on Uncertainties ······88 |
| Appendix | Effect of Impurities on Uncertainties |
| Appendix | Sample Input List for MVP |

目 次

| 1. | はじ | ごめに |
|----|-------|-------------------------------------|
| 2. | 形 | 大データ |
| 2 | 2.1 | 燃料棒 |
| 2 | 2.2 | 燃料フォロワ付き制御棒及び安全棒 |
| 2 | 2.3 | 調節用トランジェント棒 |
| 2 | 2.4 | 高速トランジェント棒 |
| 2 | 2.5 | 炉心の水平方向レイアウト |
| | 2.5. | 1 最小炉心 |
| | 2.5.1 | 2 標準炉心 |
| | 2.5. | 燃料追加ステップの中間炉心13 |
| 2 | 2.6 | 炉心の垂直方向レイアウト |
| 3. | 材料 | 斗データ |
| 3 | 8.1 | 燃料棒、制御棒及び安全棒のウラン水素化ジルコニウム16 |
| 3 | 3.2 | 燃料棒、制御棒及び安全棒のジルコニウム棒 |
| 3 | 8.3 | 燃料棒被覆管の SUS304 ステンレス鋼 |
| 3 | 8.4 | 燃料棒の上部/下部端栓の SUS304 ステンレス鋼 |
| 3 | 8.5 | 燃料棒のモリブデンディスク |
| 99 | 8.6 | 燃料棒の軸方向グラファイト反射材 |
| 3 | 8.7 | 制御棒及び安全棒の天然炭化ホウ素吸収材 |
| 3 | 8.8 | 制御棒及び安全棒の被覆管、スペーサー及び上部/下部端栓の |
| | | SUS304 ステンレス鋼 |
| 3 | 8.9 | 制御棒及び安全棒のスペーサー管、並びに調節用及び高速トランジェント棒の |
| | | 被覆管、スペーサー、フォロワ/スペーサー管 |
| | | 及び上部/下部端栓の A6061 アルミニウム合金 |
| 3 | 8.10 | 調節用及び高速トランジェント棒の濃縮炭化ホウ素吸収材 |
| 3 | 8.11 | 水減速材及び反射体 |
| 3 | 8.12 | その他の炉心構造物 |
| 4. | 運轉 | 云データ |
| 4 | .1 | 最小及び標準炉心 |
| 4 | 1.2 | 中間炉心 |
| 5. | 中位 | 生子実効増倍率の解析 |
| 5 | 5.1 | 計算方法 |
| 5 | 5.2 | 計算結果 |
| 6. | 詳約 | 細モデルの不確かさ評価 |

| 6.1 | 形状データの誤差による不確かさ43 |
|---------------|-----------------------------------|
| 6.1.1 | 燃料棒 |
| 6.1.2 | 制御棒及び安全棒 |
| 6.1.3 | 調節用及び高速トランジェント棒 |
| 6.1.4 | 格子板 |
| 6.1.5 | 実験管 |
| 6.1.6 | シュラウド |
| 6.1.7 | トランジェント棒案内管 |
| 6.1.8 | 形状データについてのまとめ |
| 6.2 | 材料データの誤差による不確かさ |
| 6.2.1 | 燃料棒、制御棒及び安全棒のウラン水素化ジルコニウム60 |
| 6.2.2 | 燃料棒、制御棒及び安全棒のジルコニウム棒62 |
| 6.2.3 | 燃料棒、制御棒、安全棒及びトランジェント棒案内管のステンレス鋼62 |
| 6.2.4 | 燃料棒のモリブデンディスク64 |
| 6.2.5 | 燃料棒の軸方向黒鉛反射材64 |
| 6.2.6 | 制御棒、安全棒、トランジェント棒 |
| | 及びその他の炉心構造物のアルミニウム合金65 |
| 6.2.7 | 制御棒及び安全棒の天然炭化ホウ素吸収材66 |
| 6.2.8 | トランジェント棒の濃縮炭化ホウ素吸収材66 |
| 6.2.9 | 材料データについてのまとめ |
| 6.3 | 軍転データの誤差による不確かさ |
| 6.3.1 | 制御棒、安全棒及びトランジェント棒の位置 |
| 6.3.2 | 温度 |
| 6.3.3 | 臨界判定 |
| 6.3.4 | 運転データについてのまとめ |
| 6.4 | 総合的な不確かさ |
| 7. まとぬ | <i>b</i> |
| 謝辞 … | |
| 参考文南 | t ······76 |
| 付録-1 | トランジェント棒位置が不確かさに及ぼす影響 |
| 付録-2 | 実験管の水置換が不確かさに及ぼす影響 |
| 付録 - 3 | 不純物が不確かさに及ぼす影響 |
| 付録-4 | MVP サンプル入力リスト ······92 |

1. Introduction

NSRR (Nuclear Safety Research Reactor) ¹⁾ operated and managed by the Nuclear Science Research Institute of the Japan Atomic Energy Agency is a versatile test and research nuclear reactor TRIGA (Training, Research, Isotopes, General Atomics) ²⁾. In general, the TRIGA reactor has excellent inherent safety, in which the rapid and large negative feedback reactivity is brought by uranium-zirconium hydride fuel during nuclear excursions due to the shift of thermal neutron spectra towards its higher energy. For this feature, NSRR is utilized for irradiation tests on nuclear fuel and materials of nuclear power reactors under the condition that the reactivity is added exceeding prompt criticality, i.e., reactivity-initiated accident conditions. The TRIGA reactor like NSRR in which a vertical irradiation hole at the center of the core is equipped and pulse operations are enabled is further categorized as the TRIGA-ACPR (Annular Core Pulse Reactor).

NSRR generates extremely large thermal power up to 23,000 MW during the irradiation tests, however, its duration is so short because of the inherent safety as mentioned above. Hence, integrated thermal power during operation is small in NSRR. This means that the decay heat from fission products and minor actinide nuclides are quite small due to so small burnup. Therefore, the Japanese safety regulation requires the safety function of reactor shutdown with neutron absorber rods for NSRR as one of the important safety issues more than the reactor cooling function.

In NSRR, eleven neutron absorber rods controlling reactivity are equipped for operations, i.e., six control rods, two safety rods, and three transient rods. Reactivity worths of those rods are periodically determined and inspected once per fiscal year to confirm the compliance with safety criteria. From the former studies ^{3,4} on the other TRIGA reactors with multiple absorber rods, it is foreseen that the reactivity worth of a particular neutron absorber rod is strongly affected by the vertical position of each rod inserted into the core as well as the horizontal positional relationship of the other rods. However, those data on the reactivity worths in NSRR have not been examined with three-dimensional models accurately simulating core structures and positions of the absorber rods using precise analyses codes and the latest nuclear data libraries so far. It is considered that the detailed examination assisted by precise computational analyses is effective for deeper understandings of the inspected data on the reactivity worth and improvement of the determination technique of the worths in NSRR.

For this purpose, the authors tried to create detailed criticality analyses models for NSRR. Those models represent the detailed layout of the core structures and positional relationship of the control, safety, and transient rods accurately. Although a small burnup is expected, the models are subjected to the first startup cores of NSRR in 1975 since uncertainties from changes in fuel compositions are to be reduced as much as possible. To create detailed models as much as possible, the data in the present models were closely examined by referring to not only the published literatures ^{1,5)} but also dimensional and material inspection records at the construction of NSRR in 1973, operation records during the first startup in 1975, and so on.

For the present models, analyses of effective neutron multiplication factor (k_{eff}), were performed using the continuous-energy Monte Carlo code MVP version 3⁶) with the latest Japanese nuclear data library, JENDL-5⁷), and the previous versions of JENDL libraries ^{8,9} to confirm the accuracy of the combination of the analyses code and libraries. Uncertainties in k_{eff} propagated from errors in dimensional, material, and operation data for the present models were also evaluated in detail with the code and libraries mentioned above.

This report summarizes the detailed criticality analyses models for the first startup cores of NSRR with the uncertainties in k_{eff} . It is expected that the present models will be used as the benchmarks on k_{eff} under delayed critical conditions with various positions of the neutron absorber rods in NSRR as a TRIGA-ACPR. For the reactivity worths of the neutron absorber rods of NSRR, it is necessary to examine the data determined at the first startup in detail. The comparison of the determined data on the reactivity worths and calculations using the present models will be conducted in future.

2. Geometry Data

For the definition of dimensions and shapes of the detailed models, the geometry data are described below with their data sources. The uranium-zirconium hydride fuel rods, and the neutron absorber rods for reactivity control, i.e., six control rods, two safety rods, three transient rods, are loaded in the NSRR core ¹⁾. The transient rods consist of one adjustable transient rod and two fast transient rods. The detailed models are categorized into three sorts of cores which were composed during the first startup, namely,

- Minimum core: a core in which the minimum number of fuel rods were loaded to reach the first criticality,
- Standard core: a core in routine uses for pulse operations having 8.52 \$ of excess reactivity,
- Intermediate core: thirty-five cores composed by the one-by-one fuel rod addition step from the minimum to standard core.

2.1 Fuel rod

Figure 2.1.1 shows the geometry model for the fuel rod. The fuel meat is approximately 20 wt% enriched uranium-zirconium hydride with a vertical hole in the center of the fuel meat for hydriding process at the manufacturing. In the center hole, zirconium rods are vertically inserted. Axial graphite reflectors are installed at both top and bottom of the fuel rod. A thin molybdenum disc as burnable poison is also installed between the uranium-zirconium hydride and the bottom axial graphite reflector. The austenitic stainless-steel type SUS304 fuel cladding and top/bottom plugs are used in the fuel rod.

The actual top/bottom plugs are shaped like arrow feathers and have slightly complicated structures. Figure 2.1.2 shows photographs of the top/bottom plugs in a replica of the fuel rod. For simplicity, the top/bottom plugs in the geometry model are shaped with surfaces of cylinders and a truncated cone which are enveloping their real shapes, as shown in Fig. 2.1.1. For this reason, the mass and volume of the plug materials in the model is larger than the real ones.

The fuel rod is supported in the core by top/bottom grid plates made from aluminum alloy type A6061. In the bottom grid, counter sinks are machined in each grid hole to support the fuel rods.

For dimensions found in the dimensional inspection records at the construction in 1973, the dimensions and their errors were obtained by using the inspection records. The other dimension data referred to nominal values from design drawings. The numerical values underlined in Fig. 2.1.1 imply the dimensions based on the dimensional inspection records at the construction in 1973.



Fig. 2.1.1 Geometry model for the fuel rod.



Fig. 2.1.2 Photographs of the top/bottom plugs in a replica of the fuel rod.

2.2 Control and safety rods with fuel followers

Figure 2.2.1 shows the geometry model for the control and safety rods. Six control and two safety rods with natural boron carbide absorber are installed in the core. The control and safety rods have uranium-zirconium hydride fuel followers of which composition is same as the fuel rod. The austenitic stainless-steel type SUS304 cladding, spacer, and top/bottom plugs are used in the control and safety rods. The aluminum alloy type A6061 spacer tube is used inside the bottom of the control and safety rods.

The control and safety rods are driven by an electric motor individually. In addition, six control rods can be simultaneously driven, as 'bank mode' ¹). The driving mechanisms for the control and safety rods are ignored in the geometry model since those are sufficiently far away from the core. The vertical position of the control and safety rods is expressed as 'unit.' The position of 100 units means full insertion of the rod, meanwhile that of 900 units does full withdrawal. The value of one unit is identical to 0.0476 cm (38.1 cm per 800 unit).

The dimensional inspection records on the control and safety rods at the construction in 1973 are not found at present. Thus, the dimension data referred to nominal values from design drawings.



Fig. 2.2.1 Geometry model for the control and safety rods.

2.3 Adjustable transient rod

Figure 2.3.1 shows the geometry model for the adjustable transient rod. One adjustable transient rod with enriched boron carbide absorber is installed in the core. The aluminum alloy type A6061 cladding, spacer, air follower and spacer tubes, and top/bottom plugs are used.

The adjustable transient rod is driven by either an electric motor or compressed air. The driving mechanisms for the adjustable transient rod are ignored in the geometry model since those are sufficiently far away from the core. The vertical position of the adjustable transient rod is expressed as 'unit' for the motor driving, similar to the control and safety rods. The position of 100 units means full insertion of the rod, meanwhile that of 900 units does full withdrawal. The value of one unit is 0.0476 cm like the control and safety rods.

The dimensional inspection records on the adjustable transient rod at the construction in 1973 are not found at present. Thus, the dimension data referred to nominal values from design drawings.

2.4 Fast transient rod

Figure 2.4.1 shows the geometry model for the fast transient rod. Two fast transient rods with enriched boron carbide absorber are installed in the core. The aluminum alloy type A6061 cladding, spacer, air follower and spacer tubes, and top/bottom plugs are used like the adjustable transient rod.

The fast transient rods are driven only by compressed air individually. The driving mechanisms for the fast transient rods are ignored in the geometry model since those are sufficiently far away from the core.

The dimensional inspection records on the fast transient rods at the construction in 1973 are not found at present. Thus, the dimension data referred to nominal values from design drawings.



Fig. 2.3.1 Geometry model for the adjustable transient rod.



Fig. 2.4.1 Geometry model for the fast transient rod.

2.5 Horizontal layout of cores

2.5.1 Minimum core

The core of the minimum number of fuel rods was reached at delayed criticality during the first startup of NSRR in 1975¹⁾. Figure 2.5.1.1 shows its horizontal layout. The minimum core was composed of one hundred and thirteen fuel rods, six control rods, and two safety rods. One adjustable transient rod and two fast transient rods were also installed in the core. The fuel rods, control and safety rods, and transient rods were configured in the hexagonal lattice using the aluminum alloy type A6061 top/bottom grid plates. The water to fuel volume ratio of a hexagonal fuel cell was about 0.423.

The cylindrical shaped aluminum alloy type A6061 shroud was installed surrounding the core. The A6061 experimental tube was installed in the center of core, which made a hexagonal shaped void region for an irradiation capsule.

For the grid plates, shroud, and experimental tube, the dimensions and their errors were obtained by using the dimensional inspection records at the construction in 1973. The numerical values underlined in Fig. 2.5.1.1 imply the dimensions based on the dimensional inspection records.

2.5.2 Standard core

Figure 2.5.2.1 shows the horizontal layout of the standard core. The standard core for pulse operations in NSRR was configured in 1975¹⁾ by adding thirty-six fuel rods in the minimum core.

The standard core was composed of one hundred and forty-nine fuel rods, six control rods, and two safety rods. The horizontal layout of the standard core was same as the minimum core excepting the difference in the number of fuel rods loaded in both cores.

The numerical values underlined in Fig. 2.5.2.1 imply the dimensions based on the inspection records at the construction in 1973, similar to the minimum core.

JAEA-Research 2025-001



Fig. 2.5.1.1 Horizontal layout of the minimum core.

JAEA-Research 2025-001



Fig. 2.5.2.1 Horizontal layout of the standard core.

2.5.3 Intermediate cores in fuel addition steps

Thirty-six fuel rods in total were added in the core using one-by-one step from the minimum to standard core during the first startup of NSRR in 1975¹⁾. Thus, thirty-five intermediate cores were configured for each fuel addition step to determine reactivities inserted by the fuel addition. The last step, i.e., the 36th fuel addition step, made the standard core.

Figure 2.5.3.1 shows the position of the fuel addition. The positions of the fuel addition in Fig. 2.5.3.1 are shown with the symbols of 'D-xx' or 'E-yy,' in which 'xx' or 'yy' is numerical values for identification.

The horizontal layout of the intermediate cores was same as the minimum or standard core excepting the difference in the number of fuel rods.



Fig. 2.5.3.1 Fuel addition position from the minimum to standard core.

2.6 Vertical layout of cores

Figure 2.6.1 shows the vertical layout of the core. The aluminum alloy type A6061 experimental tube had two sorts of shapes. As mentioned in Sec. 2.5, it has a hexagonal shaped void region below the vicinity of the top of the fuel rods. The cylindrical shaped experimental tube is placed on the top of hexagonal one.

The vertical positions of the control, safety, and transient rods were confirmed by using operation records during the first startup in 1975. Details of the position data of those rods for each core are summarized in Chap. 4.

The data source of the dimensions for the grid plates, shroud, and experimental tube is mentioned in Sec. 2.5.1. For the austenitic stainless-steel type SUS304 guide tubes for the transient rods, the dimensional inspection records at the construction in 1973 are not found at present. Thus, those dimensions referred to nominal values from design drawings. The numerical values underlined in Fig. 2.6.1 imply the dimensions based on the inspection records at the construction in 1973.



Fig. 2.6.1 Vertical layout of the core.

3. Material Data

The atomic number densities for the materials used in the present models are described below with their data sources. Nuclear constants, i.e., Avogadro's Number, atomic weight, and isotopic abundance, are based on the International Criticality Safety Benchmark Evaluation Project (ICSBEP) handbook ¹⁰.

3.1 Uranium-zirconium hydride in fuel, control, and safety rods

The density of uranium-235 was obtained by the mass inventory of uranium-235 in the whole core and the total volume of the uranium-zirconium hydride of the core. The mass inventory is consistent with nuclear material accountability data for safeguards. The total volume of the uranium-zirconium hydride was calculated by nominal dimensions in design drawings. The volume error was evaluated to be 0.41 % in relative by using both the design drawings and dimensional inspection records at the construction in 1973.

The atomic number ratio of hydrogen to uranium-235 was cited from the literature ⁵⁾, as 152.76. The atomic number ratio of hydrogen to zirconium and its error were obtained by using records of material inspection for the hydriding process of uranium and zirconium mixture. The enrichment of uranium-235 and its error were also obtained by using records of material inspection on the uranium metal as raw materials. Those material inspection records were logged at the construction in 1973.

The uranium metal was composed of three heats, GUNFC (Gulf United Nuclear Fuels Corp., US.), AI (Atomic International Inc., US.) J-04, and AI J-06. For the heats, AI J-04 and AI J-06, uranium-234 and uranium-236 compositions are available in the material inspection records, but those nuclides are not found in the GUNFC record. Since the weight of the GUNFC uranium occupied 60% of the total uranium weight, only two sorts of uranium nuclide, uranium-235 and 238, were considered.

The impurities of uranium and zirconium were obtained by using records of material inspection for the uranium metal and zirconium sponge at the construction in 1973.

The parameters and impurities, which are necessary to obtain atomic number densities, are listed in Table 3.1.1 and Table 3.1.2, respectively.

| Item | Value ± 1σ | Relative error (%) | |
|--|----------------------------------|--------------------|--|
| Volume of U-ZrH (cm ³) ^{*1} | (5.7483 ± 0.024)×10 ⁴ | 0.41 | |
| Atomic ratio: H/Zr ^{*2} | 1.62 ± 0.02 | 1.51 | |
| U-235 enrichment (wt%) ^{*2} | 19.85 ± 0.11 | 0.55 | |
| Density of H (g/cm ³) | 0.0930 ± 0.0004 | 0.41 | |
| Density of U-235 (g/cm ³) | 0.1420 ± 0.0006 | 0.41 | |
| Density of U-238 (g/cm ³) | 0.5734 ± 0.0046 | 0.80 | |
| Density of Zr (g/cm ³) | 5.2050 ± 0.0813 | 1.56 | |
| Density of U-ZrH (g/cm ³) | 6.0134 ± 0.0814 | 1.35 | |

Table 3.1.1 Parameters of the uranium-zirconium hydride in the fuel, control, and safety rods.

*1 Calculated by using the design drawings and dimensional inspection records. *2 Obtained by using the material inspection records.

| Table 3.1.2(1) Impurities in the uranium. | | |
|---|----------------|--|
| Element | Fraction (ppm) | |
| Magnesium | 12 | |
| Aluminum | 30 | |
| Silicon | 175 | |
| Chromium | 28 | |
| Iron | 158 | |
| Nickel | 52 | |

Table 3.1.2(2) Impurities in the zirconium.

| Element | Fraction (ppm) |
|-----------|----------------|
| Carbon | 140 |
| Nitrogen | 22 |
| Oxygen | 800 |
| Magnesium | 55 |
| Aluminum | 45 |
| Chlorine | 100 |
| Chromium | 46 |
| Iron | 315 |
| Hafnium | 28 |

The atomic number densities of nuclides for the uranium-zirconium hydride in the fuel, control, and safety rods are listed in Table 3.1.3.

| Nuclide | Atomic Number Density (1/barn cm) |
|----------------------|-----------------------------------|
| H-1 ^{*1} | 5.5586×10 ⁻² |
| Zr-90 ^{*1} | 1.7678×10 ⁻² |
| Zr-91 ^{*1} | 3.8552×10 ⁻³ |
| Zr-92 ^{*1} | 5.8928 × 10 ⁻³ |
| Zr-94 ^{*1} | 5.9718×10 ⁻³ |
| Zr-96 ^{*1} | 9.6209×10 ⁻⁴ |
| U-235 | 3.6389×10 ⁻⁴ |
| U-238 | 1.4505×10 ⁻³ |
| C-12 ^{*2} | 3.6133×10 ⁻⁵ |
| C-13 ^{*2} | 4.0189×10 ⁻⁷ |
| N-14 ^{*2} | 4.9050×10 ⁻⁶ |
| N-15 ^{*2} | 1.8216×10 ⁻⁸ |
| O-16 ^{*2} | 1.5673×10 ⁻⁴ |
| Mg-24 ^{*2} | 5.7755×10 ⁻⁶ |
| Mg-25 ^{*2} | 7.3116 × 10 ⁻⁷ |
| Mg-26 ^{*2} | 8.0501×10 ⁻⁷ |
| AI-27 ^{*2} | 5.7067×10 ⁻⁶ |
| Si-28 ^{*2} | 2.4758×10 ⁻⁶ |
| Si-29 ^{*2} | 1.2536 × 10 ⁻⁷ |
| Si-30 ^{*2} | 8.3215×10 ⁻⁸ |
| CI-35*2 | 6.6990×10^{-6} |
| CI-37*2 | 2.1422×10 ⁻⁶ |
| Cr-50 ^{*2} | 1.3069×10^{-7} |
| Cr-52 ^{*2} | 2.5202×10 ⁻⁶ |
| Cr-53 ^{*2} | 2.8574×10^{-7} |
| Cr-54 ^{*2} | 7.1134 × 10 ⁻⁸ |
| Fe-54 ^{*2} | 1.1152 × 10 ⁻⁶ |
| Fe-56 ^{*2} | 1.7337 × 10 ⁻⁵ |
| Fe-57 ^{*2} | 3.9695×10^{-7} |
| Fe-58 ^{*2} | 5.2926 × 10 ⁻⁸ |
| Ni-58 ^{*2} | 2.5893 × 10 ⁻⁷ |
| Ni-60 ^{*2} | 9.8989×10 ⁻⁸ |
| Ni-61* ² | 4.2858 × 10 ⁻⁹ |
| Ni-62 ^{*2} | 1.3616×10 ⁻⁸ |
| Ni-64 ^{*2} | 3.4514 × 10 ⁻⁹ |
| Hf-174 ^{*2} | 7.9659×10 ⁻¹⁰ |
| Hf-176 ^{*2} | 2.5599×10 ⁻⁸ |
| Hf-177 ^{*2} | 9.1490 × 10 ⁻⁸ |
| Hf-178 ^{*2} | 1.3422×10 ⁻⁷ |
| Hf-179 ^{*2} | 6.7017×10 ⁻⁸ |
| Hf-180 ^{*2} | 1.7259×10 ⁻⁷ |

Table 3.1.3 Atomic number densities of nuclides for the uranium-zirconium hydride in the fuel, control, and safety rods. --

*1 Thermal scattering law (TSL) data used as zirconium hydride. *2 Impurities.

3.2 Zirconium rod in fuel, control, and safety rods

The density of zirconium was cited from the literature ¹¹⁾, as 6.52 g/cm³. The difference in the density between the above value and that of the other TRIGA benchmarks, i.e., IEU-COMP-THERM-013 (ICT-013) ¹²⁾ and IEU-COMP-THERM -003 (ICT-003) ¹³⁾ in the ICSBEP handbook ¹⁰⁾, is 0.03 g/cm³ in maximum. Thus, the error in the zirconium density was estimated to be 0.03 g/cm³ (0.46 %).

The impurities of zirconium were obtained by using material inspection records at the construction in 1973. The impurities, which are necessary to obtain atomic number densities, are listed in Table 3.2.1.

| Table 3.2.1 Impurities in the zirconium rod. | | |
|--|----------------|--|
| Element | Fraction (ppm) | |
| Boron | 0.2 | |
| Carbon | 115 | |
| Nitrogen | 40 | |
| Chromium | 71.5 | |
| Iron | 560.5 | |
| Copper | 12 | |
| Hafnium | 32.5 | |

The atomic number densities of nuclides for the zirconium rod in the fuel, control, and safety rods are listed in Table 3.2.2.

| in the rule, control, and safety rous. | | |
|--|-----------------------------------|--|
| Nuclide | Atomic Number Density (1/barn cm) | |
| Zr-90 | 2.2145 × 10 ⁻² | |
| Zr-91 | 4.8293 × 10 ⁻³ | |
| Zr-92 | 7.3816 × 10 ⁻³ | |
| Zr-94 | 7.4806 × 10 ⁻³ | |
| Zr-96 | 1.2052×10 ⁻³ | |
| B-10 ^{*1} | 1.4455 × 10⁻ ⁸ | |
| B-11 ^{*1} | 5.8182×10 ⁻⁸ | |
| C-12 ^{*1} | 3.7180×10⁻⁵ | |
| C-13 ^{*1} | 4.1353 × 10 ⁻⁷ | |
| N-14 ^{*1} | 1.1171 × 10⁻⁵ | |
| N-15 ^{*1} | 4.1488 × 10 ⁻⁸ | |

Table 3.2.2 Atomic number densities of nuclides for the zirconium rod in the fuel, control, and safety rods.

*1 Impurities.

| Nuclide | Atomic Number Density (1/barn cm) | |
|----------------------|-----------------------------------|--|
| Cr-50 ^{*1} | 2.3460 × 10 ⁻⁷ | |
| Cr-52 ^{*1} | 4.5240 × 10 ⁻⁶ | |
| Cr-53 ^{*1} | 5.1293 × 10 ⁻⁷ | |
| Cr-54 ^{*1} | 1.2769×10 ⁻⁷ | |
| Fe-54 ^{*1} | 2.3251 × 10 ⁻⁶ | |
| Fe-56 ^{*1} | 3.6146×10⁻⁵ | |
| Fe-57 ^{*1} | 8.2759×10 ⁻⁷ | |
| Fe-58 ^{*1} | 1.1035×10 ⁻⁷ | |
| Cu-63 ^{*1} | 5.1287 × 10 ⁻⁷ | |
| Cu-65 ^{*1} | 2.2859×10 ⁻⁷ | |
| Hf-174 ^{*1} | 1.1582×10 ⁻⁹ | |
| Hf-176 ^{*1} | 3.7220 × 10 ⁻⁸ | |
| Hf-177 ^{*1} | 1.3302×10 ⁻⁷ | |
| Hf-178 ^{*1} | 1.9516 × 10 ⁻⁷ | |
| Hf-179 ^{*1} | 9.7440 × 10 ⁻⁸ | |
| Hf-180 ^{*1} | 2.5095 × 10 ⁻⁷ | |

Table 3.2.2 (contd.) Atomic number densities of nuclides for the zirconium rod in the fuel, control, and safety rods.

*1 Impurities.

_

3.3 Stainless-steel type SUS304 of cladding in fuel rod

The density of SUS304 was cited from the literature ¹⁴⁾, as 7.93 g/cm³. The difference in the density between the above value and that of the other TRIGA benchmarks, i.e., ICT-013¹²⁾ and ICT-003¹³⁾, is 0.07 g/cm³ in maximum. Thus, the error in the density was estimated to be 0.07 g/cm³ (0.88 %).

The composition of the cladding in the fuel rod based on the ASTM A213-66¹⁵⁾ standard was obtained by using material inspection records at the construction in 1973. The elemental composition, which is necessary to obtain atomic number densities, is listed in Table 3.3.1.

| ne 9.9.1 Elemental composition of the cladding in the ruch | | |
|--|----------------|--|
| Element | Fraction (wt%) | |
| Boron | 0.0017 | |
| Carbon | 0.0533 | |
| Silicon | 0.5367 | |
| Phosphorus | 0.021 | |
| Sulfur | 0.0137 | |
| Chromium | 18.4833 | |
| Manganese | 1.3667 | |
| Iron | 70.3569 | |
| Nickel | 9.1667 | |

Table 3.3.1 Elemental composition of the cladding in the fuel rod.

The atomic number densities of nuclides for the cladding in the fuel rod are listed in Table 3.3.2.

| Nuclide | Atomic Number Density (1/barn cm) |
|---------|-----------------------------------|
| B-10 | 1.4944 × 10 ⁻⁶ |
| B-11 | 6.0150×10 ⁻⁶ |
| C-12 | 2.0959×10 ⁻⁴ |
| C-13 | 2.3311 × 10 ⁻⁶ |
| Si-28 | 8.4167 × 10 ⁻⁴ |
| Si-29 | 4.2617 × 10 ⁻⁵ |
| Si-30 | 2.8290 × 10 ⁻⁵ |
| P-31 | 3.2378×10⁻⁵ |
| S-32 | 1.9388×10⁻⁵ |
| S-33 | 1.5303 × 10 ⁻⁷ |
| S-34 | 8.5901 × 10 ⁻⁷ |
| S-36 | 4.0808×10 ⁻⁹ |
| Cr-50 | 7.3760×10 ⁻⁴ |
| Cr-52 | 1.4224 × 10 ⁻² |
| Cr-53 | 1.6127×10 ⁻³ |
| Cr-54 | 4.0148×10 ⁻⁴ |
| Mn-55 | 1.1880×10 ⁻³ |
| Fe-54 | 3.5498 × 10 ⁻³ |
| Fe-56 | 5.5184 × 10 ⁻² |
| Fe-57 | 1.2635×10 ⁻³ |
| Fe-58 | 1.6847 × 10 ⁻⁴ |
| Ni-58 | 5.0923 × 10 ⁻³ |
| Ni-60 | 1.9468 × 10 ⁻³ |
| Ni-61 | 8.4288×10 ⁻⁵ |
| Ni-62 | 2.6778×10 ⁻⁴ |
| Ni-64 | 6.7878×10 ⁻⁵ |

Table 3.3.2 Atomic number densities of nuclides for the cladding in the fuel rod.

3.4 Stainless-steel type SUS304 of top/bottom plugs in fuel rod

The density of SUS304 was cited from the literature ¹⁴⁾, as 7.93 g/cm³, same as the cladding in the fuel rod. The error in the density was also estimated to be 0.07 g/cm³ (0.88 %), same as the cladding in the fuel rod.

The composition of the top/bottom plugs in the fuel rod based on the AMS 5370¹⁶⁾ standard was obtained by using material inspection records at the construction in 1973. The elemental composition, which is necessary to obtain atomic number densities, is listed in Table 3.4.1.

| Element | Fraction (wt%) |
|------------|----------------|
| Carbon | 0.027 |
| Silicon | 0.55 |
| Phosphorus | 0.016 |
| Sulfur | 0.02 |
| Chromium | 18.6 |
| Manganese | 1.28 |
| Iron | 70.557 |
| Nickel | 8.95 |

Table 3.4.1 Elemental composition of the top/bottom plugs in the fuel rod.

The atomic number densities of nuclides for the top/bottom plugs in the fuel rod are listed in Table 3.4.2.

| In the fuel rod. | | |
|------------------|-----------------------------------|--|
| Nuclide | Atomic Number Density (1/barn cm) | |
| C-12 | 1.0617 × 10 ⁻⁴ | |
| C-13 | 1.1809×10 ⁻⁶ | |
| Si-28 | 8.6253×10 ⁻⁴ | |
| Si-29 | 4.3674×10 ⁻⁵ | |
| Si-30 | 2.8991 × 10 ⁻⁵ | |
| P-31 | 2.4669×10 ⁻⁵ | |
| S-32 | 2.8304 × 10 ⁻⁵ | |
| S-33 | 2.2340 × 10 ⁻⁷ | |
| S-34 | 1.2540×10 ⁻⁶ | |
| S-36 | 5.9574 × 10 ⁻⁹ | |
| Cr-50 | 7.4225×10 ⁻⁴ | |
| Cr-52 | 1.4314 × 10 ⁻² | |
| Cr-53 | 1.6229×10 ⁻³ | |
| Cr-54 | 4.0401 × 10 ⁻⁴ | |
| Mn-55 | 1.1126×10 ⁻³ | |
| Fe-54 | 3.5599×10 ⁻³ | |
| Fe-56 | 5.5341 × 10 ⁻² | |
| Fe-57 | 1.2671×10 ⁻³ | |
| Fe-58 | 1.6894×10 ⁻⁴ | |
| Ni-58 | 4.9719×10 ⁻³ | |
| Ni-60 | 1.9008×10 ⁻³ | |
| Ni-61 | 8.2295×10 ⁻⁵ | |
| Ni-62 | 2.6145×10 ⁻⁴ | |
| Ni-64 | 6.6273×10 ⁻⁵ | |

Table 3.4.2 Atomic number densities of nuclides for the top/bottom plugs in the fuel rod.

3.5 Molybdenum disc in fuel rod

The density of molybdenum was cited from the literature ¹¹), as 10.28 g/cm³. The difference in the density between the above value and that of the other TRIGA benchmarks, i.e., ICT-013¹² and ICT-003¹³, is 0.08 g/cm³ in maximum. Thus, the error in the molybdenum density was estimated to be 0.08 g/cm³ (0.78 %).

The impurities of the molybdenum disc were obtained by using material inspection records at the construction in 1973. The impurities, which are necessary to obtain atomic number densities, are listed in Table 3.5.1.

| Table 3.5.1 Impurities in the molybdenum disc. | | |
|--|----------------|--|
| Element | Fraction (ppm) | |
| Hydrogen | 2 | |
| Nitrogen | 5 | |
| Oxygen | 25 | |
| Sodium | 8 | |
| Aluminum | 10 | |
| Silicon | 17 | |
| Phosphorus | 3 | |
| Calcium | 30 | |
| Chromium | 10 | |
| Manganese | 10 | |
| Iron | 40 | |
| Nickel | 10 | |
| Copper | 12 | |
| Tungsten | 90 | |

The atomic number densities of nuclides for the molybdenum disc in the fuel rod are listed in Table 3.5.2.

Table 3.5.2 Atomic number densities of nuclides for the molybdenum disc in the fuel red

| in the fuel rod. | | |
|------------------|-----------------------------------|--|
| Nuclide | Atomic Number Density (1/barn cm) | |
| Mo-92 | 9.5767 × 10 ⁻³ | |
| Mo-94 | 5.9693 × 10 ⁻³ | |
| Mo-95 | 1.0274 × 10 ⁻² | |
| Mo-96 | 1.0764 × 10 ⁻² | |
| Mo-97 | 6.1629×10 ⁻³ | |
| Mo-98 | 1.5572 × 10 ⁻² | |
| Mo-100 | 6.2145 × 10 ⁻³ | |

| | 111 0110 1001 100. |
|---------------------|-----------------------------------|
| Nuclide | Atomic Number Density (1/barn cm) |
| H-1 ^{*1} | 1.2284×10 ⁻⁵ |
| N-14 ^{*1} | 2.2017 × 10 ⁻⁶ |
| N-15 ^{*1} | 8.1766×10 ⁻⁹ |
| O-16 ^{*1} | 9.6734×10 ⁻⁶ |
| Na-23 ^{*1} | 2.1542×10 ⁻⁶ |
| AI-27 ^{*1} | 3.5532×10 ⁻⁶ |
| Si-28 ^{*1} | 5.3522×10 ⁻⁶ |
| Si-29 ^{*1} | 2.7100 × 10 ⁻⁷ |
| Si-30 ^{*1} | 1.7990×10 ⁻⁷ |
| P-31 ^{*1} | 5.9961 × 10 ⁻⁷ |
| Ca-40 ¹ | 3.1479×10 ⁻⁸ |
| Ca-42 ^{*1} | 6.4050×10 ⁻⁹ |
| Ca-43 ^{*1} | 9.8908×10 ⁻⁸ |
| Ca-44 ^{*1} | 1.9379×10 ⁻¹⁰ |
| Ca-46*1 | 9.0425×10 ⁻⁹ |
| Ca-48 ^{*1} | 8.6656×10 ⁻⁹ |
| Cr-50 ^{*1} | 5.1732×10 ⁻⁸ |
| Cr-52 ^{*1} | 9.9761 × 10 ⁻⁷ |
| Cr-53 ^{*1} | 1.1311×10 ⁻⁷ |
| Cr-54 ^{*1} | 2.8158 × 10 ⁻⁸ |
| Mn-55 ^{*1} | 1.1269×10 ⁻⁶ |
| Fe-54 ^{*1} | 2.6162 × 10 ⁻⁷ |
| Fe-56 ^{*1} | 4.0672×10 ⁻⁶ |
| Fe-57 ^{*1} | 9.3121 × 10 ⁻⁸ |
| Fe-58 ^{*1} | 1.2416×10 ⁻⁸ |
| Ni-58 ^{*1} | 7.2015 × 10 ⁻⁷ |
| Ni-60 ^{*1} | 2.7532×10 ⁻⁷ |
| Ni-61*1 | 1.1920×10 ⁻⁸ |
| Ni-62 ^{*1} | 3.7869×10 ⁻⁸ |
| Ni-64 ^{*1} | 9.5992×10 ⁻⁹ |
| Cu-63 ^{*1} | 8.0864 × 10 ⁻⁷ |
| Cu-65 ^{*1} | 3.6042×10 ⁻⁷ |
| W-180 ^{*1} | 3.6367×10 ⁻⁹ |
| W-182 ^{*1} | 7.9703×10 ⁻⁷ |
| W-183 ^{*1} | 4.3276×10 ⁻⁷ |
| W-184 ^{*1} | 9.3038×10 ⁻⁷ |
| W-186 ^{*1} | 8.6674×10 ⁻⁷ |

Table 3.5.2 (contd.) Atomic number densities of nuclides for the molybdenum disc in the fuel rod.

*1 Impurities.

3.6 Axial graphite reflector in fuel rod

The density of graphite was cited from the ICT-013¹²⁾ benchmark referring to the General Atomic TRIGA model, as 1.73 g/cm³. The error in the density is evaluated as 0.01 g/cm³ in the ICT-013, however, the discrepancy in the density is

 0.13 g/cm^3 between the ICT-013 and another TRIGA benchmark, ICT-003¹³). For this reason, the error in the graphite density was estimated to be 0.13 g/cm^3 (7.51%) conservatively.

The content of boron as an impurity in the axial graphite reflectors is mentioned in material inspection records at the construction in 1973. The boron content was smaller than 0.5 ppm of the lower limit of detection. Thus, no impurity was considered for the composition of the graphite.

The atomic number densities of nuclides for the axial graphite reflectors in the fuel rod are listed in Table 3.6.1.

Table 3.6.1 Atomic number densities of nuclides for the axial graphite reflectors

| in the fuel rod. | | |
|------------------|--------------------|-----------------------------------|
| | Nuclide | Atomic Number Density (1/barn cm) |
| | C-12 ^{*1} | 8.5785 × 10 ⁻² |
| | C-13 ^{*1} | 9.5413×10 ⁻⁴ |
| 4.4.3 | | |

*1 Thermal scattering law (TSL) data used as graphite.

3.7 Natural boron carbide absorber in control and safety rods

The material inspection records on the natural boron carbide in the control and safety rods at the construction in 1973 are not found at present. The composition of the natural boron carbide and its error were estimated by using data at the renewal of control and safety rods in 1995. The parameters, which are necessary to obtain atomic number densities, are listed in Table 3.7.1.

| In the control and safety rous. | | |
|---|-------------------|--------------------|
| Item | Value ± 1σ | Relative error (%) |
| Density of B₄C (g/cm³) ^{*1} | 2.5000 ± 0.0059 | 0.23 |
| B content of B ₄ C (wt%) ^{*1} | 78.263 ± 0.103 | 0.13 |

Table 3.7.1 Parameters of the natural boron carbide absorber in the control and safety rods.

*1 Estimated by the material inspection records in 1995.

The atomic number densities of nuclides for the natural boron carbide absorber in the control and safety rods are listed in Table 3.7.2.

| Nuclide | Atomic Number Density (1/barn cm) | |
|---------|-----------------------------------|--|
| B-10 | 2.1688 × 10 ⁻² | |
| B-11 | 8.7299×10 ⁻² | |
| C-12 | 2.6947 × 10 ⁻² | |
| C-13 | 2.9971 × 10 ⁻⁴ | |

Table 3.7.2 Atomic number densities of nuclides for the natural boron carbide absorber in the control and safety rods.

3.8 Stainless-steel type SUS304 of cladding, spacer, and top/bottom plugs in control and safety rods

The density of SUS304 was cited from the literature ¹⁴⁾, as 7.93 g/cm³, same as the cladding in the fuel rod. The error in the density was also estimated to be 0.07 g/cm³ (0.88 %), same as the cladding in the fuel rod.

The material inspection records on stainless steel type SUS304 of the cladding, spacer, and top/bottom plugs in the control and safety rods at the construction in 1973 are not found at present. Thus, the composition of those was estimated by using the standard of SUS304. The ASTM A213-66¹⁵⁾ standard was adopted for the estimation since the difference in the compositions between ASTM A213-66 and ASM 5370¹⁶⁾ is quite small. The average of upper and lower limits was adopted as estimated fraction values for the elements of which fraction is specified with the range in the standard, e.g., chromium, manganese, and nickel. The fraction value of the upper limits was adopted as estimated fraction values for the other elements, e.g., carbon, silicon, phosphorus, and sulfur.

The elemental composition, which is necessary to obtain atomic number densities, is listed in Table 3.8.1.

| In the control and safety rous. | | |
|---------------------------------|----------------|--|
| Element | Fraction (wt%) | |
| Carbon | 0.08 | |
| Silicon | 0.75 | |
| Phosphorus | 0.04 | |
| Sulfur | 0.03 | |
| Chromium | 19 | |
| Manganese | 2 | |
| Iron | 68.6 | |
| Nickel | 9.5 | |

Table 3.8.1 Elemental composition of the cladding, spacer, and top/bottom plugs

The atomic number densities of nuclides for the cladding, spacer, and top/bottom plugs in the control and safety rods are listed in Table 3.8.2.

| top, sottom prago in the control and safety rous. | | |
|---|-----------------------------------|--|
| Nuclide | Atomic Number Density (1/barn cm) | |
| C-12 | 3.1458×10 ⁻⁴ | |
| C-13 | 3.4988×10 ⁻⁶ | |
| Si-28 | 1.1762×10 ⁻³ | |
| Si-29 | 5.9555 × 10 ⁻⁵ | |
| Si-30 | 3.9533×10⁻⁵ | |
| P-31 | 6.1672×10 ⁻⁵ | |
| S-32 | 4.2456 × 10 ⁻⁵ | |
| S-33 | 3.3510 × 10 ⁻⁷ | |
| S-34 | 1.8811 × 10 ⁻⁶ | |
| S-36 | 8.9361×10 ⁻⁹ | |
| Cr-50 | 7.5822×10 ⁻⁴ | |
| Cr-52 | 1.4622×10 ⁻² | |
| Cr-53 | 1.6578×10 ⁻³ | |
| Cr-54 | 4.1270×10 ⁻⁴ | |
| Mn-55 | 1.7385×10 ⁻³ | |
| Fe-54 | 3.4612×10 ⁻³ | |
| Fe-56 | 5.3806 × 10 ⁻² | |
| Fe-57 | 1.2319×10 ⁻³ | |
| Fe-58 | 1.6426×10 ⁻⁴ | |
| Ni-58 | 5.2775 × 10 ⁻³ | |
| Ni-60 | 2.0176 × 10 ⁻³ | |
| Ni-61 | 8.7352×10 ⁻⁵ | |
| Ni-62 | 2.7752×10 ⁻⁴ | |
| Ni-64 | 7.0346×10 ⁻⁵ | |

Table 3.8.2 Atomic number densities of nuclides for the cladding, spacer, and top/bottom plugs in the control and safety rods.

3.9 Aluminum alloy type A6061 of spacer tube in control and safety rods, and of cladding, spacer, air follower/spacer tubes, and top/bottom plugs in adjustable and fast transient rods

The density of A6061 was cited from the literature ¹⁷⁾, as 2.7 g/cm³. There is no difference in the density between the above value and that of the other TRIGA benchmarks, i.e., ICT-013 ¹²⁾ and ICT-003 ¹³⁾. Thus, the error in the density was assumed not to be taken into account.

The material inspection records on aluminum alloy type A6061 for the control and safety rods, and the adjustable and fast transient rods at the construction in 1973 are not found at present. Thus, the composition of those was estimated by using the ASTM B210-12¹⁸⁾ standard of A6061. The average of upper and lower limits was adopted as estimated fraction values for the elements of which fraction is specified with the range in the standard, e.g., magnesium, silicon, chromium, and copper. The fraction value of the upper limits was adopted as estimated fraction values for the other elements, e.g., titanium, manganese, iron, and zinc.

The elemental composition, which is necessary to obtain atomic number densities, is listed in Table 3.9.1.

| in the adjustable and fast transient rods. | | |
|--|----------------|--|
| Element | Fraction (wt%) | |
| Magnesium | 1.0 | |
| Aluminum | 96.68 | |
| Silicon | 0.6 | |
| Titanium | 0.15 | |
| Chromium | 0.195 | |
| Manganese | 0.15 | |
| Iron | 0.7 | |
| Copper | 0.275 | |
| Zinc | 0.25 | |

Table 3.9.1 Elemental composition of the spacer tube in the control and safety rods, and of the cladding, spacer, air follower/spacer tubes, and top/bottom plugs

The atomic number densities of nuclides for the spacer tube in the control and safety rods, and for the cladding, spacer, air follower/spacer tubes, and top/bottom plugs in the adjustable and fast transient rods are listed in Table 3.9.2.

Table 3.9.2 Atomic number densities of nuclides for the spacer tube in the control and safety rods, and for the cladding, spacer, air follower/spacer tubes, and ton/bottom plugs in the adjustable and fast transient rods.

| top/bottom plugs in the adjustable and last transient rods. | |
|---|-----------------------------------|
| Nuclide | Atomic Number Density (1/barn cm) |
| Mg-24 | 5.2843 × 10 ⁻⁴ |
| Mg-25 | 6.6998×10 ⁻⁵ |
| Mg-26 | 7.3655×10⁻⁵ |
| Al-27 | 5.8261 × 10 ⁻² |
| Si-28 | 3.2037 × 10 ⁻⁴ |
| Si-29 | 1.6222×10⁻⁵ |
| Si-30 | 1.0768 × 10 ⁻⁵ |
| | |
| Nuclide | Atomic Number Density (1/barn cm) |
|---------|-----------------------------------|
| Ti-46 | 4.0752 × 10 ⁻⁶ |
| Ti-47 | 3.7187 × 10 ⁻⁶ |
| Ti-48 | 3.7594 × 10⁻⁵ |
| Ti-49 | 2.8017×10 ⁻⁶ |
| Ti-50 | 2.7508 × 10 ⁻⁶ |
| Cr-50 | 2.6495 × 10 ⁻⁶ |
| Cr-52 | 5.1094 × 10 ⁻⁵ |
| Cr-53 | 5.7929×10 ⁻⁶ |
| Cr-54 | 1.4421×10 ⁻⁶ |
| Mn-55 | 4.4395×10 ⁻⁵ |
| Fe-54 | 1.2025 × 10 ⁻⁵ |
| Fe-56 | 1.8694×10 ⁻⁴ |
| Fe-57 | 4.2801 × 10 ⁻⁶ |
| Fe-58 | 5.7068 × 10 ⁻⁷ |
| Cu-63 | 4.8672×10 ⁻⁵ |
| Cu-65 | 2.1694 × 10 ⁻⁵ |
| Zn-64 | 3.0209 × 10 ⁻⁵ |
| Zn-66 | 1.7342×10 ⁻⁵ |
| Zn-67 | 2.5485 × 10 ⁻⁶ |
| Zn-68 | 1.1686 × 10⁻⁵ |
| Zn-70 | 3.7295 × 10 ⁻⁷ |

Table 3.9.2 (contd.) Atomic number densities of nuclides for the spacer tube in the control and safety rods, and for the cladding, spacer, air follower/spacer tubes, and top/bottom plugs in the adjustable and fast transient rods.

3.10 Enriched boron carbide absorber in adjustable and fast transient rods

The material inspection records on the enriched boron carbide absorber in the adjustable and fast transient rods at the construction in 1973 are not found at present. The composition of the enriched boron carbide and its error were estimated by using data at the renewal of the adjustable transient rod in 1992 and the fast transient rod in 1995. The parameters, which are necessary to obtain atomic number densities, are listed in Table 3.10.1.

Table 3.10.1 Parameters of the enriched boron carbide absorber in the adjustable and fast transient rods.

| =================================== | | |
|---|------------------------|--------------------|
| Item | Value ± 1 σ | Relative error (%) |
| Density of B₄C (g/cm ³) ^{*1} | 2.3000 ± 0.0343 | 1.49 |
| B content of B_4C (wt%) ^{*1} | 77.0701 ± 0.4699 | 0.61 |
| B-10 enrichment (wt%) ^{*1} | 92.00 ± 0.47 | 0.51 |
| *1 Estimated by the motorial increation re- | cords in 1002 and 1005 | |

*1 Estimated by the material inspection records in 1992 and 1995.

The atomic number densities of nuclides for the enriched boron carbide absorber in the adjustable and fast transient rods are listed in Table 3.10.2.

Table 3.10.2 Atomic number densities of nuclides for the enriched boron carbide absorber in the adjustable and fast transient rods.

| Nuclide | Atomic Number Density (1/barn cm) |
|---------|-----------------------------------|
| B-10 | 9.8082×10 ⁻² |
| B-11 | 7.7570 × 10 ⁻³ |
| C-12 | 2.6151 × 10 ⁻² |
| C-13 | 2.9086 × 10 ⁻⁴ |

3.11 Water as moderator and reflector

The density of water was cited from the literature ¹⁹⁾. The water densities in the range of 16 to 28 °C, which are necessary to obtain atomic number densities, are listed in Table 3.11.1.

| - | |
|------------------------------|---|
| Density (g/cm ³) | |
| 0.99894 | |
| 0.99877 | |
| 0.99859 | |
| 0.99840 | |
| 0.99820 | |
| 0.99799 | |
| 0.99777 | |
| 0.99754 | |
| 0.99730 | |
| 0.99704 | |
| 0.99678 | |
| 0.99651 | |
| 0.99623 | |
| | Density (g/cm ³) 0.99894 0.99877 0.99859 0.99840 0.99820 0.99799 0.99777 0.99754 0.99730 0.99704 0.99678 0.99651 0.99623 |

The atomic number densities of nuclides for the moderator and reflector water of typical temperature, 21 and 23 °C, are listed in Table 3.11.2.

| water of typ. | ical temperature, 21 and 20°0. |
|--------------------|-----------------------------------|
| Nuclide | Atomic Number Density (1/barn cm) |
| 21 °C | |
| H-1 ^{*1} | 6.6719×10 ⁻² |
| O-16 ^{*1} | 3.3361 × 10 ⁻² |
| 23 °C | |
| H-1 ^{*1} | 6.6689×10 ⁻² |
| O-16 ^{*1} | 3.3346 × 10 ⁻² |

Table 3.11.2 Atomic number densities of nuclides for the moderator and reflector water of typical temperature, 21 and 23 °C.

*1 Thermal scattering law (TSL) data used as light water. The TSL data of O-16 used in the case of JENDL-5 library only.

3.12 Other core structures

The material inspection records on the other core structures, i.e., the experimental tube, grid plates, shroud, and guide tubes for the transient rods, at the construction in 1973 are not found at present. Thus, it was assumed that the compositions of the experimental tube, grid plates, and shroud were based on the ASTM B210-12¹⁸ standard of A6061 described in Sec. 3.9, same as the spacer tube in the control and safety rods and so on. The composition of the guide tubes for the transient rods was also assumed to be based on the ASTM A213-66¹⁵ standard of SUS304 described in Sec. 3.8, same as the cladding in the control and safety rods.

4. Operation Data

The vertical positions of the control, safety, and transient rods are essential parameters to define delayed critical conditions. The position data were confirmed by using operation records during the first startup in 1975. In addition, the model temperature affecting criticality was obtained by using the operation records. These data are described below.

4.1 Minimum and standard cores

The first criticality of the minimum core was attained by the reactivity control with only the adjustable transient rod (TA) whilst all control (R1 to R6), safety (S1 and S2), and fast transient rods (TA and TB) were being fully withdrawn ¹⁾. On the other hand, the first criticality of the standard core was attained by the reactivity control of 'bank mode' with all control rods whilst all safety and transient rods were being fully withdrawn ¹⁾.

In NSRR, the absorber rod position of 100 units means full insertion of the control, safety, and adjustable transient rod, meanwhile that of 900 units does full withdrawal of them. The stroke length from full insertion to full withdrawal is 38.1 cm. Thus, one unit is identical to 0.0476 cm (38.1 cm per 800 unit). The rod positions were confirmed by operation records logged for the first startup in 1975. The uncertainty in the rod position was estimated to be 5 units (about 2.4 mm) conservatively by the maintenance standard for the position indicator. The rod positions of both the minimum and standard cores are listed in Table 4.1.1.

The temperature of the models was also estimated to be 23 °C by using the pool water temperature logged in the operation records in 1975. The uncertainty in the temperature was assumed to be 5 °C conservatively considering the variation of the pool water temperature for each day of operations although the water temperature was measured by thermometers with ± 0.43 °C of precision.

The operation power at criticality was 0.4 and 50 W for the minimum and standard cores, respectively. The heat capacity of the uranium-zirconium hydride totally loaded in the standard core is estimated to be 1.21×10^5 J/°C at 25 °C, which is obtained by the mass heat capacity of the uranium-zirconium hydride^{*1} and its mass inventory^{*2}. Even if the operation time during the criticality at 50 W would

^{*1} The mass heat capacity is estimated to be 0.350 J/g/°C at 25°C in the case of 11.9 wt% of uranium in the uranium-zirconium hydride ²⁰⁾.

 $^{^{*2}}$ $\,$ The mass inventory is calculated to be $3.46 \times 10^5 \, {\rm g}$ from the data in Table 3.1.1.

be overestimated as one hour (= 3,600 s), the increase of the temperature of the uranium-zirconium hydride is estimated to be 1.5 °C without heat removal. This increase of temperature is within the above-mentioned uncertainty in the temperature.

4.2 Intermediate cores

The delayed criticality of the intermediate cores was attained by the reactivity control of 'bank mode'¹⁾, similar to the standard core. The positions of the control, safety, and transient rods, and their uncertainties were obtained by the same method as those for the minimum and standard cores. The absorber rod positions of the intermediate cores are listed in Table 4.2.1. The core composed in the last step, i.e., ID=aj, is identical to the standard core.

The temperature of the cores was estimated to be 21 °C by using the pool water temperature logged in the operation records for the first startup in 1975. The uncertainty in temperature was assumed to be same as that of the minimum and standard cores.

The operation power at criticality was in the range of 1.5 to 50 W. Even if the operation time during the criticality at 50 W would be overestimated as one hour, the increase of temperature in the uranium-zirconium hydride during the operation is within the uncertainty in the temperature, as described in Sec. 4.1.

| | Domorho | Reliaiks | Minimum core | Standard core | |
|----------|-----------------------|---------------|------------------|------------------|--|
| | BANK | av. (unit) | 898.2 | 213.0 | |
| | Ind TC | TC | dn | dn | |
| s. | n for TB a | TB | dn | dn | |
| rd core | ll insertior | ΤA | 782 | 895 | |
| standa | ind dn: ful | S2 | 897 | 897 | |
| n and s | hdrawal a | S1 | 899 | 899 | |
| inimur | , and TA, up: full wi | R6 | 894 | 213 | |
| f the m | | R5 | 896 | 209 | |
| tions of | 3, S1-S2, | R4 | 903 | 211 | |
| isod po | for R1-R(| R3 | 897 | 216 | |
| t.1.1 Ro | tion (unit) | R2 | 901 | 211 | |
| Table 4 | Rod posi | R1 | 898 | 218 | |
| - | ⊆ | _ ⊇ | а | ŋ | |
| | The number | of fuel rods | 113 | 149 | |
| | | Date and unie | 1975/06/30 12:00 | 1975/07/03 20:02 | |

| cores |
|---------------|
| ard |
| stand |
| and |
| mum |
| mini |
| the |
| \mathbf{of} |
| positions |
| od |
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| .1 |
| 1.1 |
| d) |

| | - ī | | | Table 4 | .2.1 Ro | d posit | ions of | the int | ermed | iate cor | es. | Ĺ | C H | | - |
|------------------|--------------|------------|-----|---------|--------------------|---------|------------------|-------------------|------------|---------------------|-----|----|--------|------------|------------------------------|
| Date and time | of fuel rods | ₽ | R1 | R2 | .) IUI N I-F R3 | R4 | , allu IA, R5 | up. Iuli wi R6 | s Indrawal | si la uli. Iu S2 | TA | TB | TC TC | av. (unit) | Position of tuel addition |
| 1975/07/02 14:32 | 114 | Ø | 812 | 808 | 810 | 808 | 803 | 802 | 898 | 896 | 895 | dn | dn | 807.2 | D-1 |
| 1975/07/02 15:35 | 115 | q | 780 | 776 | 677 | 776 | 771 | 771 | 898 | 896 | 894 | dn | dn | 775.5 | D-36 |
| 1975/07/02 16:30 | 116 | U | 748 | 743 | 746 | 744 | 739 | 739 | 898 | 896 | 894 | dn | dn | 743.2 | D-7 |
| 1975/07/02 16:57 | 117 | σ | 723 | 717 | 721 | 718 | 714 | 713 | 897 | 899 | 894 | dn | dn | 717.7 | D-28 |
| 1975/07/02 17:30 | 118 | Φ | 704 | 669 | 703 | 701 | 696 | 695 | 899 | 897 | 894 | dn | dn | 699.7 | D-8 |
| 1975/07/02 17:45 | 119 | ᠳ | 688 | 682 | 686 | 684 | 679 | 678 | 899 | 897 | 894 | dn | dn | 682.8 | D-29 |
| 1975/07/02 18:01 | 120 | Ø | 672 | 667 | 670 | 668 | 663 | 663 | 899 | 897 | 894 | dn | dn | 667.2 | D-15 |
| 1975/07/02 18:25 | 121 | ۲ | 656 | 651 | 655 | 652 | 647 | 647 | 899 | 897 | 895 | dn | dn | 651.3 | D-22 |
| 1975/07/03 10:35 | 122 | | 634 | 628 | 632 | 629 | 624 | 624 | 898 | 896 | 894 | dn | dn | 628.5 | E-37 |
| 1975/07/03 10:50 | 123 | · — | 615 | 609 | 614 | 611 | 606 | 606 | 898 | 896 | 894 | dn | dn | 610.2 | E-13 |
| 1975/07/03 11:08 | 124 | × | 596 | 590 | 594 | 591 | 586 | 586 | 898 | 896 | 894 | dn | dn | 590.5 | E-21 |
| 1975/07/03 11:23 | 125 | _ | 580 | 573 | 577 | 574 | 570 | 570 | 898 | 896 | 894 | dn | dn | 574.0 | E-45 |
| 1975/07/03 11:59 | 126 | E | 555 | 562 | 556 | 561 | 558 | 554 | 898 | 896 | 894 | dn | dn | 557.7 | E-29 |
| 1975/07/03 11:55 | 127 | Ę | 546 | 540 | 544 | 541 | 538 | 543 | 898 | 896 | 895 | dn | dn | 542.0 | E-5 |
| 1975/07/03 12:26 | 128 | 0 | 530 | 524 | 529 | 525 | 521 | 528 | 898 | 896 | 895 | dn | dn | 526.2 | E-36 |
| 1975/07/03 13:50 | 129 | ď | 518 | 511 | 517 | 514 | 509 | 516 | 898 | 896 | 895 | dn | dn | 514.2 | E-12 |
| 1975/07/03 14:08 | 130 | σ | 503 | 497 | 502 | 499 | 494 | 501 | 898 | 896 | 895 | dn | dn | 499.3 | E-20 |
| 1975/07/03 14:26 | 131 | ـ | 491 | 484 | 490 | 486 | 482 | 489 | 899 | 897 | 895 | dn | dn | 487.0 | E-44 |

| | The number | | Rod po | sition (unit |) for R1-F | 36. S1-S2. | and TA. I | up: full wi | thdrawal ; | and dn: fu | Il insertion | tor TB al | nd TC | BANK | Position of fuel |
|------------------|--------------|-----|--------|--------------|------------|------------|-----------|-------------|------------|------------|--------------|-----------|-------|------------|---------------------------|
| Date and time | of fuel rods | ₽ | R1 | R2 | R3 | R4 | R5 | R6 | S1 | S2 | TA | ΤB | ЦС | av. (unit) | addition |
| 1975/07/03 14:42 | 132 | s | 478 | 471 | 477 | 473 | 469 | 475 | 899 | 897 | 895 | dn | dn | 473.8 | E-28 |
| 1975/07/03 14:58 | 133 | t | 464 | 457 | 462 | 460 | 455 | 461 | 899 | 897 | 895 | dn | dn | 459.8 | E-4 |
| 1975/07/03 15:12 | 134 | n | 448 | 441 | 447 | 443 | 440 | 445 | 899 | 897 | 895 | dn | dn | 444.0 | E-38 |
| 1975/07/03 15:27 | 135 | > | 434 | 428 | 433 | 430 | 425 | 432 | 899 | 897 | 895 | dn | dn | 430.3 | E-14 |
| 1975/07/03 15:45 | 136 | > | 418 | 412 | 418 | 414 | 410 | 416 | 899 | 897 | 895 | dn | dn | 414.7 | E-22 |
| 1975/07/03 16:02 | 137 | × | 406 | 399 | 405 | 401 | 397 | 403 | 899 | 897 | 895 | dn | dn | 401.8 | E-46 |
| 1975/07/03 16:47 | 138 | Х | 394 | 387 | 392 | 388 | 385 | 390 | 899 | 897 | 895 | dn | dn | 389.3 | E-30 |
| 1975/07/03 17:13 | 139 | И | 378 | 371 | 377 | 373 | 369 | 375 | 899 | 897 | 895 | dn | dn | 373.8 | Е-6 |
| 1975/07/03 17:27 | 140 | аа | 364 | 357 | 362 | 358 | 355 | 360 | 899 | 897 | 895 | dn | dn | 359.3 | E-35 |
| 1975/07/03 17:42 | 141 | ab | 352 | 345 | 350 | 346 | 343 | 348 | 899 | 897 | 895 | dn | dn | 347.3 | E-11 |
| 1975/07/03 17:58 | 142 | ac | 338 | 331 | 336 | 332 | 329 | 333 | 899 | 897 | 895 | dn | dn | 333.2 | E-19 |
| 1975/07/03 18:08 | 143 | ad | 326 | 319 | 324 | 320 | 316 | 320 | 899 | 897 | 895 | dn | dn | 320.8 | E-43 |
| 1975/07/03 18:22 | 144 | ae | 311 | 305 | 311 | 306 | 303 | 307 | 899 | 897 | 895 | dn | dn | 307.2 | E-27 |
| 1975/07/03 18:37 | 145 | af | 296 | 290 | 296 | 288 | 288 | 293 | 899 | 897 | 895 | dn | dn | 291.8 | E-3 |
| 1975/07/03 19:17 | 146 | ag | 278 | 272 | 277 | 272 | 270 | 274 | 899 | 897 | 895 | dn | dn | 273.8 | E-39 |
| 1975/07/03 19:32 | 147 | ah | 260 | 254 | 260 | 254 | 252 | 257 | 899 | 897 | 895 | dn | dn | 256.2 | E-15 |
| 1975/07/03 19:45 | 148 | ai. | 240 | 234 | 239 | 233 | 231 | 236 | 899 | 897 | 895 | dn | dn | 235.5 | E-23 |
| 1975/07/03 20:02 | 149 | aj | 218 | 211 | 216 | 211 | 209 | 213 | 899 | 897 | 895 | dn | dn | 213.0 | E-47 Same as std. core |

JAEA-Research 2025-001

5. Analyses of Effective Neutron Multiplication Factors

The results of criticality analyses using the present detailed models are described below for the confirmation of both the effective neutron multiplication factor (k_{eff}) calculated by the Monte Carlo method and differences in keff among the evaluated nuclear data libraries adopted in the present work.

5.1 Calculation method

The analyses of k_{eff} of the present detailed models for minimum, standard, and intermediate cores were performed by using the MVP version 3 code ⁶) with the evaluated nuclear data libraries JENDL-4.0⁸⁾, JENDL-4.0u1⁹⁾, and JENDL-5⁷⁾. Fifty million histories (100,000 particles per batch, 700 batches in total, 200 initial batches skipped) were set for the analyses.

5.2 Calculated results

The results of the analyses on minimum and standard cores are listed in Table 5.2.1 and Table 5.2.2, respectively. In Tables 5.2.1 and 5.2.2, the standard deviation (σ) is the statistical error only from Monte Carlo calculations. The differences in k_{eff} between JENDL-4.0 and JENDL-4.0u1 are within their σ 's. The k_{eff} 's by JENDL-5 are 0.43 to 0.57 % larger than those by JENDL-4.0. The differences in k_{eff} between JENDL-5 and JENDL-4.0 are larger than three times their σ 's.

Table 5.2.1 Calculated keff for the minimum core.

| The number | D | BANK | l.:h | k | + | 1 | | k _{eff} differe | ence ± 1σ | | |
|--------------|----|------------|---------|----------------|-----|---------|------------|--------------------------|-----------|------|---------|
| of fuel rods | U | av. (unit) | Library | r _e | ff⊥ | 10 | J40-J4 | 0u1 | J | 5-J∕ | 40 |
| | | | J40 | 0.99969 | ± | 0.00013 | -0.00015 ± | 0.00018 | | | |
| 113 | а | 898.2 | J40u1 | 0.99984 | ± | 0.00013 | | | | | |
| | | | J5 | 1.00535 | ± | 0.00013 | | | 0.00566 | ± | 0.00018 |
| | 10 | | | | | | | | | | |

40: JENDL-4.0, J40u1: JENDL-4.0u1, J5: JENDL-5

| The number | Ē | BANK | | k | k +1- | | k_{eff} difference ± 1 σ | | | | | |
|--------------|-----|------------|---------|----------------------|-------|-----------|-----------------------------------|---|---------|---------|---|---------|
| of fuel rods | IJ | av. (unit) | Library | κ _{eff} ±ισ | | J40-J40u1 | | | J5-J40 | | | |
| | | | J40 | 1.00067 | ± | 0.00012 | 0.00002 | ± | 0.00018 | | | |
| 149 | а | 213.0 | J40u1 | 1.00065 | ± | 0.00013 | | | | | | |
| | | | J5 | 1.00492 | ± | 0.00012 | | | | 0.00425 | ± | 0.00017 |
| | 4.0 | | | | | | | | | | | |

J40: JENDL-4.0, J40u1: JENDL-4.0u1, J5: JENDL-5

The results of the analyses on the intermediate cores are listed in Table 5.2.3. In Table 5.2.3, σ is the statistical error only from Monte Carlo calculations, same as shown in the results from the minimum and standard cores. The differences in k_{eff} between JENDL-4.0 and JENDL-4.0u1 are within their σ 's. The k_{eff}'s by JENDL-5 are 0.36 to 0.54 % larger than those by JENDL-4.0. The differences in k_{eff} between JENDL-5 and JENDL-4.0 are larger than three times their σ 's, same as shown in the results from the minimum and standard cores.

Figure 5.2.1 shows the calculated k_{eff} and the averaged bank rod position as function of the number of fuel rods loaded in the minimum, standard, and intermediated cores. The k_{eff} 's by JENDL-4.0, JENDL-4.0u1, and JENDL-5 vary with the number of fuel rods in the range of 0.99966 to 1.00098, 0.99964 to 1.00086, and 1.00448 to 1.00535, respectively. The magnitude of the variation of k_{eff} for JENDL-5 is smaller than those for JENDL-4.0 and JENDL-4.0u1. The averaged values of k_{eff} by JENDL-4.0, JENDL-4.0u1, and JENDL-5 are 1.00042 ± 0.00035, 1.00042 ± 0.00034, and 1.00489 ± 0.00020, respectively.

Figure 5.2.2 shows the residual from the averaged k_{eff} as function of the number of fuel rods loaded in the cores. It is confirmed that the residual for JENDL-5 tends to decrease as the number of fuel rods increases, on the other hand the residuals for JENDL-4.0 and JENDL-4.0u1 tend to increase with the number of fuel rods.

The difference in k_{eff} varying with the number of fuel rods loaded in the cores and the difference in k_{eff} among the libraries are needed to be examined with consideration of uncertainties in k_{eff} involved in the present detailed models. Hence, the uncertainties in k_{eff} , which are propagated from errors in the geometry, material, and operation data, were evaluated by using the MVP version 3 code. The evaluated results are shown in Chap. 6.

| The number | | BANK | *4 | 1 k 1 | | | k_{eff} difference ± 1 σ | | | | | | |
|--------------|----|------------|---------|----------------|---------|---------|-----------------------------------|------|-------|---------|----------|---------|----------|
| of fuel rods | ID | av. (unit) | Library | К _е | ff ± | 1σ | | J40 |)-J4(|)u1 | J | 5-J4 | 0 |
| | | | J40 | 0.99986 | ± | 0.00013 | 0.0 | 0018 | ± | 0.00018 | | | |
| 114 | а | 807.2 | J40u1 | 0.99968 | ± | 0.00013 | | | | | | | |
| | | | J5 | 1.00495 | ± | 0.00012 | | | | | 0.00509 | ± | 0.00018 |
| | | | J40 | 0.99966 | ± | 0.00013 | 0.0 | 0002 | ± | 0.00019 | | | |
| 115 | b | 775.5 | J40u1 | 0.99964 | ± | 0.00012 | | | | | | | |
| | | | J5 | 1.00505 | ± | 0.00013 | | | | | 0.00539 | ± | 0.00018 |
| | | | J40 | 0.99993 | ± | 0.00013 | 0.0 | 0015 | ± | 0.00018 | | | |
| 116 | С | 743.2 | J40u1 | 0.99978 | ± | 0.00012 | | | | | | | |
| | | | J5 | 1.00503 | ± | 0.00012 | | | | | 0.00511 | ± | 0.00017 |
| | | | J40 | 1.00012 | ± | 0.00012 | -0.0 | 0001 | ± | 0.00018 | | | |
| 117 | d | 717.7 | J40u1 | 1.00013 | ± | 0.00013 | | | | | | | |
| | | | J5 | 1.00486 | ± | 0.00013 | | | | | 0.00474 | ± | 0.00018 |
| | | | J40 | 0.99993 | ± | 0.00012 | -0.0 | 0015 | ± | 0.00018 | | | |
| 118 | е | 699.7 | J40u1 | 1.00008 | ± | 0.00013 | | | | | | | |
| | | | J5 | 1.00504 | ± | 0.00013 | | | | | 0.00511 | ± | 0.00017 |
| | | | J40 | 1.00007 | ± | 0.00012 | -0.0 | 0015 | ± | 0.00017 | | | |
| 119 | f | 682.8 | J40u1 | 1.00022 | ± | 0.00012 | | | | | | | |
| | | | J5 | 1.00517 | ± | 0.00012 | | | | | 0.00510 | ± | 0.00017 |
| | | | J40 | 1.00012 | ± | 0.00013 | -0.0 | 0006 | ± | 0.00017 | | | |
| 120 | g | 667.2 | J40u1 | 1.00018 | ± | 0.00012 | | | | | | | |
| | | | J5 | 1.00503 | ± | 0.00013 | | | | | 0.00491 | ± | 0.00018 |
| | | | J40 | 1.00013 | ± | 0.00013 | 0.0 | 0014 | ± | 0.00018 | | | |
| 121 | h | 651.3 | J40u1 | 0.99999 | ± | 0.00013 | | | | | | | |
| | | J5 | 1.00512 | ± | 0.00012 | | | | | 0.00499 | ± | 0.00017 | |
| | | | J40 | 1.00009 | ± | 0.00012 | -0.0 | 0007 | ± | 0.00017 | | | |
| 122 | i | 628.5 | J40u1 | 1.00016 | ± | 0.00012 | | | | | | | |
| | | | J5 | 1.00480 | ± | 0.00012 | | | | | 0.00471 | ± | 0.00017 |
| | | | J40 | 1.00003 | ± | 0.00012 | 0.0 | 0006 | ± | 0.00017 | | | |
| 123 | j | 610.2 | J40u1 | 0.99997 | ± | 0.00012 | | | | | | | |
| | | | J5 | 1.00483 | ± | 0.00012 | | | | | 0.00480 | ± | 0.00017 |
| | | | J40 | 1.00019 | ± | 0.00012 | 0.0 | 0001 | ± | 0.00018 | | | |
| 124 | k | 590.5 | J40u1 | 1.00018 | ± | 0.00013 | | | | | | | |
| | | | J5 | 1.00468 | ± | 0.00013 | | | | | 0.00449 | ± | 0.00018 |
| | | | J40 | 1.00041 | ± | 0.00013 | 0.0 | 0007 | ± | 0.00018 | | | |
| 125 | Ι | 574.0 | J40u1 | 1.00034 | ± | 0.00013 | | | | | | | |
| | | | J5 | 1.00475 | ± | 0.00013 | | | | | 0.00434 | ± | 0.00018 |
| | | | J40 | 1.00028 | ± | 0.00012 | -0.0 | 0015 | ± | 0.00018 | | | |
| 126 | m | 557.7 | J40u1 | 1.00043 | ± | 0.00013 | | | | | | | |
| | | | J5 | 1.00490 | ± | 0.00012 | | | | | 0.00462 | ± | 0.00017 |
| | | | J40 | 1.00056 | ± | 0.00013 | 0.0 | 0017 | ± | 0.00018 | | | |
| 127 | n | 542.0 | J40u1 | 1.00039 | ± | 0.00013 | | | | | | | |
| | | | J5 | 1.00511 | ± | 0.00012 | | | | | 0.00455 | ± | 0.00018 |
| | | | J40 | 1.00029 | ± | 0.00013 | -0.0 | 0012 | ± | 0.00018 | | | |
| 128 | 0 | 526.2 | J40u1 | 1.00041 | ± | 0.00013 | | | | | 0.00.00 | | 0.000.00 |
| | | | J5 | 1.00492 | ± | 0.00012 | | | | | 0.00463 | ± | 0.00018 |
| 129 p | | | J40 | 1.00060 | ± | 0.00013 | 0.0 | 0016 | ± | 0.00018 | | | |
| | р | 514.2 | J40u1 | 1.00044 | ± | 0.00013 | | | | | 0.00.000 | | 0.000.00 |
| | | | J5 | 1.00506 | ± | 0.00012 | | | | | 0.00446 | ± | 0.00018 |

Table 5.2.3 Calculated $k_{\rm eff}$ for the intermediate cores.

*1 J40: JENDL-4.0, J40u1: JENDL-4.0u1, J5: JENDL-5

| Table 5.2.3 (contd.) | Calculated $k_{\mbox{\scriptsize eff}}$ for | the intermediate cores. |
|----------------------|---|-------------------------|

| of fuel role ID $y_{(unit)}$ Lorary $y_{(unit)}$ <t< th=""><th>The number</th><th>П</th><th>BANK</th><th></th><th colspan="2">ν^{*1} k_{*"} + 1σ —</th><th></th><th></th><th>k_{eff} differe</th><th>ence ± 1σ</th><th></th><th></th></t<> | The number | П | BANK | | ν ^{*1} k _{*"} + 1σ — | | | | k _{eff} differe | ence ± 1σ | | | |
|---|--------------|----|------------|---------|--|------|---------|----------|--------------------------|-----------|---------|------|---------|
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | of fuel rods | U | av. (unit) | Library | ĸ _{ei} | ff ± | 10 | J40 |)-J4 | 0u1 | J | 5-J∕ | 10 |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | | J40 | 1.00047 | ± | 0.00012 | -0.00009 | ± | 0.00017 | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 130 | q | 499.3 | J40u1 | 1.00056 | ± | 0.00012 | | | | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00488 | ± | 0.00012 | | | | 0.00441 | ± | 0.00017 |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | | J40 | 1.00040 | ± | 0.00012 | -0.00002 | ± | 0.00017 | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 131 | r | 487.0 | J40u1 | 1.00042 | ± | 0.00012 | | | | | | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00498 | ± | 0.00012 | | | | 0.00458 | ± | 0.00017 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J40 | 1.00044 | ± | 0.00013 | 0.00000 | ± | 0.00019 | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 132 | s | 473.8 | J40u1 | 1.00044 | ± | 0.00013 | | | | | | |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00495 | ± | 0.00013 | | | | 0.00451 | ± | 0.00018 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J40 | 1.00057 | ± | 0.00012 | -0.00011 | ± | 0.00017 | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 133 | t | 459.8 | J40u1 | 1.00068 | ± | 0.00012 | | | | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00488 | ± | 0.00013 | | | | 0.00431 | ± | 0.00018 |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | | J40 | 1.00045 | ± | 0.00013 | -0.00016 | ± | 0.00018 | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 134 | u | 444.0 | J40u1 | 1.00061 | ± | 0.00012 | | | | | | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00511 | ± | 0.00012 | | | | 0.00466 | ± | 0.00018 |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | | J40 | 1.00043 | ± | 0.00012 | -0.00005 | ± | 0.00018 | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 135 | v | 430.3 | J40u1 | 1.00048 | ± | 0.00013 | | | | | | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00472 | ± | 0.00012 | | | | 0.00429 | ± | 0.00017 |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J40 | 1.00038 | ± | 0.00013 | -0.00003 | ± | 0.00018 | | | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 136 | w | 414.7 | J40u1 | 1.00041 | ± | 0.00013 | | | | | | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00485 | ± | 0.00012 | | | | 0.00447 | ± | 0.00017 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J40 | 1.00083 | ± | 0.00012 | 0.00005 | ± | 0.00017 | | | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 137 | х | 401.8 | J40u1 | 1.00078 | ± | 0.00012 | | | | | | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00478 | ± | 0.00012 | | | | 0.00395 | ± | 0.00017 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J40 | 1.00071 | ± | 0.00012 | 0.00002 | ± | 0.00017 | | | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 138 | у | 389.3 | J40u1 | 1.00069 | ± | 0.00012 | | | | | | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00483 | ± | 0.00012 | | | | 0.00412 | ± | 0.00017 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J40 | 1.00084 | ± | 0.00013 | -0.00002 | ± | 0.00017 | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 139 | z | 373.8 | J40u1 | 1.00086 | ± | 0.00012 | | | | | | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00526 | ± | 0.00012 | | | | 0.00442 | ± | 0.00018 |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J40 | 1.00057 | ± | 0.00012 | -0.00013 | ± | 0.00017 | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 140 | aa | 359.3 | J40u1 | 1.00070 | ± | 0.00013 | | | | | | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00481 | ± | 0.00012 | | | | 0.00424 | ± | 0.00017 |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | | J40 | 1.00098 | ± | 0.00012 | 0.00017 | ± | 0.00017 | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 141 | ab | 347.3 | J40u1 | 1.00081 | ± | 0.00012 | | | | | | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00460 | ± | 0.00012 | | | | 0.00362 | ± | 0.00017 |
| 142ac333.2J40u1 1.00083 ± 0.00013 J5 0.00013 ± 0.00013 1.00503 ± 0.00013 0.00413 ± 0.00018 143ad320.8J40u1 1.00086 ± 0.00012 J5 0.00012 0.00009 ± 0.00018 143ad320.8J40u1 1.00077 ± 0.00013 J5 0.00012 0.00079 ± 0.00018 144ae307.2J40u1 1.00078 ± 0.00013 J5 0.00010 ± 0.00018 0.00018 ± 0.00018 144ae307.2J40u1 1.00078 ± 0.00012 J5 0.00012 ± 0.00018 0.00395 ± 0.00018 145af291.8J40u1 1.00070 ± 0.00012 J5 0.00013 ± 0.00012 0.00032 ± 0.00017 | | | | J40 | 1.00090 | ± | 0.00012 | 0.00007 | ± | 0.00017 | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 142 | ac | 333.2 | J40u1 | 1.00083 | ± | 0.00013 | | | | | | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00503 | ± | 0.00013 | | | | 0.00413 | ± | 0.00018 |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | | J40 | 1.00086 | ± | 0.00012 | 0.00009 | ± | 0.00018 | | | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 143 | ad | 320.8 | J40u1 | 1.00077 | ± | 0.00013 | | | | | | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | | J5 | 1.00465 | ± | 0.00012 | | | | 0.00379 | ± | 0.00017 |
| 144 ae 307.2 J40u1 1.00078 ± 0.00012 0.00012 J5 1.00483 ± 0.00013 0.00395 ± 0.00018 J40 1.00073 ± 0.00012 0.00003 ± 0.00017 145 af 291.8 J40u1 1.00070 ± 0.00012 0.00012 J5 1.00465 ± 0.00013 0.00392 ± 0.00017 | | | | J40 | 1.00088 | ± | 0.00013 | 0.00010 | ± | 0.00018 | | | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 144 | ae | 307.2 | J40u1 | 1.00078 | ± | 0.00012 | | | | | | |
| J40 1.00073 ± 0.00012 0.00003 ± 0.00017 145 af 291.8 J40u1 1.00070 ± 0.00012 J5 1.00465 ± 0.00013 0.00392 ± 0.00017 | | | | J5 | 1.00483 | ± | 0.00013 | | | | 0.00395 | ± | 0.00018 |
| 145 af 291.8 J40u1 1.00070 ± 0.00012 J5 1.00465 ± 0.00013 0.00392 ± 0.00017 | | | | J40 | 1.00073 | ± | 0.00012 | 0.00003 | ± | 0.00017 | | | |
| J5 1.00465 ± 0.00013 0.00392 ± 0.00017 | 145 | af | 291.8 | J40u1 | 1.00070 | ± | 0.00012 | | | | | | |
| | | | | J5 | 1.00465 | ± | 0.00013 | | | | 0.00392 | ± | 0.00017 |

*1 J40: JENDL-4.0, J40u1: JENDL-4.0u1, J5: JENDL-5

| | | 14010 0 | | iui, cuit | 0110 | accounter i | ior ene m | 001 | mediate | 00100. | | |
|---|-------|------------|---------|-----------------|------|-------------|-----------|-----------|--------------------------|---------|---|---------|
| The number | Ē | BANK | | k | | 1_ | | | k _{eff} differe | ence±1σ | | |
| of fuel rods | U | av. (unit) | Library | ĸ _{ei} | fΞ | 10 | J40 | J40-J40u1 | | | | 0 |
| | | | J40 | 1.00083 | ± | 0.00013 | 0.00008 | ± | 0.00019 | | | |
| 146 | ag | 273.8 | J40u1 | 1.00075 | ± | 0.00013 | | | | | | |
| | - | | J5 | 1.00471 | ± | 0.00013 | | | | 0.00388 | ± | 0.00018 |
| | | | J40 | 1.00067 | ± | 0.00012 | 0.00000 | ± | 0.00016 | | | |
| 147 | ah | 256.2 | J40u1 | 1.00067 | ± | 0.00011 | | | | | | |
| | | | J5 | 1.00448 | ± | 0.00012 | | | | 0.00381 | ± | 0.00017 |
| | | | J40 | 1.00060 | ± | 0.00012 | -0.00015 | ± | 0.00017 | | | |
| 148 | ai | 235.5 | J40u1 | 1.00075 | ± | 0.00013 | | | | | | |
| | | | J5 | 1.00453 | ± | 0.00012 | | | | 0.00393 | ± | 0.00017 |
| | | | J40 | 1.00067 | ± | 0.00012 | 0.00002 | ± | 0.00018 | | | |
| 149 | aj *2 | 213.0 | J40u1 | 1.00065 | ± | 0.00013 | | | | | | |
| | - | | J5 | 1.00492 | ± | 0.00012 | | | | 0.00425 | ± | 0.00017 |
| *1.40°, JENDI -4 0, J40u1°, JENDI -4 0u1, J5°, JENDI -5 | | | | | | | | | | | | |

Table 5.2.3 (contd.) Calculated k_{eff} for the intermediate cores.

*2 Same as standard core



Fig. 5.2.1 Calculated keff and averaged bank rod position as function of the number of fuel rods.



Fig. 5.2.2 Residual from averaged k_{eff} as function of the number of fuel rods.

6. Evaluation of Uncertainties for Detailed Models

The uncertainties in k_{eff} for the present detailed models, which are propagated from the errors in the geometry, material, and operation data as sources of the uncertainties, were evaluated by using the MVP version 3 code with the evaluated nuclear data libraries JENDL-4.0, JENDL-4.0u1, and JENDL-5. The uncertainties in k_{eff} were respectively evaluated for the minimum, standard, and intermediate cores. For the intermediate cores, three sorts of representative cores were selected, in which all control rods were being inserted to the vicinity of the core midplane. This means that those rod positions bring the largest amount of reactivity addition per unit of the control rod. The core ID's of the representative intermediate cores are p, q, and r listed in Table 4.2.1.

If both positive and negative values of errors were given as a source of the uncertainty, the bias of k_{eff} was evaluated as the mean of absolute value of the difference in k_{eff} due to the positive error, and of that due to the negative one. If either positive or negative value of an error was given as a source of the uncertainty, the bias of k_{eff} was evaluated as the positive or negative value of the difference in k_{eff} due to the positive or negative or negative to the positive or negative or negative value of the difference in k_{eff} due to the positive or negative value of the difference in k_{eff} due to the error.

The bias of k_{eff} was calculated with the above JENDL libraries for each error as a source of the uncertainty in k_{eff} . The histories in the Monte Carlo calculations were set to be the same as described in Chap. 5. The averaged bias of k_{eff} was determined by using the mean of the biases calculated by the JENDL-4.0, JENDL-4.0u1, and JENDL-5 libraries. For the intermediate core, the averaged bias was determined further by using the mean of the bias for each representative core (ID = p, q, and r).

The uncertainty in k_{eff} propagated from the error was finally evaluated by the square root of the summation of the square values of the averaged bias and its standard deviation (σ). If the absolute value of the averaged bias was smaller than its σ , the uncertainty in k_{eff} was considered to be negligibly small and not taken into account for the evaluation of the uncertainties.

6.1 Uncertainties from errors in geometry data

The evaluated results of the uncertainties in k_{eff} propagated from the errors in the geometry data are summarized in Table 6.1. For each item listed in Table 6.1, details are described below.

| ltem | Source of uncertainty | Core | Average (∆k _e | ed k eff ± | bias: B _{av} : 1σ) | Max. difference in B _{av} : D | D/σ | Uncertainty in k _{eff} (Δk _{eff}) | Aggregated uncertainty for item (Δk_{eff}) |
|--------------------|---|--------------|-----------------------------|---------------|--------------------------------|--|------|--|---|
| | 0.06% of outer diameter of | Minimum | ±0.00043 | ± | 0.00007 | | | 0.0004 | |
| | U-ZrH: | Standard | ±0.00040 | ± | 0.00007 | 0.00005 | 0.71 | 0.0004 | |
| | ± 0.002 (cm) | Intermediate | ±0.00045 | ± | 0.00007 | | | 0.0005 | _ |
| | 0.20% of boight of LL 7rH. | Minimum | ±0.00062 | ± | 0.00007 | | | 0.0006 | |
| | ± 0.15 (cm) | Standard | ±0.00064 | ± | 0.00007 | 0.00004 | 0.51 | 0.0006 | |
| | | Intermediate | ±0.00066 | ± | 0.00007 | | | 0.0007 | _ |
| | 0.31% of inner diameter of | Minimum | ±0.00005 | ± | 0.00007 | | | negligible | |
| | U-ZrH: | Standard | ±0.00006 | ± | 0.00007 | 0.00001 | 0.18 | negligible | |
| | ± 0.002 (cm) | Intermediate | ±0.00007 | ± | 0.00007 | | | negligible | _ |
| | 0 18% of diameter of 7r rod | Minimum | ±0.00004 | ± | 0.00007 | | | negligible | |
| | ± 0.001 (cm) | Standard | ±0.00005 | ± | 0.00007 | 0.00002 | 0.22 | negligible | |
| | | Intermediate | ±0.00004 | ± | 0.00007 | | | negligible | - |
| | 0.03% of inner diameter of | Minimum | ±0.00049 | ± | 0.00007 | | | 0.0005 | |
| | cladding: | Standard | ±0.00046 | ± | 0.00007 | 0.00003 | 0.37 | 0.0005 | |
| | ± 0.001 (cm) | Intermediate | ±0.00046 | ± | 0.00007 | | | 0.0005 | Minimum: |
| | 0.05% of outer diameter of | Minimum | ±0.00120 | ± | 0.00007 | | | 0.0012 | 0.0016 Standard |
| Fuel rod | cladding: | Standard | ±0.00124 | ± | 0.00007 | 0.00005 | 0.64 | 0.0012 | 0.0016 |
| | ± 0.002 (cm) | Intermediate | ±0.00125 | ± | 0.00007 | | | 0.0012 | Intermediate: |
| | 0.06% of diameter of Mo disc: | Minimum | ±0.00001 | ± | 0.00007 | | | negligible | 0.0016 |
| | ± 0.002 (cm) | Standard | ±0.00002 | ± | 0.00007 | 0.00002 | 0.23 | negligible | |
| | | Intermediate | ±0.00000 | ± | 0.00007 | | | negligible | - |
| | 1.25% of thickness of | Minimum | ±0.00002 | ± | 0.00007 | | | negligible | |
| | Modisc: | Standard | ±0.00001 | ± | 0.00007 | 0.00002 | 0.24 | negligible | |
| | ± 0.001 (cm) | Intermediate | ±0.00001 | ± | 0.00007 | | | negligible | - |
| | 0.03% of diameter of axial graphite reflector: ± 0.001 (cm) | Minimum | ±0.00004 | ± | 0.00007 | | | negligible | |
| | | Standard | ±0.00003 | ± | 0.00007 | 0.00001 | 0.20 | negligible | |
| | | Intermediate | ±0.00004 | ± | 0.00007 | | | negligible | - |
| | 0.09% of height of axial | Minimum | ±0.00000 | ± | 0.00007 | | | negligible | |
| | graphite reflector: | Standard | ±0.00000 | ± | 0.00007 | 0.00002 | 0.29 | negligible | |
| | ± 0.008 (cm) | Intermediate | ±0.00002 | ± | 0.00007 | | | negligible | - |
| | Replacement of the parts of | Minimum | +0.00047 | ± | 0.00007 | | | 0.0005 | |
| | top/bottom plugs with water | Standard | +0.00047 | ± | 0.00007 | 0.00002 | 0.25 | 0.0005 | |
| | | Intermediate | +0.00045 | ± | 0.00007 | | | 0.0005 | |
| | 0.28% of outer diameter of | Minimum | ±0.00010 | ± | 0.00007 | | | 0.0001 | |
| | U-ZrH: | Standard | ±0.00003 | ± | 0.00007 | 0.00006 | 0.85 | negligible | |
| | ± 0.01 (cm) | Intermediate | ±0.00004 | ± | 0.00007 | | | negligible | - |
| | 0.31% of inner diameter of | Minimum | ±0.00001 | ± | 0.00007 | | | negligible | |
| | U-ZrH: | Standard | ±0.00003 | ± | 0.00007 | 0.00004 | 0.50 | negligible | |
| | ± 0.002 (CIII) | Intermediate | ±0.00004 | ± | 0.00007 | | | negligible | - |
| | 0.39% of height of U-ZrH: | Minimum | ±0.00024 | ± | 0.00007 | | | 0.0003 | Minimum: |
| | ± 0.15 (cm) | Standard | ±0.00031 | ± | 0.00007 | 0.00040 | 5.49 | 0.0003 | 0.0007 |
| Control and safety | | Intermediate | ±0.00064 | ± | 0.00007 | | | 0.0006 | Standard: |
| roas | 0.18% of diameter of Zr rod: | Minimum | ±0.00004 | ± | 0.00007 | | | negligible | 0.0003 Intermediate |
| | ± 0.001 (cm) | Standard | ±0.00006 | ± | 0.00007 | 0.00004 | 0.59 | negligible | 0.0007 |
| | | Intermediate | ±0.00002 | ± | 0.00007 | | | negligible | - |
| | 0.55% of inner diameter of | Minimum | ±0.00054 | ± | 0.00007 | | | 0.0005 | |
| | cladding: ± 0.02 (cm) | Standard | ±0.00003 | ± | 0.00007 | 0.00051 | 7.01 | negligible | |
| _ | | Intermediate | ±0.00028 | ± | 0.00007 | | | 0.0003 | - |
| | 0.27% of outer diameter of S cladding: ± 0.01 (cm) | Minimum | ±0.00037 | ± | 0.00007 | 0.000 | 0.7- | 0.0004 | |
| | | Standard | ±0.00009 | ± | 0.00007 | 0.00028 | 3.86 | 0.0001 | |
| | | Intermediate | ±0.00024 | ± | 0.00007 | | | 0.0003 | |

Table 6.1 Summary of uncertainties in k_{eff} propagated from the errors in the geometry data.

| ltem | Source of uncertainty | Core | Average (∆k _e | ed k eff ± | bias: B _{av} : 1σ) | Max. difference in B _{av} : D | D/σ | Uncertainty in k _{eff} (Δ k _{eff}) | Aggregated uncertainty for item (∆k _{eff}) |
|------------------------------|--|--------------|-----------------------------|---------------|--------------------------------|--|------|---|---|
| | 4.000/ 11 11 1. 1 | Minimum | +0.00002 | ± | 0.00007 | | | negligible | |
| | 1.38% smaller diameter of B4C: - 0.05 (cm) | Standard | -0.00002 | ± | 0.00007 | 0.00005 | 0.75 | negligible | |
| | B10: 0:00 (0iii) | Intermediate | +0.00003 | ± | 0.00007 | | | negligible | Minimum: |
| | 0.05% and 0.01% of height of | Minimum | ±0.00006 | ± | 0.00007 | | | negligible | negligible |
| Fast and adjustable | B ₄ C in adjustable and fast | Standard | ±0.00006 | ± | 0.00007 | 0.00005 | 0.74 | negligible | Standard: |
| ti ansient rous | transient rod: ± 0.02 and ± 0.01 (cm) | Intermediate | ±0.00001 | ± | 0.00007 | | | negligible | Intermediate: |
| | 0.26% of outor diamator of | Minimum | ±0.00005 | ± | 0.00007 | | | negligible | negligible |
| | cladding: ± 0.01 (cm) | Standard | ±0.00006 | ± | 0.00007 | 0.00002 | 0.23 | negligible | |
| | ······································ | Intermediate | ±0.00005 | ± | 0.00007 | | | negligible | |
| | 0.07% of hexagonal lattice | Minimum | ±0.00008 | ± | 0.00007 | | | 0.0001 | Minimum: |
| | pitch: | Standard | ±0.00019 | ± | 0.00007 | 0.00011 | 1.46 | 0.0002 | 0.0001 |
| Grid plate | ± 0.003 (cm) | Intermediate | ±0.00014 | ± | 0.00007 | | | 0.0002 | Standard: |
| | Replacement of grid plates | Minimum | -0.00006 | ± | 0.00007 | | | negligible | 0.0002 |
| | with water | Standard | -0.00008 | ± | 0.00007 | 0.00006 | 0.78 | 0.0001 | |
| | | Intermediate | -0.00002 | ± | 0.00007 | | | negligible | 0.0002 |
| | 0.18% of face-to-face distance | Minimum | ±0.00025 | ± | 0.00007 | | | 0.0003 | |
| | tube: | Standard | ±0.00028 | ± | 0.00007 | 0.00004 | 0.51 | 0.0003 | |
| | ± 0.043 (cm) | Intermediate | ±0.00027 | ± | 0.00007 | | | 0.0003 | _ |
| | 0.78% of thickness of | Minimum | ±0.00004 | ± | 0.00007 | | | negligible | Minimum |
| | hexagonal experimental tube: | Standard | ±0.00004 | ± | 0.00007 | 0.00002 | 0.27 | negligible | 0 0003 |
| Ever entre entre to the | ± 0.005 (cm) | Intermediate | ±0.00002 | ± | 0.00007 | | | negligible | Standard: |
| Experimental tube | 0 11% of outer diameter of | Minimum | ±0.00006 | ± | 0.00007 | | | negligible | 0.0003 |
| | cylindrical experimental tube: | Standard | ±0.00001 | ± | 0.00007 | 0.00005 | 0.75 | negligible | Intermediate: |
| | ± 0.028 (cm) | Intermediate | ±0.00000 | ± | 0.00007 | | | negligible | 0.0003 |
| | 0.78% of thickness of | Minimum | ±0.00006 | ± | 0.00007 | | | negligible | - |
| | cylindrical experimental tube: | Standard | ±0.00000 | ± | 0.00007 | 0.00005 | 0.75 | negligible | |
| | ± 0.005 (cm) | Intermediate | ±0.00003 | ± | 0.00007 | | | negligible | |
| | | Minimum | -0.00001 | ± | 0.00007 | | | negligible | |
| Shroud | Replacement of shroud with | Standard | -0.00004 | ± | 0.00007 | 0.00009 | 1.20 | negligible | - |
| Official | Water | Intermediate | +0.00004 | ± | 0.00007 | | | negligible | |
| Guide tube for transient rod | | Minimum | -0.00001 | ± | 0.00007 | | | negligible | |
| | Replacement of guide tube S with water Inte | Standard | -0.00002 | ± | 0.00007 | 0.00005 | 0.61 | negligible | - |
| | | Intermediate | +0.00003 | ± | 0.00007 | | | negligible | |

Table 6.1 (contd.) Summary of uncertainties in $k_{\rm eff}$ propagated from the errors in the geometry data.

6.1.1 Fuel rod

Outer diameter and height of uranium-zirconium hydride

The relative errors in the outer diameter and height of the uranium-zirconium hydride in the fuel rod were evaluated as 0.06 % and 0.39 %, respectively, using the dimensional inspection records at the construction in 1973. The relative error in the height is more than six times larger than that in the outer diameter. This suggests that the effect to the volume and mass inventory of the uranium-zirconium hydride by the former may be greater than that by the latter.

The difference in the averaged bias among the minimum, standard, and intermediate cores for the error in the outer diameter of the uranium-zirconium hydride in the fuel rod is within 0.71 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the outer diameter of the uranium-zirconium hydride in the fuel rod for the minimum, standard, and intermediate cores are of comparable magnitude.

The difference in the averaged bias among the minimum, standard, and intermediate cores for the error in the height of the uranium-zirconium hydride in the fuel rod is within 0.51 times its σ . It is also confirmed that the uncertainties in k_{eff} propagated from the error in the height of the uranium-zirconium hydride in the fuel rod for the minimum, standard, and intermediate cores are of comparable magnitude.

The uncertainties in k_{eff} propagated from the error in the height of the uranium-zirconium hydride are larger than those from the error in the outer diameter due to the greater effect to the volume and mass inventory of the uranium-zirconium hydride brought by the error in the height, as mentioned above. The error in the outer diameter of the uranium-zirconium hydride brings changes in the water to fuel volume ratio of the hexagonal fuel cell, which may affect k_{eff} , however, it is considered that the impact of changes in the volume and mass inventory of the uranium-zirconium hydride is dominant.

Inner diameter of uranium-zirconium hydride

The inner diameter of the uranium-zirconium hydride in the fuel rods was confirmed by design drawings since the dimensional inspection records at the construction in 1973 are not found at present. Thus, the dimension error in the inner diameter of the uranium-zirconium hydride was assumed to be same as the error in the outer diameter, which was estimated to be ± 0.002 cm. The relative error in the inner diameter became to be 0.31 %.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.18 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the inner diameter of the uranium-zirconium hydride in the fuel rod are negligibly small for all cores.

The relative error in the inner diameter is larger than that in the outer one, but the effect to the volume and mass inventory of uranium-zirconium hydride by the former may be smaller than that by the latter. For this reason, it is considered that the uncertainties in k_{eff} propagated from the error in the inner diameter of the uranium-zirconium hydride become smaller than those from the error in the outer diameter.

Diameter of zirconium rod

For the zirconium rod in the fuel rods, the relative error in the diameter was evaluated as 0.18 % using the dimensional inspection records at the construction in 1973.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.22 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the diameter of the zirconium rod in the fuel rod are negligibly small for all cores.

Inner and outer diameter of cladding in fuel rod

For the cladding in the fuel rod, the relative errors in the inner and outer diameters were evaluated as 0.03 and 0.05 %, respectively, using the dimensional inspection records at the construction in 1973.

The difference in the averaged bias among the minimum, standard, and intermediate cores for the error in the inner diameter of the cladding in the fuel rod is within 0.37 times its σ . It is confirmed that there is almost no difference in the uncertainties in k_{eff} propagated from the error in the inner diameter of the cladding in the fuel rod among the minimum, standard, and intermediate cores.

The difference in the averaged bias among the minimum, standard, and intermediate cores for the error in the outer diameter of the cladding in the fuel rod is within 0.64 times its σ . It is also confirmed that there is almost no difference in the uncertainties in k_{eff} propagated from the error in the outer diameter of the cladding in the fuel rod among the minimum, standard, and intermediate cores.

Both the relative and absolute errors in the outer diameter of the cladding in the fuel rod are larger than those in the inner one. This means that the effect to k_{eff} by the former may be greater than that by the latter due to the stainless-steel cladding behaving as thermal neutron absorber. In addition, the error in the outer diameter of the cladding brings changes in the water to fuel volume ratio of the hexagonal fuel cell, which affects k_{eff} . For this reason, it is considered that the uncertainties in k_{eff} propagated from the error in the outer diameter of the cladding become larger than those from the error in inner one.

Diameter and thickness of molybdenum disc

For the molybdenum disc in the fuel rod, the relative errors in the diameter and thickness were evaluated as 0.06 and 1.25 %, respectively, using the dimensional inspection records at the construction in 1973.

The difference in the averaged bias among the minimum, standard, and intermediate cores for the error in the diameter of the molybdenum disc is within 0.23 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the diameter of the molybdenum disc in the fuel rod are negligibly small for all cores.

The difference in the averaged bias among the minimum, standard, and intermediate cores for the error in the thickness of the molybdenum disc is within 0.24 times its σ . It is also confirmed that the uncertainties in k_{eff} propagated from the error in the thickness of the molybdenum disc in the fuel rod are negligibly small for all cores.

Diameter and height of axial graphite reflector

For the axial graphite reflector in the fuel rod, the relative errors in the diameter and height were evaluated as 0.03 % and 0.09 %, respectively, using the dimensional inspection records at the construction in 1973.

The difference in the averaged bias among the minimum, standard, and intermediate cores for the error in the diameter of the axial graphite reflector is within 0.20 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the diameter of the axial graphite reflector in the fuel rod are negligibly small for all cores.

The difference in the averaged bias among the minimum, standard, and intermediate cores for the error in the height of the axial graphite reflector is within 0.29 times its σ . It is also confirmed that the uncertainties in $k_{\rm eff}$ propagated from the error in the height of the axial graphite reflector in the fuel rod are negligibly small for all cores.

Replacement of top/bottom plugs with water

The top/bottom plugs in the fuel rod were modeled using the enveloping surfaces of their real shapes. For simplicity, the uncertainties in k_{eff} 's propagated from the errors in the dimensions of the plugs were evaluated conservatively by the replacement of both the top plug over the cladding and the bottom plug under the cladding with water.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.25 times its σ . It is confirmed for all cores that the positive reactivity effect is brought by the replacement. It is also confirmed that there is almost no difference in the uncertainties in $k_{\rm eff}$ propagated from the replacement among the minimum, standard, and intermediate cores.

Aggregated uncertainty in k_{eff}

The aggregated uncertainties in k_{eff} propagated from the errors in the geometry data of the fuel rod were obtained as the square root of summation of square values of the respective uncertainties mentioned above. Hereinafter, the same method was adopted to obtain the aggregated uncertainties.

There is almost no difference in the aggregated uncertainties in k_{eff} propagated from the errors in the geometry data of the fuel rod among the minimum, standard, and intermediate cores, evaluated to be 0.0016 Δk_{eff} for all cores. The largest contribution to the uncertainties in k_{eff} is the error in the outer diameter of the cladding in the fuel rod. The second largest contribution is the error in the height of the uranium-zirconium hydride in the fuel rod.

6.1.2 Control and safety rods

Outer diameter of uranium-zirconium hydride

For the control and safety rods, all dimensions were confirmed by design drawings since the dimensional inspection records at the construction in 1973 are not found at present. Thus, the relative error in the outer diameter of the uranium-zirconium hydride in the control and safety rods was assumed to be 0.28 % using the difference in the dimensions from that in the fuel rod. On the other hand, the error in the outer diameter of the uranium-zirconium hydride in the fuel rod was 0.06 % as mentioned above, using the dimensional inspection records. It is considered that 0.28 % as the relative error in the outer diameter of the uranium-zirconium hydride in the control and safety rods is conservative assumption.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.85 times its σ . It is confirmed that the averaged bias for the minimum core is slightly larger than those for the standard and intermediate cores, but the uncertainty in k_{eff} propagated from the error in the outer diameter of the uranium-zirconium hydride in the control and safety rods is quite small for the minimum core. It is also confirmed that the uncertainties in

 k_{eff} propagated from the error in the outer diameter of the uranium-zirconium hydride in the control and safety rods are negligibly small for the standard and intermediate cores.

The error in the outer diameter affects the volume and mass inventory of the uranium-zirconium hydride in the fuel followers, similar to the fuel rods. In the minimum core, all control and safety rods were being fully withdrawn. This means that all fuel followers were being fully inserted. Thus, it is considered for the minimum core that the volume and mass inventory of the uranium-zirconium hydride in the fuel followers affect $k_{\rm eff}$ more than for the standard and intermediate cores. For this reason, it is considered that the uncertainty for the minimum core is slightly larger than those for the standard and intermediate cores.

Inner diameter of uranium-zirconium hydride

For the inner diameter of the uranium-zirconium hydride in the control and safety rods, there is no difference in the dimension from that in the fuel rod. Thus, the relative error in the inner diameter was assumed to be 0.31 % as much as that for the fuel rod.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.50 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the inner diameter of the uranium-zirconium hydride in the control and safety rods are negligibly small for all cores.

Height of uranium-zirconium hydride

For the height of the uranium-zirconium hydride in the control and safety rods, there is also no difference in the dimension from that in the fuel rod. Thus, the relative error in the height was assumed to be 0.39 % as much as that for the fuel rod.

The difference in the averaged bias among the minimum, standard, and intermediate cores is more than three times its σ . It is considered that the error in the height of the uranium-zirconium hydride in the control and safety rods affects the vertical position of the fuel followers rather than the volume and mass inventory of the uranium-zirconium hydride in the cores. In the representative intermediate cores, the top planes of the fuel followers in the control rods were positioned at the vicinity of the core midplane where changes in the positions of the fuel followers affect k_{eff} maximally, but on the other hand the top planes of the

fuel followers for the minimum and standard cores were at the vicinities of the top and bottom edges of cores, respectively. For this reason, it is considered that the uncertainty in $k_{\rm eff}$ for the intermediate cores is larger than those for the minimum and standard cores.

Diameter of zirconium rod

For the diameter of the zirconium rod in the control and safety rods, there is also no difference in the dimension from that in the fuel rod. Thus, the relative error in the diameter was assumed to be 0.18 % as much as that for the fuel rod.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.59 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the diameter of the zirconium rod in the control and safety rods are negligibly small for all cores.

Inner and outer diameter of cladding in control and safety rods

The errors in the inner and outer diameters of the cladding in the control and safety rods were assumed to be 0.55 and 0.27 %, respectively, using the difference in the dimensions from those of the cladding in the fuel rod. On the other hand, the errors in the inner and outer diameters of the cladding in the fuel rod were 0.03 and 0.05 %, respectively, as mentioned above. It is considered that both 0.55 and 0.27 % as the relative errors in the inner and outer diameters of the cladding in the considered that both 0.55 and 0.27 % as the relative errors in the inner and outer diameters of the cladding in the control and safety rods are conservative assumption.

The difference in the averaged bias among the minimum, standard, and intermediate cores for the error in the inner diameter of the cladding in the control and safety rods is more than three times its σ . The difference in the averaged bias among the minimum, standard, and intermediate cores for the error in the outer diameter of the cladding in the control and safety rods is also more than three times its σ .

It is confirmed for the errors in both the inner and outer diameter that the averaged biases tend to become larger as the number of fuel rods loaded in the core decreases. In the minimum core, where the minimum number of fuel rods were loaded, all fuel followers were being fully inserted. Thus, it is considered for the minimum core that the errors in both the inner and outer diameter of the stainless-steel cladding behaving as thermal neutron absorber like the cladding in the fuel rod affect $k_{\rm eff}$ more than those for the standard and intermediate cores.

Diameter and height of natural boron carbide

For the natural boron carbide absorber in the control and safety rods, its diameter and height in the present detailed models were compared with the dimensional inspection records at the renewal of several control rods in 1995. There were no differences in values of the diameter and height of the absorber between the present model and the inspection records in 1995. In addition, it was confirmed that there were not any variations of multi-point measurement values for the diameter and height in the inspection records in 1995. For this reason, the errors in the diameter and height of the natural boron carbide absorber in the control and safety rods were assumed not to be taken into account.

Aggregated uncertainty in k_{eff}

The aggregated uncertainties in k_{eff} propagated from the errors in the geometry data of the control and safety rods are in the range of 0.0003 to 0.0007 Δk_{eff} . The largest contribution to the uncertainties in k_{eff} excepting the minimum core is the error in the height of the uranium-zirconium hydride in the control and safety rods. For the minimum core, the largest contribution to the uncertainties in k_{eff} is the error in the inner diameter of the cladding in the control and safety rods.

6.1.3 Adjustable and fast transient rods

Diameter of enriched boron carbide

The dimensions of the adjustable and fast transient rods were confirmed by design drawings since the dimensional inspection records at the construction in 1973 are not found at present. The adjustable and fast transient rods were renewed in 1993 and 1995, respectively, of which dimension inspection records are available.

For the enriched boron carbide absorber in the adjustable and fast transient rods, the diameter in the present detailed models was compared with the dimensional inspection records at the renewal in 1993 and 1995. The measured diameters of the enriched boron carbide absorber shown in the dimensional inspection records were maximally 1.38 % smaller than those of the present detailed models. Thus, the error in the diameters of the enriched boron carbide absorber in the adjustable and fast transient rods was estimated using the 1.38 % smaller dimensions of the diameters.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.75 times its σ . It is confirmed that the uncertainties

in k_{eff} propagated from the error in the diameter of the enriched boron carbide absorber in the adjustable and fast transient rods are negligibly small for all cores.

Height of enriched boron carbide

The height of the enriched boron carbide absorber in the adjustable and fast transient rods in the present detailed models was compared with the dimensional inspection records at the renewal in 1993 and 1995, respectively. The inspection records in 1993 and 1995 showed ± 0.02 cm (0.05% in relative) and ± 0.01 cm (0.01% in relative) of errors in the height of the enriched boron carbide absorber for the adjustable and fast transient rods, respectively. Thus, the errors in the height of the enriched by assuming that the same errors existed in the present detailed models.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.74 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the height of the enriched boron carbide absorber in the adjustable and fast transient rods are negligibly small for all cores.

Inner and outer diameter of cladding in adjustable and fast transient rods

For the cladding in the adjustable and fast transient rods, the inner and outer diameters of the present detailed models were also compared with dimensional inspection records at the renewal in 1993 and 1995. There was no difference in values of the inner diameters between the present detailed models and the inspection records. For this reason, the error in the inner diameters of the cladding in the adjustable and fast transient rods was assumed not to be taken into account. On the other hand, differences in the outer diameters between the present detailed models and the inspection records in 1993 and 1995 were confirmed as maximally 0.26 %. Thus, the relative error in the outer diameter of the claddings in the adjustable and fast transient rods was assumed to be 0.26 %.

The difference in the averaged bias among the minimum, standard, and intermediate cores for the error in the outer diameter of the claddings in the adjustable and fast transient rods is within 0.23 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the outer diameter of the cladding in the adjustable and fast transient rods are negligibly small for all cores.

Aggregated uncertainty in keff

The aggregated uncertainties in k_{eff} propagated from the errors in the geometry data of the adjustable and fast transient rods are negligibly small for all cores. The adjustable and fast transient rods were being fully withdrawn for the standard and intermediate cores. For the minimum core, the adjustable transient rod was being inserted up to 15 % of full stroke whilst the fast transient rods were being fully withdrawn. In those cases, it is considered that the errors in the geometry data of the adjustable and fast transient rods may not significantly affect the uncertainties in k_{eff} . The effect of the transient rod positions on the uncertainties in k_{eff} is discussed in Appendix-1.

6.1.4 Grid plate

Hexagonal lattice pitch of grid plate

The relative error in the hexagonal lattice pitch of the top/bottom grid plates was evaluated as 0.07 % using the dimensional inspection records at the construction in 1973.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 1.46 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the lattice pitch for the minimum core in which the minimum number of fuel rods is loaded is slightly smaller than the standard and intermediate cores.

Replacement of grid plates with water

The errors in the thickness of the grid plates, and in the diameter of the holes for the loading the fuel rods were confirmed in the dimensional inspection records at the construction in 1973. It is considered that the effects of those errors may be small since the grid plates are made from aluminum alloy and installed far away from the core midplane. Thus, the uncertainties in k_{eff} propagated from the errors in the dimensions of the grid plates other than the lattice pitch were evaluated conservatively by the replacement of the whole grid plates with water.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.78 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the replacement are negligibly small for the minimum and intermediate cores. It is also confirmed that the uncertainty in k_{eff} propagated from the replacement is quite small for the standard core.

Aggregated uncertainty in keff

The aggregated uncertainties in k_{eff} propagated from the errors in the geometry data of the grid plates are in the range of 0.0001 to 0.0002 Δk_{eff} . For all cores, the largest contribution to the uncertainties in k_{eff} is the errors in the lattice pitch, but they are quite small.

6.1.5 Experimental tube

Face-to-face distance and thickness of hexagonal experimental tube

The experimental tube is composed of two sorts of shapes as mentioned in Sec. 2.6. The relative errors in the face-to-face distance and thickness of the hexagonal experimental tube were evaluated as 0.18 and 0.78 %, respectively, using the dimensional inspection records at the construction in 1973.

The differences in the averaged bias among the minimum, standard, and intermediate cores for the errors in the face-to-face distance and thickness of the hexagonal experimental tube are 0.51 and 0.27 times their σ 's, respectively. It is confirmed that there is almost no difference in the uncertainties in k_{eff} from the error in the face-to-face distance of the hexagonal experimental tube among the minimum, standard, and intermediate cores. It is also confirmed that the uncertainties in k_{eff} from the error in the thickness of the hexagonal experimental tube are negligibly small for all cores. It is considered that the former uncertainties become larger than the latter ones since the absolute error in the face-to-face distance is larger than that in the thickness.

Outer diameter and thickness of cylindrical experimental tube

The relative errors in the outer diameter and thickness of the cylindrical experimental tube were evaluated as 0.11 and 0.78 %, respectively, using the dimensional inspection records at the construction in 1973.

The differences in the averaged bias among the minimum, standard, and intermediate cores for the errors both in the outer diameter and thickness of the cylindrical experimental tube are 0.75 times their σ 's. It is confirmed that the uncertainties in k_{eff} propagated from the errors both in the outer diameter and thickness of the cylindrical experimental tube are negligibly small for all cores. The cylindrical experimental tube was being installed at the horizontal center of the core, but vertically far away from the core. Thus, it is considered that the errors in the dimensions of the cylindrical experimental tube less affect k_{eff}.

<u>Aggregated uncertainty in keff</u>

There is almost no difference in the aggregated uncertainties in k_{eff} propagated from the errors in the geometry data of the experimental tubes among the minimum, standard, and intermediate cores. The aggregated uncertainties are $0.0003 \ \Delta k_{eff}$ for all cores. There is no contribution to the uncertainties in k_{eff} from the errors in the geometry data excepting the face-to-face distance of the hexagonal experimental tube for all cores.

For reference, evaluated results of the uncertainties in k_{eff} from the replacement of the experimental tube with water are shown in Appendix-2.

6.1.6 Shroud

The errors in the dimensions of the shroud were confirmed in the dimensional inspection records at the construction in 1973. but it is considered that the effects of those errors may be small since the shroud is made from aluminum alloy and installed far away from the core. Thus, the uncertainties in k_{eff} propagated from the errors in the dimensions of the shroud were evaluated conservatively by the replacement of the whole shroud with water.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 1.20 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the replacement are negligibly small for all cores.

6.1.7 Guide tube for transient rod

The dimensions of the guide tubes for transient rods were confirmed by design drawings since the dimensional inspection records at the construction in 1973 are not found at present. It is considered that the effects of the errors in the dimensions of the guide tubes may be small since those are installed far away from the core. Thus, the uncertainties in k_{eff} propagated from the errors in the dimensions of the guide tubes were evaluated conservatively by the replacement of all guide tubes with water like the evaluation for the shroud.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.61 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the replacement are negligibly small for all cores.

6.1.8 Summary for geometry data

The aggregated uncertainties in k_{eff} propagated from the errors in the geometry data are summarized in Table 6.1.8.1. The aggregated uncertainties are in the range of 0.0017 to 0.0018 Δk_{eff} .

Figure 6.1.8.1 shows the contribution of the geometry data to the uncertainties in k_{eff} . As shown in Fig. 6.1.8.1, it is confirmed that 80 to 91 % of the aggregated uncertainties are owing to the errors in the geometry data of the fuel rod. Figure 6.1.8.2 shows the contribution of the geometry data in the fuel rod to the uncertainties in k_{eff} . As shown in Fig. 6.1.8.2, it is confirmed that the error in the outer diameter of the cladding in the fuel rod contributes to 58 to 60 % of the aggregated uncertainties owing to the error in the fuel rod.

Table 6.1.8.1 Aggregated uncertainties in k_{eff} propagated from the errors in the geometry data.

| Source of uncertainty | Core | Uncertainty in k _{eff} |
|---------------------------------|--------------|---------------------------------|
| Source of uncertainty | COIE | (Δk_{eff}) |
| Aggregation of upportainting in | Minimum | 0.0018 |
| Aggregation of uncertainties in | Standard | 0.0017 |
| geometry data | Intermediate | 0.0018 |



Fig. 6.1.8.1 Contribution of the geometry data to the uncertainty in $k_{\rm eff.}$



Contribution of fuel rod geometry data to uncertainty in keff

Fig. 6.1.8.2 Contribution of the geometry data in the fuel rod to the uncertainty in $k_{\rm eff.}$

6.2 Uncertainties from errors in material data

The evaluated results of the uncertainties in k_{eff} propagated from the errors in the material data are summarized in Table 6.2. For each item listed in Table 6.2, details are described below.

| Table 6.2 Summary of uncertainties in keff propagated from the errors |
|---|
| in the material data. |

| ltem | Source of uncertainty | Core | Averageo (∆k _{ef} | db _{ff} ± | iias: B _{av} 1σ) | Max. difference in B _{av} : D | D/σ | Uncertainty in k _{eff} (Δk _{eff}) | Aggregated uncertainty for item (Δk_{eff}) |
|---|--|-------------------------------------|----------------------------------|-----------------------|-------------------------------|--|------|--|---|
| | 0.41% of U-ZrH volume: $\pm 0.024 \times 10^4 (cm^3)$ | Minimum Standard Intermediate | ±0.00169 ±0.00168 ±0.00164 | ± ± ± | 0.00007 0.00007 0.00007 | 0.00005 | 0.72 | 0.0017 0.0017 0.0016 | _ |
| U-ZrH in fuel, | 1.51% of H/Zr atomic number ratio: ± 0.02 | Minimum Standard Intermediate | ±0.00042 ±0.00035 ±0.00043 | ± ± ± | 0.00007 0.00007 0.00007 | 0.00008 | 1.11 | 0.0004 0.0004 0.0004 | Minimum: 0.0018 Standard: |
| rods | 0.55% of U-235 enrichment: ± 0.11 (wt%) | Minimum Standard Intermediate | ±0.00020 ±0.00021 ±0.00027 | ± ± ± | 0.00007 0.00007 0.00007 | 0.00007 | 0.97 | 0.0002 0.0002 0.0003 | 0.0018 Intermediate: 0.0017 |
| | Taking U-234 and U-236 into account as uranium composition | Minimum Standard Intermediate | -0.00021 -0.00032 -0.00019 | ± ± ± | 0.00007 0.00007 0.00007 | 0.00013 | 1.78 | 0.0002 0.0003 0.0002 | |
| Zr rod in fuel, control, and safety rods | 0.46% of Zr density: ± 0.03 (g/cm ³) | Minimum Standard Intermediate | ±0.00006 ±0.00002 ±0.00003 | ± ± ± | 0.00007 0.00007 0.00007 | 0.00003 | 0.45 | negligible negligible negligible | - |
| Stainless-steel in fuel, control, safety | 0.88% of stainless-steel density: ± 0.07 (g/cm3) | Minimum Standard Intermediate | ±0.00047 ±0.00045 ±0.00053 | ± ± ± | 0.00007 0.00007 0.00007 | 0.00008 | 1.11 | 0.0005 0.0005 0.0005 | Minimum: 0.0005 Standard: |
| rods, and guide tube for transient rod | Replacement of stainlees-steel composition in fuel rod with standard value | Minimum Standard Intermediate | -0.00012 -0.00021 -0.00013 | ± ± ± | 0.00007 0.00007 0.00007 | 0.00010 | 1.34 | 0.0001 0.0002 0.0001 | 0.0005 Intermediate: 0.0006 |
| Mo disc in fuel rod | 0.78% of Mo density: ± 0.08 (g/cm ³) | Minimum Standard Intermediate | ±0.00002 ±0.00005 ±0.00002 | ± ± ± | 0.00007 0.00007 0.00007 | 0.00003 | 0.38 | negligible negligible negligible | - |
| Axial graphite | 7.51% of graphite density: ± 0.13 (g/cm ³) | Minimum Standard Intermediate | ±0.00092 ±0.00098 ±0.00099 | ± ± ± | 0.00007 0.00007 0.00007 | 0.00007 | 0.97 | 0.0009 0.0010 0.0010 | Minimum: 0.0009 Standard: |
| reflector in fuel rod | Taking B-10 and B-11 into account as impurity | Minimum Standard Intermediate | +0.00008 -0.00008 +0.00009 | ± ± ± | 0.00007 0.00007 0.00007 | 0.00017 | 2.33 | 0.0001 0.0001 0.0001 | 0.0010 Intermediate: 0.0010 |
| Al alloy in control, safety, transient rods, and other core structures | Replacement of aluminum alloy compositions with aluminum-27 only | Minimum Standard Intermediate | +0.00026 +0.00025 +0.00029 | ± ± ± | 0.00007 0.00007 0.00007 | 0.00003 | 0.45 | 0.0003 0.0003 0.0003 | - |

| ltem | Source of uncertainty | Core | Average (∆k _e | ed b eff ± | bias: B _{av} 1σ) | Max. difference in B _{av} : D | D/σ | Uncertainty in k _{eff} (Δ k _{eff}) | Aggregated uncertainty for item (∆k _{eff}) |
|---------------------------|---|--------------|-----------------------------|---------------|------------------------------|--|------|---|---|
| | 0.23% of natural B4C density: | Minimum | ±0.00001 | ± | 0.00007 | | | negligible | Minimum [.] |
| | $+ 0.0059 (a/cm^3)$ | Standard | ±0.00008 | ± | 0.00007 | 0.00006 | 0.88 | 0.0001 | negligible |
| Natural B ₄ C | ± 0.0003 (g/cm ⁻) | Intermediate | ±0.00002 | ± | 0.00007 | | | negligible | Standard: |
| absorber in control | 0.13% of B content of natural | Minimum | ±0.00004 | ± | 0.00007 | | | negligible | 0.0001 |
| and salety lous | B4C: | Standard | ±0.00003 | ± | 0.00007 | 0.00004 | 0.52 | negligible | Intermediate: |
| | ± 0.103 (wt%) | Intermediate | ±0.00000 | ± | 0.00007 | | | negligible | negligible |
| | 1.49% of enriched B4C | Minimum | ±0.00001 | ± | 0.00007 | | | negligible | |
| | density: | Standard | ±0.00001 | ± | 0.00007 | 0.00001 | 0.09 | negligible | |
| | ± 0.0343 (g/cm ³) | Intermediate | ±0.00002 | ± | 0.00007 | | | negligible | Minimum: |
| Enriched B ₄ C | 0.61% of B content of enriched | Minimum | ±0.00004 | ± | 0.00007 | | | negligible | negligible |
| absorber in transient | B4C: | Standard | ±0.00005 | ± | 0.00007 | 0.00004 | 0.55 | negligible | negligible |
| rods | ± 0.4694 (wt%) | Intermediate | ±0.00001 | ± | 0.00007 | | | negligible | Intermediate: |
| _ | 0.54% of D.40 envicements | Minimum | ±0.00002 | ± | 0.00007 | | | negligible | negligible |
| | 0.51% of B-10 enrichment: + 0.47 (wt%) | Standard | ±0.00001 | ± | 0.00007 | 0.00002 | 0.22 | 0.22 negligible | |
| | 20.11 (000) | Intermediate | ±0.00001 | ± | 0.00007 | | | negligible | |

Table 6.2 (contd.) Summary of uncertainties in k_{eff} propagated from the errors in the material data.

6.2.1 Uranium-zirconium hydride in fuel, control, and safety rods <u>Total volume of uranium-zirconium hydride</u>

The error in the total volume of the uranium-zirconium hydride in the core propagates to that of the density of the uranium-zirconium hydride. The relative error in the volume was evaluated as 0.41 % using both the design drawings and dimensional inspection records at the construction in 1973.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.72 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the total volume of the uranium-zirconium hydride for the minimum, standard, and intermediate cores are of comparable magnitude.

Atomic number ratio of hydrogen to zirconium

The error in the atomic number ratio of hydrogen to zirconium propagates to that of the atomic number density of zirconium in the uranium-zirconium hydride. The relative error in the ratio was evaluated as 1.51 % using the material inspection records at the construction in 1973.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 1.11 times its σ . It is confirmed that there is almost no difference in the uncertainties in k_{eff} propagated from the error in the atomic

number ratio of hydrogen to zirconium among the minimum, standard, and intermediate cores.

Uranium-235 enrichment

The error in the uranium-235 enrichment propagates to those of the atomic number densities of the uranium nuclides in the uranium-zirconium hydride. The relative error in the enrichment was evaluated as 0.55 % using the material inspection records at the construction in 1973.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.97 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the uranium-235 enrichment for the minimum, standard, and intermediate cores are of comparable magnitude.

Effect of uranium-234 and uranium-236

The material inspection records at the construction in 1973 on two heats of the uranium metal supplied by AI showed that the uranium recovered by fuel reprocessing was used due to the presence of uranium-236. Thus, the effects of the uranium nuclides other than uranium-235 and uranium-238 were evaluated by using the composition of the AI J-04 and AI J-06 heats. The atomic number densities of the uranium including uranium-234 and uranium-236 are shown in Table 6.2.1.1.

| 1ľ | ncluding uranium-234 | and uranium-236 based on the AI neats |
|----|----------------------|---------------------------------------|
| - | Nuclide | Atomic Number Density (1/barn cm) |
| | U-234 | 1.8776×10 ⁻⁶ |
| | U-235 | 3.6561 × 10 ⁻⁴ |
| | U-236 | 2.5004 × 10 ⁻⁶ |
| | U-238 | 1.4444 × 10 ⁻³ |

Table 6.2.1.1 Atomic number densities of nuclides in the uranium including uranium-234 and uranium-236 based on the AI heats.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 1.78 times its σ . It is confirmed for all cores that the negative reactivity effect is brought by taking uranium-234 and uranium-236 into account. It is also confirmed that the absolute value of the averaged bias for the standard core in which the largest amount of the uranium-zirconium hydride is loaded is slightly larger than those for the minimum and intermediate cores, but

the uncertainty in k_{eff} propagated from taking uranium-234 and uranium-236 into account for the minimum, standard, and intermediate cores are of comparable magnitude.

Aggregated uncertainty in k_{eff}

The aggregated uncertainties are in the range of 0.0017 to 0.0018 Δk_{eff} . The largest contribution to the aggregated uncertainties is the error in the total volume of the uranium-zirconium hydride. The second largest contribution to the aggregated uncertainties is the error in the atomic number ratio of hydrogen to zirconium, but it is smaller than the contribution of the error in the total volume of the uranium-zirconium hydride.

For reference, evaluated results of the uncertainties in k_{eff} propagated from the ignoring the impurities in the uranium-zirconium hydride are shown in Appendix-3.

6.2.2 Zirconium rod in fuel, control, and safety rods

The relative error in the zirconium density was assumed to be 0.46 % in comparison with the other TRIGA benchmarks, ICT-013¹²⁾ and ICT-003¹³⁾. The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.45 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the zirconium density are negligibly small for all cores.

For reference, evaluated results of the uncertainties in k_{eff} propagated from the ignoring the impurities in the zirconium rod are shown in Appendix-3.

6.2.3 Stainless-steel in fuel, control, and safety rods, and in guide tube for transient rod

Density of stainless-steel

The relative error in the density of the stainless-steel was assumed to be 0.88 % in comparison with the other TRIGA benchmarks, ICT-013¹²⁾ and ICT-003¹³⁾. The difference in the averaged bias among the minimum, standard, and intermediate cores is within 1.11 times its σ . It is confirmed that there is almost no difference in the uncertainties in k_{eff} propagated from the error in the density of the stainless-steel among the minimum, standard, and intermediate cores.

Composition of stainless-steel

The compositions of the stainless-steel in the fuel rods were evaluated by using the material inspection records at the construction in 1973, on the other hand those in the control and safety rods, and in the guide tubes for the transient rods were based on the standard values because of lack of the inspection records. It is considered that the difference in the compositions of the stainless-steel of the fuel rods affects k_{eff} 's more than those of the control and safety rods, and of the guide tubes since the total amount of the stainless-steel of the fuel rods is quite larger than the others. Thus, the uncertainties in k_{eff} from the difference in the compositions of the stainless-steel were evaluated by the replacement of the standard values used in the control and safety rods, and in the guide tubes.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 1.34 times its σ . It is confirmed for all cores that the negative reactivity effect is brought by the replacement. It is also confirmed that the absolute value of the averaged bias for the standard core in which the largest number of fuel rods is loaded is slightly larger than those for the minimum and intermediate cores, but the uncertainty in k_{eff} propagated from the replacement for the minimum, standard, and intermediate cores are of comparable magnitude.

The total fraction of the elements of chromium, manganese, nickel, and iron is more than 98% of the atomic number density in the stainless-steel. The cross sections of (n, γ) capture reactions at 0.0253 eV (2,200 m/s) for the elements of chromium, manganese, and nickel are larger than that of the element of iron. For example, the capture cross sections at 0.0253 eV are evaluated in the JENDL-5 library ⁷ as 3.14, 13.27, 4.09, and 2.57 barns for the elements of chromium, manganese, nickel, and iron, respectively. The fraction of those elements other than iron in the stainless-steel based on the standard compositions is larger than those in the stainless-steel in the fuel rods, of which compositions are confirmed by the material inspection records. The reason for the negative reactivity effect is that the replacement with the standard compositions brings slightly larger cross sections for the thermal neutron capture of the stainless-steel more than those by the compositions in the fuel rods.

Aggregated uncertainty in k_{eff}

The aggregated uncertainties are in the range of 0.0005 to 0.0006 Δk_{eff} . The largest contribution to the uncertainties is the error in the density of the stainlesssteel.

6.2.4 Molybdenum disc in fuel rod

The relative error in the molybdenum density was assumed to be 0.78 % in comparison with the other TRIGA benchmarks, ICT-013¹²⁾ and ICT-003¹³⁾. The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.38 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the molybdenum density are negligibly small for all cores.

For reference, evaluated results of the uncertainties in k_{eff} propagated from ignoring the impurities in the molybdenum disc are shown in Appendix-3.

6.2.5 Axial graphite reflector in fuel rod

Density of graphite

The relative error in the graphite density was conservatively assumed to be 7.51 % by the difference between the other TRIGA benchmarks, ICT-013 12 and ICT-003¹³⁾. The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.97 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the density of the graphite for the minimum, standard, and intermediate cores are of comparable magnitude.

Effect of impurities

The material inspection records at the construction in 1973 showed that the boron content in the graphite was smaller than 0.5 ppm of the lower limit of detection. Thus, the effects of the boron nuclides were evaluated by using the value of the lower limit. The atomic number densities of boron-10 and boron-11 are shown in Table 6.2.5.1.

| in the axial graphite reflectors. | |
|-----------------------------------|-----------------------------------|
| Nuclide | Atomic Number Density (1/barn cm) |
| B-10 | 9.5885×10 ⁻⁹ |
| B-11 | 3.8595 × 10 ⁻⁸ |

Table 6.2.5.1 Atomic number densities of nuclides of boron
The difference in the averaged bias among the minimum, standard, and intermediate cores is within 2.33 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the consideration of the boron nuclides are quite small for all cores.

Aggregated uncertainty in keff

The aggregated uncertainties are in the range of 0.0009 to 0.0010 Δk_{eff} , same as the uncertainties in k_{eff} propagated from the error in the density of the graphite.

6.2.6 Aluminum alloy in control, safety, and transient rods, and in other core structures

The compositions of the aluminum alloy were based on the standard values because of lack of the material inspection records at the construction in 1973. The nuclide of aluminum-27 is only considered in the other TRIGA benchmarks, ICT-013¹²⁾ and ICT-003¹³⁾. Thus, the uncertainties in k_{eff} propagated from the difference in the compositions of the aluminum alloy were evaluated by the replacement of the compositions of the present models with the nuclide of aluminum-27 only.

The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.45 times its σ . It is confirmed for all cores that the positive reactivity effect is brought by the replacement. It is also confirmed that there is almost no difference in the uncertainties in k_{eff} propagated from the replacement of the aluminum alloy compositions among the minimum, standard, and intermediate cores.

The cross sections of (n, γ) capture reactions at 0.0253 eV (2,200 m/s) for the elements of titanium, chromium, manganese, iron, copper, and zinc are larger than that of the element of aluminum. For example, the capture cross sections at 0.0253 eV for the elements of titanium, chromium, manganese, iron, copper, and zinc are evaluated as 6.41, 3.14, 13.27, 2.57, 3.77, and 1.06 barns, respectively, in the JENDL-5 library ⁷). On the other hand, the capture cross section for the element of aluminum is evaluated as 0.23 barns in the same library. The averaged capture cross section weighted by the atomic number densities for the aluminum alloy in the present models is calculated to be 0.26 barns. It is slightly larger than the value of the cross section for the element of aluminum only. The reason for the positive reactivity effect is that the replacement with the composition involving

only aluminum-27 brings smaller cross sections for the thermal neutron capture of the aluminum alloy more than those by the composition in the present models.

$6.2.7 \quad \text{Natural boron carbide absorber in control and safety rods}$

Density of natural boron carbide

The relative error in the density of the natural boron carbide was estimated to be 0.23 % using the material inspection records at the renewal of the control and safety rods in 1995. The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.88 times its σ . It is confirmed that the averaged bias for the standard core in which the largest amount of the natural boron carbide absorber in the control rods is inserted into the core is slightly larger than those for the minimum and intermediate cores, but the uncertainty in k_{eff} propagated from the error in the density of the natural boron carbide is quite small for the standard core. It is also confirmed that the uncertainties in k_{eff} propagated from the error in the density of the natural boron carbide are negligibly small for the minimum and intermediate cores.

Boron content in natural boron carbide

The relative error in the boron content in the natural boron carbide was also estimated to be 0.13 % using the material inspection records at the renewal of the control and safety rods in 1995. The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.52 times its σ . It is confirmed that the uncertainties in k_{eff} the error in the boron content are negligibly small for all cores.

<u>Aggregated uncertainty in k_{eff}</u>

The aggregated uncertainties in k_{eff} are same as the uncertainties propagated from the error in the density of the natural boron carbide since the uncertainties propagated from the error in the boron content are negligibly small for all cores.

6.2.8 Enriched boron carbide absorber in transient rod

Density of enriched boron carbide

The relative error in the density of the enriched boron carbide was estimated to be 1.49 % using the material inspection records at the renewal of transient rods in 1992 and 1995. The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.09 times its σ . It is confirmed that

the uncertainties in k_{eff} propagated from the error in the density of the enriched boron carbide are negligibly small for all cores.

Boron content in enriched boron carbide

The relative error in the boron content in the enriched boron carbide was also estimated to be 0.61 % using the material inspection records at the renewal of transient rods in 1992 and 1995. The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.55 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the boron content are negligibly small for all cores.

Boron-10 enrichment of enriched boron carbide

The relative error in the boron-10 enrichment of the enriched boron carbide was also estimated to be 0.51 % using the material inspection records at the renewal of transient rods in 1992 and 1995. The difference in the averaged bias among the minimum, standard, and intermediate cores is within 0.22 times its σ . It is confirmed that the uncertainties in k_{eff} propagated from the error in the boron-10 enrichment are negligibly small for all cores.

Aggregated uncertainty in keff

The aggregated uncertainties are negligibly small for all cores. This is considered to be due to the same reason as mentioned in Sec. 6.1.3. The effect of the transient rod positions on the uncertainties in k_{eff} is discussed in Appendix-1.

6.2.9 Summary for material data

The aggregated uncertainties in k_{eff} propagated from the errors in the material data are summarized in Table 6.2.9.1. The aggregated uncertainties are 0.0021 Δk_{eff} for all cores.

Figure 6.2.9.1 shows the contribution of the material data to the uncertainties in k_{eff} . As shown in Fig. 6.2.9.1, it is confirmed that 68 to 73% of the aggregated uncertainties are owing to the errors in the material data of the uranium-zirconium hydride.

Figure 6.2.9.2 shows the contribution of the material data of the uraniumzirconium hydride to the uncertainties in k_{eff} . As shown in Fig. 6.2.9.2, it is confirmed that the contribution of the error in the total volume of the uraniumzirconium hydride affecting its density becomes 90 to 91% of the aggregated uncertainties owing to the errors in the uranium-zirconium hydride.

| Source of uncertainty | Core | Uncertainty in k_{eff} (Δk_{eff}) |
|---------------------------------|--------------|--|
| Aggregation of uncortainties in | Minimum | 0.0021 |
| Aggregation of uncertainties in | Standard | 0.0021 |
| malenai uala | Intermediate | 0.0021 |

Table 6.2.9.1 Aggregated uncertainties in k_{eff} propagated from the errors in the material data.



Contribution of material data to uncertainty in \mathbf{k}_{eff}

Fig. 6.2.9.1 Contribution of the material data to the uncertainty in $k_{\mbox{\scriptsize eff}}$



Contribution of U-ZrH material data to uncertainty in \mathbf{k}_{eff}

Fig. 6.2.9.2 Contribution of the material data of the uranium-zirconium hydride to the uncertainty in $k_{\rm eff}$

6.3 Uncertainties from errors in operation data

The evaluated results of the uncertainties in k_{eff} propagated from the errors in the operation data are summarized in Table 6.3. For each item listed in Table 6.3, details are described below.

Table 6.3 Summary of uncertainties in $k_{\rm eff}$ propagated from the errors in the operation data.

| Source of uncertainty | Core | Averaged bias: B _{av} (Δk _{eff} ±1σ) | Max. difference in <u>[</u> B _{av} : D | D/ σ Uncertainty in k _{eff} (Δk_{eff}) |
|---|--------------|---|---|--|
| Cumite of real realitions | Minimum | ±0.00029 ± 0.00007 | | 0.0003 |
| 5 units of rod position: + 0.24 (cm) | Standard | ±0.00047 ± 0.00007 | 0.00048 6 | 3.61 0.0005 |
| ± 0.24 (6m) | Intermediate | ±0.00077 ± 0.00007 | | 0.0008 |
| Tomporature changes: | Minimum | ±0.00066 ± 0.00007 | | 0.0007 |
| + 5 ($^{\circ}$ C) | Standard | ±0.00026 ± 0.00007 | 0.00040 5 | 5.41 0.0003 |
| ± 3 (0) | Intermediate | ±0.00042 ± 0.00007 | | 0.0004 |

6.3.1 Rod position for control, safety, and transient rods

The error in the absorber rod position was assumed to be 5 units (2.4 mm) conservatively by the maintenance standard. The difference in the averaged bias among the minimum, standard, and intermediate cores is more than three times of its σ . It is confirmed that the uncertainty in k_{eff} propagated from the error in the rod position for the representative intermediate cores is the largest one since all control rods were being inserted into the cores at the vicinity of the core midplane. It is also confirmed that the uncertainty in k_{eff} propagated from the error in the rod position for the minimum core is the smallest one since all control and safety rods were being fully withdrawn.

6.3.2 Temperature

The error in the temperature was assumed to be 5 °C, conservatively by the variation of the measured temperature in the operation records for the first startup in 1975. The difference in the averaged bias among the minimum, standard, and intermediate cores is more than three times of its σ . It is confirmed that the uncertainty in k_{eff} propagated from the error in the temperature tends to become larger as the number of fuel rods loaded in the core decreases.

It is considered that the neutron leakage along horizontal directions in the case of the smaller number of fuel rods loaded in the core is larger than that of the larger number of fuel rods since the smaller number of fuel rods may bring the larger horizontal geometrical buckling. In addition, it is considered that the neutron leakage from the core varies with both the changes in the water density, and the thermal neutron spectrum shift in the uranium-zirconium hydride and water, which are brought by temperature variation. For those reasons, it is considered that the larger uncertainty in $k_{\rm eff}$ is brought by the smaller number of fuel rods, i.e., larger horizontal geometrical buckling, which is sensitive to the changes in the neutron leakage.

6.3.3 Criticality judgement

The criticality judgement was done visually by NSRR operators with recorder chart of linear power channel detectors. In NSRR, the reactivity that the power increases by 25% in 5 minutes is evaluated to be 0.94 \notin (= 0.000069 Δk_{eff})*³. It is considered that this degree of power variation can be easily found by the visual check of the operators. For this reason, the uncertainty in k_{eff} propagated from the criticality judgement is smaller than 0.00007 Δk_{eff} . Thus, the uncertainty in k_{eff} from the criticality judgement was assumed not to be taken into account.

6.3.4 Summary for operation data

The aggregated uncertainties in k_{eff} propagated from the errors in the operation data are summarized in Table 6.3.4.1. The aggregated uncertainties in k_{eff} are in the range of 0.0005 to 0.0009 Δk_{eff} .

Figure 6.3.4.1 shows the contribution of the operation data to the uncertainties in k_{eff} . As shown in Fig. 6.3.4.1, it is confirmed that the contribution of the error in the absorber rod position is 75 to 77 % of the aggregated uncertainties for the standard and intermediate cores. For the minimum core, the contribution of the error in the temperature is quite larger than the contribution of that in the rod positions and occupies 83 % of the aggregated uncertainties.

^{*3} The value of effective delayed neutron fraction is set to be 0.0073 as shown in the literature ¹).

| Source of uncertainty | Core | Uncertainty in k _{eff} (Δk_{eff}) |
|---------------------------------|--------------|--|
| Aggregation of uncortainties in | Minimum | 0.0007 |
| Aggregation of uncertainties in | Standard | 0.0005 |
| | Intermediate | 0.0009 |

Table 6.3.4.1 Aggregated uncertainties in k_{eff} propagated from the errors in the operation data.



Contribution of operation data to uncertainty in \mathbf{k}_{eff}

Fig. 6.3.4.1 Contribution of the operation data to the uncertainty in $k_{\rm eff.}$

6.4 Overall uncertainties

As overall uncertainties in k_{eff} , the aggregated uncertainties in k_{eff} propagated from the errors in the geometry, material, and operation data are summarized in Table 6.4.1. The aggregated uncertainties in k_{eff} are evaluated to be in the range of 0.0027 to 0.0029 Δk_{eff} .

Figure 6.4.1 shows the contribution of the errors in the geometry, material, and operation data to the uncertainties in k_{eff} . As shown in Fig. 6.4.1, it is confirmed that the largest contribution to the uncertainties in k_{eff} is the errors in the material data. It is also confirmed that the second largest contribution is the errors in the geometry data.

| Source of uncertainty | Core | Uncertainty in k _{eff} (∆k _{eff}) |
|-----------------------------------|--------------|---|
| Aggregation of uncertainties in | Minimum | 0.0028 |
| geometry, material, and operation | Standard | 0.0027 |
| data | Intermediate | 0.0029 |

Table 6.4.1 Aggregated uncertainties in $k_{\rm eff}$ propagated from the errors in the geometry, material, and operation data.

The evaluated overall uncertainties in k_{eff} are equivalent to about 40 ¢ *4 as reactivity. It is shown in the literature ¹⁾ that the absorber rod worths were determined in the range of 162 to 225 ¢ for the individual rod (R1 to R6, S1, S2, TA, TB, and TC) of the standard core during the first startup in 1975. The uncertainty for the standard core is smaller than a quarter of those values of the absorber rod worths, thus it is considered that the evaluated overall uncertainty in k_{eff} may also be sufficiently applicable to the future analyses on the absorber rod worths.

In the cases of the other TRIGA benchmarks, ICT-003¹³⁾ and ICT-013¹²⁾, the overall uncertainties in k_{eff} are being evaluated to be 0.0056 and 0.0015 Δk_{eff} , respectively. The evaluated overall uncertainties in the present detailed models become about half the magnitude of that of ICT-003. On the other hand, the present evaluated uncertainties are about twice as large as that of ICT-013, but

^{*4} The reactivity is obtained using the same value of effective delayed neutron fraction as described in the footnote *3.

it is suggested in the earlier studies ^{3,4)} that an unknown bias might exist in the ICT-013 benchmark.



Contribution of geometry, material, and operation data to uncertainty in \mathbf{k}_{eff}

Fig. 6.4.1 Contribution of the geometry, material, and operation data to the uncertainty in $k_{\rm eff}$

From the results of the overall uncertainties in k_{eff} for the present detailed models mentioned above, it is concluded for the minimum, standard, and intermediate cores that the differences in the calculated k_{eff} 's by between JENDL-5 and JENDL-4.0, as confirmed in Tables 5.2.1, 5.2.2, and 5.2.3, are not significant in terms of the magnitude of the overall uncertainties in k_{eff} since the differences are within 2 times the overall uncertainties in k_{eff} . It is also concluded for the intermediate cores that the variations in the calculated k_{eff} 's, as shown in Fig. 5.2.1 and Fig. 5.2.2, are not significant in terms of the present overall uncertainties in k_{eff} since the variations are in the range of 0.30 to 0.45 times the overall uncertainties in k_{eff} .

7. Summary

The detailed models for the precise criticality analyses on the first startup cores of NSRR, i.e., the minimum, standard, and intermediate cores, were created for the purposes of deeper understandings of the safety inspection data on the absorber rod worths and improvement of the determination technique of the worth in NSRR. For the creation of detailed models as much as possible, the evaluation on model data was conducted using not only the published literature but also dimensional and material inspection records at the construction of NSRR in 1973, operation records during the first startup in 1975, and so on.

The uncertainties in k_{eff} propagated from the geometry, material, and operation data used in the present model were evaluated in detail by using the MVP version 3 code with the latest Japanese nuclear data library, JENDL-5, and the previous versions of JENDL. As a result, the overall uncertainties in k_{eff} for the present detailed models were evaluated to be in the range of 0.0027 to 0.0029 Δk_{eff} .

From the calculated results by using the MVP version 3 code, it is confirmed that the k_{eff} 's calculated by JENDL-5 were 0.36 to 0.57 % larger than those by JENDL-4.0, but the differences between them were within 2 times the overall uncertainties in k_{eff} for the present detailed models. In addition, it is confirmed for the intermediate cores that the variations in the calculated k_{eff} 's with the changes in the absorber rod position to attain delayed criticality by 'bank mode' were in the range of 0.30 to 0.45 times the overall uncertainties in k_{eff} for the present detailed models and there was no significancy in the variations.

It is considered that the present detailed models are expected to be utilized as the benchmark of k_{eff}'s for TRIGA-ACPR. Moreover, it is confirmed that the evaluated overall uncertainties were sufficiently smaller than the values of absorber rod worths determined in NSRR. Thus, it is also considered that the present models are applicable to future analyses on the absorber rod worths in NSRR.

Furthermore, the vertical positions of the control, safety, and transient rods were individually specified as 'symbolic parameters' ⁶) in the MVP input data (refer to Appendix-4) for the analyses shown in this report. In the analyses, the positions of those absorber rods can be easily set like real operation in NSRR. It is considered that the present models implemented as the MVP input data are applicable to analyses prior to operations on the absorber rod worths with various rod positions. This function will be useful to examine further improvement of the determination technique of the absorber rod worths in NSRR.

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Appendix-1 Effect of Transient Rod Positions on Uncertainties

The uncertainties in k_{eff} propagated from the errors in both the geometry data of the transient rods and the material data of the enriched boron carbide absorber in the transient rods were negligibly small for the minimum, standard, and intermediate cores, as described in Sec. 6.1.3 and Sec. 6.2.8, respectively. Those errors may not affect the uncertainties in k_{eff} because of the transient rods fully withdrawn or small amount of the insertion for those cores.

Hence, the effect of the transient rod positions on the uncertainties in k_{eff} was examined on the cores composed for the determination of absorber rod worths by the rod drop technique during the first startup in NSRR¹⁾. Table A.1.1 lists the absorber rod positions of eleven sorts of cores (ID = tr1 to tr11) subjected to the present examination. Those cores were composed with various transient rod positions to confirm the operation power at delayed criticality before the absorber rod was dropped. The operation power at delayed criticality was in the range of 29 to 32 W. The number of fuel rods and their loaded pattern were the same as the standard core. The temperature of the cores was evaluated to be 23 °C by the operation records in 1975, which is the same as the standard core.

The results of the criticality analyses on those cores with the various transient rod positions are listed in Table A.1.2. In Table A.1.2, σ is the statistical error of Monte Carlo calculations. The differences in k_{eff} between JENDL-4.0 and JENDL-4.0u1 are within their σ 's. The k_{eff}'s by JENDL-5 are 0.42 to 0.47 % larger than those by JENDL-4.0. The differences in k_{eff} between JENDL-5 and JENDL-4.0 are larger than three times their σ 's, similar to the minimum, standard, and intermediate cores, as shown in Sec. 5.2.

As shown in Fig. A.1.1, the k_{eff} by JENDL-4.0, JENDL-4.0u1, and JENDL-5 varies with the transient rod positions in the range of 0.99743 to 1.00035, 0.99748 to 1.00037, and 1.00196 to 1.00502, respectively. The averaged values of k_{eff} by JENDL-4.0, JENDL-4.0u1, and JENDL-5 are 0.99932 \pm 0.00104, 0.99937 \pm 0.00095, and 1.00381 \pm 0.00098, respectively. It is confirmed that the ranges of the above variations are larger than those for the intermediate cores shown in Sec. 5.2.

| | | Reiliaiks | Standard core | R1 worth | measurement | R2 worth | measurement | R3 worth | measurement | R4 worth | measurement | R5 worth | measurement | R6 worth | measurement | R1 worth | measurement | R2 worth | measurement | | | S1 worth | measurement | TA worth | |
|----------|---------------|-----------------|------------------------|------------------|-------------|------------------|----------------|------------------|--------------|------------------|-------------|------------------|-------------|------------------|-------------|-------------------|-------------|-------------------|-------------|------------------|------------|------------------|----------------|--------------------------|-------------------|
| | Transion trad | I TARISIERI FOU | All full withdrawal | TA partial | insertion | TA partial | insertion | TA partial | insertion | TA partial | insertion | TA partial | insertion | TA partial | insertion | TB full insertion | | TB full insertion | | TA and TC full | insertion | TA, TB, and TC | full insertion | TB and TC full insertion | |
| | Cofety | oalety rou | All full withdrawal | All partial | insertion | All partial | insertion | All partial | insertion | All partial | insertion | All partial | insertion | All partial | insertion | All partial | insertion | All partial | insertion | All full | withdrawal | All full | withdrawal | All full withdrawal | MIII 101 1244 121 |
| | BANK | av. (unit) | 213.0 | 0 220 | 7.107 | 000 | 0.002 | 0000 | 7.007 | 738 F | 0.002 | 0 250 | 4.104 | 030.0 | 1.001 | 237.3 | 2 | 238.0 | | 448.5 | | 581.0 |) | 460.8 | |
| sitions | Ind TC | TC | dn | ŝ | dh | 2 | dh | 2 | dh | 2 | dh | 2 | 2 | 2 | 2 | g | <u>)</u> | an | <u>-</u> | qu | | qu | 5 | dn | |
| od pos | n for TB a | TB | dn | 2 | dh | 2 | dh | 2 | dh | 2 | dh | 2 | d n | | d n | qu | 5 | dn | | qn | <u>-</u> | qu | 5 | dn | |
| sient r | II insertio | ΤA | 895 | E OO | 202 | GEA | 5 | GGE | 200 | БЛЛ | 5 | 658 | 000 | 620 | 670 | 894 | - | 894 | | 100 | | 102 | | 901 | |
| trans | and dn: fu | S2 | 897 | 500 | 000 | 652 | 000 | CC1 | 50 | БЛЛ | 5 | 667 | 5 | 631 | | 672 | 5 | 713 | | 896 | | 894 | - | 897 | |
| arious | thdrawal | S1 | 899 | 507 | 100 | 652 | 200 | CC 1 | 100 | 612 | | 657 | 5 | 637 | 100 | 672 | 5 | 714 | | 899 | | 897 | 0 | 899 | |
| with v | up: full wi | R6 | 213 | 100 | 701 | 100 | 701 | 001 | 701 | 100 | 701 | 100 | 701 | 011 | - | 102 | | 102 | | 526 | | 582 | | 461 | |
| cores v | , and TA, | R5 | 209 | 102 | 201 | 102 | 201 | 102 | 201 | 102 | 201 | 000 | 000 | 103 | 201 | 103 | 2 | 103 | | 103 | | 581 | - | 461 | |
| itical d | 86, S1-S2 | R4 | 211 | 102 | 201 | 201 | 201 | 201 | 201 | 800 | 002 | 103 | 2 | 103 | 2 | 103 | 2 | 103 | | 102 | | 582 | | 460 | |
| 1.1 Cr |) for R1-F | R3 | 216 | 101 | 5 | 101 | 5 | 200 | 106 | 101 | 5 | 101 | 5 | 104 | 5 | 104 | - | 104 | | 526 | | 580 | 0 | 461 | |
| ble A. | ition (unit | R2 | 211 | 106 | 001 | 010 | 210 | 106 | 001 | 106 | 001 | 106 | 001 | 106 | 001 | 106 | 2 | 908 | 9 | 526 | | 581 | - | 461 | |
| Tal | Rod pos | R1 | 218 | 005 | 202 | 100 | 001 | 100 | 001 | 100 | 001 | 108 | 001 | 108 | 001 | 906 | | 108 | | 908 | | 580 | 0 | 461 | |
| | ⋸ | 2 | а | + 1- | - | ç | 711 | ¢‡ | 2 | 1+1 | 5 | tr.5 | 2 | trG | | tr7 | ; | tr8 |) | tr:9 | 1 | tr10 | 2 | tr11 | |
| | The number | of fuel rods | 149 | 140 | | 140 | 1 | 140 | 1 | 140 | - 1 0 | 110 | | 149 | | 149 | 2 | 149 | | 149 | | 149 | 2 | 149 | |
| | Date and time | Date and time | 1975/07/03 20:02 | 107E/07/07 17:3E | | 1075/07/07 17:40 | 1910/1010/0101 | 1075/07/07 18-00 | 191010101010 | 1075/07/07 18.11 | | 1075/07/07 18-24 | | 1975/07/07 18-31 | | 1975/07/07 19-07 | | 1975/07/07 19:20 | | 1975/07/07 20:18 | | 1975/07/08 10:18 | | 1975/07/09 15:50 | |

| The number | п | Libron (*1 | k | + ' | 10 | k_{eff} difference ± 1 σ | | | | |
|--------------|------|------------|---------|-----|---------|-----------------------------------|-----|---------|-----------|---------|
| of fuel rods | U | Library | Nef | ή⊥ | 10 | J40- | -J4 | 0u1 | J5-J | J40 |
| | | J40 | 0.99886 | ± | 0.00013 | -0.00008 | ± | 0.00018 | | |
| 149 | tr1 | J40u1 | 0.99895 | ± | 0.00012 | | | | | |
| | | J5 | 1.00349 | ± | 0.00012 | | | | 0.00463 ± | 0.00018 |
| | | J40 | 0.99986 | ± | 0.00012 | 0.00011 | ± | 0.00018 | | |
| 149 | tr2 | J40u1 | 0.99975 | ± | 0.00013 | | | | | |
| | | J5 | 1.00420 | ± | 0.00012 | | | | 0.00434 ± | 0.00017 |
| | | J40 | 1.00035 | ± | 0.00013 | -0.00002 | ± | 0.00019 | | |
| 149 | tr3 | J40u1 | 1.00037 | ± | 0.00013 | | | | | |
| | | J5 | 1.00502 | ± | 0.00013 | | | | 0.00467 ± | 0.00018 |
| | | J40 | 0.99988 | ± | 0.00012 | 0.00001 | ± | 0.00018 | | |
| 149 | tr4 | J40u1 | 0.99987 | ± | 0.00012 | | | | | |
| | | J5 | 1.00430 | ± | 0.00013 | | | | 0.00442 ± | 0.00018 |
| | | J40 | 0.99990 | ± | 0.00013 | 0.00005 | ± | 0.00018 | | |
| 149 | tr5 | J40u1 | 0.99985 | ± | 0.00012 | | | | | |
| | | J5 | 1.00411 | ± | 0.00013 | | | | 0.00421 ± | 0.00018 |
| | | J40 | 0.99957 | ± | 0.00013 | -0.00006 | ± | 0.00018 | | |
| 149 | tr6 | J40u1 | 0.99963 | ± | 0.00013 | | | | | |
| | | J5 | 1.00394 | ± | 0.00013 | | | | 0.00437 ± | 0.00018 |
| | | J40 | 0.99748 | ± | 0.00012 | -0.00014 | ± | 0.00018 | | |
| 149 | tr7 | J40u1 | 0.99761 | ± | 0.00013 | | | | | |
| | | J5 | 1.00215 | ± | 0.00013 | | | | 0.00467 ± | 0.00017 |
| | | J40 | 0.99743 | ± | 0.00012 | -0.00005 | ± | 0.00018 | | |
| 149 | tr8 | J40u1 | 0.99748 | ± | 0.00012 | | | | | |
| | | J5 | 1.00196 | ± | 0.00012 | | | | 0.00453 ± | 0.00017 |
| | | J40 | 0.99966 | ± | 0.00013 | -0.00008 | ± | 0.00018 | | |
| 149 | tr9 | J40u1 | 0.99974 | ± | 0.00012 | | | | | |
| | | J5 | 1.00395 | ± | 0.00012 | | | | 0.00429 ± | 0.00018 |
| | | J40 | 0.99962 | ± | 0.00012 | 0.00006 | ± | 0.00017 | | |
| 149 | tr10 | J40u1 | 0.99956 | ± | 0.00012 | | | | | |
| | | J5 | 1.00427 | ± | 0.00013 | | | | 0.00465 ± | 0.00018 |
| | | J40 | 1.00030 | ± | 0.00013 | 0.00016 | ± | 0.00018 | | |
| 149 | tr11 | J40u1 | 1.00014 | ± | 0.00012 | | | | | |
| | | J5 | 1.00480 | ± | 0.00013 | | | | 0.00450 ± | 0.00018 |

Table A.1.2 Calculated k_{eff} for the cores with various transient rod positions.

*1 J40: JENDL-4.0, J40u1: JENDL-4.0u1, J5: JENDL-5



Fig. A.1.1 Calculated k_{eff} for the cores with various transient rod positions.

For the examination on significancy of those ranges of the variations in k_{eff} , the uncertainties in k_{eff} for six sorts of representative cores (ID = tr1, tr3, tr8, tr9, tr10, and tr11) were evaluated focusing on the errors in the data of the transient rods. The cores, ID = tr1 and tr3, give the minimum and maximum k_{eff} 's, respectively, among the cores, ID = tr1 to tr6, in which the adjustable transient rod (TA) was partially inserted. On the condition of the fast transient rod (TB) fully inserted, the core, ID = tr8, gives the smaller k_{eff} than that of the core, ID = tr7. For the cores, ID = tr9 to tr11, more than two transient rods were fully inserted. The evaluation method for the uncertainties was the same as described in Chap. 6.

(1) Uncertainties from geometry data of transient rods

The uncertainties in k_{eff} propagated from the errors in the diameter and height of the enriched boron carbide absorber, and the outer diameter of the cladding in the adjustable and fast transient rods were evaluated by using the method as described in Sec. 6.1.3. The evaluated results of the uncertainties in k_{eff} propagated from those errors in the geometry data of the adjustable and fast transient rods are summarized in Table A.1.3. The aggregated uncertainties in k_{eff} propagated from those errors in the geometry data of the transient rods are summarized in Table A.1.4. The aggregated uncertainties in k_{eff} are in the range of 0.0001 to 0.0003 Δk_{eff} for the representative cores with various transient rod positions excepting the cores, ID = tr1 and tr3. The aggregated uncertainties in k_{eff} are negligibly small for the cores, ID = tr1 and tr3.

| Source of uncertainty | Core | Averaged bias: B _{av} (Δk _{eff} ±1σ) | Max. difference in B _{av} : D | D/σ | Uncertainty in k_{eff} (Δk_{eff}) |
|----------------------------------|----------|---|--|------|--|
| | Standard | -0.00002 ± 0.00007 | | | negligible |
| | tr1 | -0.00004 ± 0.00007 | | | negligible |
| 1.38% smaller diameter of B₄C | tr3 | +0.00007 ± 0.00007 | | | negligible |
| in adjustable and fast transient | tr8 | +0.00008 ± 0.00007 | 0.00029 | 3.96 | 0.0001 |
| rods: - 0.05 (cm) | tr9 | +0.00021 ± 0.00007 | | | 0.0002 |
| | tr10 | +0.00025 ± 0.00007 | | | 0.0003 |
| | tr11 | +0.00017 ± 0.00007 | | | 0.0002 |
| | Standard | ±0.00006 ± 0.00007 | | 0.88 | negligible |
| | tr1 | ±0.00000 ± 0.00007 | 0.00006 | | negligible |
| 0.05% and 0.01% of height of | tr3 | ±0.00003 ± 0.00007 | | | negligible |
| B_4C in adjustable and fast | tr8 | ±0.00001 ± 0.00007 | | | negligible |
| transient rod: ± 0.02 and 0.01 | tr9 | ±0.00004 ± 0.00007 | | | negligible |
| (011) | tr10 | ±0.00000 ± 0.00007 | | | negligible |
| | tr11 | $\pm 0.00003 \pm 0.00007$ | | | negligible |
| | Standard | ±0.00006 ± 0.00007 | | | negligible |
| | tr1 | $\pm 0.00005 \pm 0.00007$ | | | negligible |
| 0.26% of outer diameter of | tr3 | $\pm 0.00003 \pm 0.00007$ | | | negligible |
| adjustable and fast transient | tr8 | ±0.00004 ± 0.00007 | 0.00005 | 0.71 | negligible |
| rods cladding: ± 0.01 (cm) | tr9 | ±0.00005 ± 0.00007 | | | negligible |
| | tr10 | ±0.00001 ± 0.00007 | | | negligible |
| | tr11 | $\pm 0.00004 \pm 0.00007$ | | | negligible |

Table A.1.3 Summary of uncertainties in k_{eff} propagated from the errors in the geometry data of the adjustable and fast transient rods for the cores with various transient rod positions.

| Source of uncertainty | Core | Uncertainty in k _{eff} (Δk_{eff}) |
|--|----------|--|
| | Standard | negligible |
| | tr1 | negligible |
| O a superstant data in a disatable and | tr3 | negligible |
| fast transient rods | tr8 | 0.0001 |
| | tr9 | 0.0002 |
| | tr10 | 0.0003 |
| | tr11 | 0.0002 |

| Table A.1.4 Aggregated uncertainties in k _{eff} propagated from the errors |
|---|
| in the geometry data of the adjustable and fast transient rods |
| for the cores with various transient rod positions. |

(2) Uncertainties from material data of absorber in transient rods

The uncertainties in k_{eff} propagated from the errors in the density, boron content, and boron-10 enrichment of the enriched boron carbide absorber in the adjustable and fast transient rods were evaluated by using the method as described in Sec. 6.2.8. The evaluated results of the uncertainties in k_{eff} propagated from those errors in the material data of the adjustable and fast transient rods are summarized in Table A.1.5. The aggregated uncertainties in k_{eff} propagated from those errors in the material data of the transient rods are summarized in Table A.1.6. The aggregated uncertainties in k_{eff} are negligibly small for all cores.

| Source of uncertainty | Core | Averaged bias: B _{av} (Δk _{eff} ±1σ) | Max. difference in B _{av} : D | D/σ | Uncertainty in k _{eff} (∆k _{eff}) |
|--|----------|---|--|------|---|
| | Standard | ±0.00001 ± 0.00007 | | | negligible |
| | tr1 | ±0.00004 ± 0.00007 | | | negligible |
| | tr3 | ±0.00000 ± 0.00007 | | | negligible |
| 1.49% of enriched B_4C density: + 0.0343 (g/cm ³) | tr8 | ±0.00000 ± 0.00007 | 0.00006 | 0.83 | negligible |
| ± 0.0343 (g/cm²) | tr9 | ±0.00006 ± 0.00007 | | | negligible |
| | tr10 | ±0.00002 ± 0.00007 | | | negligible |
| | tr11 | $\pm 0.00005 \pm 0.00007$ | | | negligible |
| | Standard | $\pm 0.00005 \pm 0.00007$ | | | negligible |
| | tr1 | $\pm 0.00003 \pm 0.00007$ | | 0.59 | negligible |
| 0.61% of B content of enriched | tr3 | ±0.00002 ± 0.00007 | | | negligible |
| B ₄ C: | tr8 | ±0.00002 ± 0.00007 | 0.00004 | | negligible |
| ± 0.4694 (wt%) | tr9 | $\pm 0.00003 \pm 0.00007$ | | | negligible |
| | tr10 | $\pm 0.00005 \pm 0.00007$ | | | negligible |
| | tr11 | $\pm 0.00006 \pm 0.00007$ | | | negligible |
| | Standard | ±0.00001 ± 0.00007 | | | negligible |
| | tr1 | ±0.00002 ± 0.00007 | | | negligible |
| 0.540 of D 40 surjeture surf. | tr3 | ±0.00002 ± 0.00007 | | | negligible |
| 0.51% of B-10 enrichment: + 0.47 (wt%) | tr8 | ±0.00004 ± 0.00007 | 0.00006 | 0.81 | negligible |
| _ 0 (w(/0) | tr9 | $\pm 0.00006 \pm 0.00007$ | | | negligible |
| | tr10 | $\pm 0.00000 \pm 0.00007$ | | | negligible |
| | tr11 | ±0.00001 ± 0.00007 | | | negligible |

Table A.1.5 Summary of uncertainties in k_{eff} propagated from the errors in the material data of the adjustable and fast transient rods for the cores with various transient rod positions.

$\begin{array}{l} \mbox{Table A.1.6 Aggregated uncertainties in k_{eff} propagated from the errors} \\ \mbox{in the material data of the adjustable and fast transient rods} \\ \mbox{for the cores with various transient rod positions.} \end{array}$

| Source of uncertainty | Core | Uncertainty in k _{eff} (∆k _{eff}) |
|-----------------------|----------|---|
| | Standard | negligible |
| | tr1 | negligible |
| | tr3 | negligible |
| fast transient rods | tr8 | negligible |
| | tr9 | negligible |
| | tr10 | negligible |
| | tr11 | negligible |

(3) Uncertainties from operation data of rod positions

For the cores examined here, the positions of the control and safety rods were also different from those in the minimum, standard, and intermediate cores. This means that there may be differences in the effect of the errors in the absorber rod positions to the uncertainties in k_{eff} . Hence, the uncertainties in k_{eff} propagated from the errors in the rod position were also evaluated by using the method as described in Sec. 6.3.1. The evaluated uncertainties in k_{eff} are listed in Table A.1.7. The uncertainties in k_{eff} are in the range of 0.0003 to 0.0007 Δk_{eff} for the representative cores with various transient rod positions.

| Source of uncertainty | Core | Averaged bias: B _{av} (Δk _{eff} ±1σ) | Max. difference in B _{av} : D | D/σ | Uncertainty in k_{eff} (Δk_{eff}) |
|---|----------|---|--|------|--|
| | Standard | ±0.00047 ± 0.00007 | | | 0.0005 |
| | tr1 | ±0.00043 ± 0.00007 | | | 0.0004 |
| | tr3 | $\pm 0.00055 \pm 0.00007$ | | | 0.0006 |
| 5 units of rod position: + 0.24 (cm) | tr8 | $\pm 0.00033 \pm 0.00007$ | 0.00033 | 4.59 | 0.0003 |
| ± 0.24 (CIII) | tr9 | ±0.00032 ± 0.00007 | | | 0.0003 |
| | tr10 | $\pm 0.00065 \pm 0.00007$ | | | 0.0007 |
| | tr11 | ±0.00065 ± 0.00007 | | | 0.0007 |

Table A.1.7 Uncertainties in k_{eff} propagated from the error in the rod position of the control, safety, and transient rods for the cores with various transient rod positions.

(4) Overall uncertainties for cores with various transient rod positions

The aggregated uncertainties in k_{eff} were estimated as the overall uncertainties by assuming that the uncertainties other than the those in Tables A.1.4, A.1.6, and A.1.7 were the same magnitude as those for the standard cores. The aggregated uncertainties in k_{eff} propagated from the errors in the geometry, material, and operation data in total are summarized in Table A.1.8. The aggregated uncertainties in k_{eff} are in the range of 0.0027 to 0.0028 Δk_{eff} for the representative cores with various transient rod positions. It is confirmed that the differences in the overall uncertainties between the representative cores with various transient rod positions and standard core are quite small.

| Source of uncertainty | Core | Uncertainty in k _{eff} (Δk_{eff}) |
|-----------------------------------|----------|--|
| | Standard | 0.0027 |
| | tr1 | 0.0027 |
| Aggregation of uncertainties in | tr3 | 0.0028 |
| geometry, material, and operation | tr8 | 0.0027 |
| data | tr9 | 0.0027 |
| | tr10 | 0.0028 |
| | tr11 | 0.0028 |

| Table A.1.8 Aggregated uncertainties in $k_{\rm eff}$ propagated from | the e | errors |
|---|-------|--------|
| in the geometry, material, and operation data | | |
| for the cores with various transient rod positions. | | |

From the results of the estimated overall uncertainties in k_{eff} mentioned above, it is considered that the variations in the calculated k_{eff} 's shown in Fig. A.1.1 are not significant in terms of the uncertainty of the calculation models since the variations are in the range of 1.03 to 1.13 times the overall uncertainties. It is also considered that the differences between k_{eff} 's by JENDL-5 and JENDL-4.0 are not significant in terms of the uncertainty of the calculation models since the differences are within 1.67 times the overall uncertainties.

Appendix-2 Effect of Replacement of Experimental Tube with Water on Uncertainties

For simplicity, the uncertainties in k_{eff} propagated from the geometry errors in the core structures, such as the grid plate, shroud, guide tube for the transient rod, were evaluated by the replacement of those with water, as described in Sec. 6.1. For reference, the uncertainties were evaluated by the same method as described in Chap. 6 in the case that the experimental tube is also replaced with water. The evaluated uncertainties are shown below.

(1) Uncertainties propagated from replacement of hexagonal shaped experimental tube with water

Table A.2.1 lists the uncertainties in k_{eff} propagated from the replacement of the hexagonal shaped experimental tube with water. The uncertainties in k_{eff} propagated from the replacement are evaluated to be in the range of 0.0032 to 0.0037 Δk_{eff} for the minimum, standard, and intermediate cores. The uncertainties in k_{eff} propagated from the replacement are larger than the overall uncertainties in k_{eff} , which were evaluated to be in the range of 0.0027 to 0.0029 Δk_{eff} in Table 6.4.1. It is confirmed that the replacement of the hexagonal shaped experimental tube with water affects the overall uncertainties in k_{eff} .

| 0 | 1 1 | | |
|-------------------------------|--------------|--------------------------------|---------------------------------|
| Source of upgortainty | Coro | Averaged bias | Uncertainty in k _{eff} |
| Source of uncertainty | Core | $(\Delta k_{eff} \pm 1\sigma)$ | (Δk_{eff}) |
| Replacement of hexagonal | Minimum | +0.00372 ± 0.00007 | 0.0037 |
| shaped experimental tube with | Standard | +0.00318 ± 0.00007 | 0.0032 |
| water | Intermediate | +0.00356 ± 0.00007 | 0.0036 |

Table A.2.1 Uncertainties in $k_{\rm eff}$ propagated from the replacement of the hexagonal shaped experimental tube with water.

(2) Uncertainties propagated from replacement of cylindrical shaped experimental tube with water

Table A.2.2 lists the uncertainties in k_{eff} propagated from the replacement of the cylindrical shaped experimental tube with water. The uncertainties in k_{eff} propagated from the replacement are evaluated to be 0.0002 Δk_{eff} for all cores. It is considered that the cylindrical shaped experimental tube may be replaced with water because of trivial effect on the overall uncertainties in k_{eff} shown in Table 6.4.1.

| | Corre | Averaged bias | Uncertainty in k _{eff} |
|-------------------------------|--------------|--------------------------------|---------------------------------|
| Source of uncertainty | Core | $(\Delta k_{eff} \pm 1\sigma)$ | (Δk_{eff}) |
| Replacement of cylindrical | Minimum | +0.00014 ± 0.00007 | 0.0002 |
| shaped experimental tube with | Standard | +0.00015 ± 0.00007 | 0.0002 |
| water | Intermediate | +0.00018 ± 0.00007 | 0.0002 |

Table A.2.2 Uncertainties in $k_{\rm eff}$ propagated from the replacement of the cylindrical shaped experimental tube with water.

Appendix-3 Effect of Impurities on Uncertainties

For reference, the effect of the impurities in the uranium-zirconium hydride, zirconium rod, and molybdenum disc on the uncertainties in $k_{\rm eff}$ were evaluated by the same method as described in Chap. 6. The evaluated uncertainties in $k_{\rm eff}$ are shown below.

(1) Uncertainties in $k_{\rm eff}$ propagated from ignoring impurities in uranium-zirconium hydride

Table A.3.1 lists the uncertainties in k_{eff} propagated from the ignoring the impurities in the uranium-zirconium hydride, which are shown in Tables 3.1.1(1) and 3.1.2(2). It is confirmed that the evaluated uncertainties in k_{eff} are 0.0016 Δk_{eff} for all cores. It is considered that the impurities in the uranium-zirconium hydride may not be ignored since the impurities significantly affect the overall uncertainties in k_{eff} shown in Table 6.4.1.

Table A.3.1 Uncertainties in k_{eff} propagated from the ignoring the impurities in the uranium-zirconium hydride.

| | Coro | Averaged bias | Uncertainty in k _{eff} |
|------------------------------|--------------|--------------------------------|---------------------------------|
| Source of uncertainty | Core | $(\Delta k_{eff} \pm 1\sigma)$ | (Δk_{eff}) |
| | Minimum | +0.00156 ± 0.00007 | 0.0016 |
| Ignoring impurities in U-ZrH | Standard | +0.00158 ± 0.00007 | 0.0016 |
| | Intermediate | +0.00160 ± 0.00007 | 0.0016 |

(2) Uncertainties in k_{eff} propagated from ignoring impurities in zirconium rod

Table A.3.2 lists the uncertainties in k_{eff} propagated from the ignoring the impurities in the zirconium rod, which are shown in Table 3.2.1. It is confirmed that the evaluated uncertainty in k_{eff} is 0.0001 Δk_{eff} for the minimum core. It is also confirmed that the uncertainties are negligibly small for the standard, and intermediate cores. It is considered that the impurities in the zirconium rod may be ignored because of little or no effect on the overall uncertainties in k_{eff} shown in Table 6.4.1.

| Source of upportainty | Coro | Averaged bias | Uncertainty in k _{eff} |
|-------------------------------|--------------|--------------------------------|---------------------------------|
| Source of uncertainty | Core | $(\Delta k_{eff} \pm 1\sigma)$ | (Δk_{eff}) |
| | Minimum | +0.00010 ± 0.00007 | 0.0001 |
| Ignoring impurities in Zr rod | Standard | -0.00000 ± 0.00007 | negligible |
| | Intermediate | +0.00007 ± 0.00007 | negligible |

Table A.3.2 Uncertainties in k_{eff} propagated from the ignoring the impurities in the zirconium rod.

(3) Uncertainties in k_{eff} propagated from ignoring impurities in molybdenum disc Table A.3.3 lists the uncertainties in k_{eff} propagated from the ignoring the impurities in the molybdenum disc, which are shown in Table 3.5.1. It is confirmed that the evaluated uncertainties in k_{eff} are negligibly small for all cores. It is considered that the impurities in the molybdenum disc may be ignored because of no effect on the overall uncertainties in k_{eff} shown in Table 6.4.1.

Table A.3.3 Uncertainties in k_{eff} propagated from the ignoring the impurities in the molybdenum disc.

| | Corre | Averaged bias | Uncertainty in k _{eff} |
|--------------------------------|--------------|--------------------------------|---------------------------------|
| Source of uncertainty | Core | $(\Delta k_{eff} \pm 1\sigma)$ | (Δk_{eff}) |
| | Minimum | -0.00004 ± 0.00007 | negligible |
| lgnoring impurities in Mo disc | Standard | -0.00006 ± 0.00007 | negligible |
| | Intermediate | +0.00000 ± 0.00007 | negligible |

Appendix-4 Sample Input List for MVP

A sample input list of the MVP version 3 code ⁶⁾ is attached below. The input was prepared for the analyses on the standard core using the JENDL-5 library ⁷⁾. In the input, the absorber rod positions are specified by using the following 'symbolic parameters' ⁶⁾, i.e., UZCR1' to 'UZCR6' for the control rods, UZSR1' and 'UZSR2' for the safety rods, UZTA1' for the adjustable transient rod, and 'UZTB1' and 'UZTC1' for the fast transient rods.

| million histories JENDL-5 | *++++++ |
|---|---|
| ++++++ | *++++++ |
|)PTIONS + | * % C1Z1 = -20.95 - <bzcr1> /* height of bottom of u-zrh (cm)</bzcr1> |
| SETA-EFFECTIVE DOPPLER-SCATTERING (EXACT) | % C1Z2 = <c1z1> + 38.1 /* height of top of u-zrh (cm)</c1z1> |
| EUTRON PERTURBATION DYNAMIC-MEMORY (55000000) | <pre>% C1Z3 = <c1z1> - 3.18 /* height of bottom of sp1 (cm)</c1z1></pre> |
| IGEN-VALUE FREE-LATTICE-FRAME LATTICE FLUX-PRINT | % C1Z4 = <c1z3> - 65.12 /* height of bottom of spacer tube (cm) % C1Z5 = <c1z4> - 2.21 /* height of bottom of bottom plug (cm)</c1z4></c1z3> |
| | * |
| BT = 500 /* number of effective batches | <pre>% C1Z7 = <c1z2> + 0.63 /* height of bottom of sp2 (cm)</c1z2></pre> |
| SK = 200 /* number of skipped batches | <pre>% C1Z8 = <c1z7> + 1.27 /* height of bottom of b4c (cm) % C1Z8 = <c1z7> + 0.1</c1z7></c1z7></pre> |
| HT = 1000000 /* number of particles per batch | <pre>% C1Z9 = <c1z8> + 38.1 /^ neight of top of D4C (cm) % C1Z10 = <c1z9> + 0.3 /* beight of bottom of sp3 (cm)</c1z9></c1z8></pre> |
| PART(<(NBT+NSK)*NHT>) /* total number of histories | <pre>% C1Z11 = <c1z10> + 1.27 /* height of top of sp3 (cm)</c1z10></pre> |
| HIST(<nht>) /* number of particles per batch</nht> | <pre>% C1Z12 = <c1z11> + 13.61 /* height of bottom of top plug (cm)</c1z11></pre> |
| ANK(<nht*2>) /* length of particle bank</nht*2> | % C1Z13 = <c1z12> + 3.81 /* height of top of top plug (cm)</c1z12> |
| SKIP(<nsk>) /* number of skipped batches</nsk> | *++++++ |
| | * PARAMETERS FOR CR2 (INITIAL TYPE) |
| <pre>IEMO(100) /* number of next-zone memory per zone</pre> | *++++++ |
| CP.N(2.0E7) /* top of neutron energy (eV) | <pre>% C2Z1 = -20.95 - <bzcr2> /* height of bottom of u-zrh (cm)</bzcr2></pre> |
| <pre>30T.N(1.0E-5) /* bottom of neutron energy (eV)</pre> | <pre>% C2Z2 = <c2z1> + 38.1 /* height of top of u-zrh (cm)</c2z1></pre> |
| TOULD N/ 120) | <pre>% C2Z3 = <c2z1> - 3.18 /* height of bottom of sp1 (cm) % C2Z4 = <c2z2></c2z2></c2z1></pre> |
| GYB.N(2.0000E+07 1.5795E+07 1.2474E+07 9.8515E+06 7.7803E+06 | <pre>% C224 = <c223> - 00.12 /^ height of bottom of spacer tube (cm) % C225 = <c224> - 2.21 /* height of bottom of bottom plug (cm)</c224></c223></pre> |
| 6.1445E+06 4.8526E+06 3.8324E+06 3.0266E+06 2.3903E+06 | * |
| 1.8877E+06 1.4909E+06 1.1774E+06 9.2986E+05 7.3436E+05 | <pre>% C2Z7 = <c2z2> + 0.63 /* height of bottom of sp2 (cm)</c2z2></pre> |
| 5./990E+U5 4.58U3E+U5 3.01/3E+U5 2.8568E+U5 2.2561E+U5 1 7818E+U5 1 4072E+U5 1 1113E+U5 0 7767E+U4 6 0315E+U4 | |
| 5.4741E+04 4.3232E+04 3.4143E+04 2.6964E+04 2.1295E+04 | <pre>% C2Z10 = <c2z9> + 0.3 /* height of bottom of sp3 (cm)</c2z9></pre> |
| 1.6818E+04 1.3282E+04 1.0490E+04 8.2841E+03 6.5424E+03 | % C2Z11 = <c2z10> + 1.27 /* height of top of sp3 (cm)</c2z10> |
| 5.1669E+03 4.0806E+03 3.2226E+03 2.5451E+03 2.0100E+03 | <pre>% C2Z12 = <c2z11> + 13.61 /* height of bottom of top plug (cm)</c2z11></pre> |
| 1.58/4E+03 1.253/E+03 9.9008E+02 7.8192E+02 6.1/52E+02 4.8769E+02 3.8516E+02 3.0418E+02 2.4023E+02 1.8972E+02 | <pre>% C2213 = <c2212> + 3.81 /* height of top of top plug (cm) *</c2212></pre> |
| 1.4983E+02 1.1833E+02 9.3451E+01 7.3803E+01 5.8286E+01 | *++++++ |
| 4.6032E+01 3.6354E+01 2.8711E+01 2.2674E+01 1.7907E+01 | * PARAMETERS FOR CR3 (INITIAL TYPE) |
| 1.4142E+01 1.1169E+01 8.8206E+00 6.9661E+00 5.5015E+00 4.3449E+00 3.4313E+00 2.7000E+00 2.1402E+00 1.6002E+00 | *++++++ |
| 1.3348E+00 1.0542E+00 8.3255E-01 6.5751E-01 5.1927E-01 | <pre>% C3Z1 = -20.95 - <bzcr3> /* height of bottom of u-zrh (cm)</bzcr3></pre> |
| 4.1010E-01 3.2388E-01 2.5578E-01 2.0200E-01 1.5953E-01 | <pre>% C3Z2 = <c3z1> + 38.1 /* height of top of u-zrh (cm)</c3z1></pre> |
| 1.2599E-01 9.9503E-02 7.8583E-02 6.2061E-02 4.9013E-02 | <pre>% C3Z3 = <c3z1> - 3.18 /* height of bottom of sp1 (cm) % C3Z4 = <c3z1> - (5.10 /* height of bottom of sp1 (cm)</c3z1></c3z1></pre> |
| 1.1892E-02 9.3918E-03 7.4172E-03 5.8578E-03 4.6262E-03 | <pre>% C324 = <c323> - 65.12 /* height of bottom of spacer tube (cm) % C325 = <c324> - 2.21 /* height of bottom of bottom plug (cm)</c324></c323></pre> |
| 3.6536E-03 2.8854E-03 2.2788E-03 1.7997E-03 1.4213E-03 | * |
| 1.1225E-03 8.8647E-04 7.0009E-04 5.5290E-04 4.3666E-04 | <pre>% C3Z7 = <c3z2> + 0.63 /* height of bottom of sp2 (cm)</c3z2></pre> |
| 3.4485E-04 2.7235E-04 2.1509E-04 1.6987E-04 1.3415E-04 | % C3Z8 = <c3z7> + 1.27 /* height of bottom of b4c (cm) % C3Z8 = <c3z8> + 28 1 /* height of top of b4c (cm)</c3z8></c3z7> |
| 3.2549E-05 2.5706E-05 2.0301E-05 1.6033E-05 1.2662E-05 | % C3Z10 = <c3z9> + 0.3 /* height of bottom of sp3 (cm)</c3z9> |
| 1.0000E-5) | <pre>% C3Z11 = <c3z10> + 1.27 /* height of top of sp3 (cm)</c3z10></pre> |
| | <pre>% C3Z12 = <c3z11> + 13.61 /* height of bottom of top plug (cm) % C3Z12 = <c3z12> + 2.01 /* height of bottom of top plug (cm)</c3z12></c3z11></pre> |
| ARAMETERS FOR CONTROL ROD POSITION | <pre>% C3213 = <c3212> + 3.81 /^ neight of top of top plug (cm) *</c3212></pre> |
| ++++++ | *+++++++- |
| CR1 = 218 /* cr1 unit (100-900) | *++++++ |
| CR3 = 216 /* cr3 unit (100-900) | <pre>% C4Z1 = -20.95 - <bzcr4> /* height of bottom of u-zrh (cm)</bzcr4></pre> |
| SCR4 = 211 /* cr4 unit (100-900) | % C4Z2 = <c4z1> + 38.1 /* height of top of u-zrh (cm)</c4z1> |
| CR5 = 209 /* cr5 unit (100-900) | <pre>% C4Z3 = <c4z1> - 3.18 /* height of bottom of sp1 (cm) % C4Z4 = <c4z2></c4z2></c4z1></pre> |
| SR1 = 899 /* sr1 unit (100-900) | % C424 - <c423> - 65.12 /^ neight of bottom of spacer tube (cm) % C425 = <c424> - 2.21 /* height of bottom of bottom plug (cm)</c424></c423> |
| SR2 = 897 /* sr2 unit (100-900) | * |
| TA1 = 895 /* ta unit (100-900) | % C4Z7 = <c4z2> + 0.63 /* height of bottom of sp2 (cm)</c4z2> |
| TEL = 900 /* tD pos. (100:dn, 900:up) TEL = 900 /* tD pos. (100:dn, 900:up) | $\approx C428 = (C427) + 1.27$ /* height of bottom of b4c (cm) $\approx C479 = (C478) + 38.1$ /* height of top of b4c (cm) |
| ···· / ··· / ························· | % C4Z10 = <c4z9> + 0.3 /* height of bottom of sp3 (cm)</c4z9> |
| CR1 = <(900-UZCR1)*38.1/800> /* cr1 bias (cm) | <pre>% C4Z11 = <c4z10> + 1.27 /* height of top of sp3 (cm)</c4z10></pre> |
| CR2 = <(900-UZCR2)*38.1/800> /* cr2 bias (cm) | % C4Z12 = <c4z11> + 13.61 /* height of bottom of top plug (cm)</c4z11> |
| CR4 = <(900-UZCR4)*38.1/800> /* cr4 bias (cm) | * CTAILS - NCTAILS T 3.01 /^ neight of top of top plug (Cm) * |
| CR5 = <(900-UZCR5)*38.1/800> /* cr5 bias (cm) | *++++++ |
| <pre>XR6 = <(900-UZCR6)*38.1/800> /* cr6 bias (cm)</pre> | * PARAMETERS FOR CR5 (INITIAL TYPE) |
| SR1 = <(900-02SR1)*38.1/800> /* sr1 blas (CM) SR2 = <(900-02SR2)*38.1/800> /* sr2 bias (CM) | * |
| TA1 = <(900-UZTA1)*38.1/800> /* ta bias (cm) | % C5Z1 = -20.95 - <bzcr5> /* height of bottom of u-zrh (cm)</bzcr5> |
| TB1 = <(900-UZTB1)*76.2/800> /* tb bias (cm) | <pre>% C5Z2 = <c5z1> + 38.1 /* height of top of u-zrh (cm)</c5z1></pre> |
| TC1 = <(900-UZTC1)*76.2/800> /* tc bias (cm) | % C5Z3 = <c5z1> - 3.18 /* height of bottom of sp1 (cm) % C5Z4 = <c5z3> = 65.12 /* height of bottom of spaces tube (cm)</c5z3></c5z1> |
| ++++++ | % C525 = <c524> - 2.21 /* height of bottom of spacer tube (cm) % C525 = <c524> - 2.21 /* height of bottom of bottom plug (cm)</c524></c524> |
| RAMETERS FOR CONTROL ROD (INITIAL TYPE) | * |
| ++++++ | <pre>% C5Z7 = <c5z2> + 0.63 /* height of bottom of sp2 (cm)</c5z2></pre> |
| 1 = 0.285 /* radius of zirconium (cm) | <pre>% C528 = <c527> + 1.27 /* height of bottom of b4c (cm) % C529 = <c528> + 38 1 /* height of top of b4c (cm)</c528></c527></pre> |
| 2 = 0.32 /* inner radius of U-ZrH (cm) | <pre>% C5Z10 = <c5z9> + 0.3 /* height of bottom of sp3 (cm)</c5z9></pre> |
| | |
| 3 = 1.78 /* outer radius of U-ZrH (cm) | % C5211 = <c5210> + 1.27 / ^ neight of top of sp3 (Cm)</c5210> |
| 3 = 1.78 /* outer radius of U-ZrH (cm) 4 = 1.83 /* inner radius of cladding (cm) (* inner radius of cladding (cm) | % C5211 = <c5210 (cm)<br="" +="" 1.27="" height="" of="" sp3="" top="">% C5212 = <c5211> + 13.61 /* height of bottom of top plug (cm)</c5211></c5210> |
| 3 = 1.78 /* outer radius of U-ZrH (cm) 4 = 1.83 /* inner radius of cladding (cm) 5 = 1.88 /* outer radius of cladding (cm) 6 = 1.815 /* radius of PAC4 (cm) | <pre>% C5211 = <c5210 +="" 1.2="" <="" td=""></c5210></pre> |

6 C621 = -20.95 - <B2CR6> /* height of bottom of u-zrh (cm) 6 C622 = <C621> + 38.1 /* height of top of u-zrh (cm) 6 C623 = <C621> - 31.8 /* height of bottom of spl (cm) 8 C624 = <C623> - 65.12 /* height of bottom of spacer tube (cm) 8 C625 = <C624> - 2.21 /* height of bottom of bottom plug (cm) PARAMETERS FOR SRI (INITIAL TYPE)

 S121
 = -20.95 - <BZSR1> /* height of bottom of u-zrh (cm)

 S122
 = <S121> + 38.1
 /* height of top of u-zrh (cm)

 S123
 = <S121> - 3.18
 /* height of bottom of spl (cm)

 S124
 = <S123> - 65.12
 /* height of bottom of spacer tube (cm)

 S125
 = <S124> - 2.21
 /* height of bottom of bottom plug (cm)

 PARAMETERS FOR SR2 (INITIAL TYPE) = -20.95 - <BZSR2> /* height of bottom of u-zrh (cm) = <S2Z1> + 38.1 /* height of top of u-zrh (cm) = <S2Z1> - 3.18 /* height of bottom of spl (cm) = <S2Z3> - 65.12 /* height of bottom of spacer tube (cm) = <S2Z4> - 2.21 /* height of bottom of bottom plug (cm) S2Z1 = S2Z2 S2Z3 S2Z4 S2Z5 S227 = (S222> + 0.63 /* height of bottom of sp2 (cm) S228 = (S227> + 1.27 /* height of bottom of b4c (cm) S229 = (S228> + 0.3 /* height of bottom of sp3 (cm) S2210 = (S229> + 0.3 /* height of bottom of sp3 (cm) S2211 = (S221> + 1.27 /* height of bottom of top plug (cm) S2213 = (S221> + 3.81 /* height of top of top plug (cm) PARAMETERS FOR TA ROD (INITIAL TYPE)

 AR1
 =
 1.815
 /* radius of b4c (cm)

 AR2
 =
 1.655
 /* inner radius of spacer tube (cm)

 AR3
 =
 1.745
 /* outer radius of follower tube (cm)

 AR4
 =
 1.655
 /* inner radius of follower tube (cm)

 AR5
 =
 1.745
 /* outer radius of follower tube (cm)

 AR6
 =
 1.815
 /* inner radius of follower tube (cm)

 AR7
 =
 1.905
 /* outer radius of cladding (cm)

 ----+ PARAMETERS FOR TB AND TC ROD (INITIAL TYPE) $\begin{array}{rrrr} TR1 & = & 1.815 \\ TR2 & = & 1.655 \\ TR3 & = & 1.745 \\ TR4 & = & 1.655 \\ TR5 & = & 1.745 \\ TR6 & = & 1.815 \\ TR7 & = & 1.905 \end{array}$ /* radius of b4c (cm)
/* inner radius of spacer tube (cm)
/* outer radius of spacer tube (cm)
/* inner radius of follower tube (cm)
/* outer radius of follower tube (cm)
/* inner radius of cladding (cm)
/* outer radius of cladding (cm) PARAMETERS FOR TA (INITIAL TYPE) PARAMETERS FOR TB (INITIAL TYPE) PARAMETERS FOR TC (INITIAL TYPE)

 TCZ1
 = 19.05
 - <BZTC1>
 /* height of bottom of b4c (cm)

 TCZ2
 = <TCZ1> + 76.2
 /* height of top of b4c (cm)

 TCZ3
 = <TCZ1> - 2.54
 /* height of bottom of sp1 (cm)

 TCZ4
 = <TCZ3> - 68.23
 /* height of bottom of follower tube (cm)

 TCZ5
 = <TCZ4> - 1.58
 /* height of bottom of tc (cm)

 FR1
 =
 0.285
 /* radius of zirconium (cm)

 FR2
 =
 0.32
 /* inner radius of U-ZrH (cm)

 FR3
 =
 1.775
 /* outer radius of U-ZrH (cm)

 FR4
 =
 1.82
 /* inner radius of cladding (cm)

 FR5
 =
 1.82
 /* outer radius of cladding (cm)

 FR6
 =
 1.815
 /* radius of Mo disc (cm)

 FR7
 =
 1.715
 /* radius of axial graphite reflector (cm)

| * 00 00 00 * | FR8 FR9 FR10 FR11 FR12 | | 0.8775 1.937 0.795 1.855 0.32 | /* rad_1 ot top end cap (cm) /* rad_2 of top end cap (cm) /* rad_1 of bottom end cap (cm) /* rad_2 of bottom end cap (cm) /* rad_3 of bottom end cap (cm) |
|---|--|--|--|--|
| * * * * * * * * * | FZ1 FZ2 FZ3 FZ4 FZ5 FZ6 FZ7 FZ8 FZ9 | | -19.05 19.05 <fz1> - 0.08 <fz3> - 8.69 <fz4> - 0.91 <fz5> - 1.01 <fz6> - 3.345 <fz7> - 1.535 <fz8> - 1.7</fz8></fz7></fz6></fz5></fz4></fz3></fz1> | <pre>/* height of bottom of core (cm) /* height of bottom of Mo disc (cm) /* height of bottom of Mo disc (cm) /* height of bottom of bottom graphite (cm) /* height of bottom of cladding (cm) /* hl of bottom end cap (cm) /* h2 of bottom end cap (cm) /* h3 of bottom end cap (cm) /* height of bottom of fuel rod (cm)</pre> |
| ~ * * * * * * | FZ10 FZ11 FZ12 FZ13 FZ14 FZ15 | | <fz2> + 8.69 <fz10> + 0.63 <fz11> + 0.9 <fz12> + 1.01 <fz13> + 2.15 <fz14> + 4.34</fz14></fz13></fz12></fz11></fz10></fz2> | <pre>/* height of top of top graphite (cm) /* height of bottom of top plug (cm) /* height of top of cladding (cm) /* hl of top end cap (cm) /* h2 of top end cap (cm) /* height of top of fuel rod (cm)</pre> |
| * | PARAMI | ETER | RS FOR FUEL L | ATTICE |
| * % | FPN | = | 23 | /* number of cells in lattice (FPN by FPN) /* lattice nitch (cm) |
| * % | PPP | = | <fpp>/SQRT(3)</fpp> | , <u>littlet</u> prodi (em) |
| *- | PARAMI | + ETEI | RS FOR GRID P | + |
| * | CEDE | +- | 1 05 | / ==================================== |
| 60 GO GI | GTRC GTB | = | 2.0575 28.59 | /* radius of ruel hole (cm) /* radius of crd hole (cm) /* height of bottom of t_grid (cm) |
| d0 * d | GTT | - | 31.025 | <pre>/* height of top of t_grid (cm) /* radius of fuel hele (cm)</pre> |
| 00 00 00 | GBRC GBB | = | 2.055 | /* radius of crd hole (cm) /* height of bottom of b_grid (cm) |
| % * * | GBT | = | <fz7-fr11+gbr< td=""><td><pre>F> /* height of top of fuel hole (cm) </pre></td></fz7-fr11+gbr<> | <pre>F> /* height of top of fuel hole (cm) </pre> |
| * | PARAM | ETEI +- | RS FOR EXPERI | MENTAL TUBE |
| * % | EH1 | = | 24.465 | /* outer width of hex tube (cm) |
| e de de | EC1 EC2 | = | 12.4575 11.8175 | /* outer radius of cyl tube (cm) /* inner radius of cyl tube (cm) |
| * % | EHB | = - | -130.56 | /* bottom of hex tube (cm) |
| ° % | ECT | = | 115.30 | /* top of cyl tube (cm) |
| * | PARAMI | ETEI | RS FOR SHROUD | +++++++ |
| * % % * * | SH1 SH2 | = | 48.4475 47.45 | /* outer radius of shroud (cm) /* inner radius of shroud (cm) |
| *- | PARAMI | +- ETEI | | +++++++ |
| - + | | | NO FOR IRANDI | ENI ROD GUIDE IOBE |
| * | GR1 | +- | 2.2225 | /* outer radius of guide tube (cm) |
| * % % % * | GR1 GR2 GZB | +- = = = | 2.2225 2.0725 <gtt+0.79></gtt+0.79> | /* outer radius of guide tube (cm) /* inner radius of guide tube (cm) /* height of bottom of guide tube (cm) |
| * % % % * * * | GR1 GR2 GZB TEMPEI | +- = = +- RATI | 2.2225 2.0725 <gtt+0.79></gtt+0.79> | /* outer radius of guide tube (cm) /* inner radius of guide tube (cm) /* height of bottom of guide tube (cm) |
| * * * * * * * * * | GR1 GR2 GZB TEMPEI | +- = = RATI | 2.2225 2.0725 <gtt+0.79> </gtt+0.79> | /* outer radius of guide tube (cm) /* inner radius of guide tube (cm) /* height of bottom of guide tube (cm) |
| * * * * * * * * * * * | GR1 GR2 GZB TEMPEI TP TPF | +- = = RATI +- = = | 2.2225 2.0725 <gtt+0.79> </gtt+0.79> | <pre>/* outer radius of guide tube (cm) /* inner radius of guide tube (cm) /* height of bottom of guide tube (cm) /* height of bottom of guide tube (cm) /* temperature (deg-C) /* fuel temperature (deg-C)</pre> |
| * * * * * * * * * * * * * * | GR1 GR2 GZB TEMPEI TP TPF CONST: | ++ = = ++ = = ++ ANT: | 2.2225 2.0725 <gtt+0.79> JRE 23.0 23.0 5</gtt+0.79> | /* outer radius of guide tube (cm) /* inner radius of guide tube (cm) /* inner radius of guide tube (cm) /* height of bottom of guide tube (cm) /* height of bottom of guide tube (cm) /* temperature (deg-C) /* temperature (deg-C) |
| * % % % * * * * % % * * * * % | GR1 GR2 GZB TEMPEI TP TPF CONST: | ++ = = ++ = = ++ ANT: ++ | 2.2225 2.0725 <gtt+0.79> JRE 23.0 23.0 23.0 100.0</gtt+0.79> | /* outer radius of guide tube (cm) /* inner radius of guide tube (cm) /* height of bottom of guide tube (cm) /* height of bottom of guide tube (cm) /* temperature (deg-C) /* fuel temperature (deg-C) /* fuel temperature (deg-C) /* moderator density (%) |
| * | GR1 GR2 GZB TEMPEI TP TPF CONSTI | ++ = = ++ = = ++ ANT? ++ = = | 2,2225 2,0725 <gtt+0.79> Z3.0 23.0 23.0 100.0 100.0</gtt+0.79> | <pre>/* outer radius of guide tube (cm) /* inner radius of guide tube (cm) /* height of bottom of guide tube (cm) /* temperature (deg-C) /* fuel temperature (deg-C) /* moderator density (%) /* reflector density (%)</pre> |
| * | GR1 GR2 GZB TEMPEI TP TPF FRM FRM FRR CROSS | ++ = = = RATI ++ = ++ ANT: +- = = SE(| 2.2225 2.0725 <gtt+0.79> JRE 23.0 23.0 100.0 100.0 TTION</gtt+0.79> | <pre>/* outer radius of guide tube (cm) /* inner radius of guide tube (cm) /* height of bottom of guide tube (cm) /* temperature (deg-C) /* fuel temperature (deg-C) /* moderator density (%) /* reflector density (%)</pre> |
| * | GR1 GR2 GZB TEMPEI TP TPF CONST FRM FRR FRR CROSS SEC ZIECOL | ++ = = RATI ++ = -+++ ANTS ++ SE(++ SE(++) | 2.2225 2.0725 (GTT+0.79> JRE 23.0 23.0 23.0 100.0 100.0 | <pre>/* outer radius of guide tube (cm) /* inner radius of guide tube (cm) /* height of bottom of guide tube (cm) /* height of bottom of guide tube (cm) /* temperature (deg-C) /* fuel temperature (deg-C) /* moderator density (%) /* reflector density (%) </pre> |
| · * 8 8 8 * * * * * 8 8 * * * * * 8 * 8 | GR1 GR2 GR2 GR2 GR3 FTP FTP FRM FRR CR055 CR055 CR055 CR052 CR052 CR051 | ++ = = = -+++ = = = -+++ = = = -+++ SEC +++ SEC +++ SEC +++ SEC +++ SEC +++ SEC +++ SEC +++ SEC +++ SEC +++ SEC ++++ SEC ++++++ SEC ++++++++++++++++++++++++++++++++++ | 2.2225 2.0725 <gtt+0.79> 23.0 23.0 23.0 23.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 4 1.1) 273.15+TP>) (2.2145E-02 (4.4293E-03 (7.4816E-03</gtt+0.79> | <pre>/* outer radius of guide tube (cm) /* inner radius of guide tube (cm) /* inner radius of guide tube (cm) /* temperature (deg-C) /* fuel temperature (deg-C) /* fuel temperature (deg-C) /* moderator density (%) /* reflector density (%)))))))))))))))))))</pre> |

| | TEMPMT(<2 | 7 | 2 | 1. | 5 | ŀΤ | PF | ~ | ۰. | | |
|------------|---|--------------|---|---|--|---|-------------------|---|----|---|--|
| | H00017J50 (| í | 5. | 5 | 58 | 36 | E- | 02 | ' |) | |
| | ZR090ZJ50 (| | 1. | 7 | 6 | 78 | E- | 02 | | í | |
| | ZR091ZJ50(| | 3. | 8 | 55 | 52 | E- | 03 | |) | |
| | ZR092ZJ50(| | 5. | 8 | 92 | 28 | E- | 03 | |) | |
| | ZR094ZJ50 (| | 5. | 9 | 7: | 18 | E- | 03 | |) | |
| | ZR0962J50(1102350.750/ | | 9. २ | 6 | 20 | 50 13 | E- | 04 | |) | |
| | U02380J50(| | 1. | 4 | 50 | 05 | Е- | 03 | | ś | |
| | C00120J50(| | з. | 6 | 1: | 33 | E- | 05 | |) | |
| | C00130J50(| | 4. | 0: | 18 | 39 | E- | 07 | |) | |
| | N00140J50(| | 4. | 91 | 0.5 | 50 | E- | 06 | |) | |
| | N00150J50 (| | 1. | 82 | 2: | 16 73 | E- | 08 | |) | |
| | MC0240750(| | 1. 5 | 7 | 0 74 | / 3 | E- | .04 .06 | | 2 | |
| | MG0250J50 (| | 7. | 3: | 11 | L 6 | E- | 07 | | ś | |
| | MG0260J50(| | 8. | 0 | 50 |)1 | E- | 07 | |) | |
| | AL0270J50(| | 5. | 71 | 0 6 | 67 | E- | 06 | |) | |
| | SI0280J50(| | 2. | 4 | 7 5 | 58 | E- | 06 | |) | |
| | SI0290J50 (| | 1. ° | 2: | 5. | 36 | E- | 07 | |) | |
| | CL0350J50 (| | о. 6 | 6 | ۲ - ۵ (| 20 | E- | 00 | | ζ. | |
| | CL0370.750 (| | 2. | 1. | 4: | 22 | E- | 06 | | 5 | |
| | CR0500J50 (| | 1. | 3 | 56 | 59 | Е- | 07 | | ź | |
| | CR0520J50 (| | 2. | 5 | 20 |)2 | E- | 06 | |) | |
| | CR0530J50(| | 2. | 8 | 51 | 74 | E- | 07 | |) | |
| | CR0540J50 (| | 7. | 1: | 11 | 34 | E- | 08 | |) | |
| | FE0540J50 (| | 1. 1 | 1. | 13 | 22 | E- | 06 | |) | |
| | FE0560J50(| | 1. 3 | 0 | 3. 60 | 37 | E- | 03 | | 2 | |
| | FE0580J50(| | 5. | 2 | 93 | 26 | E- | 0.8 | | ŝ | |
| | NI0580J50(| | 2. | 51 | 3 9 | 93 | Е- | 07 | | ś | |
| | NI0600J50(| | 9. | 8 | 98 | 39 | E- | 08 | |) | |
| | NI0610J50(| | 4. | 21 | 33 | 58 | E- | 09 | |) | |
| | NI0620J50(| | 1. | 3 | 61 | 16 | E- | 08 | |) | |
| | NI0640J50 (| | 3. | 4: | 5. | - 4 | E- | 09 | |) | |
| | HF1 /40J50 (| | /. ? | 9 | 53 | 29 | E- | 00 | |) | |
| | HF1770.750 (| | 2. 9. | 1. | 40 | 2 3 9 0 | E- | 08 | | 5 | |
| | HF1780J50(| | 1. | 3. | 42 | 22 | Е- | 07 | | ś | |
| | HF1790J50(| | 6. | 71 | 0: | 17 | E- | 08 | | ź | |
| | HF1800J50(| | 1. | 72 | 23 | 59 | E- | 07 | |) | |
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| * | SUS304 CLA | LE | D: | IN | G | | | | | | |
| 5 | IDMAT(3) | 1 | ` | | | | | | | | |
| | TEMPMT(<2 | 1 7 | ر ۲ | 1. | 5 | ĿТ | P | | | | |
| | B00100J50(| | 1. | 4 | ġ. | 14 | E- | 06 | |) | |
| | B00110J50(| | 6. | 0 | 15 | 50 | E- | 06 | |) | |
| | C00120J50(| | 2. | 0 | 95 | 59 | E- | 04 | |) | |
| | C00130J50(| | 2. | 3: | 3: | 11 | E- | 06 | |) | |
| | SI0280J50(| | 8. | 4: | 16 | 57 | E- | 04 | |) | |
| | SI0290J50 (| | 4. | 21 | b. 20 | L / | E- | 05 | |) | |
| | P00310.750 (| | ۲. ٦ | 2 | 2: | 70 78 | E- | 0.5 | | ζ. | |
| | S00320J50 (| | 1. | 9 | 38 | 38 | Е- | 05 | | ś | |
| | S00330J50 (| | 1. | 5 | 30 | 3 | E- | 07 | |) | |
| | S00340J50(| | 8. | 5 | 90 |)1 | E- | 07 | |) | |
| | S00360J50(| | 4. | 0 | 3 (|)8 | E- | 09 | |) | |
| | CR0500J50 (| | 7. | 3 | 74 | 50 | E- | 04 | |) | |
| | CR0520350(| | ÷. | 6 | 2 - 1 - | 24 | E- | 02 | | 2 | |
| | CR0530750/ | | | | | - ' | - | 0.5 | | 1 | |
| | CR0530J50 (| | 1. 4 | 0. | 1.4 | 18 | E - | 0.4 | | ۱. | |
| | CR0530J50 (CR0540J50 (MN0550J50 (| | 1. 4. 1. | 0: | 14 | 18 30 | E- E- | 04 | |) | |
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| * * 5 | CR0530J50(CR0540J50(MN0550J50(FE0540J50(FE0560J50(FE0580J50(NI0580J50(NI0580J50(NI0610J50(NI0620J50(NI0640J50(SUS304 PLU IDMAT(4) | IG | 4 3 5 1 5 1 8 2 6 | 0: 11 5: 21 61 9: 4: 67 | 1 8 9 4 8 1 8 1 8 1 8 1 8 1 8 1 8 1 8 1 8 1 8 | 18 30 38 35 17 23 58 38 78 78 | | 04 03 02 03 04 03 05 04 05 | |)))))))))))) | |
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| * * | CR0530450 (CR0540350) MN0550350 (FE0540350) FE0540350 (FE0570350) FE0570350 (FE0570350) NID680350 NID680350 (NID680350) NID640350 SU3304 PLC IDMAT (4) TPRECS (). TEMPMT (-2) SU3304 PLC IDMAT (4) SID280350 SID280350 SID280350 SID280350 | 1G 1 7 | | 0: 11 5: 20 0: 12 0: 12 0: 12 0: 12 0: 11 0: 12 0: 110 0: 11 0 10 0 10 0 10 0 10 0 10 10 10 10 10 | 1498 4992 844 844 84 84 84 84 84 84 84 84 84 84 8 | 180 384 385 385 387 470 588 588 588 588 588 588 588 58 | EEEEEEEE PEEEE | 04 03 02 03 04 03 05 04 05 04 06 04 05 05 | |)))))))))) | |
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| * * 52 | cc6530350 (cc6540,550) FED540,550 (FED540,550) FED560,550 (FED570,550) FED570,550 (N10560,350 (N1060,350 (N1060,350 (N1060,350 (N1060,350 (N1060,350 (N1060,350 (SU330,4 PLU IDMA7(4) FEMPMT (SU330,4 PLU IDMA7(4) SU330,4 PLU IDMA7(4) SU330,4 PLU IDMA7(4) SU330,4 PLU IDMA7(4) SU330,4 PLU IDMA7(4) SU330,4 PLU SU330,4 | 1G 1 7 | | 0 1 5 2 6 9 4 6 7 1 0 1 6 3 8 4 8 4 8 4 8 4 8 4 8 4 8 4 8 4 8 4 8 4 8 4 8 4 8 4 8 4 8 1 1 1 1 1 1 1 1 1 1 1 1 1 | 14 88 49 10 10 10 10 10 10 10 10 10 10 | 180845738888 1258888 1258888 1258888 1258888 125888888 125888888 125888888 125888888 125888888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 125888888 125888888 125888888 125888888 125888888 125888888 125888888 125888888 125888888 12588888888 1258888888 125888888 125888888 1258888888888 | | 04 03 02 04 03 05 04 05 04 05 04 05 05 05 05 05 | |)))))))))) | |
| * * 52 | CR0530350 (CR0540350 (PE0540350) FE0540350 (FE0540350) FE0540350 (FE0570350 (FE0570350 (NID680350 (NID680350 (NID640350 (SUS304 PLL IDMA7(4) TPRECS (0.120470 (C00120350 (SID280350 (SI | 1G 1 7 | | 0 1 5 2 6 0 9 4 6 7 1 0 1 6 3 8 4 8 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 | 14 88 49 10 10 10 10 10 10 10 10 10 10 10 10 10 | 180845738888 1258888 1258888 1258888 1258888 1258888 1258888 1258888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 12588888 125888888 12588888 125888888 125888888 125888888 125888888 1258888888 1258888888 1258888888 1258888888 1258888888 1258888888 12588888888 1258888888888 | | 04 03 02 04 03 03 04 03 05 04 05 04 05 05 05 05 05 07 06 | | | |
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| ÷ * | CR0530.50 (CR0540.50 (MR0550.50 (FE0540.50 (FE0540.50 (FE0540.50 (FE0540.50 (FE0540.50 (NI0600.50 (NI0600.50 (NI0600.50 (NI0600.50 (SU3304 PL) SU3304 PL SU3304 PL SU3304 SU3305 (SU3304 SU350 (SU3304 SU350 (SU3304 SU350 (SU3305 SU350 SU350 (SU3305 SU350 | 1G 1 7 | | 0 1 5 2 6 0 9 4 6 7 1 0 1 6 3 8 4 8 2 2 9 4 6 7 1 1 6 1 1 6 1 1 1 1 1 1 1 1 1 1 1 1 1 | 14 18 18 18 18 18 18 18 18 18 18 | 1830 1930 1933 1933 1933 1933 1933 1933 1933 1935 19 5 19 5 19 5 19 5 19 5 19 5 19 5 1 | | 04 03 02 03 04 03 05 04 03 05 04 04 05 05 05 05 06 09 04 | | | |
| * * 52 | CR0530050(CR0540505) FR05405050(FR05405050) FR05405050(FR05405050) FR0540500(NID600500) NID600500 NID600500 NID600500 NID600500 SU3204050(SU3204050) SU3204050(SU3204050) SU3204050(SU32050050) SU32050050(SU32050050) SU32050050(SU32050050) SU32050050(SU32050050) SU32050050(SU32050050) SU32050050(SU32050050) SU32050050(SU32050050) SU32050050(SU32050050) SU32050050(SU32050050) SU32050050(SU32050050) SU3205050(SU32050050) SU3205050(SU32050050) SU3205050(SU32050050) SU3205050(SU32050050) SU3205050(SU32050050) SU3205050(SU32050050) SU3205050(SU32050050) SU3205050(SU32050050) SU3205050(SU32050050) SU3205050(SU32050050) SU3205050(SU32050050) SU3205050(SU32050050) SU3205050(SU32050050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU3205050(SU3205050) SU32050(SU32050050) SU320500500000000000000000000000000000000 | 1G 1 7 | 41351151826)3118422221571 | 0 1 5 2 6 0 9 4 6 7 1 0 1 6 3 8 4 8 2 2 9 4 6 7 1 1 6 1 1 6 1 1 1 6 1 1 1 1 1 1 1 1 1 1 1 1 1 | 14 14 14 14 14 14 14 14 14 14 | 1830 19 19 19 19 19 19 19 19 19 19 19 19 19 1 | | 04 03 02 03 04 03 05 04 05 04 05 04 05 05 06 09 02 02 00 05 05 06 09 02 00 00 00 00 00 00 00 00 00 00 00 00 | | | |
| * * 52 | CR0530450(CR0540550) FR0540550(FR0540550) FR0540550(FR0560550) FR0580500(N10600550) N10600550(N10600550) SU3304 PLU SU3304 PLU SU34 P | 1G | 14.1 3.5 1.1 5.1 1.5 1.5 1.5 1.5 1.5 1 | 011 52 60 94 67 10 16 38 48 22 94 46 71 10 11 63 84 82 29 44 67 | 5 | 1830 1830 19 10 19 10 19 10 19 10 19 10 19 10 19 10 10 10 10 10 10 10 10 10 10 10 10 10 | | 04 03 02 04 03 02 04 03 05 04 05 06 04 05 05 06 09 02 03 02 04 05 05 06 09 02 03 05 00 04 05 00 00 00 00 00 00 00 00 00 00 00 00 | | | |
| 5 * * | CR0530050(CR054050)(FR054050)(FR054050)(FR054050)(FR050050)(FR050050)(NI1660050)(NI1660050)(NI1660050)(NI1660050)(NI1660050)(SU3304 PL)(SU3304 PL)(SU3304 PL)(SU3304 PL)(SU3304 SU3050)(SU3304 SU3050)(SU32050)(| 1G 1 7 | 1 4 1 3 5 1 1 5 1 1 5 1 1 5 1 1 5 1 1 5 1 1 5 1 1 5 1 1 5 1 1 5 1 5 1 1 5 1 1 | 011 52 60 94 67 101 63 84 82 29 4 60 1 | 1449844498 5 | 1830 19 1 19 1 | | 043 023 023 043 05 04 004 005 04 005 04 002 04 002 04 002 004 002 004 005 04 005 04 005 04 005 04 000 000 | | | |
| * * 5 | CR05304050(CR0540505) FR0540505(FR0540505) FR0570505(FR0570505) NI0600505(NI0600505) NI0600505(NI0600505) SU3304 PLU IDMAT(4) TEMEMT(4) TEMEMT(4) TEMEMT(4) C00120505(SU3204050) SU320505(SU32050505) SU320505(SU320505) SU32050505(SU320505) SU320505(SU320505) SU320505(SU320505) SU320505(SU32050505) SU320505(SU32050505) SU320505(SU32050505) SU320505(SU32050505) SU320505(SU32050505) SU320505(SU32050505) SU320505(SU32050505) SU320505(SU32050505) SU320505(SU3205050505) SU320505(SU3205050505050505050505050505050505050505 | 1G 1 7 | 1 4 | 0:11 5:52 60 94 67 10 16 38 4 82 22 94 4 4 60 01 16 38 4 82 22 95 4 4 4 60 01 16 16 16 16 16 16 16 16 16 16 16 16 16 | 144988 144988 144988 14498 144988 144988 144988 144988 14 | 1830 303 343 343 343 343 343 343 3 | | 043 032 032 0343 0354 0004 0004 0004 0004 0004 0004 | | | |
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| * * 52 | CR053050(CR054050) FR054050(FR054050) FR054050(FR0505050) FR054050(NID60050) NID60050(NID60050) NID60050(NID60050) NID60050(SU2804050) SU2804050(SU2804050) SU2804050(SU2804050) SU2804050(SU2804050) SU2804050(SU2804050) SU2804050(SU2804050) SU2804050(SU2804050) SU2804050(SU2804050) SU2804050(SU2804050) SU2804050(SU2804050) SU2804050(SU2804050) SU2804050(SU2804050) FR05405050(FR05405050) FR05405050(FR05405050) FR05405050(FR05405050) | 1G 1 7 | 14. 13. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1 | 0:11 5:52 6:09 9:42 6:09 9:42 6:09 9:42 6:01 1:01 1:62 3:82 4:42 6:01 1:55 5:29 4:46 6:01 1:55 5:29 4:46 6:01 1:155 5:29 4:46 6:01 1:155 5:29 4:46 6:01 1:155 5:29 4:46 6:01 1:155 5:29 4:46 6:01 1:155 5:29 4:46 6:01 1:155 5:29 4:46 6:01 1:155 5:29 4:46 6:01 1:155 5:29 4:46 7:155 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 | 141 141 141 141 141 141 141 141 | 18308433578 +TT795374109537410074525488 +TT795374100741007410254991102091101 | | 043 032 032 034 035 045 004 0045 005 005 004 004 002 004 002 004 002 004 002 004 002 004 002 002 | | | |
| * * 52 | CR0530.50(CR0540.50) FR0540.50) FR0540.50) FR0540.50) FR0570.50) N10600.50) N10600.50) N10600.50) N10600.50) N10600.50) SUS304 PLC IDMAT(4) TEMEMT(-2) C00120.50) S102900000000000000000000000000000000000 | 1G 1 7 |)))))))))))))))))))))))))))))))))))))) | 0:11 5:22 6 0:94 6 7 11 01 6 38 4 8 22 94 4 6 0 1 5 5 2 6 0 1 1 6 0 1 1 6 0 1 1 6 0 1 1 1 6 0 1 1 1 1 | 148849999999999999999999999999999999999 | 18308433578 +TT7553388878 +T75537410537400000000000000000000000000000000000 | | 043 032 043 0354 005 0464 055 057 094 203 032 005 005 005 005 005 005 005 005 005 00 | | | |
| * * 5 | CR0530050(CR0540550) FR05405050(FR054050) FR0540500(FR0500500) FR0500500(NI1660050) NI1660050(NI1660050) NI1660050(NI1660050) SU3304 PLC SU3304 PLC SU3304 PLC SU3304 PLC SU3304 SU33050(SU3304 SU350) SU3304 SU350(SU3304 SU350) SU340 SU350(SU3304 SU350) SU3304 SU350(SU3304 SU350) SU340 SU350(SU340 SU350(SU340 SU350) SU340 SU | 1G 1 7 | 1 4 1 3 3 5 1 1 1 3 5 1 1 1 3 3 5 1 1 1 3 3 5 1 1 1 3 3 5 1 1 1 1 | 0:11 5:22 60 9:46 7: 100 16 38:48 22 9:44 60 15 5:22 60 9:46 7: 100 16 38:48 22 9:44 60 15 5:22 60 9:46 7: 100 11 60 9:46 7:10 11 100 1000 1000 100 100 100 100 1 | 1438 14 14 14 14 14 14 14 14 14 14 14 14 14 1 | 1830334 303433578 +T70033417238888 +T700334174258888 +T70033410404 +T700334104 +T700334104 +T700334104 +T70033410 +T70034100 +T700341 | | 043022 043002 0043005 00045 00045 000420 0042004 0023043 0023045 00045 000420 004203043 0023043 00230045 000420 00230043 00230045 00200040 00200040 00200040 00200040 00200040 00200040 0020000000 00200000000 | | | |
| * * 52 | CR05304050(CR0540.505) FR0540.5050(FR0540.5050) FR0540.5050(FR0580.5050) FR0580.5050(N10600.5050) N10620.5050(N10620.5050) SU3304 PLU SU3304 PLU SU34 PLU | 1G 17 | 1 4 1 3 3 5 1 1 1 3 5 1 1 1 5 1 1 1 5 1 1 1 5 1 1 1 5 1 1 1 5 1 1 1 5 1 1 1 5 1 1 1 1 5 1 1 1 1 5 1 1 1 1 1 5 1 1 1 1 1 5 1 1 1 1 1 1 5 1 1 1 1 1 1 5 1 1 1 1 1 1 5 1 1 1 1 1 1 1 5 1 | 0:11 5:20 60 9 4 60 9 4 60 9 4 60 10 <td>148 148 148 148 148 148 148 148</td> <td>18303345 18303345 1830334778 +1793344 187034 18704 1</td> <td></td> <td>04332234330543 00330035 04645555576942234332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 00355 00355 00355 00365 00365 00365 00365 00365 00375 0000000000</td> <td></td> <td></td> <td></td> | 148 148 148 148 148 148 148 148 | 18303345 18303345 1830334778 +1793344 187034 18704 1 | | 04332234330543 00330035 04645555576942234332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 0034332 00355 00355 00355 00365 00365 00365 00365 00365 00375 0000000000 | | | |
| * * 52 | CR0530350 (CR0540350 (FE0540350 (FE0540350 (FE0540350 (FE0540350 (FE0570350 (NID60350 (NID6 | 1G 17 | 4 4 1 3 1 1 5 1 1 5 1 1 5 1 1 5 1 1 5 1 1 5 1 1 5 1 1 5 1 1 5 1 5 1 1 5 1 1 1 1 5 1 1 1 1 5 1 1 1 1 1 5 1 1 1 1 1 5 1 1 1 1 1 5 1 1 1 1 1 1 1 1 1 1 1 1 1 | 0:11 5:20 60 9 4 60 1 10 | | 18008335778 +TT09334526888888 +TT0933741904042514991171494985 | | 04332234333054 0000000000000000000000000000000 | | | |
| | CR032030(CR0340350) FR0340350) FR0340350) FR0340350) FR0350350 SR0350 SR | 1G 17 | 1 4 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 1 3 1 1 1 3 1 1 1 3 1 1 1 3 1 1 1 1 1 1 1 1 1 1 1 1 1 | 0:11 5:20 60 9:40 100 110 </td <td></td> <td>1800833173 180083317238 1723888878 177933455488888 1779334100410 18008574 190085</td> <td></td> <td>0433223433545 0464555557694234332000 00005555769423433023433054 00005555769423433023433004 00005555769423433000000000000000000000000000000000</td> <td></td> <td></td> <td></td> | | 1800833173 180083317238 1723888878 177933455488888 1779334100410 18008574 190085 | | 0433223433545 0464555557694234332000 00005555769423433023433054 00005555769423433023433004 00005555769423433000000000000000000000000000000000 | | | |
| * * * * | CR0530.50 (CR0540.50 (MR0550.50 (FE0540.50 () FE0540.50 () FE0540.50 () FE0540.50 () FE0540.50 () SU0340 FE0540.50 () NI0640.50 () SU0340 FE0540.50 () SU0340 FE0540.50 () SU0340 FE0540.50 () SU0340 FE0540.50 () SU0340 FE0540.50 () SU0340.50 () SU034 | 1G 1 7 | 1 4 1 3 3 5 1 1 1 3 5 1 1 1 3 5 1 1 1 5 1 1 8 2 2 6 1 1 1 1 1 8 2 2 2 2 2 1 1 5 5 1 1 1 4 1 1 8 8 2 2 6 1 1 1 4 1 1 8 8 2 6 1 1 1 4 1 1 8 8 2 6 1 1 1 4 1 1 8 8 2 6 1 1 1 4 1 1 1 8 8 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 0:11 5:20 60 9:40 71 100 11 6:33 8:44 8:22 9:44 4:60 1:55 5:20 6:99 9:20 6:60 6:00 1:55 5:20 6:99 9:20 6:60 6:00 1:55 5:20 6:99 9:20 6:60 6:00 1:55 5:20 6:99 9:20 6:60 6:00 1:55 5:20 6:99 9:20 6:60 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 1:55 5:20 6:00 </td <td>14894889999997777000000000000000000000000</td> <td>1809345258888 170933472388888 1709334172388888 17093341742548 17144998 180944 19</td> <td></td> <td>04332234330545)466455557694223433023433054 000055557694223433023433054 000055557694223433023433054 000055557694223433023433054 0000055557694223433023433054 0000055557694223433023433054 0000055557694223433023433054 0000055557694223433023433054 000005555769423433054 000005555769423433023433054 000005555769423433020000000000000000000000000000000</td> <td></td> <td></td> <td></td> | 14894889999997777000000000000000000000000 | 1809345258888 170933472388888 1709334172388888 17093341742548 17144998 180944 19 | | 04332234330545)466455557694223433023433054 000055557694223433023433054 000055557694223433023433054 000055557694223433023433054 0000055557694223433023433054 0000055557694223433023433054 0000055557694223433023433054 0000055557694223433023433054 000005555769423433054 000005555769423433023433054 000005555769423433020000000000000000000000000000000 | | | |
| * * 51 ** | CR0530050(CR0540550) FR0540500(FR054050) FR0540500(FR054050) FR0540500(FR054050) FR0540500(SU3304 PLD) SU3304 PLD SU3304 PLD SU3304 PLD SU3304 SU3304 SU3304 SU33050(SU3304 SU33050) SU3304 SU33050(SU3304 SU350) SU3305050 SU3305050(SU3305050) SU3305050(SU3305050) SU3305050(SU3305050) SU3305050(SU3305050) SU3305050(SU3305050) SU3305050(SU3305050) SU3305050(SU3305050) SU3305050(SU3305050) SU3305050(SU3305050) SU3305050(SU3305050) SU3305050(SU3305050) SU3305050(SU3305050) SU3305050(SU35050500) SU3305050(SU3505050) SU3305050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU3505050) SU3505050(SU35050500) SU3505050(SU35050500) SU3505050(SU35050500) SU3505050(SU3505000) SU3505050(SU3505000) SU35050000000000000000000000000000000000 | 1G 1 7 | 1 4 1 3 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 | 0:1155260994677 101163384822294460015552669992266 | | 1808317388888 FT79381738888888 FT7938193123888888 FT793811238888888 FT79331410454291691111111111111111111111111111111111 | | 04332234332000 00000 00000 00000 00000 00000 00000 0000 | | | |
| * * 52 | CR05304050(CR0540,505) FE0540,5050(FE0540,5050) FE0540,5050(FE0560,5050) FE0580,5050(N10660,5050) N10660,5050 N10660,5050 SU3304 PEUL IDMAT(4) TEMEMT(-2 C00120,5050) SU3304 PEUL IDMAT(5) SU3304 PEUL IDMAT(5) SU3304 PEUL IDMAT(5) SU3304 PEUL SU3304 PEUL IDMAT(5) SU3304 PEUL SU3304 PEUL SU34 | 1G 17 | 1 4 1 3 3 5 1 1 1 5 1 1 8 2 2 6) 3 1 1 1 8 4 4 2 2 2 2 2 1 5 7 1 1 4 1 1 8 2 2 6 . | 0115526094677 101163844822294446001555266992266 | 14899105334085555233200956991000 | 18083317388888 +10033112388888 +10033112388888 +10033110040404 +100331100404 +100331100404 +10033110040 +1003311004 +100311004 +10033110000000000000000000000000000000 | | 0403 0300 0400 0500 0400 0500 0500 0500 0400 0500 0500 00000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 | | | |
| 5 * * 5 | CR0530050(CR0540550) FE0540505(FE05405050) FE05405050(FE05605050) FE05605050(NI16600500) NI16600500 NI16600500 NI16600500 NI16600500 NI16600500 NI16600500 NI16600500 S10290500 S100000 S1029050000000000000000000000000000000000 | 1G 1 7 | 1 4 1 3 5 1 1 3 5 1 1 1 5 1 1 8 2 2 6) 3 1 1 1 8 2 2 2 2 1 1 5 7 1 1 1 4 1 1 8 2 2 6) 3 1 1 1 4 4 1 8 2 2 6) 3 1 1 4 4 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 2 2 6) 3 1 1 4 4 1 1 8 1 2 1 1 1 4 1 1 8 2 2 1 1 1 4 1 1 8 2 1 1 1 4 1 1 8 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 0:1552 60 9:467 1 1:0163 8:4822 9:4460 1:552 6:0992 6:6 | 148891881889188891888888888888888888888 | 1808331238888 FL293741093412888888 FL293741094542916941114 | | 0403 03203 0403 0403 0406 0406 0406 0505 0505 0706 0904 03303 02203 0303 0303 0305 0405 0506 0506 0405 0506 000000 | | | |
| * * 52 * * | CR05304050(CR0540.505) FR0540.5050(FR0540.5050) FR0540.5050(FR0580.5050) FR0580.5050(NI0620.5050) NI0620.5050(NI0620.5050) SU3304 PLL IDMAT(4) TEMEMT(4) TEMEMT(4) TEMEMT(4) C00120.5050(SU320.5050) SU320.5050(SU320.5050(SU320.5050) SU320.5050(SU320.5050(SU320.5050) SU320.5050(SU320.5050(SU320.5050) SU320.5050(SU320.5050(SU320.5050) SU320.5050(SU320.5050(SU320.5050) SU320.5050(SU320.5050(SU320.5050(SU320.5050) SU320.5050(SU3200(SU3200(SU3200(SU3200(SU3200(SU3 | 1G 17 | 1 4 1 3 3 5 1 1 3 5 1 1 1 5 1 1 8 2 2 6 9 1 1 1 8 2 2 2 2 1 1 5 7 1 1 1 3 3 5 5 1 1 1 4 4 1 1 3 3 5 5 1 1 1 4 4 1 1 8 2 2 6 9 1 3 0 1 1 1 4 4 1 1 8 2 2 1 1 1 4 4 1 1 8 2 2 1 1 1 4 4 1 1 1 8 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 0:1 5:2 6 0:1 5 2 6 0:1 5 2 6 0:1 5 2 6 0:1 5 5 2 6 0:1 5 5 2 6 0:1 5 5 2 6 0:1 5 5 2 6 9 9 2 6 1 5 | 14899166394027 73 5-5:00000000000000000000000000000000000 | 180845777 +179341044549110491104554911045549110455491104554911045549110455491104554911045549110455491104554911045549110455491104554911045549110455491104554910000000000 | | 0403 00203 00403 005 0406 005 0505 005 005 005 005 005 | | | |
| 2 * * | CR0530350 (CR0540350 (FE0540350 (FE0540350 (FE0540350 (FE0570350 (FE0570350 (NID600350 (NID600350 (NID600350 (NID640350 (NID640350 (SID290350 (CO0120350 (SID290350 (SID290 | 1G 17 | 1 4 1 3 5 1 1 1 5 1 1 8 2 6 6) 3 1 1 1 8 4 4 2 2 2 2 2 1 1 5 1 1 4 1 3 5 1 1 4 4 1 8 2 2 6) 3 9 5 | 0.115 5.206 0.946 7 1.0016 3.84822294446 0.155526699922666 1.556266992666 1.556266992666 1.5562669922666 1.5562669922666 1.5562669922666 1.5562669922666 1.5562669922666 1.5562669922666 1.5562669922666 1.5562669922666 1.5562669922666 1.5562669922666 1.5562669922666 1.556266992669 1.556266992669 | 148891663940277 5-5300000000000000000000000000000000000 | 180845778 FT793240044224911149188573 FT793240044573 FT7932400445549111491985573 | | 0403 00203 00403 005 00403 005 00406 005 005 005 005 005 005 005 0 | | | |
| * * 5 | CR05304050(CR0540505) FR0540505(FR0540505) FR0540505(FR0540505) FR0580505(SU3304 PLL IDMAT(4) TERES(8) SU3304 PLL IDMAT(4) TERES(10, SU3304 PLL IDMAT(4) TERES(10, SU3304 PLL IDMAT(4) FR0540505(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU3304050(SU3304050) SU34050(SU3304050) SU34050(SU3304050) SU34050(SU3304050) SU34050(SU3304050) SU34050(SU3405 | IG 17 | 1 4 1 3 5 1 1 1 5 1 8 2 6) 3 1 1 1 8 4 4 2 2 2 2 2 1 5 7 1 1 4 4 1 3 5 5 1 1 4 4 1 8 2 6) 3 9 5 1 1 | 01155206094677 1001633848222944460015522699922666 15900 | | 180845778 FT793494004429169111491873 FT7334 | | 0403 00203 00403 005 00400 005 00400 005 005 00400 005 005 | | | |
| 52 * * | CR0530.50 (CR0540.50 (FR0540.50 (FR0540.50 () FR0540.50 () FR0540.50 () FR0540.50 () FR0540.50 () SU0304 FR0540.50 () N10640.50 () N10640.50 () SU0304 FR05 SU0304 FR05 SU0304 FR05 SU0304 FR05 SU0304 FR05 SU0304 FR05 SU0304 FR05 SU03040 () SU03040 () | 1G 17 | 1 4 1 3 5 1 1 3 5 1 1 1 5 1 1 8 2 2 6) 3 1 1 1 8 4 4 2 2 2 2 1 5 7 1 1 1 4 1 8 2 2 6) 3 9 5 5 1 1 1 4 1 8 8 2 6) 3 9 5 5 1 1 1 | 11 5 2 6 0 9 4 6 1 5 2 6 0 9 4 6 7 1 0 1 6 3 8 4 8 2 2 9 4 4 6 0 1 5 5 2 6 9 9 2 6 6 1 5 9 9 2 6 6 1 5 9 9 2 6 6 1 5 9 9 2 6 6 1 5 9 9 2 6 6 1 5 9 0 | | 130845738888 FT79341040452L491633412026911714998573 FT79344 | | 04403 002203 004403 005 004600 004600 005 005 007 009 004 003 003 003 003 003 003 003 | | | |
| * * 52 | CR05304050(CR0540,502) FR0540,505(FR0540,505) FR0540,505(FR0540,505) FR0540,505(SU3304 PLL IDMA7(4) TERES(6) SU3304 PLL IDMA7(4) TERES(6) SU3304 PLL IDMA7(4) TERES(6) SU3304 PLL IDMA7(4) TERES(6) SU3304 PLL IDMA7(4) FR0540,505 SU3304,505 SU34,505 | IG 17 | 1 4 1 3 5 1 1 5 1 8 2 2 6) 3 1 1 8 4 2 2 2 2 1 5 7 1 1 1 4 1 3 5 1 1 4 4 2 2 2 2 2 1 5 7 1 1 4 4 1 8 2 2 6) 3 9 5 1 1 1 6 | 11 5 2 6 0 9 4 6 7 1 0 1 6 3 8 4 8 2 2 9 4 4 6 0 1 5 5 2 6 9 9 2 6 1 5 9 9 2 6 1 5 9 9 2 6 6 1 5 9 9 2 6 6 1 5 9 9 2 6 6 1 5 9 0 0 1 1 5 9 0 0 1 1 5 9 0 0 1 1 5 9 0 0 1 1 5 9 0 0 1 1 5 9 0 0 1 1 5 9 0 0 1 1 5 9 0 0 | | 13033312383878 FT7934193694004252129163341238888 FT793419369400452129163911404553878 FT79344988678 | | 04403 002203 004403 004400 005 004600 005 005 007 00600 00303 00303 00303 00303 00303 00303 00303 00303 00303 00303 00303 00303 00303 0030 | | | |
| * * 52 | CR05304050(CR0540505)(FR0540505)(FR0540505)(FR0540505)(FR0540505)(SU054050)(SU054 | IG 17 | 1 4 1 3 5 1 1 5 1 8 2 6) 3 1 1 8 4 2 2 2 2 2 1 5 7 1 1 4 1 3 5 1 1 4 4 1 8 2 6) 3 9 5 1 1 1 6 1 | 101155260994677 1001633848222944460015552669992666 1590000155 1590000155 1590000155 1590000155 | | 180845738888 FT793419400425491104919458878 FT7934492 | | 0403 00203 004 0030 005 004 005 005 005 005 005 00 | | | |
| * * 52 | CR0530050(CR054050) FE054050) FE054050) FE054050) FE0505050(FE0505050) FE0505050) SU3304 FE05 SU3304 FE05 SU3304 FE05 SU3304 FE05 SU3304 FE05 SU3304 FE05 SU3304 SU330 SU3304 SU330 SU3304 SU330 SU3304 SU330 SU3304 SU330 SU33050 SU350 SU3 | IG 17 | 14135111518226)311184422222157114113551114118226)39511161161 | 101155260994677 1001633848222944460015552669992666 15900001522 159000015522 159000015522 159000015522 | | 180843577 FT7937419504000911009157 FT7937419504009157 FT79374195040009157 | | 0403 00203 003004 00300 0040 005 0040 005 005 005 005 | | | |
| 52 * * 52 | CR05304050(CR0540.502) FR0540.5030(FR0540.5030) FR0540.5030(FR0540.5030) FR0540.5030(SU3304 PEL IDMA7(4) TERES(6) SU3304 PEL IDMA7(4) TERES(6) C00120.5030(C00120.5030(C00120.5030) SU320.5030(SU320.5030(SU320.5030) SU320.5030(SU320.5030(SU320.5030(SU320.5030) SU320.5030(SU3200(SU3200(SU3200(SU3200(SU3200(SU3200(| IG 17 17 | 14.13551115118226)3.11184422222155711.4413551114418226)3.955111661661 | 1011552260994671 1011633848222944460015522699922666 1599000152226 1599000152226 1599000152226 1599000152226 | | 1308435738888 FT7937419504004172549911149553 FT7937429254 | | 040300200000000000000000000000000000000 | | | |
| | CRO304050 (CRO304050) FEO54050 (FEO54050) FEO54050 (FEO54050) FEO54050 (NID60050) NID60050) NID60050 (NID60050) NID60050) NID60050) NID60050 (NID60050) NID60050) NID60050 (NID60050) NID60050 | IG 17 | 14.13.551115118226)311184422222157711144113551114418226)39511166116192 | 1011552260994671 1011633848222944460015522699922662 1159000115222692 | | 180845738888 +179374196010000000000000000000000000000000000 | | 04033000000000000000000000000000000000 | | | |
| * * 52 | CR05304050(CR0540.502) FR0540.5030(FR0540.5030) FR0540.5030(FR0540.5030) FR0540.5030(FR0540.5030) SU3304 PLU IDMAT(4) TEMES(10) SU3304 PLU IDMAT(4) TEMES(10) SU3304 PLU IDMAT(4) TEMES(10) SU3304 PLU IDMAT(4) SU3304 PLU IDMAT(4) SU3304 PLU IDMAT(4) SU3304 PLU IDMAT(4) SU3304 PLU SU3304 PLU IDMAT(4) SU3304 PLU SU3304 PLU SU340 PLU SU3 | IG 17 | 14.13.55.11.15.1.82.26)31.11.84.42.22.22.1.55.71.11.41.182.26)3.95.1.1.66.1.66.1.92.28 | 11 5 5 1 | | 180845738888 FT7937419201004549110491853 FT7344921534475 | | 04033000000000000000000000000000000000 | | | |
| | CR0530450 (CR0540.505 (FR0540.505 (FR0540.505 () FR0540.505 () FR0540.505 () FR0540.505 () SU0304 FR0540.505 () N10640.505 () N10640.505 () N10640.505 () N10640.505 () SU0304 FR05 () SU0304 FR05 () SU0304 FR05 () SU0304 FR05 () SU0304 FR05 () SU03040 () SU0400 () SU03040 () SU03040 () SU03040 () SU03040 () SU03040 | IG 17 17 | 14135111518226) 31118442222215771114113551114118226) 3955111611611922822 | 11 15 12 16 10 16 13 14 16 15 12 16 15 15 16 15 15 15 16 15 15 15 16 15< | | 180845738888 FT79534194042549111498573 FT7374692215441762 | | 04030000000000000000000000000000000000 | | | |
| * * 52 | CR05304050(CR0540,505) FR0540,505(FR0540,505) FR0540,505(FR0540,505) FR0540,505(FR0540,505) FR0540,505(SU3304 PLL IDMA7(4) TEMES(4) SU3304 PLL IDMA7(4) TEMES(4) SU3304 PLL IDMA7(4) TEMES(4) SU3304 PLL IDMA7(4) SU3304 PLL IDMA7(4) FR0540,505 SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU3304,505(SU3304,505) SU340,505(SU340,505) SU34 | IG 17 17 | 14135111518226) 31118442222215771114113551114118226) 39551116116119228223 | 001155520600946671 1001163384482229444600115552669992666 115900001552226211155 | | 180845738888 FT795341940472549111498573 FT737459245134762221544191095457 FT737459245434762221544174498 | | 040300200000000000000000000000000000000 | | | |
| * * 52 | CR05304050(CR0540.502) FR0540.5030(FR0540.5030) FR0540.5030(FR0540.5030) FR0540.5030(FR0540.5030) SU3304 PEU IDMAT(4) TEMENT(4) TEMENT(4) TEMENT(4) TEMENT(4) C00120.5030(SU3304 PEU IDMAT(4) TEMENT(4) SU3304 PEU IDMAT(4) SU3304 PEU IDMAT(4) SU3304 PEU IDMAT(4) SU3304 PEU IDMAT(4) SU3304 PEU IDMAT(4) SU3304 PEU IDMAT(4) SU3304 PEU IDMAT(5) SU3304 PEU SU3304 PEU IDMAT(5) SU3304 PEU SU3304 PEU IDMAT(5) SU3304 PEU SU3304 PEU | IG 17 | 14.13.551.182.26) 3.11.184.422.222.15.771.14.1.35.11.14.1.82.26) 3.95.11.16.1.61.19.2.8.22.3.5 $^\circ$ | 001155520600946671 1001163384482229444600115552669992666 1159000015522662115331 | | 180845738888 FL093419404524916045917 F73344922715449166222 | | 040303002000000000000000000000000000000 | | | |
| * * 52 | CR05304050(CR0540350(FR0540350) FR0540350(FR0540350) FR0540350(FR0580350) SU3304 PLL IDMA7(4) TFRC58(0) SU3304 PLL IDMA7(4) TFRC58(0) SU3304 PLL IDMA7(4) TFRC58(0) SU3304 PLL IDMA7(4) FR058030(SU3304) SU3304 PLL IDMA7(4) FR058030(SU3304) SU3304 PLL IDMA7(4) FR058030(SU3304) SU3304 PLL IDMA7(4) FR058030(SU3304) SU3304 SU330(SU3304) SU3304 SU3404 SU3 | IG 17 | 14.13.551.182.26) 3.111.884.22.22.15.771.14.1.35.111.41.882.6) 3.95.51.16.16.19.2.8.22.3.52.1 | 11552 101 1638 4822 94460 1552 1590001 1522 2621 15377 | | 180845738888 FL093419404524916045917 F733447622200 | | 040330200000000000000000000000000000000 | | | |
| 52 * * 52 | CR05304050(CR0540.502) FR0540.5030(FR0540.5030) FR0540.5030(FR0540.5030) FR0540.5030(FR0540.5030) SU3304 PELI IDMAT(4) TERES(6) SU3304 PELI IDMAT(4) TERES(7) C0120.5030(C0120.5030) SU3304 DELI SU3304 SU330 SU3304 SU3304 SU330 SU3304 SU3304 SU330 | 1G 17 17 | 141351151826)311184222221571114135511 3111844222221577114135511 39551161616192822352215 | 11552 101 101 1638 4822 944 4601 1552 669 926 1159 0001 1522 621 15377 266 1159 0001 1522 262 115 377 266 1159 0001 1522 262 115 377 266 1159 0001 1522 262 115 377 266 1159 0001 1522 266 1159 20001 1522 266 1159 20001 1522 266 1159 20001 1522 266 1159 20001 1522 266 1159 20001 1522 266 1159 20001 1522 266 1159 20001 1522 266 1159 20001 1522 266 1159 20001 1522 266 1159 20001 1522 266 1159 20001 1522 266 1159 20001 1522 266 1159 20001 1537 20001 | | 130845738888 T1033419404521291691114948553 T5334492229001 | | 040330020300000000000000000000000000000 | | | |
| * * 5 | CROS30201 CROS30201 MNOS50201 FEOS402501 FEOS402501 FEOS402501 FEOS402501 NID602501 NI | 1G 1 7 17 | 141351151826)311184222221571114135111418226)3951116116192822352153 | 001155526099467 1001633848222994460015552669922665 1599000155226211153377991 | | 180845738888 T1937419404521491691114945857 T534492250011 T537419404722491691114945857 T534492259162220001 T5374194045220001 | | 040330220300000000000000000000000000000 | | | |
| | CR05304050(CR0540.502) FR0540.5030(FR0540.5030) FR0540.5030(FR0540.5030) FR0580.5030(SU3304 PELL IDMAT(4) TERES(10) SU3304 PELL IDMAT(4) TERES(10) SU3304 PELL IDMAT(4) TERES(10) SU3304 PELL IDMAT(4) FR0540.5030(SU3304.5030) SU3304.5030(SU3304.5030(SU3304.5030) SU3304.5030(SU3304.5030(SU3304.5030) SU3304.5030(SU3304.5030(SU3304.5030) SU34.5030(SU34.5030(SU34.5030(SU34.5030) SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU34.5030(SU | IG 17 | 14133511518226)31118422222157711441335111418226)395511161161192822352215336 | 00155526099467 101633848222944601555269992666 159000155226211533777914 | | 1808457388888 FL0934194549169111498553 FC03449222000190 | | 040330200000000000000000000000000000000 | | | |
| 52 * * 52 | CR05304050(CR0540.502) FR0540.505(FR0540.505) FR0540.505(FR0540.505) FR0540.505(SR0540.505) SR0540 | IG 17 | 14133511518226)31118422222157711441335111418226)3955111611611928233521553669 | 001555260994671 10163384822294446001555266992266 15900015222621153377791448 | | 1808457388888 TT933419454916911149853 TT533449225917508 | | 040330020000000000000000000000000000000 | | | |
| * * 52 | CR05304050(CR0540,502) FR0540,505(FR0540,505) FR0540,505(FR0540,505) FR0540,505(FR0540,505) FR0540,505(SR0540,505) SR0540 | 1G 17 17 | 1413551151826)3118442222157114413551141826)3951116161619282352153691 | 001555260994677 100163384822294446001555266992266 1590001522266211533777914489 | | 18083357388888 FT7933419254991114918553 FT73344927254844765222000199 | | 040 040 030 0220 030 040 05 05 07 06 09 04 00 05 05 07 06 09 04 00 05 05 07 06 09 00 00 00 00 00 00 00 00 00 | | | |

| CA0480J50(8.6656E-09) CR0500J50(5.1732E-08) CR0520J50(9.9761E-07) |
|--|
| CR0530J50 (1.131E-07) CR0540J50 (2.153E-08) MM0550J50 (2.1652E-07) FED540J50 (3.652E-07) FED570J50 (3.121E-08) FED590J50 (1.2416E-08) NI0580J50 (1.2416E-08) NI0640J50 (2.7532E-07) NI0640J50 (2.7532E-07) NI0640J50 (3.7869E-08) NI0640J50 (3.6042E-07) W01800J50 (3.6042E-07) W01800J50 (4.3276E-07) W01800J50 (4.3276E-07) W01800J50 (4.3276E-07) W01800J50 (4.3276E-07) W01800J50 (3.6042E-07) |
| * GRAPHITE & IDMAT(6) TFRECS(1.0) TEMEMT(<273.15+TF>) CO012cJS0F00(8.5785E-02) C0013cJS0F00(9.5413E-04) * |
| * MODERATOR 6 IDMAT(7) TPRECS(0.1) TEMEWIT(<273.15+TF>) HO00HJ50(<6.6689E-02+FEM/100.0>) O00166J50(<3.3346E-02+FEM/100.0>) |
| * * * * * * * * * * * * * * * * * * * |
| <pre>* A6061 STD 4 IDMRT(9) TFRECS(0.1) TEMEMT(<273.15+TF>) MC0240350(5.2843E-04) MC02260350(5.2843E-04) MC0260350(5.2843E-04) MC0260350(3.2037E-04) S10280350(3.2037E-04) S10280350(1.0768E-05) T10460350(1.0768E-05) T10460350(2.8017E-06) T10480350(3.7187E-06) T10480350(3.7187E-06) T10480350(2.8017E-06) T10480350(2.8017E-06) T10480350(2.8017E-06) T10490350(2.8017E-06) T10490350(2.8017E-06) T10500350(2.8017E-06) CR0550350(5.7292E-06) CR0550350(1.2649E-06) CR0550350(1.2649E-05) FE0560350(1.2649E-05) FE0560350(1.2649E-06) FE0550350(2.1694E-04) FE0550350(2.1694E-04) FE0550350(2.1694E-04) FE0550350(2.1694E-05) ZN0460350(1.2722E-05) ZN0460350(1.2722E-05) ZN0460350(1.2722E-05) ZN0460350(1.2722E-05) ZN0460350(1.2722E-05) ZN0460350(1.2725E-05) ZN0460350(1.2725E-05) ZN0460350(1.2725E-05) ZN0460350(1.2725E-05) ZN0460350(1.2725E-05) ZN0460350(1.2725E-05) ZN0460350(1.2725E-05) ZN0460350(1.2725E-05) ZN0460350(1.2725E-05) ZN0460350(1.2648E-05) ZN0460350(1.2648E-05) ZN0460350(1.2648E-05) ZN040350(1.2648E-05) ZN0400350(1.2648E-05) ZN040350(1.2648E-05) ZN0400350(1.2648E-05) ZN040350(2.2648E-05) ZN040350(2.2648E-05) ZN040350(2.2648E-05) ZN040350(2.2648E-05) ZN0404550(2.2648E-05) ZN0404550(2.2648E-05) ZN040350(2.2648E-05)</pre> |
| * SUS304 STD 4 IDMAT(10) TFERECS(0.1) TEMPMT(<273.15+TFP) CO0120J50(3.1498E-04) CO0130J50(3.4988E-06) ST0280J50(1.4762E-03) ST0280J50(1.9555E-05) ST0280J50(3.955E-05) ST0320J50(4.2456E-05) S00320J50(4.2456E-05) S00320J50(3.3510E-07) S00340J50(1.8811E-06) S00340J50(1.8811E-06) S00340J50(1.893E-07) S00340J50(1.4622E-02) CR0550J50(1.4622E-02) CR0550J50(1.4622E-02) CR0550J50(1.4622E-02) CR0550J50(1.4622E-03) FE0550J50(3.4612E-03) FE0550J50(1.2319E-03) FE050J50(1.2319E-03) FE050J50 |
| * * * * * * * * * * * * * * * * * * * |
| <pre>* * * * * * * * * * * * * * * * * * *</pre> |
| \$END XSEC * |
| ** |

| CYL (60000 0.0 0.0 << CYL (61000 0.0 0.0 < | GTB> < GBB> < | GTT-GTB> | (SH2>) (SH2>) | /* t_g /* b-g |
|---|--|--|---|---------------------------|
| * over shroud CYL (70000 0.0 0.0 < CYL (71000 0.0 0.0 < | GTT> < GTT> < | FZ15-GTT> - | <sh1>) <sh2>)</sh2></sh1> | |
| * guide tube TA CYL (500 < 9.0*PPP> 0 CYL (501 < 9.0*PPP> 0 | .0 <0 | GZB> <ect-gzb> GZB> <ect-gzb></ect-gzb></ect-gzb> | <gr1>) <gr2>)</gr2></gr1> | |
| * guide tube TB CYL (510 <-4.5*PPP> < | -4.5*FPP> | <gzb> <ect-gzb></ect-gzb></gzb> | <gr1></gr1> |) |
| * guide tube TC CYL (520 <-4.5*PPP> < | 4.5*FPP> | <gzb> <ect gzb=""></ect></gzb> | <gr1></gr1> |) |
| CYL (521 <-4.5*PPP> < * grid water hole 1 CYL (60110 < 4.5*PPP> | < 9.5*FPP> | <gzb> <ect-gzb></ect-gzb></gzb> | > <grz> 3> <gtrf></gtrf></grz> |)) /* tg |
| TRC (60111 < 4.5*PPP> CYL (60112 < 4.5*PPP> | < 9.5*FPP> < 9.5*FPP> | <pre><gbt> 0.0 0</gbt></pre> | .0 <fz7-gbt: .>) /* b 3> <gbrf></gbrf></fz7-gbt: | > g1) /* bg2 |
| CYL (60120 < 6.0*PPP> TRC (60121 < 6.0*PPP> | < 9.0*FPP> < 9.0*FPP> | <gtb> <gtt-gtf <gbt> 0.0 0 <gbrf> <fr11< td=""><td><pre>3> <gtrf> .0 <fz7-gbt: .="">) /* b</fz7-gbt:></gtrf></pre></td><td>) /* tg > al</td></fr11<></gbrf></gbt></gtt-gtf </gtb> | <pre>3> <gtrf> .0 <fz7-gbt: .="">) /* b</fz7-gbt:></gtrf></pre> |) /* tg > al |
| CYL (60122 < 6.0*PPP> CYL (60130 < 7.5*PPP> TPC (60131 < 7.5*PPP> | < 9.0*FPP> < 8.5*FPP> | <gbb> <gbt-gbf <gtb> <gtt-gtf <cbt> 0 0 0</cbt></gtt-gtf </gtb></gbt-gbf </gbb> | 3> <gbrf> 3> <gtrf> 0 <f77-cbt< p=""></f77-cbt<></gtrf></gbrf> |) /* bg2) /* tg |
| CYL (60132 < 7.5*PPP> | < 8.5*FPP> | <pre><gbi> 0.0 0 <gbrf> <fr11 <gbb=""> <gbt-gbe< pre=""></gbt-gbe<></fr11></gbrf></gbi></pre> | .>) /* b 3> <gbrf></gbrf> | g1) /* bg2 |
| TRC (60140 < 9.0*PPP> | < 8.0*FPP> | <pre><gtb> <gtt-gtf <gbt> 0.0 0 <gbrf> <fr11< pre=""></fr11<></gbrf></gbt></gtt-gtf </gtb></pre> | .0 <fz7-gbt: .>) /* b</fz7-gbt: |)/^ tg > g1 |
| CYL (60142 < 9.0*PPP> CYL (60150 < 10.5*PPP> TRC (60151 < 10.5*PPP> | < 8.0*FPP> < 7.5*FPP> < 7.5*FPP> | <pre><gbb> <gbt-gbi <gtb=""> <gtt-gt <gbt=""> 0.0 0</gtt-gt></gbt-gbi></gbb></pre> | 3> <gbrf> B> <gtrf> .0 <fz7-gbt< td=""><td>) /* bg2) /* tg ></td></fz7-gbt<></gtrf></gbrf> |) /* bg2) /* tg > |
| CYL (60152 < 10.5*PPP> CYL (60160 < 12.0*PPP> | < 7.5*FPP> < 7.0*FPP> | <pre> <gbrf> <fr11 <gbb=""> <gbt-gb <gtb=""> <gtt-gt< pre=""></gtt-gt<></gbt-gb></fr11></gbrf></pre> | .>) /* b B> <gbrf> B> <gtrf></gtrf></gbrf> | g1) /* bg2) /* tg |
| TRC (60161 < 12.0*PPP> | < 7.0*FPP> | <pre><gbt> 0.0 0 <gbt> <fr11 <gbb=""> <gbt-gb< pre=""></gbt-gb<></fr11></gbt></gbt></pre> | .0 <fz7-gbt .>) /* b</fz7-gbt | > g1) /* bg2 |
| * grid water hole 2 CYL (60210 < 16.5*PPP> | < 2.5*FPP> | <gtb> <gtt-gt< td=""><td>B> <gtrf></gtrf></td><td>) /* tg</td></gtt-gt<></gtb> | B> <gtrf></gtrf> |) /* tg |
| CYL (60212 < 16.5*PPP> | < 2.5*FPP> | <pre><gbt> 0.0 0 <gbrf> <fr11 <gbb=""> <gbt-gb< pre=""></gbt-gb<></fr11></gbrf></gbt></pre> | .0 <f27-gbt .>) /* b B> <gbrf></gbrf></f27-gbt | , g1) /* bg2 |
| CYL (60220 < 16.5*PPP> TRC (60221 < 16.5*PPP> | < 1.5*FPP> < 1.5*FPP> | <pre> <gtb> <gtt-gt <gbt=""> 0.0 0 <gbrf> <fr11 <="" pre=""></fr11></gbrf></gtt-gt></gtb></pre> | B> <gtrf> .0 <fz7-gbt .>) /* b</fz7-gbt </gtrf> |) /* tg > g1 |
| CYL (60222 < 16.5*PPP> CYL (60230 < 16.5*PPP> TRC (60231 < 16.5*PPP> | < 1.5*FPP> < 0.5*FPP> < 0.5*FPP> | <pre><gbb> <gbt-gb <gtb=""> <gtt-gt <gbt=""> 0.0 0</gtt-gt></gbt-gb></gbb></pre> | B> <gbrf> B> <gtrf> .0 <fz7-gbt< p=""></fz7-gbt<></gtrf></gbrf> |) /* bg2) /* tg |
| CYL (60232 < 16.5*PPP> | < 0.5*FPP> | <gbrf> <fr11 <gbb> <gbt-gb< td=""><td>.>) /* b B> <gbrf></gbrf></td><td>g1) /* bg2</td></gbt-gb<></gbb></fr11 </gbrf> | .>) /* b B> <gbrf></gbrf> | g1) /* bg2 |
| TRC (60240 < 16.5*PPP> | <-0.5*FPP> | <pre><gib> <gii=gi <gbt> 0.0 0 <gbrf> <fr11< pre=""></fr11<></gbrf></gbt></gii=gi </gib></pre> | .0 <fz7-gbt .>) /* b</fz7-gbt |) / |
| CYL (60242 < 16.5*PPP> CYL (60250 < 16.5*PPP> TRC (60251 < 16.5*PPP> | <-0.5*FPP> <-1.5*FPP> <-1.5*FPP> | <pre><gbb> <gbt-gb <gtb=""> <gtt-gt <gbt=""> 0.0 0</gtt-gt></gbt-gb></gbb></pre> | B> <gbrf> B> <gtrf> .0 <fz7-gbt< td=""><td>) /* bg2) /* tg ></td></fz7-gbt<></gtrf></gbrf> |) /* bg2) /* tg > |
| CYL (60252 < 16.5*PPP> CYL (60260 < 16.5*PPP> | <-1.5*FPP> <-2.5*FPP> | <pre> <gbrf> <fr11 <gbb=""> <gbt-gb <gtb=""> <gtt-gt.< pre=""></gtt-gt.<></gbt-gb></fr11></gbrf></pre> | .>) /* b B> <gbrf> B> <gtrf></gtrf></gbrf> | g1) /* bg2) /* tg |
| TRC (60261 < 16.5*PPP> CYL (60262 < 16.5*PPP> | <-2.5*FPP> | <pre><gbt> 0.0 0 <gbrf> <fr11 <gbb=""> <gbt-gb< pre=""></gbt-gb<></fr11></gbrf></gbt></pre> | .0 <fz7-gbt .>) /* b B> <gbrf></gbrf></fz7-gbt | > g1) /* ba2 |
| * grid water hole 3 CYL (60310 < 4.5*PPP> TPC (60311 < 4.5*PPP> | <-9.5*FPP> | <gtb> <gtt-gth< td=""><td>3> <gtrf></gtrf></td><td>) /* tg</td></gtt-gth<></gtb> | 3> <gtrf></gtrf> |) /* tg |
| CYL (60312 < 4.5*PPP> | <-9.5*FPP> | <pre><gbrf> <fr11 <gbb=""> <gbt-gbe <="" pre=""></gbt-gbe></fr11></gbrf></pre> | <pre>.>) /* b B> <gbrf> CONDEN</gbrf></pre> | g1) /* bg2 |
| TRC (60321 < 6.0*PPP> | <-9.0*FPP> | <pre><gtb> <gtt-gtf <gbt> 0.0 0 <gbrf> <fr11< pre=""></fr11<></gbrf></gbt></gtt-gtf </gtb></pre> | .0 <fz7-gbt: .>) /* b</fz7-gbt: |) /^ tg > g1 |
| CYL (60322 < 6.0*PPP> CYL (60330 < 7.5*PPP> TRC (60331 < 7.5*PPP> | <-9.0*FPP> <-8.5*FPP> <-8.5*FPP> | <gbb> <gbt-gbi <gtb> <gtt-gti <gbt> 0.0 0</gbt></gtt-gti </gtb></gbt-gbi </gbb> | 3> <gbrf> 3> <gtrf> .0 <fz7-gbt:< td=""><td>) /* bg2) /* tg ></td></fz7-gbt:<></gtrf></gbrf> |) /* bg2) /* tg > |
| CYL (60332 < 7.5*PPP> CYL (60340 < 9.0*PPP> | <-8.5*FPP> | <gbrf> <fr11 <gbb> <gbt-gbf <gtb> <gtt-gtf< td=""><td>.>) /* b 3> <gbrf> 3> <gtrf></gtrf></gbrf></td><td>g1) /* bg2) /* tg</td></gtt-gtf<></gtb></gbt-gbf </gbb></fr11 </gbrf> | .>) /* b 3> <gbrf> 3> <gtrf></gtrf></gbrf> | g1) /* bg2) /* tg |
| TRC (60341 < 9.0*PPP> | <-8.0*FPP> | <gbt> 0.0 0 <gbrf> <fr11< td=""><td>.0 <fz7-gbt< td=""><td>g1</td></fz7-gbt<></td></fr11<></gbrf></gbt> | .0 <fz7-gbt< td=""><td>g1</td></fz7-gbt<> | g1 |
| CYL (60350 < 10.5*PPP> TRC (60351 < 10.5*PPP> | <-7.5*FPP> <-7.5*FPP> | <pre><gbb> <gb1 <<="" <gb1="" gb1="" td=""><td>B> <gtrf> .0 <fz7-gbt< td=""><td>) /* tg ></td></fz7-gbt<></gtrf></td></gb1></gbb></pre> | B> <gtrf> .0 <fz7-gbt< td=""><td>) /* tg ></td></fz7-gbt<></gtrf> |) /* tg > |
| CYL (60352 < 10.5*PPP> CYL (60360 < 12.0*PPP> | <-7.5*FPP> <-7.0*FPP> | <pre><gbrf> <frii <gbb> <gbt-gb <gtb> <gtt-gt< pre=""></gtt-gt<></gtb></gbt-gb </gbb></frii </gbrf></pre> | .>) /^ D B> <gbrf> B> <gtrf></gtrf></gbrf> |) /* bg2) /* tg |
| TRC (60361 < 12.0*PPP> CYL (60362 < 12.0*PPP> | <-7.0*FPP> | <pre><gbt> 0.0 0</gbt></pre> | .0 <fz7-gbt .>) /* b B> <gbrf></gbrf></fz7-gbt | > g1) /* bg2 |
| * grid water hole 4 CYL (60410 < -4.5*PPP> TRC (60411 < -4.5*PPP> | <-9.5*FPP> | <pre><gtb> <gtt-gt <gbt=""> 0.0 0</gtt-gt></gtb></pre> | B> <gtrf> .0 <fz7-gbt< td=""><td>) /* tg ></td></fz7-gbt<></gtrf> |) /* tg > |
| CYL (60412 < -4.5*PPP> | <-9.5*FPP> | <gbrf> <fr11 <gbb> <gbt-gb< td=""><td>.>) /* b B> <gbrf></gbrf></td><td>g1) /* bg2</td></gbt-gb<></gbb></fr11 </gbrf> | .>) /* b B> <gbrf></gbrf> | g1) /* bg2 |
| TRC (60420 < -6.0*PPP> | <-9.0*FPP> | <pre><gib> <gii=gi <gbt> 0.0 0 <gbrf> <fr11< pre=""></fr11<></gbrf></gbt></gii=gi </gib></pre> | .0 <fz7-gbt .>) /* b</fz7-gbt |) /- Lg > g1 |
| CYL (60422 < -6.0*PPP> CYL (60430 < -7.5*PPP> TRC (60431 < -7.5*PPP> | <-9.0*FPP> <-8.5*FPP> <-8.5*FPP> | | B> <gbrf> B> <gtrf> .0 <fz7-gbt< td=""><td>) /* bg2) /* tg ></td></fz7-gbt<></gtrf></gbrf> |) /* bg2) /* tg > |
| CYL (60432 < -7.5*PPP> CYL (60440 < -9.0*PPP> | <-8.5*FPP> <-8.0*FPP> | <gbrf> <fr11 <gbb> <gbt-gb <gtb> <gtt-gt< td=""><td>.>) /* b B> <gbrf> B> <gtrf></gtrf></gbrf></td><td>g1) /* bg2) /* tg</td></gtt-gt<></gtb></gbt-gb </gbb></fr11 </gbrf> | .>) /* b B> <gbrf> B> <gtrf></gtrf></gbrf> | g1) /* bg2) /* tg |
| TRC (60441 < -9.0*PPP> | <-8.0*FPP> | <pre><gbt> 0.0 0 <gbt> <fr11 <gbb=""> <gbt-gb< pre=""></gbt-gb<></fr11></gbt></gbt></pre> | .0 <fz7-gbt .>) /* b B> <gbre></gbre></fz7-gbt | > g1) /* bg2 |
| CYL (60450 <-10.5*PPP> TRC (60451 <-10.5*PPP> | <-7.5*FPP> | <pre><gtb> <gtt-gt <gbt=""> 0.0 0 </gtt-gt></gtb></pre> | B> <gtrf> .0 <fz7-gbt< td=""><td>) /* tg</td></fz7-gbt<></gtrf> |) /* tg |
| CYL (60452 <-10.5*PPP> CYL (60460 <-12.0*PPP> | <-7.5*FPP> | <gbr> <gbt-gb <gbb> <gbt-gb <gtb> <gtt-gt< td=""><td>) /^ D B> <gbrf> B> <gtrf></gtrf></gbrf></td><td>) /* bg2) /* tg</td></gtt-gt<></gtb></gbt-gb </gbb></gbt-gb </gbr> |) /^ D B> <gbrf> B> <gtrf></gtrf></gbrf> |) /* bg2) /* tg |
| TRC (60461 <-12.0*PPP> CYL (60462 <-12.0*PPP> | <-7.0*FPP> | <pre><gbt> 0.0 0 <gbrf> <fr11 <gbb=""> <gbt-gb< pre=""></gbt-gb<></fr11></gbrf></gbt></pre> | .0 <fz7-gbt .>) /* b B> <gbrf></gbrf></fz7-gbt | > g1) /* bg2 |
| * grid water hole 5 CYL (60510 <-16.5*PPP> TRC (60511 <-16.5*PPP> | < 2.5*FPP> < 2.5*FPP> | <pre><gtb> <gtt-gt. <gbt> 0.0 0</gbt></gtt-gt. </gtb></pre> | B> <gtrf> .0 <fz7-gbt< td=""><td>) /* tg ></td></fz7-gbt<></gtrf> |) /* tg > |
| CYL (60512 <-16.5*PPP> CYL (60520 <-16 5*PPD> | < 2.5*FPP> | <gbrf> <fr11 <gbb> <gbt-gb <gtb> <ctt-ct< td=""><td>.>) /* b B> <gbrf> B> <gtrf></gtrf></gbrf></td><td>g1) /* bg2) /* +a</td></ctt-ct<></gtb></gbt-gb </gbb></fr11 </gbrf> | .>) /* b B> <gbrf> B> <gtrf></gtrf></gbrf> | g1) /* bg2) /* +a |
| TRC (60521 <-16.5*PPP> | < 1.5*FPP> | <pre><gbt> 0.0 0 <gbt> <fr11 <="" pre=""></fr11></gbt></gbt></pre> | .0 <fz7-gbt< td=""><td>) /+ 1</td></fz7-gbt<> |) /+ 1 |
| CYL (60530 <-16.5*PPP> TRC (60531 <-16.5*PPP> | < 0.5*FPP> < 0.5*FPP> < 0.5*FPP> | <pre><gbd> <gbt-gb <gtb=""> <gtt-gt <gbt=""> 0.0 0 </gtt-gt></gbt-gb></gbd></pre> | B> <gtrf> .0 <fz7-gbt< td=""><td>) /* bg2) /* tg ></td></fz7-gbt<></gtrf> |) /* bg2) /* tg > |
| CYL (60532 <-16.5*PPP> CYL (60540 <-16.5*PPP> | < 0.5*FPP> <-0.5*FPP> | <gbrf> <fr11 <gbb> <gbt-gb <gtb> <gtt-gt< td=""><td>.>) /* b B> <gbrf> B> <gtrf></gtrf></gbrf></td><td>gi) /* bg2) /* tg</td></gtt-gt<></gtb></gbt-gb </gbb></fr11 </gbrf> | .>) /* b B> <gbrf> B> <gtrf></gtrf></gbrf> | gi) /* bg2) /* tg |
| TRC (60541 <-16.5*PPP> | <-0.5*FPP> | <gbt> 0.0 0</gbt> | .0 <fz7-gbt< td=""><td>></td></fz7-gbt<> | > |

| CYL. | <pre></pre> | |
|---|--|--|
| CYL | (60550 <-16.5*PPP> <-1.5*FPP> <gtb> <gtt-gtb> <gtrf>) /* tg</gtrf></gtt-gtb></gtb> | |
| TRC | (60551 <-16.5*PPP> <-1.5*FPP> <gbt> 0.0 0.0 <fz7-gbt></fz7-gbt></gbt> | |
| | <gbrf> <fr11>) /* bg1</fr11></gbrf> | |
| CYL | (60552 <-16.5*PPP> <-1.5*FPP> <gbb> <gbt-gbb> <gbrf>) /* bg2</gbrf></gbt-gbb></gbb> | |
| CYL | (60560 <-16.5*PPP> <-2.5*FPP> <gtb> <gtt-gtb> <gtrf>) /* tg</gtrf></gtt-gtb></gtb> | |
| TRC | (60561 <-16.5*PPP> <-2.5*FPP> <gbt> 0.0 0.0 <fz -gbt=""> //* hal</fz></gbt> | |
| CYL | (60562 <-16.5*PPP> <-2.5*FPP> <gbb> <gbt-gbb> <gbrf>) /* bq2</gbrf></gbt-gbb></gbb> | |
| * gri | id water hole 6 | |
| CYL | (60610 < -4.5*PPP> < 9.5*FPP> <gtb> <gtt-gtb> <gtrf>) /* tg</gtrf></gtt-gtb></gtb> | |
| TRC | (60611 < -4.5*PPP> < 9.5*FPP> <gbt> 0.0 0.0 <fz7-gbt></fz7-gbt></gbt> | |
| | <pre> <gbrf> <fr11>) /* bg1 (60(10 (4 5+222) (0 5+222) (GBR) (GBR) (GBR) (GBR)) (+) (2)</fr11></gbrf></pre> | |
| CYL | (60620 < -6.0*PPP> < 9.0*FPP> <gtb> <gtt-gtb> <gtrf>) /* to</gtrf></gtt-gtb></gtb> | |
| TRC | (60621 < -6.0*PPP> < 9.0*FPP> <gbt> 0.0 0.0 <fz7-gbt></fz7-gbt></gbt> | |
| | <gbrf> <fr11>) /* bg1</fr11></gbrf> | |
| CYL | (60622 < -6.0*PPP> < 9.0*FPP> <gbb> <gbt-gbb> <gbrf>) /* bg2</gbrf></gbt-gbb></gbb> | |
| CYL | (60630 < -7.5*PPP> < 8.5*FPP> <gtb> <gtt-gtb> <gtrf>) /* tg</gtrf></gtt-gtb></gtb> | |
| IRC | (60631 < -/.J~PPP> < 8.J~PPP> < GB1> 0.0 0.0 <p2 -gb1=""> (GBRF> <fr11>) /* bg1</fr11></p2> | |
| CYL | (60632 < -7.5*PPP> < 8.5*FPP> <gbb> <gbt-gbb> <gbrf>) /* bg2</gbrf></gbt-gbb></gbb> | |
| CYL | (60640 < -9.0*PPP> < 8.0*FPP> <gtb> <gtt-gtb> <gtrf>) /* tg</gtrf></gtt-gtb></gtb> | |
| TRC | (60641 < -9.0*PPP> < 8.0*FPP> <gbt> 0.0 0.0 <fz7-gbt></fz7-gbt></gbt> | |
| | <pre> <gbrf> <fr11>) /* bg1</fr11></gbrf></pre> | |
| CYL | (60650 <-10 5*PPP> < 8.0^FFP> <gbb> <gbt-gbb> <gbrf>) /* bgz</gbrf></gbt-gbb></gbb> | |
| TRC | (60651 <-10.5*PPP> < 7.5*FPP> <gbt> 0.0 0.0 <fz7-gbt></fz7-gbt></gbt> | |
| | <gbrf> <fr11>) /* bg1</fr11></gbrf> | |
| CYL | (60652 <-10.5*PPP> < 7.5*FPP> <gbb> <gbt-gbb> <gbrf>) /* bg2</gbrf></gbt-gbb></gbb> | |
| CYL | (60660 <-12.0*PPP> < 7.0*FPP> <gtb> <gtt-gtb> <gtrf>) /* tg</gtrf></gtt-gtb></gtb> | |
| TRC | (60661 <-12.0*PPP> < /.0*FPP> <gbt> 0.0 0.0 <fz -gbt=""> //* hal</fz></gbt> | |
| CYL | (60662 <-12.0*PPP> < 7.0*FPP> <gbb> <gbt-gbb> <gbrf>) /* bg2</gbrf></gbt-gbb></gbb> | |
| * cor | ntrol rod 1 | |
| CYL | (1001 0.0 < 6.0*FPP> <c1z1> <c1z2-c1z1> <cr1>) /* zr</cr1></c1z2-c1z1></c1z1> | |
| CYL | (1002 0.0 < 6.0*FPP> <c1z1> <c1z2-c1z1> <cr2>) /* v</cr2></c1z2-c1z1></c1z1> | |
| CIL | (1005 0.0 < 0.0*FPF> <cizi> <cizi> <cizi> <cr3>) /* UZTH (1004 0.0 < 6.0*FPF> <cizi> <cizi> <cp4>) /* ··</cp4></cizi></cizi></cr3></cizi></cizi></cizi> | |
| CYL | (1005 0.0 < 6.0*FPP> <c1z3> <c1z1-c1z3> <cr4>) /* sn1</cr4></c1z1-c1z3></c1z3> | |
| CYL | (1006 0.0 < 6.0*FPP> <c1z4> <c1z3-c1z4> <cr7>) /* v</cr7></c1z3-c1z4></c1z4> | |
| CYL | (1007 0.0 < 6.0*FPP> <c1z4> <c1z3-c1z4> <cr8>) /* st</cr8></c1z3-c1z4></c1z4> | |
| CYL | (1008 0.0 < 6.0*FPP> <c1z4> <c1z3-c1z4> <cr4>) /* v</cr4></c1z3-c1z4></c1z4> | |
| CYL | (1005 0.0 < 6.0*FPPS <c1z5> <c1z4=c1z5> <cr4>) /* bp</cr4></c1z4=c1z5></c1z5> | |
| CYL | (1011 0.0 < 6.0*FPP> <c128> <c129-c128> <cr6>) /* b4c</cr6></c129-c128></c128> | |
| CYL | (1012 0.0 < 6.0*FPP> <c1z8> <c1z10-c1z8> <cr4>) /* v</cr4></c1z10-c1z8></c1z8> | |
| CYL | (1013 0.0 < 6.0*FPP> <c1z10> <c1z11-c1z10> <cr4>) /* sp3</cr4></c1z11-c1z10></c1z10> | |
| CYL | (1014 0.0 < 6.0*FPP> <c1z11> <c1z12-c1z11> <cr4>) /* v</cr4></c1z12-c1z11></c1z11> | |
| CYL | (1015 U.U < 6.0*FPP> <c1z12> <c1z13-c1z12> <cr4>) /* tp (1016 0.0 < 6.0*FPP> <c1z5> <c1z13-c1z5> <cp5>) /* clad</cp5></c1z13-c1z5></c1z5></cr4></c1z13-c1z12></c1z12> | |
| * cor | ntrol rod 2 | |
| CYL | (2001 < 9.0*PPP> < 3.0*FPP> <c2z1> <c2z2-c2z1> <cr1>) /* zr</cr1></c2z2-c2z1></c2z1> | |
| CYL | (2002 < 9.0*PPP> < 3.0*FPP> <c2z1> <c2z2-c2z1> <cr2>) /* v</cr2></c2z2-c2z1></c2z1> | |
| CYL | (2003 < 9.0*PPP> < 3.0*PPP> <czzi> <czzi> <czzi> <cr3>) /* UZTH</cr3></czzi></czzi></czzi> | |
| CYL | (2005 < 9.0*PPP> < 3.0*FPP> <c2z3> <c2z1-c2z3> <cr4>) /* sp1</cr4></c2z1-c2z3></c2z3> | |
| CYL | (2006 < 9.0*PPP> < 3.0*FPP> <c2z4> <c2z3-c2z4> <cr7>) /* v</cr7></c2z3-c2z4></c2z4> | |
| CYL | (2007 < 9.0*PPP> < 3.0*FPP> <c2z4> <c2z3-c2z4> <cr8>) /* st</cr8></c2z3-c2z4></c2z4> | |
| CYL | (2008 < 9.0*PPP> < 3.0*FPP> <c2z4> <c2z3-c2z4> <cr4>) /* v</cr4></c2z3-c2z4></c2z4> | |
| CYL | (2009 < 9.0"FFF7 < 3.0"FFF7 < C2237 <c224-c2237 "="")="" <cr47="" bp<br="">(2010 < 9.0*FFF7 < 3.0*FFF7 <c2237)="" *="" <c228-c2275="" <cr47="" ep2<="" td=""><td></td></c2237></c224-c2237> | |
| CYL | (2011 < 9.0*PPP> < 3.0*FPP> <c2z8> <c2z9-c2z8> <cr6>) /* b4c</cr6></c2z9-c2z8></c2z8> | |
| CYL | (2012 < 9.0*PPP> < 3.0*FPP> <c2z8> <c2z10-c2z8> <cr4>) /* v</cr4></c2z10-c2z8></c2z8> | |
| CYL | (2013 < 9.0*PPP> < 3.0*FPP> <c2z10> <c2z11-c2z10> <cr4>) /* sp3</cr4></c2z11-c2z10></c2z10> | |
| | | |
| CYL | (2014 < 9.0*PPP> < 3.0*FPP> <c2z11> <c2z12-c2z11> <cr4>) /* v</cr4></c2z12-c2z11></c2z11> | |
| CYL CYL | <pre>(2014 < 9.0*PPP> < 3.0*PPP> <c2z11> <czz12-cz211> <cr4>) /* v (2015 < 9.0*PPP> < 3.0*PPP> <c2z12> <cz213-czz12> <cr4>) /* tp (2016 < 0.0*PPP> < 3.0*PPP> <c2z12> <cz213-czz12> <cr4>) /* clad</cr4></cz213-czz12></c2z12></cr4></cz213-czz12></c2z12></cr4></czz12-cz211></c2z11></pre> | |
| CYL CYL CYL * cor | <pre>(2014 < 9.0*PEP> < 3.0*PEP> <c2211> <c2212-c2211> <cr4>) /* v (2015 < 9.0*PEP> < 3.0*PEP> <c2212> <c2213-c2212> <cr4>) /* tp (2016 < 9.0*PEP> < 3.0*FEP> <c225> <c2213-c225> <cr5>) /* clad ntrol rod 3</cr5></c2213-c225></c225></cr4></c2213-c2212></c2212></cr4></c2212-c2211></c2211></pre> | |
| CYL CYL CYL * cor CYL | <pre>(2014 < 9.0*PEP> < 3.0*FEP> <c2211> <c2212-c2211> <cr4>) /* v (2015 < 9.0*PEP> < 3.0*FEP> <c2212> <c2212-c2212> <cr4>) /* tp (2016 < 9.0*PEP> < 3.0*FEP> <c225> <c2213-c225> <cr5>) /* clad htrol rod 3 (3001 < 9.0*PEP> <-3.0*FEP> <c321> <c322-c321> <cr1>) /* zr</cr1></c322-c321></c321></cr5></c2213-c225></c225></cr4></c2212-c2212></c2212></cr4></c2212-c2211></c2211></pre> | |
| CYL CYL CYL CYL CYL CYL CYL | <pre>(2014 < 9.0*PEP> < 3.0*FFEP> <c2211> <c2212-c2211> <cr4>) /* v (2015 < 9.0*PEP> < 3.0*FFEP> <c2212> <c2213-c221> <cr4>) /* tp (2016 < 9.0*PEP> < 3.0*FFEP> <c225> <c2213-c222> <cr5>) /* clad htrol rod 3 (3001 < 9.0*PEP> <-3.0*FFEP> <c321> <c322-c321> <cr>) /* zr (3002 < 9.0*PEP> <-3.0*FFEP> <c321> <c322-c321> <cr>) /* v (3002 < 9.0*PEP> <-3.0*FFEP> <c321> <c322-c321> <cr>) /* v</cr></c322-c321></c321></cr></c322-c321></c321></cr></c322-c321></c321></cr5></c2213-c222></c225></cr4></c2213-c221></c2212></cr4></c2212-c2211></c2211></pre> | |
| CYL CYL CYL CYL CYL CYL CYL | <pre>(2014 < 9.0*PEP> < 3.0*FEP> <22211 > <c2212 -="" c2211=""> <cr4>) /* v (2015 < 9.0*PEP> < 3.0*FEP> <c2212> <c212 -="" c212=""> <cr4>) /* tp (2016 < 9.0*PEP> < 3.0*FEP> <c225> <c2213 -="" c225=""> <cr5>) /* clad introl rod 3 (3001 < 9.0*FEP> <-3.0*FEP> <c221> <c322 -="" c321=""> <cr1>) /* rr (3002 < 9.0*FEP> <-3.0*FEP> <c221> <c322 -="" c321=""> <cr2>) /* v (3003 < 9.0*FEP> <-3.0*FEP> <c221> <c322 -="" c321=""> <cr2>) /* v (3004 < 9.0*FEP> <-3.0*FEP> <c321> <c322 -="" c321=""> <cr2>) /* v (3004 < 9.0*FEP> <-3.0*FEP> <c321> <c322 -="" c321=""> <cr2>) /* v (3004 < 9.0*FEP> <-3.0*FEP> <c321> <c322 -="" c331=""> <cr3>) /* UzcH (3004 < 9.0*FEP> <-3.0*FEP> <c321> <c327 -="" c331=""> <cr3>) /* v (3004 < 9.0*FEP> <-3.0*FEP> <c321> <c327 -="" c331=""> <cr3>) /* v (***********************************</cr3></c327></c321></cr3></c327></c321></cr3></c322></c321></cr2></c322></c321></cr2></c322></c321></cr2></c322></c221></cr2></c322></c221></cr1></c322></c221></cr5></c2213></c225></cr4></c212></c2212></cr4></c2212></pre> | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL | <pre>(2014 < 9.0*PEP> < 3.0*PEP> <c2211> <c2212-c2211> <cr4>) /* v (2015 < 9.0*PEP> < 3.0*PEP> <c221> <c221-c2212> <cr4>) /* tp (2016 < 9.0*PEP> < 3.0*PEP> <c225> <c2213-c221> <cr4>) /* tp (3001 < 0.0*PEP> <-3.0*PEP> <c321> <c322-c321> <cr5>) /* clad (3002 < 9.0*PEP> <-3.0*PEP> <c321> <c322-c321> <cr2>) /* v (3002 < 9.0*PEP> <-3.0*FEP> <c321> <c322-c321> <cr2>) /* v (3003 < 9.0*PEP> <-3.0*FEP> <c321> <c322-c321> <cr2>) /* v (3004 < 9.0*PEP> <-3.0*FEP> <c321> <c322-c321> <cr4>) /* v (3005 < 9.0*PEP> <-3.0*FEP> <c322> <c321< c32=""> <cr4>) /* v</cr4></c321<></c322></cr4></c322-c321></c321></cr2></c322-c321></c321></cr2></c322-c321></c321></cr2></c322-c321></c321></cr5></c322-c321></c321></cr4></c2213-c221></c225></cr4></c221-c2212></c221></cr4></c2212-c2211></c2211></pre> | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL | <pre>(2014 < 9.0*PEP> < 3.0*PEP> <22211 < C2212-C2211 < CR4>) /* v (2015 < 9.0*PEP> < 3.0*PEP> <c2212 <="" cc213-c2212="" cr4="">) /* tp (2016 < 9.0*PEP> < 3.0*PEP> <c225 <="" c213-c225="" cr5="">) /* clad ntrol rod 3 (3001 < 9.0*PEP> <-3.0*PEP> <c321 <="" c322-c321="" cr5="">) /* x (3002 < 9.0*PEP> <-3.0*PEP> <c321 <="" c322-c321="" cr5="">) /* x (3003 < 9.0*PEP> <-3.0*PEP> <c321 <="" c322-c321="" cr5="">) /* u (3004 < 9.0*PEP> <-3.0*PEP> <c321 <="" c322-c321="" cr5="">) /* u (3004 < 9.0*PEP> <-3.0*PEP> <c321 <="" c322-c321="" cr5="">) /* u (3004 < 9.0*PEP> <-3.0*PEP> <c321 <="" c327-c321="" cr5="">) /* u (3005 < 9.0*PEP> <-3.0*PEP> <c322 <="" c327-c323="" cr4="">) /* spl (3006 < 9.0*PEP> <-3.0*PEP> <c322 <="" c337-c323="" cr4="">) /* u (1) /* u (2) </c322></c322></c321></c321></c321></c321></c321></c321></c225></c2212></pre> | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL CYL | <pre>(2014 < 9.0*PEP> < 3.0*PEP> <c2211> <c2212-c2211> <cr4>) /* v (2015 < 9.0*PEP> < 3.0*PEP> <c221> <c2212-c221><cr4>) /* tp (2016 < 9.0*PEP> < 3.0*PEP> <c225> <c2213-c225> <cr5>) /* clad htrol rod 3 (3001 < 9.0*PEP> <-3.0*PEP> <c221> <c322-c31> <cr1>) /* rr (3002 < 9.0*PEP> <-3.0*PEP> <c321> <c322-c31> <cr2>) /* v (3003 < 9.0*PEP> <-3.0*PEP> <c321> <c322-c31> <cr5>) /* u (3004 < 9.0*PEP> <-3.0*PEP> <c321> <c322-c31> <cr5>) /* u (3005 < 9.0*PEP> <-3.0*PEP> <c323> <c321-c323> <cr4>) /* y (3005 < 9.0*PEP> <-3.0*PEP> <c324> <c321-c323> <cr4>) /* y (3006 < 9.0*PEP> <-3.0*PEP> <c324> <c323-c324> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c324> <c323-c324> <cr5>) /* y</cr5></c323-c324></c324></cr5></c323-c324></c324></cr4></c321-c323></c324></cr4></c321-c323></c323></cr5></c322-c31></c321></cr5></c322-c31></c321></cr2></c322-c31></c321></cr1></c322-c31></c221></cr5></c2213-c225></c225></cr4></c2212-c221></c221></cr4></c2212-c2211></c2211></pre> | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL CYL | <pre>(2014 < 9.0*PEP> < 3.0*FEP> <c2211> <c2212-c2211> <cr4>) /* v (2015 < 9.0*PEP> < 3.0*FEP> <c221> <c221-2c212> <cr4>) /* tp (2016 < 9.0*PEP> < 3.0*FEP> <c225> <c2213-c221> <cr5>) /* clad ntrol rod 3 (3001 < 9.0*PEP> <-3.0*FEP> <c321> <c322-c321> <cr2>) /* v (3002 < 9.0*FEP> <-3.0*FEP> <c321> <c322-c321> <cr2>) /* v (3003 < 9.0*FEP> <-3.0*FEP> <c321> <c322-c321> <cr2>) /* v (3004 < 9.0*FEP> <-3.0*FEP> <c321> <c322-c321> <cr2>) /* v (3005 < 9.0*FEP> <-3.0*FEP> <c321> <c322-c321> <cr4>) /* v (3006 < 9.0*FEP> <-3.0*FEP> <c321> <c322-c321> <cr4>) /* v (3007 < 9.0*FEP> <-3.0*FEP> <c322< <c322-c321=""> <cr4>) /* v (3007 < 9.0*FEP> <-3.0*FEP> <c324< <c322-c324=""> <cr4>) /* v (3007 < 9.0*FEP> <-3.0*FEP> <c324> <c322-c324> <cr4>) /* v (3007 < 9.0*FEP> <-3.0*FEP> <c324> <c322-c324> <cr4>) /* v (3007 < 9.0*FEP> <-3.0*FEP> <c324> <c322-c324> <cr4>) /* v (3006 < 9.0*FEP> <-3.0*FEP> <c324> <c322-c324> <cr4>) /* v (3006 < 9.0*FEP> <-3.0*FEP> <c324> <c322-c324> <cr4>) /* v (3006 < 9.0*FEP> <-3.0*FEP> <c324> <c322-c324> <cr4>) /* v</cr4></c322-c324></c324></cr4></c322-c324></c324></cr4></c322-c324></c324></cr4></c322-c324></c324></cr4></c322-c324></c324></cr4></c322-c324></c324></cr4></c324<></cr4></c322<></cr4></c322-c321></c321></cr4></c322-c321></c321></cr2></c322-c321></c321></cr2></c322-c321></c321></cr2></c322-c321></c321></cr2></c322-c321></c321></cr5></c2213-c221></c225></cr4></c221-2c212></c221></cr4></c2212-c2211></c2211></pre> | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL CYL | <pre>(2014 < 9.0*PEP> < 3.0*PEP> <22211 > <c2212 -="" <="" c2212="" cr4="">) /* v (2015 < 9.0*PEP> < 3.0*PEP> <c2252> <c2213 -="" c2212=""> <cr5>) /* told (2015 < 9.0*PEP> < 3.0*PEP> <c225> <c213 -="" c225=""> <cr5>) /* clad ntrol rod 3 (3001 < 9.0*PEP> <-3.0*PEP> <c225> <c322 -="" c321=""> <cr5>) /* v (3002 < 9.0*PEP> <-3.0*PEP> <c225> <c322 -="" c321=""> <cr5>) /* v (3003 < 9.0*PEP> <-3.0*PEP> <c225> <c322 -="" c321=""> <cr5>) /* v (3004 < 9.0*PEP> <-3.0*PEP> <c225> <c322 -="" c321=""> <cr5>) /* v (3004 < 9.0*PEP> <-3.0*PEP> <c225> <c322 -="" c321=""> <cr5>) /* v (3005 < 9.0*PEP> <-3.0*PEP> <c222> <c327 -="" c321=""> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c222> <c327 -="" c323=""> <cr4>) /* spl (3006 < 9.0*PEP> <-3.0*PEP> <c224> <c322 -="" c324=""> <cr5>) /* st (3008 < 9.0*PEP> <-3.0*PEP> <c224> <c322 -="" c324=""> <cr5>) /* v (3008 < 9.0*PEP> <-3.0*PEP> <c224> <c322 -="" c324=""> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c224> <c322 -="" c324=""> <cr5>) /* v (3008 < 9.0*PEP> <-3.0*PEP> <c224> <c322 -="" c324=""> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c225> <c324 -="" c325=""> <cr4>) /* vp (3010 < 9.0*PEP> <-3.0*PEP> <c225> <c324 -="" c325=""> <cr4>) /* vp</cr4></c324></c225></cr4></c324></c225></cr5></c322></c224></cr5></c322></c224></cr5></c322></c224></cr5></c322></c224></cr5></c322></c224></cr4></c327></c222></cr5></c327></c222></cr5></c322></c225></cr5></c322></c225></cr5></c322></c225></cr5></c322></c225></cr5></c322></c225></cr5></c213></c225></cr5></c2213></c2252></c2212></pre> | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL CYL | <pre>(2014 < 9.0*PEP> < 3.0*PEP> <c2211> <c2212 -="" <="" <cr4="" c2212="">) /* v (2015 < 9.0*PEP> < 3.0*PEP> <c221> <c221 -="" <="" <cr4="" c2212="">) /* to (2016 < 9.0*PEP> < 3.0*PEP> <c225> <c2213 -="" c221=""> <cr5>) /* clad ntrol rod 3 (3001 < 9.0*PEP> <-3.0*PEP> <c221> <c322 -="" c321=""> <cr5>) /* u (3002 < 9.0*PEP> <-3.0*PEP> <c221> <c322 -="" c321=""> <cr5>) /* u (3004 < 9.0*PEP> <-3.0*PEP> <c321> <c322 -="" c321=""> <cr5>) /* u (3005 < 9.0*PEP> <-3.0*PEP> <c321> <c322 -="" c321=""> <cr5>) /* u (3005 < 9.0*PEP> <-3.0*PEP> <c322> <c321 -="" c223=""> <cr5>) /* u (3005 < 9.0*PEP> <-3.0*PEP> <c322> <c321 -="" c223=""> <cr5>) /* v (3007 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* sp1 (3006 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* v (3009 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* v (3009 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* sp1 (3009 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* sp1 (3009 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* sp1 (3009 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* sp1 (3010 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* sp2 (3011 < 9.0*PEP> <-3.0*PEP> <c324> <c328 <c328=""> <c325> /* d28>) /* sp2</c325></c328></c324></cr5></c323></c324></cr5></c323></c324></cr5></c323></c324></cr5></c323></c324></cr5></c323></c324></cr5></c323></c324></cr5></c323></c324></cr5></c323></c324></cr5></c323></c324></cr5></c323></c324></cr5></c321></c322></cr5></c321></c322></cr5></c322></c321></cr5></c322></c321></cr5></c322></c221></cr5></c322></c221></cr5></c2213></c225></c221></c221></c2212></c2211></pre> | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL CYL | <pre>(2014 < 9.0*PEP> < 3.0*PEP> <c2211> <c2212-c2212<<<cr4>) /* v (2015 < 9.0*PEP> < 3.0*PEP> <c221> <c2212-c221>CC21> <cc4>) /* tp (2016 < 9.0*PEP> < 3.0*PEP> <c225> <c2213-c225> <cr5>) /* telad ntrol rod 3 (3001 < 9.0*PEP> <-3.0*PEP> <c221> <c322-c321> <cr5>) /* v (3002 < 9.0*PEP> <-3.0*PEP> <c321> <c322-c321> <cr5>) /* v (3003 < 9.0*PEP> <-3.0*PEP> <c321> <c322-c321> <cr5>) /* v (3004 < 9.0*PEP> <-3.0*PEP> <c321> <c322-c321> <cr5>) /* v (3004 < 9.0*PEP> <-3.0*PEP> <c321> <c322-c321> <cr5>) /* v (3004 < 9.0*PEP> <-3.0*PEP> <c321> <c322-c321> <cr5>) /* v (3005 < 9.0*PEP> <-3.0*PEP> <c322> <c322-c321> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c322> <c322-c321> <cr5>) /* v (3007 < 9.0*PEP> <-3.0*PEP> <c324> <c323-c324> <cr5>) /* v (3007 < 9.0*PEP> <-3.0*PEP> <c324> <c323-c324> <cr5>) /* v (3007 < 9.0*PEP> <-3.0*PEP> <c324> <c323-c324> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c324> <c323-c324> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c324> <c323-c324> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c324> <c323-c324> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c324> <c323-c324> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c324> <c323-c324> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c324> <c323-c324> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c324> <c325> <cr5>) /* v (3007 <-9.0*PEP> <-3.0*PEP> <c324> <c325> <cr5>) /* v (3010 <-0*PEP> <-3.0*PEP> <c328> <c328> <cr5>) /* v (5012 <-0*PEP> <-3.0*PEP> <c328> <cr5>) /* v (5012 <-0*PEP> <-3.0*PEP> <c328> <c328> <cr5>) /* v (5012 <-0*PEP> <-3.0*PEP> <c328> <cr5>) /* v (701 <-0*PEP> <-</cr5></c328></cr5></c328></cr5></c328></cr5></c328></cr5></c328></cr5></c328></cr5></c328></cr5></c328></cr5></c328></cr5></c328></c328></cr5></c328></cr5></c328></c328></cr5></c328></c328></cr5></c328></c328></cr5></c328></c328></cr5></c325></c324></cr5></c325></c324></cr5></c323-c324></c324></cr5></c323-c324></c324></cr5></c323-c324></c324></cr5></c323-c324></c324></cr5></c323-c324></c324></cr5></c323-c324></c324></cr5></c323-c324></c324></cr5></c323-c324></c324></cr5></c323-c324></c324></cr5></c322-c321></c322></cr5></c322-c321></c322></cr5></c322-c321></c321></cr5></c322-c321></c321></cr5></c322-c321></c321></cr5></c322-c321></c321></cr5></c322-c321></c321></cr5></c322-c321></c221></cr5></c2213-c225></c225></cc4></c2212-c221></c221></c2212-c2212<<<cr4></c2211></pre> | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL CYL | <pre>(2014 < 9.0*PEP> < 3.0*PEP> <22211 > <c2212 -="" c2211=""> <cr4>) /* v (2015 < 9.0*PEP> < 3.0*PEP> <c2212> <c213 -="" c2212=""> <cr4>) /* tp (2016 < 9.0*PEP> < 3.0*PEP> <c225> <c213 -="" c225=""> <cr5>) /* tlad intol rod 3 (3001 < 9.0*PEP> <-3.0*PEP> <c225> <c213 -="" c225=""> <cr5>) /* v (3002 < 9.0*PEP> <-3.0*PEP> <c225> <c213 -="" c221=""> <cr5>) /* v (3003 < 9.0*PEP> <-3.0*PEP> <c221> <c222 -="" c21=""> <cr5>) /* v (3004 < 9.0*PEP> <-3.0*PEP> <c221> <c222 -="" c21=""> <cr5>) /* v (3005 < 9.0*PEP> <-3.0*PEP> <c221> <c222 -="" c21=""> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c221> <c327 -="" c21=""> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c222> <c221 -="" c223=""> <cr5>) /* v (3007 < 9.0*PEP> <-3.0*PEP> <c222> <c221 -="" c223=""> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c222> <c221 -="" c223=""> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c222> <c221 -="" c223=""> <cr5>) /* v (3010 < 9.0*PEP> <-3.0*PEP> <c222> <c324 -="" c325=""> <cr5>) /* v (3010 < 9.0*PEP> <-3.0*PEP> <c222> <c234 -="" c325=""> <cr5>) /* v (3011 < 9.0*PEP> <-3.0*PEP> <c222> <c234 -="" c235=""> <cr5>) /* v (3011 < 9.0*PEP> <-3.0*PEP> <c222> <c221 -="" c223=""> <cr5>) /* v (3012 < 9.0*PEP> <-3.0*PEP> <c222> <c221 -="" c223=""> <cr5>) /* v (3012 < 9.0*PEP> <-3.0*PEP> <c222> <c221 -="" c223=""> <cr5>) /* v (3012 < 9.0*PEP> <-3.0*PEP> <c222> <c221 -="" c223=""> <cr5>) /* v (3012 < 9.0*PEP> <-3.0*PEP> <c221> <c231 -="" c223=""> <cr5>) /* v (3012 < 9.0*PEP> <-3.0*PEP> <c221> <c231 -="" c223=""> <cr5>) /* v (3013 < 9.0*PEP> <-3.0*PEP> <c221> <c221 <-c221=""> <cr5>) /* v (3014 < 9.0*PEP> <-3.0*PEP> <c221> <c221 <-c221=""> <cr5>) /* v (3014 < 9.0*PEP> <-3.0*PEP> <c221> <c221 <-c221=""> <cr5>) /* v (3014 < 9.0*PEP> <-3.0*PEP> <c221> <c221> <c221> <c221> <c25> /* v (222) <c221> /* v (3014 < 9.0*PEP> <-3.0*PEP> <c221> <c221> <c221> <c25> /* v (222) <c221> /* v (223) /* v (232) /* v (232) <c221> /* v (232) /* v (232) /* v (232) <c221> /* v (232) /</c221></c221></c221></c25></c221></c221></c221></c221></c25></c221></c221></c221></c221></cr5></c221></c221></cr5></c221></c221></cr5></c221></c221></cr5></c231></c221></cr5></c231></c221></cr5></c221></c222></cr5></c221></c222></cr5></c221></c222></cr5></c221></c222></cr5></c234></c222></cr5></c234></c222></cr5></c324></c222></cr5></c221></c222></cr5></c221></c222></cr5></c221></c222></cr5></c221></c222></cr5></c327></c221></cr5></c222></c221></cr5></c222></c221></cr5></c222></c221></cr5></c213></c225></cr5></c213></c225></cr5></c213></c225></cr4></c213></c2212></cr4></c2212></pre> | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL CYL | <pre>(2014 < 9.0*PEP> < 3.0*PEP> <22211 > <c2212 -="" <="" <cr4="" c2212="">) /* v (2015 < 9.0*PEP> < 3.0*PEP> <c221> <c221 -="" <="" <cr4="" c2212="">) /* clad htrol rod 3 (3001 < 9.0*PEP> <3.0*PEP> <c225> <c2213 -="" c225=""> <cr5>) /* clad f(3002 < 9.0*PEP> <3.0*PEP> <c221> <c322 -="" c321=""> <cr3>) /* v (3002 < 9.0*PEP> <3.0*PEP> <c221> <c322 -="" c321=""> <cr3>) /* v (3004 < 9.0*PEP> <3.0*PEP> <c321> <c322 -="" c321=""> <cr5>) /* v (3005 < 9.0*PEP> <-3.0*PEP> <c321> <c322 -="" c321=""> <cr5>) /* v (3005 < 9.0*PEP> <-3.0*PEP> <c321> <c322 -="" c321=""> <cr5>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c322> <c321 -="" c321=""> <cr4>) /* v (3007 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* v (3009 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* v (3009 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* v (3009 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* v (3009 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* v (3009 < 9.0*PEP> <-3.0*PEP> <c324> <c323 -="" c324=""> <cr5>) /* v (3010 < 9.0*PEP> <-3.0*PEP> <c322> <c324 -="" <c323="" c324=""> <cr5>) /* v (3011 < 9.0*PEP> <-3.0*PEP> <c322> <c324 <c325=""> <cr5>) /* v (3012 < 9.0*PEP> <-3.0*PEP> <c322> <c321 -="" c323=""> <cr5>) /* v (3012 < 9.0*PEP> <-3.0*PEP> <c322> <c321 -="" c323=""> <cr5>) /* v (3012 < 9.0*PEP> <-3.0*PEP> <c322> <c321 -="" c323=""> <cr5>) /* v (3013 < 9.0*PEP> <-3.0*PEP> <c322> <c321 -="" c321=""> <cr5>) /* v (3013 < 9.0*PEP> <-3.0*PEP> <c322> <c321 -="" c321=""> <cr5>) /* v (3014 < 9.0*PEP> <-3.0*PEP> <c321> <c321 -="" c321=""> <cr5>) /* v</cr5></c321></c321></cr5></c321></c322></cr5></c321></c322></cr5></c321></c322></cr5></c321></c322></cr5></c321></c322></cr5></c324></c322></cr5></c324></c322></cr5></c323></c324></cr5></c323></c324></cr5></c323></c324></cr5></c323></c324></cr5></c323></c324></cr5></c323></c324></cr4></c321></c322></cr5></c322></c321></cr5></c322></c321></cr5></c322></c321></cr3></c322></c221></cr3></c322></c221></cr5></c2213></c225></c221></c221></c2212></pre> | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL CYL | $ \left(\begin{array}{c} 2014 < 9,0^{0} \mbox{FPP} < 3,0^{0} \mbox{FPP} < (2211 \times C2212 - C2211 \times CR4 >) /* \mbox{trol} \\ 2015 < 9,0^{0} \mbox{FPP} < 3,0^{0} \mbox{FPP} < (2222 \times C2213 - C223 \times CR5 >) /* \mbox{tolad} \\ (3001 < 9,0^{0} \mbox{FPP} < 3,0^{0} \mbox{FPP} < C221 \times (C322 - C321 \times CR5 >) /* \mbox{tolad} \\ (3002 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C321 \times (C322 - C321 \times CR5 >) /* \mbox{tolad} \\ (3004 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C321 \times (C322 - C321 \times CR5 >) /* \mbox{tolad} \\ (3004 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C321 \times (C322 - C321 \times CR5 >) /* \mbox{tolad} \\ (3004 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C322 \times (C322 - C321 \times CR5 >) /* \mbox{tolad} \\ (3006 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C322 \times (C322 - C321 \times CR5 >) /* \mbox{sol} \\ (3006 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C322 \times (C323 - C324 \times CR5 >) /* \mbox{sol} \\ (3008 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C322 \times (C323 - C324 \times CR5 >) /* \mbox{sol} \\ (3010 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C322 \times (C323 - C323 \times CR5) /* \mbox{sol} \\ (3011 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C322 \times (C321 - C323 \times CR5) /* \mbox{sol} \\ (3014 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C322 \times (C321 - C323 \times CR5) /* \mbox{sol} \\ (3014 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C322 \times (C321 - C321 \times CR5 \times) /* \mbox{sol} \\ (3014 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C321 \times (C321 \times C321 \times CR5) /* \mbox{sol} \\ (3014 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C321 \times C321 \times C321 \times CR5) /* \mbox{sol} \\ (3014 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C321 \times C321 \times C321 \times \mbox{CR5 }) /* \mbox{sol} \\ (3014 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C321 \times \mbox{C321} < CR5) /* \mbox{sol} \\ (3014 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C321 \times \mbox{C321} < C321 \times \mbox{CR5 }) /* \mbox{sol} \\ (3014 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < C322 \times \mbox{C321} < C321 \times \mbox{CR5 }) /* \mbox{sol} \\ (3016 < 9,0^{0} \mbox{FPP} < -3,0^{0} \mbox{FPP} < \mbox{C322} \times \mbox$ | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL CYL | $ \left(\begin{array}{c} 2014 < 9, 0^{0}\text{PEPP} < 3, 0^{0}\text{PEPP} < C2211 > C2212 - C2211 > CC21 > CR4 >) /* v \\ (2015 < 9, 0^{0}\text{PEPP} < 3, 0^{0}\text{PEPP} < C225 > C2213 - C221 > CCR4 >) /* clad \\ \text{Introl rod 3} \\ (3001 < 9, 0^{0}\text{PEPP} < 3, 0^{0}\text{PEPP} < C225 > C2213 - C225 > (CR5 >) /* clad \\ (3002 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C221 > C221 > CCR4 >) /* v \\ (3003 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C221 > C221 > CCR4 >) /* v \\ (3004 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C221 > C221 > CCR4 >) /* v \\ (3004 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C221 > C221 > CCR3 >) /* v \\ (3005 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C221 > C221 > CCR4 >) /* v \\ (3006 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C222 > C221 - C223 > CCR4 >) /* v \\ (3006 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C222 > C221 - C232 > CCR4 >) /* v \\ (3006 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C224 > C232 - C324 > CCR3 >) /* v \\ (3006 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C224 > CCR24 > C282 - C284 >) /* v \\ (3010 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C228 > C282 - C328 - C383 >) /* v \\ (3011 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C228 > C282 - C328 - C383 >) /* v \\ (3012 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C322 > C282 - C328 - C383 >) /* v \\ (3012 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C322 > C282 - C328 - C383 >) /* v \\ (3013 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C321 > CC821 - C321 > CCR4 >) /* v \\ (3013 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C321 > CC321 - C321 > CCR4 >) /* v \\ (3015 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C321 > CC321 - C321 > CCR4 >) /* v \\ (3015 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C322 > CC321 - C321 > CCR4 >) /* v \\ (3015 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C321 > CC321 - C321 > CCR4 >) /* v \\ (3015 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C322 > CC321 - C321 > CCR4 >) /* v \\ (3015 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C322 > CC321 - CC321 > CCR4 >) /* v \\ (3015 < 9, 0^{0}\text{PEPP} < C3, 0^{0}\text{PEPP} < C322 > CC321 - CC321 > CCR4 >) /* v \\ (3015 < 9, 0^$ | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL CYL | <pre>(2014 < 9.0*PEP> < 3.0*PEP> <c2211> <c2212-c2212<<<rd>) /* v (2015 < 9.0*PEP> < 3.0*PEP> <c221> <c2212<c221>C221> <cr>) /* tp (2016 < 9.0*PEP> < 3.0*PEP> <c225> <c2213-c225> <cr>) /* clad ntrol rod 3 (3001 < 9.0*PEP> <-3.0*PEP> <c225> <c2213-c225> <cr>) /* clad (3002 < 9.0*PEP> <-3.0*PEP> <c225> <c2213-c225> <cr>) /* v (3003 < 9.0*PEP> <-3.0*PEP> <c225> <c2213-c225> <cr>) /* v (3003 < 9.0*PEP> <-3.0*PEP> <c225> <c2213-c225> <cr>) /* v (3004 < 9.0*PEP> <-3.0*PEP> <c225> <c221-c223> <cr>) /* v (3005 < 9.0*PEP> <-3.0*PEP> <c225> <c221-c223> <cr>) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c222> <c232-c221> <cr>) /* v (3007 < 9.0*PEP> <-3.0*PEP> <c222> <c232-c223> <cr>) /* v (3007 < 9.0*PEP> <-3.0*PEP> <c222> <c232-c223> <cr>) /* v (3007 < 9.0*PEP> <-3.0*PEP> <c222> <c232-c223> <cr>) /* v (3010 < 9.0*PEP> <-3.0*PEP> <c222> <c232+c223> <cr>) /* v (3011 < 9.0*PEP> <-3.0*PEP> <c322> <c231-c223> <cr>) /* v (3012 < 9.0*PEP> <-3.0*PEP> <c321> <c231> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c322> <c321-c223> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c322> <c321-c223> <cr>) /* v (3016 < 9.0*PEP> <-3.0*PEP> <c322> <c321-c223> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c322> <c321-c223> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c322> <c321-c223> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c322> <c321-c223> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c322> <c321-c223> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c322> <c321-c223> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c325> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c325> <c3213-c325> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c325> <c3213-c325> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c325> <c3213-c325> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c325> <c3213-c325> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c325> <c3213-c325> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c325> <c3213-c325> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c325> <c3213-c325> <cr>) /* v (2015 < 9.0*PEP> <-3.0*PEP> <c325> <c3213-c325> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c325> <c3213-c325> <cr>) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c325> <c3213-c3< td=""><td></td></c3213-c3<></c325></cr></c3213-c325></c325></cr></c3213-c325></c325></cr></c3213-c325></c325></cr></c3213-c325></c325></cr></c3213-c325></c325></cr></c3213-c325></c325></cr></c3213-c325></c325></cr></c3213-c325></c325></cr></c3213-c325></c325></cr></c325></cr></c321-c223></c322></cr></c321-c223></c322></cr></c321-c223></c322></cr></c321-c223></c322></cr></c321-c223></c322></cr></c321-c223></c322></cr></c321-c223></c322></cr></c321-c223></c322></cr></c231></c321></cr></c231-c223></c322></cr></c232+c223></c222></cr></c232-c223></c222></cr></c232-c223></c222></cr></c232-c223></c222></cr></c232-c221></c222></cr></c221-c223></c225></cr></c221-c223></c225></cr></c2213-c225></c225></cr></c2213-c225></c225></cr></c2213-c225></c225></cr></c2213-c225></c225></cr></c2213-c225></c225></cr></c2212<c221></c221></c2212-c2212<<<rd></c2211></pre> | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL CYL | $ \left(\begin{array}{c} 2014 < 9, 0^{0\text{PEPP}} < 3, 0^{0\text{PEPP}} < C2211 > C2212 - C2211 > CC21 > CR >) /* ty \\ 2015 < 9, 0^{0\text{PEPP}} < 3, 0^{0\text{PEPP}} < C225 > C2213 - C225 > CR >) /* tlad \\ 10\text{trol rod 3} \\ (3001 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C225 > C2213 - C225 > CR >) /* t ar \\ 3002 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C225 > C2213 - C225 > CR >) /* tuz \\ 3004 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C225 > C2213 - C225 > CR >) /* tuz \\ 3004 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C221 > C222 - C221 > CR >) /* tuz \\ 3005 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C221 > C222 - C221 > CR >) /* tuz \\ 3006 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C222 > C232 - C321 > CR >) /* tuz \\ 3006 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C222 > C232 - C321 > CR >) /* tuz \\ 3007 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C222 > C321 - C323 > CR >) /* tu \\ 3008 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C222 > C324 - C323 > CR >) /* tu \\ 3010 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C222 > C324 - C325 > CR >) /* tu \\ 3011 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C222 > C321 - C223 > CR >) /* tu \\ 3011 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C222 > C321 - C223 > CR >) /* tu \\ 3011 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C222 > C321 - C223 > CR >) /* tu \\ 3011 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C221 > C221 > C221 > CR >) /* tu \\ 3011 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C212 > C321 - C321 > CR >) /* tu \\ 3011 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C212 > CC22 - C421 > CR >) /* tu \\ 4000 0, 0 < < 6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR >) /* tu \\ 4000 0, 0 < < 6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR >) /* tu \\ 4000 0, 0 < < 6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR >) /* tu \\ \\ 4000 0, 0 < < 6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR >) /* tu \\ \\ 4000 0, 0 < < 6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR >) /* tu \\ \\ \\ \\ 4000 0, 0 < < 6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR >) /* tu \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $ | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL CYL | $ \left(\begin{array}{c} 2014 < 9, 0^{0\text{PEPP} < 3, 0^{0\text{PEPP} < C2211 > C2212 - C2211 > CC21 > CR4 >) /* v \\ (2015 < 9, 0^{0\text{PEPP} < 3, 0^{0\text{PEPP} < C225 > C2213 - C225 > CR5 >) /* clad \\ \text{Introl rod 3} \\ (3001 < 9, 0^{0\text{PEPP} < 3, 0^{0\text{PEPP} < C225 > C2213 - C225 > CR5 >) /* v \\ (3002 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C322 - C321 > CR2 >) /* v \\ (3003 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C322 - C321 > CR3 >) /* v \\ (3004 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C322 - C321 > CR3 >) /* v \\ (3005 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C322 - C321 > CR3 >) /* v \\ (3006 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C322 - C321 > CR4 >) /* v \\ (3006 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C322 > C321 - C323 > CR4 >) /* v \\ (3006 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C322 > C321 - C323 > CR4 >) /* v \\ (3006 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C324 > C323 - C324 > CR3 >) /* v \\ (3006 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C322 > C321 - C323 > CR4 >) /* v \\ (3010 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C322 > C324 - C335 > CR4 >) /* v \\ (3011 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C322 > C321 - C323 > CR4 >) /* v \\ (3011 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C322 > C321 - C323 > CR4 >) /* v \\ (3011 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C322 > C321 - C323 > CR4 >) /* v \\ (3011 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C322 > C321 - C323 > CR4 >) /* v \\ (3011 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C321 > CR4 >) /* v \\ (3011 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C321 > CR4 >) /* v \\ (3011 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C321 > CR4 >) /* v \\ (3011 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C321 > CR4 >) /* v \\ (3011 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C422 - C421 > CR5 >) /* v \\ (4000 0, 0 < < 6, 0^{0\text{PEPP} < C421 > C422 - C421 > CR5 >) /* v \\ (4000 0, 0 < < 6, 0^{0\text{PEPP} < C421 > C422 - C421 > CR5 >) /* v \\ (4000 0, 0 < < 6, 0^{0\text{PEPP} < C421 > C422 - C421 > CR5 >) /* v \\$ | |
| CYL CYL | $ \left(\begin{array}{c} 2014 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{FEPP} < C2211 > C2212 - C2211 > CR4>) /* ty \\ (2015 < 9.0^{0} \text{FEPP} < 3.0^{0} \text{FEPP} < C222 > C2213 - C223 < CR5>) /* clad \\ \text{itrol rod 3} \\ (3001 < 9.0^{0} \text{FEPP} < 3.0^{0} \text{FEPP} < C222 > C2213 - C223 > CR5>) /* clad \\ \text{itrol rod 3} \\ (3001 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C221 > C322 - C321 > CR5>) /* tr \\ (3002 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C321 > C322 - C321 > CR5>) /* tr \\ (3004 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C321 > C322 - C321 > CR5>) /* tr \\ (3005 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C321 > C322 - C321 > CR5>) /* tr \\ (3006 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C322 > C321 - C323 > CR5>) /* tr \\ (3006 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C322 > C321 - C323 > CR5>) /* tr \\ (3006 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C322 > C332 - C324 > CR5>) /* tr \\ (3007 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C324 > C332 - C324 > CR5>) /* tr \\ (3010 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C324 > C332 - C324 > CR5>) /* tr \\ (3010 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C324 > C332 - C324 > CR5>) /* tr \\ (3011 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C322 > C332 - C324 > CR5>) /* tr \\ (3012 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C322 > C323 - C324 > CR5>) /* tr \\ (3013 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C322 > C323 - C324 > CR5>) /* tr \\ (3014 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C321 > C321 - C321 > CR5>) /* tr \\ (3015 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C321 > C321 - C321 > CR5>) /* tr \\ (3015 < 9.0^{0} \text{FEPP} < -3.0^{0} \text{FEPP} < C321 > C321 - C321 > CR5>) /* tr \\ (4001 0.0 < -6.0^{0} \text{FEPP} < C421 > C422 - C421 < CR5>) /* tr \\ (4002 0.0 < -6.0^{0} \text{FEPP} < C421 > C422 - C421 < CR5>) /* tr \\ (4000 0.0 < -6.0^{0} \text{FEPP} < C421 > C422 - C421 < CR5>) /* tr \\ (4000 0.0 < -6.0^{0} \text{FEPP} < C421 > C422 - C421 < CR5>) /* tr \\ (4000 0.0 < -6.0^{0} \text{FEPP} < C421 > C422 - C421 < CR5>) /* tr \\ (4000 0.0 < -6.0^{0} \text{FEPP} < C421 > C422 - C421 < CR5>) /* tr \\ (4000 0.0 < -6.0^{0} \text{FEPP} < C421 > C422 - C421 < CR5>$ | |
| CYL | $ \left(\begin{array}{c} 2014 < 9, 0^{0\text{PEPP}} < 3, 0^{0\text{PEPP}} < C2211 > C2212 - C2211 > CC21 > CR >) /* tp \\ 2015 < 9, 0^{0\text{PEPP}} < 3, 0^{0\text{PEPP}} < C225 > C2213 - C225 > CR >) /* clad \\ \text{Introl rod 3} \\ (3001 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C225 > C2213 - C225 > CR >) /* tr \\ 3002 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C225 > C2213 - C225 > (CR >) /* tr \\ (3004 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C225 > C2213 - C225 > (CR >) /* tr \\ (3004 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C225 > C2213 - C225 > (CR >) /* tr \\ (3004 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C221 > C327 - C321 > CR >) /* tr \\ (3005 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C222 > C321 - C323 > CR >) /* tr \\ (3006 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C222 > C321 - C323 > CR >) /* tr \\ (3006 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C224 > C322 - C321 > CR >) /* tr \\ (3006 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C224 > C322 - C324 > CR >) /* tr \\ (3006 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C224 > C322 - C321 > CR >) /* tr \\ (3010 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C224 > C322 - C321 > CR >) /* tr \\ (3010 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C322 > C324 - C325 > CR >) /* tr \\ (3012 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C322 > C324 - C325 > CR >) /* tr \\ (3014 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C321 > C321 - C321 > CR >) /* tr \\ (3014 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C321 > C321 - C321 > CR >) /* tr \\ (3015 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C321 > C321 - C321 > CR >) /* tr \\ (4001 0, 0 < < -6, 0^{0\text{PEPP}} < C321 < C422 - C421 > CR >) /* tr \\ (4002 0, 0 < < -6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR >) /* tr \\ (4000 0, 0 < < -6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR >) /* tr \\ (4000 0, 0 < < -6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR >) /* tr \\ (4000 0, 0 < < -6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR >) /* tr \\ (4000 0, 0 < < -6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR >) /* tr \\ (4000 0, 0 < < -6, 0^{0\text{PEPP}} < C421 $ | |
| CYL | $ \left(\begin{array}{c} 2014 < 9, 0^{0\text{PEPP} < 3, 0^{0\text{PEPP} < C2211 > C2212 - C2211 > CC21 > CR4 >) /* tp} \\ (2015 < 9, 0^{0\text{PEPP} < 3, 0^{0\text{PEPP} < C225 > C2213 - C225 > CR5 >) /* clad \\ \text{itrol rod 3} \\ (3001 < 9, 0^{0\text{PEPP} < 3, 0^{0\text{PEPP} < C225 > C2213 - C225 > CR5 >) /* tr \\ (3002 < 9, 0^{0\text{PEPP} < 3, 0^{0\text{PEPP} < C225 > C2213 - C225 > CR5 >) /* tr \\ (3004 < 9, 0^{0\text{PEPP} < -3, 0^{0\text{PEPP} < C221 > C221 > C221 > CR3 >) /* tr \\ (3004 < 9, 0^{0\text{PEPP} < -3, 0^{0\text{PEPP} < C221 > C322 - C321 > CR3 >) /* tr \\ (3004 < 9, 0^{0\text{PEPP} < -3, 0^{0\text{PEPP} < C221 > C327 - C321 > CR3 >) /* tr \\ (3005 < 9, 0^{0\text{PEPP} < -3, 0^{0\text{PEPP} < C221 > C327 - C321 > CR4 >) /* sp \\ (3006 < 9, 0^{0\text{PEPP} < -3, 0^{0\text{PEPP} < C222 > C321 - C323 > CR4 >) /* sp \\ (3006 < 9, 0^{0\text{PEPP} < -3, 0^{0\text{PEPP} < C324 > C323 - C344 > CR8 >) /* st \\ (3006 < 9, 0^{0\text{PEPP} < -3, 0^{0\text{PEPP} < C324 > C323 - C344 > CR8 >) /* st \\ (3011 < 9, 0^{0\text{PEPP} < -3, 0^{0\text{PEPP} < C324 > C323 - C324 > CR4 >) /* sp \\ (3011 < 9, 0^{0\text{PEPP} < -3, 0^{0\text{PEPP} < C3228 > C328 - C325 > CCR4 >) /* sp \\ (3011 < 9, 0^{0\text{PEPP} < -3, 0^{0\text{PEPP} < C321 > C324 - C325 > CCR4 >) /* sp \\ (3011 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C3210 - C213 > CR4 >) /* sp \\ (3011 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C3210 - C213 > CR4 >) /* sp \\ (3011 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C3210 - C321 > CR4 >) /* sp \\ (3015 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C3210 - C321 > CR4 >) /* sp \\ (3015 < 9, 0^{0\text{PEPP} < C3, 0^{0\text{PEPP} < C321 > C422 - C421 > CR1 >) /* sr \\ (4000 1, 0, (< 6, 0^{0\text{PEPP} < C422 > C422 - C421 > CR2 >) /* tr \\ (4000 1, 0, (< 6, 0^{0\text{PEPP} < C422 > C422 - C421 > CR2 >) /* tr \\ (4000 1, 0, (< 6, 0^{0\text{PEPP} < C422 > C422 - C421 > CR3 >) /* sp \\ (4000 1, 0, (< 6, 0^{0\text{PEPP} < C422 > C422 - C421 > CR3 >) /* sp \\ (4000 1, 0, (< 6, 0^{0\text{PEPP} < C424 > C422 - C421 > CR4 >) /* sp \\ (4000 1, 0, (< 6, 0^{0\text{PEPP} < C424 > C422 - C4$ | |
| CYL CYL CYL CYL CYL CYL CYL CYL CYL CYL | $ \left(\begin{array}{c} 2014 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{PEPP} < (2211 > C2212 - C2211 > CR4)) /* tp \\ (2015 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{PEPP} < (2225 > C2213 - C225 > CR5)) /* clad \\ \text{itrol rod 3} \\ (3001 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{PEPP} < C225 > C322 - C321 > CR5)) /* tr \\ (3002 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C225 > C322 - C321 > CR2)) /* v \\ (3003 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C322 - C321 > CR2)) /* v \\ (3004 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C322 - C321 > CR2)) /* v \\ (3005 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C322 - C321 > CR3)) /* v \\ (3006 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C321 - C323 > CR4)) /* v \\ (3006 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C321 - C323 > CR4)) /* v \\ (3006 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C332 - C324 > CR8)) /* v \\ (3007 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C324 > C332 - C324 > CR8)) /* v \\ (3001 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C324 > C332 - C324 > CR8)) /* v \\ (3010 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C332 - C324 > CR8)) /* v \\ (3010 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C332 - C324 > CR8)) /* v \\ (3011 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C332 - C324 > CR8)) /* v \\ (3012 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C321 - C321 > CR4)) /* v \\ (3013 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C321 < C321 > CR4)) /* v \\ (3016 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C422 - C421 > CR4)) /* v \\ (4001 0.0 < -6.0^{0} \text{PEPP} < C421 > C422 - C421 > CR2)) /* v \\ (4000 0.0 < -6.0^{0} \text{PEPP} < C421 > C422 - C421 < CR2)) /* v \\ (4000 0.0 < -6.0^{0} \text{PEPP} < C421 > C422 - C421 < CR2)) /* v \\ (4000 0.0 < -6.0^{0} \text{PEPP} < C422 < C422 - C421 < CR2)) /* v \\ (4000 0.0 < -6.0^{0} \text{PEP} < C422 < C422 - C421 < CR2)) /* v \\ (4000 0.0 < -6.0^{0} \text{PEPP} < C424 > C422 - C424 < CR2)) /* v \\ (4000 0.0 < -6.0^{0} \text{PEPP} < C424 > C422 - C424 < CR4)) /* v \\ (4000 0.0 < -6.0^{0} \text{PEPP} < C424 > C422 - C424 < CR4)) /* v \\ (4000 0.0 < -6.0^{0} \text{PEP} < C424 >$ | |
| CYL CYL CYL | $ \left(\begin{array}{c} 2014 < 9, 0^{0\text{PEPP} < 3, 0^{0\text{PEPP} < C2211 > C2212 - C2211 > CC21 < CR4 >) /* tp} \\ (2015 < 9, 0^{0\text{PEPP} < 3, 0^{0\text{PEPP} < C225 > C2213 - C225 > CR5 >) /* clad \\ \text{ntrol rod 3} \\ (3001 < 9, 0^{0\text{PEPP} < 3, 0^{0\text{PEPP} < C225 > C2213 - C225 > CR5 >) /* tr \\ (3002 < 9, 0^{0\text{PEPP} < 3, 0^{0\text{PEPP} < C225 > C2213 - C225 > C221 > C225 > C222 > C22 > $ | |
| CYL | $ \left(\begin{array}{c} 2014 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C2211 > C2212 - C2211 > CR4>) /* ty \\ (2015 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C222 > C2213 - C223 < CR5>) /* clad \\ \text{itrol rod 3} \\ (3001 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C225 > C2213 - C225 < CR5>) /* clad \\ \text{itrol rod 3} \\ (3001 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C225 > C2213 - C225 > CR5>) /* tr \\ (3002 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C225 > C222 - C221 > CR5>) /* tr \\ (3003 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C225 > C222 - C221 > CR5>) /* tr \\ (3004 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C222 > C322 - C321 > CR5>) /* tr \\ (3004 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C222 > C322 - C321 > CR5>) /* tr \\ (3005 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C222 > C322 - C321 > CR5>) /* ty \\ (3005 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C322 > C321 - C323 > CR4>) /* tr \\ (3005 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C322 > C321 - C323 > CR4>) /* tr \\ (3007 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C322 > C332 - C324 > CR5>) /* tr \\ (3007 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C322 > C332 - C324 > CR5>) /* tr \\ (3010 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C322 > C332 - C324 > CR5>) /* tr \\ (3011 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C322 > C323 - C324 > CR5>) /* tr \\ (3011 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C322 > C323 - C324 > CR5>) /* tr \\ (3011 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C321 > C2321 > C321 > C232 > C234 > CR5>) /* tr \\ (3011 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C321 > C422 > C321 - C322 > CR4>) /* tr \\ (3011 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < C321 > C422 > C321 > C321 > CR4>) /* tr \\ (3011 < 9.0^{\text{OPEPP} < C3.0^{\text{OPEPP} < C321 > C422 < C421 > C123 > (CR4)) /* tr \\ (4001 0.0 < -6.0^{\text{OPEPP} < C421 > C422 - C421 > CR5>) /* cr4 \\ (4001 0.0 < -6.0^{\text{OPEPP} < C421 < C422 - C421 > CR3 >) /* clad \\ tr \\ (4000 0.0 < -6.0^{\text{OPEPP} < C424 < C423 - C424 > CR4 >) /* tr \\ (4000 0.0 < -6.0^{\text{OPEPP} < C424 < C423 - C424 > CR4 >) /* tr \\ (4000 0.0 < -6.0^{\text{OPEPP} < C424 < C423 - C424 > CR4 >) /* tr \\ (4000 0.0 < -6.0^{\text{OPEPP} < C424 > C423 - C424 > CR4 >) /* tr \\ (4000 0.0 < -6.0^{\text{OPEPP} < C42$ | |
| CAT CAT CAT | $ \left(\begin{array}{c} 2014 < 9, 0^{0\text{PEPP}} < 3, 0^{0\text{PEPP}} < C2211 > C2212 - C2211 > CC213 > CR4 >) /* tp \\ 2015 < 9, 0^{0\text{PEPP}} < 3, 0^{0\text{PEPP}} < C225 > C2213 - C225 > CR5 >) /* clad \\ \text{Introl rod 3} \\ (3001 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C225 > C2213 - C225 > CR5 >) /* tr \\ 3002 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C225 > C2213 - C225 > CR5 >) /* tr \\ (3004 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C225 > C2213 - C225 > CR5 >) /* tr \\ (3004 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C221 > C322 - C321 > CR3 >) /* tr \\ (3004 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C221 > C322 - C321 > CR3 >) /* tr \\ (3005 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C222 > C321 - C323 > CR4 >) /* tr \\ (3006 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C322 > C321 - C323 > CR4 >) /* tr \\ (3006 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C322 > C321 - C323 > CR4 >) /* tr \\ (3006 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C322 > C324 - C325 > CR4 >) /* tr \\ (3006 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C322 > C324 - C325 > CR4 >) /* tr \\ (3010 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C322 > C321 - C323 > CR4 >) /* tr \\ (3011 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C322 > C321 - C323 > CR4 >) /* tr \\ (3012 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C321 > C322 - C321 > CR4 >) /* tr \\ (3013 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C321 > C321 - C321 > CR4 >) /* tr \\ (3014 < 9, 0^{0\text{PEPP}} < -3, 0^{0\text{PEPP}} < C321 > C321 - C321 > CR4 >) /* tr \\ (4001 0, 0 < < 6, 0^{0\text{PEPP} < C421 > C422 - C421 > CR2 >) /* tr \\ (4002 0, 0 < < 6, 0^{0\text{PEPP}} < C321 < C421 > C422 - C421 > CR4 >) /* tr \\ (4000 0, 0 < < 6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR4 >) /* tr \\ (4000 0, 0 < < 6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR4 >) /* tr \\ (4000 0, 0 < < 6, 0^{0\text{PEPP}} < C421 > C422 - C421 > CR4 >) /* tr \\ (4000 0, 0 < < 6, 0^{0\text{PEPP}} < C424 > C422 - C424 > CR4 >) /* tr \\ (4000 0, 0 < < 6, 0^{0\text{PEPP}} < C424 > C422 - C424 > CR4 >) /* tr \\ (4000 0, 0 < < 6, 0^{0\text{PEPP}} <$ | |
| CXT CXT CYT CXT CYT CXT CYT CYT CYT CYT CYT CYT CYT CYT CYT CYT CYT | $ \left(\begin{array}{c} 2014 < 9, 0^{+}\text{PFP} < 3, 0^{+}\text{FFP} < C2211 > C2212 - C2211 > CC212 > CR4 >) /* tp \\ (2015 < 9, 0^{+}\text{FFP} < 3, 0^{+}\text{FFP} < C222 > C2213 - C225 > CR5 >) /* clad \\ \text{trcl} rod 3 \\ (3001 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C221 > C322 - C321 > CR5 >) /* tr \\ (3002 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5 >) /* tr \\ (3003 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5 >) /* tr \\ (3004 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5 >) /* tr \\ (3004 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5 >) /* tr \\ (3005 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5 >) /* tr \\ (3006 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C321 - C323 > CR4 >) /* tr \\ (3006 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C322 - C321 > CR5 >) /* tr \\ (3006 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C322 - C323 > CR4 >) /* tr \\ (3006 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C322 - C323 > CR4 >) /* tr \\ (3010 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C322 - C323 > CR4 >) /* tr \\ (3010 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C323 - C323 > CR4 >) /* tr \\ (3011 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C323 > C321 - C323 > CR4 >) /* tr \\ (3011 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C323 > C321 - C321 > CR4 >) /* tr \\ (3013 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C323 > C321 - C321 > CR4 >) /* tr \\ (3014 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C323 > C321 - C321 > CR4 >) /* tr \\ (3015 < 9, 0^{+}\text{FFP} < C321 > C422 - C421 > CR4 >) /* tr \\ (4001 0, 0 < (-6, 0^{+}\text{FFP} < C421 > C422 - C421 < CR5 >) /* tr \\ (4000 1, 0 < (-6, 0^{+}\text{FFP} < C422 > C422 - C421 < CR5 >) /* tr \\ (4000 1, 0 < (-6, 0^{+}\text{FFP} < C422 > C422 - C421 < CR5 >) /* tr \\ (4000 1, 0 < (-6, 0^{+}\text{FFP} < C422 > C422 - C421 < CR5 >) /* tr \\ (4000 1, 0 < (-6, 0^{+}\text{FFP} < C422 < C421 < C423 < CR4 >) /* tr \\ (4000 1, 0 < (-6, 0^{+}\text{FFP} < C422 < C422 - C421 < CR5 >) /* tr \\ (4000 1, 0 < (-6, 0^{+}\text{FFP} < C422 < C422 - C421 < CR5 >) /* tr \\ (4000 0, 0 < (-6, 0^{+}\text$ | |
| CAT CAT CAT CAT CAT CAT CAT CAT CAT CAT | $ \left(\begin{array}{c} 2014 < 9.0^{0} \mbox{FPP} < 3.0^{0} \mbox{FPP} < C2211 > C2212-C2211 > CCR4 >) /* ty \\ (2015 < 9.0^{0} \mbox{FPP} < 3.0^{0} \mbox{FPP} < C222 > CC213-C223 > CCR5)) /* clad \\ \mbox{trol rod 3} \\ (3001 < 9.0^{0} \mbox{FPP} < 3.0^{0} \mbox{FPP} < C223 > CC2213-C225 > (CR5)) /* tr \\ (3002 < 9.0^{0} \mbox{FPP} < C30^{0} \mbox{FPP} < C223 > CC2213-C225 > (CR5)) /* tr \\ (3003 < 9.0^{0} \mbox{FPP} < C30^{0} \mbox{FPP} < C223 > CC2213-C225 > (CR5)) /* tr \\ (3004 < 9.0^{0} \mbox{FPP} < C30^{0} \mbox{FPP} < C223 > CC221 > CC232 - CC231 > CR3) /* tr \\ (3004 < 9.0^{0} \mbox{FPP} < C30^{0} \mbox{FPP} < C223 > CC221 > CC221 > CC23 > (CR5)) /* tr \\ (3005 < 9.0^{0} \mbox{FPP} < C30^{0} \mbox{FPP} < C223 > CC232 - CC231 > CR4) /* tr \\ (3005 < 9.0^{0} \mbox{FPP} < C30^{0} \mbox{FPP} < C223 > CC232 - CC234 > CCR5) /* tr \\ (3006 < 9.0^{0} \mbox{FPP} < C30^{0} \mbox{FPP} < C224 > CC232 - CC234 > CCR5) /* tr \\ (3007 < 9.0^{0} \mbox{FPP} < C30^{0} \mbox{FPP} < C224 > CC232 - CC232 > CR8) /* tr \\ (3001 < 9.0^{0} \mbox{FPP} < C30^{0} \mbox{FPP} < C222 > CC232 - CC234 > CR8) /* tr \\ (3010 < 9.0^{0} \mbox{FPP} < C30^{0} \mbox{FPP} < C222 > CC232 - CC234 > CR8) /* tr \\ (3011 < 9.0^{0} \mbox{FPP} < C30^{0} \mbox{FPP} < C222 > CC232 - CC234 > CR4) /* tr \\ (3013 < 9.0^{0} \mbox{FPP} < C30^{0} \mbox{FPP} < C221 > CC221 > CC221 > CCR4) /* tr \\ (3015 < 9.0^{0} \mbox{FPP} < C30^{0} \mbox{FPP} < C221 > CC22 - C421 > CR4) /* tr \\ (4001 0.0 < < 6.0^{0} \mbox{FPP} < C242 > CC422 - C421 < CR2) /* tr \\ (4000 0.0 < < 6.0^{0} \mbox{FPP} < C242 > CC422 - C421 < CR2) /* tr \\ (4000 0.0 < < 6.0^{0} \mbox{FPP} < C242 > CC422 - C421 < CR2) /* tr \\ (4000 0.0 < < 6.0^{0} \mbox{FPP} < C242 < CC422 - C421 < CR2) /* tr \\ (4000 0.0 < < 6.0^{0} \mbox{FPP} < C242 < CC42 - C421 < CR3) /* tr \\ (4000 0.0 < < 6.0^{0} \mbox{FPP} < C242 < CC42 - C421 < CR3) /* tr \\ (4000 0.0 < < 6.0^{0} \mbox{FPP} < C242 < CC42 - C421 < CR3) /* tr \\ (4000 0.0 < < 6.0^{0} \mbox{FPP} < C242 < CC42 - C421 < CR4) /* tr \\ (4000 0.0 < < 6.0^{0} \mbox{FPP} < $ | |
| CAT CAT CAT | $ \left(\begin{array}{c} 2014 < 9, 0^{ 0 PEPP < 3}, 0^{ PEPP < C2211 > C2212 - C2211 > CC212 > CR4>) /* ty \\ (2015 < 9, 0^{ PEPP < 3}, 0^{ PEPP < C225 > C2213 - C225 > CR5>) /* clad \\ ntrol rod 3 \\ (3001 < 9, 0^{ PEPP < 3}, 0^{ PEPP < C225 > C2213 - C225 > CR5>) /* tr \\ (3002 < 9, 0^{ PEPP < 3}, 0^{ PEPP < C225 > C2213 - C225 > CR5>) /* tr \\ (3002 < 9, 0^{ PEPP < 3}, 0^{ PEPP < C225 > C2221 > C222 - C221 > CR5>) /* tr \\ (3003 < 9, 0^{ PEPP < 3}, 0^{ PEPP < C225 > C2221 > C222 - C221 > CR5>) /* tr \\ (3004 < 9, 0^{ PEPP < 3}, 0^{ PEPP < C222 > C222 - C221 > CR5>) /* tr \\ (3004 < 9, 0^{ PEPP < 3}, 0^{ PEPP < C222 > C222 - C221 > CR5>) /* tr \\ (3005 < 9, 0^{ PEPP < 3}, 0^{ PEPP < C222 > C222 - C221 > CR5>) /* tr \\ (3006 < 9, 0^{ PEPP < 3}, 0^{ PEPP < C222 > C222 - C221 > CR5>) /* tr \\ (3006 < 9, 0^{ PEPP < 3}, 0^{ PEPP < C222 > C222 - C224 > CR5>) /* tr \\ (3006 < 9, 0^{ PEPP < 3}, 0^{ PEPP < C222 > C222 - C224 > CR5>) /* tr \\ (3006 < 9, 0^{ PEPP < 3}, 0^{ PEPP < C222 > C222 - C224 > CR5>) /* tr \\ (3010 < 9, 0^{ PEPP < 3}, 0^{ PEPP < C222 > C222 - C223 > CR6>) /* tr \\ (3010 < 9, 0^{ PEPP < C3, 0^{ PEPP < C222 > C222 - C223 > CR6>) /* tr \\ (3011 < 9, 0^{ PEPP < C3, 0^{ PEPP < C222 > C222 - C223 > CR6>) /* tr \\ (3011 < 9, 0^{ PEPP < C3, 0^{ PEPP < C321 > C232 > C232 > CR6>) /* tr \\ (3011 < 9, 0^{ PEPP < C3, 0^{ PEPP < C321 > C232 > C232 > CR6>) /* tr \\ (3011 < 9, 0^{ PEPP < C3, 0^{ PEPP < C321 > C232 > C232 > CR6>) /* tr \\ (3011 < 9, 0^{ PEPP < C3, 0^{ PEPP < C321 > C232 > C232 > CR6>) /* tr \\ (4001 0, 0 < < 6, 0^{ PEPP < C321 > C232 > C232 > CR6>) /* tr \\ (4000 0, 0 < < 6, 0^{ PEPP < C321 > C232 > C232 < CR6>) /* tr \\ (4000 0, 0 < < 6, 0^{ PEPP < C321 > C232 > C242 < CR1 >) /* tr \\ (4000 0, 0 < < 6, 0^{ PEP < C421 > C422 - C421 > CR2 >) /* tr \\ (4000 0, 0 < < 6, 0^{ PEPP < C421 > C242 - C421 > CR6 >) /* tr \\ (4000 0, 0 < < 6, 0^{ PEPP < C421 > C242 - C421 > CR6 >) /* tr \\ (4000 0, 0 < < 6, 0^{ PEPP < C421 > C242 - C421 > CR6 >) /* tr \\ (4000 0, 0 < < 6, 0^{$ | |
| CAT | $ \left(\begin{array}{c} 2014 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ211 > CC2212 - CZ211 < CR4>) /* v \\ (2015 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ25 > CZ213 - CZ25 < CR5>) /* clad \\ \text{trol rod 3} \\ (3001 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ25 > CC221 - CZ25 < CR5>) /* clad \\ (3002 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ25 > CC221 - CZ25 < CR5>) /* v \\ (3002 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ25 > CC221 - CZ25 > CC21 > CR5>) /* v \\ (3003 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ25 > CC221 > CC221 - CR5>) /* v \\ (3003 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ25 > CC221 > CC32 - CZ31 > CR5>) /* v \\ (3004 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ25 > CC221 > CC321 - CR5>) /* v \\ (3005 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ22 > CC221 - CZ23 > CC321 > CR5>) /* v \\ (3006 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ22 > CC221 - CZ23 > CR5>) /* v \\ (3006 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ22 > CC221 - CZ23 > CCR5 >) /* v \\ (3007 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ22 > CC224 > CC223 - CC224 > CR5 >) /* v \\ (3007 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ22 > CC224 > CC223 - CC224 > CR5 >) /* v \\ (3010 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ22 > CC224 - CZ23 > CCR5 >) /* b \\ (3011 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ22 > CC224 > CC224 > CR5 >) /* v \\ (3011 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ22 > CC224 > CC224 > CR6 >) /* v \\ (3013 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ22 > CC221 > CC221 > CR5 >) /* v \\ (3014 < 9.0^{\text{OPEPP} < 3.0^{\text{OPEPP} < CZ22 > CC221 > CC221 > CR5 >) /* v \\ (4000 < 0.0 < < 6.0^{\text{OPEPP} < CZ22 > CZ21 > CZ21 > CR6 >) /* v \\ (4000 < 0.0 < < 6.0^{\text{OPEPP} < CZ22 > CZ21 > CZ21 > CR6 >) /* v \\ (4000 < 0.0 < < 6.0^{\text{OPEPP} < CZ22 > CZ21 > CZ21 > CR6 >) /* v \\ (4000 < 0.0 < < 6.0^{\text{OPEPP} < CZ22 > CZ21 > CZ21 > CR6 >) /* v \\ (4000 < 0.0 < < 6.0^{\text{OPEPP} < CZ22 > CZ21 > CZ21 > CZ21 > CZ2 > V \\) /* v \\ (4000 < 0.0 < < 6.0^{\text{OPEPP} < CZ22 > CZ21 > CZ21 > CZ2 > CZ2 > V \\) /* v \\ (4000 < 0.0 < < 6.0^{\text{OPEPP} < CZ22 > CZ22 > CZ21 > CZ1 > V \\) /* v \\ (4000 < 0.0 < < 6.0^{\text{OPEPP} < CZ22 > CZ22 > CZ2 > CZ2 > CZ2 > V \\) /* v \\ (4000 < 0.$ | |
| CAT CAT CAT | $ \left(\begin{array}{c} 2014 < 9.0^{\text{o}\text{PEPP} < 3.0^{\text{e}\text{PEP}} < C2211 > C2212 - C2211 > CC212 > CR4>) /* ty \\ 2015 < 9.0^{\text{e}\text{PEPP} < 3.0^{\text{e}\text{PEP}} < C225 > C2213 - C225 > CR5>) /* clad \\ \text{introl rod 3} \\ (3001 < 9.0^{\text{e}\text{PEPP} < 3.0^{\text{e}\text{PEP}} < C225 > C322 - C321 > CCR5>) /* tr \\ 3002 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEP}} < C225 > C322 - C321 > CR2>) /* tr \\ (3004 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEP}} < C321 > C322 - C321 > CR2>) /* tr \\ (3004 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEP}} < C321 > C322 - C321 > CR3>) /* tr \\ (3004 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEP}} < C321 > C322 - C321 > CR3>) /* tr \\ (3005 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEPP}} < C322 > C321 - C323 > CR4>) /* tr \\ (3005 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEPP}} < C322 > C332 - C324 > CR3>) /* tr \\ (3006 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEPP}} < C322 > C332 - C324 > CR3>) /* tr \\ (3006 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEPP}} < C324 > C333 - C324 > CR8>) /* tr \\ (3006 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEPP}} < C324 > C333 - C324 > CR8>) /* tr \\ (3006 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEPP}} < C322 > C332 - C324 > CR8>) /* tr \\ (3010 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEPP}} < C322 > C332 - C328 > CR8>) /* tr \\ (3011 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEPP}} < C322 > C332 - C328 > CR8>) /* tr \\ (3011 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEPP}} < C322 > C332 - C328 > CR8>) /* tr \\ (3011 < 9.0^{\text{e}\text{PEPP} < -3.0^{\text{e}\text{PEPP}} < C321 > $ | |
| CATT CATT CATT CATT CATT CATT CATT CATT | $ \left(\begin{array}{c} 2014 < 9, 0^{+}\text{PFP} < 3, 0^{+}\text{FFP} < C2211 > C2212 - C2211 > CR4 >) /* ty \\ (2015 < 9, 0^{+}\text{FFP} < 3, 0^{+}\text{FFP} < C222 > C2213 - C221 > CR5) /* clad \\ \text{htrol rod 3} \\ (3001 < 9, 0^{+}\text{FFP} < 3, 0^{+}\text{FFP} < C221 > C322 - C321 > CR5) /* tr \\ (3002 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5) /* tr \\ (3003 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5) /* tr \\ (3004 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5) /* tr \\ (3004 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5) /* tr \\ (3005 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5) /* tr \\ (3005 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C321 - C323 > CR4) /* y \\ (3005 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C324 > C322 - C321 > CR5) /* tr \\ (3006 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C324 > C322 - C321 > CR5) /* tr \\ (3006 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C324 > C322 - C321 > CR5) /* tr \\ (3006 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C324 > C322 - C321 > CR5) /* tr \\ (3006 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C324 - C325 > CR6) /* tr \\ (3010 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C324 - C325 > CR6) /* tr \\ (3011 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C324 - C325 > CR6) /* tr \\ (3011 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C321 - C321 > CR6) /* tr \\ (3011 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C321 - C321 > CR6) /* tr \\ (3011 < 9, 0^{+}\text{FFP} < C321 > C321 > C321 - C321 > CR6) /* tr \\ (3011 < 9, 0^{+}\text{FFP} < C421 > C422 - C421 > CR6) /* tr \\ (4001 0, 0 < < 6, 0^{+}\text{FFP} < C421 > C422 - C421 > CR6) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text{FFP} < C421 > C422 - C421 > CR6) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text{FFP} < C421 > C422 - C421 > CR6) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text{FFP} < C421 > C422 - C421 > CR6) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text{FFP} < C421 < C422 - C421 > CR6) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text{FFP} < C421 < C421 - C421 > CR6) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text{FFP} < C421 < C421 - C421 < CR6) /* tr \\ (4010 0, 0 < < $ | |
| CAT CAT CAT | $ \left(\begin{array}{c} 2014 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C2211 > C2212 - C2211 > CR4>) /* ty \\ (2015 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C2213 - C225 > CR5>) /* clad \\ \text{itrol rod 3} \\ (3001 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C322 - C321 > CR5>) /* tr \\ (3002 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C322 - C321 > CR5>) /* tr \\ (3002 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322 - C321 > CR5>) /* tr \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322 - C321 > CR5>) /* tr \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322 - C321 > CR5>) /* tr \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C322 - C321 > CR5>) /* tr \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C321 - C323 > CR5>) /* tr \\ (3006 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C321 - C323 > CR5>) /* tr \\ (3006 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332 - C324 > CR5>) /* tr \\ (3007 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C324 > C332 - C324 > CR5>) /* tr \\ (3007 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332 - C324 > CR5>) /* tr \\ (3010 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332 - C324 > CR5>) /* tr \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332 - C324 > CR5>) /* tr \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C323 - C324 > CR5>) /* tr \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C321 > C2321 > CR5>) /* tr \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C321 < C321 > C232 > CR5>) /* tr \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C321 > C321 > C231 > CR5>) /* tr \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C321 > C232 > C323 > CR5>) /* tr \\ (3011 < 9.0^{\text{PEPP} < C30 + C421 > C422 - C421 > CR5>) /* tr \\ (4001 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP}} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 >$ | |
| CATT GAT CAT CAT CAT CAT CAT CAT CAT CAT CAT C | $ \left(\begin{array}{c} 2014 < 9, 0^{ 0 \text{PEPP} < 3, 0^{ \text{PEPP}} < C2211 > C2212 - C2211 > CR4>) /* ty \\ (2015 < 9, 0^{ 0\text{PEPP} < 3, 0^{ \text{PEPP}} < C225 > C2213 - C225 > CR5>) /* clad \\ \text{itrol rod 3} \\ (3001 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C225 > C322 - C321 > CR5>) /* tr \\ (3002 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C225 > C322 - C321 > CR5>) /* tr \\ (3003 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C225 > C322 - C321 > CR5>) /* tr \\ (3004 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C321 > C322 - C321 > CR5>) /* tr \\ (3004 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C321 > C322 - C321 > CR5>) /* tr \\ (3004 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C321 > C322 - C321 > CR5>) /* tr \\ (3005 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C322 > C321 - C323 > CR4>) /* tr \\ (3006 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C322 > C321 - C323 > CR4>) /* tr \\ (3006 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C322 > C321 - C323 > CR4>) /* tr \\ (3006 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C324 > C332 - C324 > CR5>) /* tr \\ (3006 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C322 > C324 - C325 > CR4>) /* tr \\ (3006 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C322 > C324 - C325 > CR4>) /* tr \\ (3010 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C322 > C321 - C323 > CR4>) /* tr \\ (3011 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C322 > C321 - C323 > CR4>) /* tr \\ (3011 < 9, 0^{ \text{PEPP} < 3, 0^{ \text{PEPP}} < C321 > C321 > C321 > C321 > C321 > CR4>) /* tr \\ (3011 < 9, 0^{ \text{PEPP} < C3, 0^{ \text{PEPP}} < C321 > C321 > C321 > C321 > CR4>) /* tr \\ (3011 < 9, 0^{ \text{PEPP} < C3, 0^{ \text{PEPP}} < C321 > C422 - C421 > CR4>) /* tr \\ (4001 0, 0 < < 6, 0^{ \text{PEPP}} < C321 > C422 - C421 > CR4>) /* tr \\ (4001 0, 0 < < 6, 0^{ \text{PEPP}} < C421 > C422 - C421 > CR4>) /* tr \\ (4000 0, 0 < < 6, 0^{ \text{PEPP}} < C421 > C422 - C421 > CR4>) /* tr \\ (4000 0, 0 < < 6, 0^{ \text{PEPP}} < C421 > C422 - C421 > CR4>) /* tr \\ (4000 0, 0 < < 6, 0^{ \text{PEPP}} < C421 > C422 - C421 > CR4>) /* tr \\ (4000 0, 0 < < 6, 0^{ \text{PEPP}} < C421 > C422 - C421 > CR4>) /* tr \\ (4000 0, 0 < < 6, 0^{ P$ | |
| CATF CAT CAT CAT CAT CAT CAT CAT CAT CAT CAT | $ \left(\begin{array}{c} 2014 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{PEPP} < C2211 > C2212 - C2211 > CR4>) /* ty \\ (2015 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{PEPP} < C225 > C2213 - C225 > CR5>) /* clad \\ \text{itrol rod 3} \\ (3001 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{PEPP} < C225 > C2213 - C225 > CR5>) /* clad \\ \text{isrol rod 3} \\ (3001 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{PEPP} < C225 > C222 - C221 > CR5>) /* tr \\ (3002 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C322 - C321 > CR5>) /* tr \\ (3003 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C322 - C321 > CR5>) /* tr \\ (3004 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C322 - C321 > CR5>) /* tr \\ (3005 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C321 - C323 > CR5>) /* tr \\ (3005 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C321 - C323 > CR5>) /* tr \\ (3006 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C321 - C323 > CR5>) /* tr \\ (3006 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C324 > C332 - C324 > CR5>) /* tr \\ (3007 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C324 > C332 - C324 > CR5>) /* tr \\ (3006 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C324 > C332 - C324 > CR5>) /* tr \\ (3010 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C324 > C323 - C324 > CR5>) /* tr \\ (3011 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C328 - C325 > CR5>) /* tr \\ (3011 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C3211 > C3212 > CR4>) /* tr \\ (3011 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C3212 > C3213 - C321 > (CR5)) /* tr \\ (3011 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C3212 > C3213 - C321 > (CR5)) /* tr \\ (4003 0.0 < -6.0^{0} \text{PEPP} < C421 > C422 - C421 > CR4>) /* tr \\ (4003 0.0 < -6.0^{0} \text{PEPP} < C421 > C422 - C421 > CR4>) /* tr \\ (4003 0.0 < -6.0^{0} \text{PEPP} < C422 > C424 > CR5) / * tr \\ (4003 0.0 < -6.0^{0} \text{PEPP} < C422 > C424 > CR5) / * tr \\ (4001 0.0 < -6.0^{0} \text{PEP} < C422 > C424 > CR5) / * tr \\ (4001 0.0 < -6.0^{0} \text{PEP} < C422 > C424 > CR5) / * tr \\ (4001 0.0 < -6.0^{0} \text{PEP} < C422 > C424 > CR5) / * tr \\ (4010 0.0 < -6.0^{0} \text{PEP} < C422 > C424 > C423 - C424 > CR5) / * tr \\ (4010$ | |
| CATT CATT CATT CATT CATT CATT CATT CATT | $ \left(\begin{array}{c} 2014 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{PEPP} < C2211 > C2212-C2211 > CC213 > CR4>) /* ty \\ 2016 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{PEPP} < C225 > C2213-C225 > CR5>) /* clad \\ \text{itrol rod 3} \\ (3001 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{PEPP} < C225 > C322-C321 > CR5>) /* tr \\ 3002 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C322-C321 > CR5>) /* tr \\ (3004 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C322-C321 > CR5>) /* tr \\ (3005 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C322-C321 > CR5>) /* tr \\ (3004 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C322-C321 > CR5>) /* tr \\ (3005 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C321-C323 > CR5>) /* tr \\ (3006 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C332-C324 > CR5>) /* tr \\ (3006 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C332-C324 > CR5>) /* tr \\ (3006 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C324 > C333-C324 > CR5>) /* tr \\ (3006 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C324 > C333-C324 > CR5>) /* tr \\ (3006 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C332-C324 > CR5>) /* tr \\ (3010 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C332-C324 > CR5>) /* tr \\ (3010 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C332-C323 > CR6>) /* tr \\ (3011 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C322 > C3321 - C3213 > CR6>) /* tr \\ (3014 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C3211 > C3212 > C321 > CR4>) /* tr \\ (3015 < 9.0^{0} \text{PEPP} < -3.0^{0} \text{PEPP} < C321 > C3212 > C3213 - C321 > CR4>) /* tr \\ (4001 0.0 < < 6.0^{0} \text{PEPP} < C421 > C422 - C421 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{0} \text{PEPP} < C421 > C422 - C421 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{0} \text{PEPP} < C422 > C422 - C421 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{0} \text{PEPP} < C422 > C422 - C424 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{0} \text{PEPP} < C422 > C422 - C424 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{0} \text{PEPP} < C422 > C422 - C424 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{0} \text{PEPP} < C422 > C422 - C424 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{0} \text{PEPP} < C422 > C422 - C424 > CR4>) /* tr \\ (4000 0.0 < < 6.0^$ | |
| CATT CATT CATT CATT CATT CATT CATT CATT | $ \left(\begin{array}{c} 2014 < 9, 0^{+}\text{PFP} < 3, 0^{+}\text{FFP} < C2211 > C2212 - C2211 > CR4 >) /* tp \\ (2015 < 9, 0^{+}\text{FFP} < 3, 0^{+}\text{FFP} < C225 > C2213 - C225 > CR5 >) /* clad \\ \text{itrol rod 3} \\ (3001 < 9, 0^{+}\text{FFP} < 3, 0^{+}\text{FFP} < C225 > C322 - C321 > CR5 >) /* tr \\ (3002 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5 >) /* tr \\ (3003 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5 >) /* tr \\ (3004 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5 >) /* tr \\ (3004 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5 >) /* tr \\ (3005 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C322 - C321 > CR5 >) /* tr \\ (3006 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C321 - C323 > CR4 >) /* tr \\ (3006 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C321 - C323 > CR4 >) /* tr \\ (3007 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C324 > C323 - C324 > CR5 >) /* tr \\ (3008 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C324 > C323 - C324 > CR5 >) /* tr \\ (3010 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C324 - C325 > CR4 >) /* tr \\ (3010 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C324 - C325 > CR4 >) /* tr \\ (3011 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C322 > C321 - C323 > CR4 >) /* tr \\ (3011 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C321 - C321 > CR4 >) /* tr \\ (3011 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C321 - C321 > CR4 >) /* tr \\ (3011 < 9, 0^{+}\text{FFP} < C3, 0^{+}\text{FFP} < C321 > C321 - C321 > CR4 >) /* tr \\ (4001 0, 0 < < 6, 0^{+}\text{FFP} < C421 > C422 - C421 > CR2 >) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text{FFP} < C421 > C422 - C421 > CR2 >) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text{FFP} < C421 > C422 - C421 > CR4 >) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text{FFP} < C421 > C422 - C421 > CR4 >) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text{FFP} < C421 > C422 - C421 > CR4 >) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text{FFP} < C421 > C422 - C421 > CR4 >) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text{FFP} < C421 > C422 - C421 > CR4 >) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text{FFP} < C421 > C422 - C421 > CR4 >) /* tr \\ (4000 0, 0 < < 6, 0^{+}\text$ | |
| CYLL CYLL CYLL CYLL CYLL CYLL CYLL CYLL | $ \left(\begin{array}{c} 2014 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C2211 > C2212-C2211 > CR4>) /* ty \\ (2015 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C2213-C225 > CR5>) /* clad \\ \text{Introl rod 3} \\ (3001 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C322-C321 > CR5>) /* tr \\ (3002 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C322-C321 > CR5>) /* tr \\ (3003 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* tr \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* tr \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* tr \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* tr \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C321-C323 > CR5>) /* tr \\ (3006 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C321-C323 > CR4>) /* st \\ (3006 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C324 > C332-C324 > CR5>) /* tr \\ (3007 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C324 > C332-C324 > CR5>) /* st \\ (3008 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C324 > C332-C324 > CR5>) /* st \\ (3010 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* st \\ (3010 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* br \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* br \\ (3012 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C323-C323 > CR5>) /* br \\ (3013 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C3211 > C3212 > C232 > C328 > CR5>) /* tr \\ (3014 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C3211 > C3212 > C231 > CR5>) /* tr \\ (4001 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4001 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR5>) /* tr \\ (4000 0.0 <$ | |
| CATT CATT CATT CATT CATT CATT CATT CATT | $ \left(\begin{array}{c} 2014 < 9, 0^{+} PEP < 3, 0^{+} FEP < C2211 > C2212 - C2211 > CR4 >) /* tp \\ 2016 < 9, 0^{+} PEP < 3, 0^{+} FEP < C225 > C2213 - C225 > (CR5 >) /* clad \\ ntrol rod 3 \\ (3001 < 9, 0^{+} PEP < 3, 0^{+} FFP < C225 > (C322 - C321 > CR5 >) /* tr \\ 3002 < 9, 0^{+} PEP < -3, 0^{+} FFP < C321 > (C322 - C321 > CR5 >) /* tr \\ 3003 < 9, 0^{+} PEP < -3, 0^{+} FFP < C321 > (C322 - C321 > CR5 >) /* tr \\ 3004 < 9, 0^{+} PEP < -3, 0^{+} FFP < C321 > (C322 - C321 > CR5 >) /* tr \\ 3004 < 9, 0^{+} PEP < -3, 0^{+} FFP < C321 > (C322 - C321 > CR5 >) /* tr \\ 3005 < 9, 0^{+} PEP < -3, 0^{+} FFP < C322 > (C321 - C323 > CR4 >) /* tr \\ 3005 < 9, 0^{+} PEP < -3, 0^{+} FFP < C322 > (C321 - C323 > CR4 >) /* tr \\ 3006 < 9, 0^{+} PEP < -3, 0^{+} FFP < C322 > (C323 - C324 > CR5 >) /* tr \\ 3007 < 9, 0^{+} PEP < -3, 0^{+} FFP < C322 > (C324 - C323 > CR4 >) /* tr \\ 3000 < 9, 0^{+} PEP < -3, 0^{+} FFP < C322 > (C324 - C325 > CR4 >) /* tr \\ 3010 < 9, 0^{+} PEP < -3, 0^{+} FFP < C322 > (C324 - C325 > CR4 >) /* tr \\ 3010 < 9, 0^{+} PEP < -3, 0^{+} FFP < C322 > (C321 - C321 > CR4 >) /* tr \\ 3011 < 9, 0^{+} PEP < -3, 0^{+} FFP < C322 > (C321 - C321 > CR4 >) /* tr \\ 3011 < 9, 0^{+} PEP < <3, 0^{+} FFP < C321 > (C321 - C321 > CR4 >) /* tr \\ 3011 < 9, 0^{+} PEP < <3, 0^{+} FFP < C321 > (C321 - C321 > CR4 >) /* tr \\ 3011 < 9, 0^{+} PEP < <3, 0^{+} FFP < C321 > (C321 - C421 > CR4 >) /* tr \\ 4000 0, 0 < <6, 0^{+} FFP < C421 > (C422 - C41 > CR2 >) /* tr \\ 4000 0, 0 < <6, 0^{+} FFP < C421 > (C422 - C421 > CR4 >) /* tr \\ 4000 0, 0 < <6, 0^{+} FFP < C421 > (C422 - C421 > CR4 >) /* tr \\ 4000 0, 0 < <6, 0^{+} FFP < C421 > (C422 - C421 > CR4 >) /* tr \\ 4000 0, 0 < <6, 0^{+} FFP < C422 > C422 - C421 > CR4 >) /* tr \\ 4000 0, 0 < <6, 0^{+} FFP < C422 > C422 - C421 > CR4 >) /* tr \\ 4000 0, 0 < <6, 0^{+} FFP < C422 > C422 - C421 > CR4 >) /* tr \\ 4000 0, 0 < <6, 0^{+} FFP < C422 > C422 - C421 > CR4 >) /* tr \\ 4000 0, 0 < <6, 0^{+} FFP < C422 > C422 - C421 > CR4 >) /* tr \\ 4000 0, 0 < <6, 0^{+} FFP < C422 > C422 - C421 < CR4 >) /* tr$ | |
| CATT CATT CATT CATT CATT CATT CATT CATT | $ \left(\begin{array}{c} 2014 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C2211 > C2212 - C2211 > CR4>) /* v \\ (2015 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C2213 - C225 < CR5>) /* clad \\ \text{itrol rod 3} \\ (3001 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C2213 - C225 > CR5>) /* v \\ (3002 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C2221 > C223 - C231 > CR5>) /* v \\ (3003 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C2221 > C223 - C231 > CR5>) /* v \\ (3003 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C222 - C231 > CR5>) /* v \\ (3003 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C232 - C231 > CR5>) /* v \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C232 - C231 > CR5>) /* v \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C232 - C232 > CC324 > CR5>) /* v \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C232 - C232 > CC324 > CR5>) /* v \\ (3006 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C224 > C233 - C234 > CR5>) /* v \\ (3007 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C324 > C233 - C234 > CR5>) /* v \\ (3001 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C324 > C232 - C232 > CC324 > CR5>) /* v \\ (3010 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C232 + C232 > CC324 > CR5>) /* v \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C232 + C232 > CC324 > CR5>) /* v \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C2321 > C2321 > CC84 >) /* v \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C2321 > C232 > CC85) / * v \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C2321 > C2321 > CC85 >) /* v \\ (3011 < 9.0^{\text{PEPP}} < C3.0^{\text{PEPP}} < C321 > C2321 > C232 > CC85) / * v \\ (4001 0.0 < < 0.0^{\text{PEPP} < C321 > C2321 > CC321 > CC85) /* v \\ (4001 0.0 < < 0.0^{\text{PEPP} < C321 > C2321 > CC321 > CC85) /* v \\ (4001 0.0 < < 0.0^{\text{PEPP} < C321 > CC423 > CC84 >) /* v \\ (4000 0.0 < < 0.0^{\text{PEPP} < C421 > C422 > C212 > C212 > C212 > (12)) /* v \\ (4000 0.0 < < 0.0^{\text{PEPP} < C421 > C422 > C212 > C212 > C212 > (12)) /* v \\ (4000 0.0 < < 0.0^{\text{PEPP} < C423 > CC423 > CC42 > CR4 >) /* v \\ (4000 0.0 < < 0.0^{\text{PEPP} < C423 > CC423 > CC424 > CR4 >) /* v \\ (4000 0.0 < < 0.0^{\text{PEPP} < C423 > CC423 > CC$ | |
| CATT CATT CATT CATT | $ \left(\begin{array}{c} 2014 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C2211 > C2212-C2211 > CC213 > CR4>) /* ty \\ 2016 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C223 > C2213-C223 > CR5>) /* clad \\ \text{introl rod 3} \\ (3001 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C223 > C322-C321 > CR5>) /* tr \\ 3002 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C223 > C322-C321 > CR5>) /* tr \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* tr \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* tr \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* tr \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C322-C321 > CR5>) /* tr \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C321-C323 > CR4>) /* sp \\ (3006 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* tr \\ (3007 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* st \\ (3008 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* tr \\ (3001 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* st \\ (3001 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* tr \\ (3012 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C323 > CR6>) /* bc \\ (3012 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C323 > CR6>) /* tr \\ (3014 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C3212 - C3213 > CR4>) /* tr \\ (3014 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C3212 > C3213 - C321 > CR4>) /* tr \\ (3015 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C422 - C421 > CR4>) /* tr \\ (4001 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR4>) /* tr \\ (4002 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C422 > C422 - C424 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C422 > C422 - C424 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C422 > C422 - C424 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C422 > C422 - C424 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C422 > C422 - C424 > CR4>) /* tr \\ (4000 0.0 < < 6.0$ | |
| CATT CALL CATT CALL CALL CATT CALL CALL CALL CALL CALL CALL CALL | $ \left(\begin{array}{c} 2014 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C2211 > C2212 - C2211 > CR4>) /* ty \\ (2015 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C2213 - C225 > CR5>) /* clad \\ \text{Introl rod 3} \\ (3001 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C2213 - C225 > CR5>) /* tar \\ (3002 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C2221 > C221 > CR5>) /* tr \\ (3003 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C2221 > C223 - C231 > CR5>) /* tr \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C222 - C221 > CR5>) /* tr \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C222 - C221 > CR5>) /* tr \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C222 - C221 > CR5>) /* tr \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C222 - C223 > CR5>) /* tr \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C222 - C223 > CR5>) /* tr \\ (3006 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C222 - C223 > CR5>) /* tr \\ (3007 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C222 + C222 > C224 > CR5>) /* tr \\ (3007 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C222 + C222 > C224 > CR5>) /* tr \\ (3006 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C224 - C225 > CR6>) /* tr \\ (3010 < 5.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C222 + C223 > CCR4 >) /* tr \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C221 - C223 > CR6>) /* tr \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C222 + C223 > CR6>) /* tr \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C221 - C223 > CR6>) /* tr \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C223 > C221 - C223 > CR6>) /* tr \\ (3011 < 9.0^{\text{PEPP} < C3.0^{\text{PEPP}} < C222 > C221 > C223 > CR6>) /* tr \\ (3011 < 9.0^{\text{PEPP} < C3.0^{\text{PEPP}} < C321 > C222 - C223 > CR6>) /* tr \\ (3011 < 9.0^{\text{PEPP} < C3.0^{\text{PEPP}} < C321 > C222 > C223 > CR6>) /* tr \\ (4001 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR6A >) /* tr \\ (4002 0.0 < < 6.0^{\text{PEPP} < C422 > C424 > C223 > CR6>) /* tr \\ (4003 0.0 < < 6.0^{\text{PEPP}} < C422 > C424 > C223 > CR6 >) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP}} < C422 > C424 > C223 - C424 > CR6 >) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP}} < C422 > C422 - C422 > C$ | |
| CATT GATT CATT CATT CATT CATT | $ \left(\begin{array}{c} 2014 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C2211 > C2212-C2211 > CR4>) /* v \\ (2015 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C2213-C225 > CR5>) /* clad \\ \text{itrol rod 3} \\ (3001 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C225 > C322-C321 > CR5>) /* v \\ (3002 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* v \\ (3003 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* v \\ (3003 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* v \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* v \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* v \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C321-C323 > CR4>) /* v \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C321-C323 > CR4>) /* v \\ (3006 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C324 > C332-C324 > CR5>) /* v \\ (3007 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C324 > C332-C324 > CR5>) /* v \\ (3010 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* v \\ (3010 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* v \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C328-C323 > CR4>) /* v \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C3221 > C3211 > C3212 > CR4>) /* v \\ (3013 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C3221 > C3213 - CR4>) /* v \\ (3015 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C3221 > C3213 - CR4>) /* v \\ (4001 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR4>) /* v \\ (4000 1.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR4>) /* v \\ (4000 0.0 < < 6.0^{\text{PEPP}} < C421 > C422 - C421 > CR4>) /* v \\ (4000 0.0 < < 6.0^{\text{PEPP}} < C421 > C422 - C421 > CR4>) /* v \\ (4000 0.0 < < 6.0^{\text{PEPP}} < C421 > C422 - C421 > CR4>) /* v \\ (4000 0.0 < < 6.0^{\text{PEPP}} < C421 > C422 - C421 > CR4>) /* v \\ (4000 0.0 < < 6.0^{\text{PEPP}} < C421 > C422 - C421 > CR4>) /* v \\ (4000 0.0 < < 6.0^{\text{PEPP}} < C421 > C422 - C421 > CR4>) /* v \\ (4000 0.0 < < 6.0^{\text{PEPP}} < C421 > C422 - C421 > CR4>) /* v \\ (4000 0.0 < < 6.0^{\text{PEPP}} < C421 > C422 - C421 > CR4>) /* v \\ (4000 0.0 < < 6.0^{\text{PEPP}} < C421 < C422 - C421$ | |
| CYLL CYLL CYLL CYLL CYLL CYLL CYLL CYLL | $ \left(\begin{array}{c} 2014 < 9, 0^{+} PFP < 3, 0^{+} FFP < C2212 > C2212 - C2212 > CR4>) /* ty \\ 2016 < 9, 0^{+} FFP < 3, 0^{+} FFP < C225 > C2213 - C225 > CR5>) /* clad \\ ntrol rod 3 \\ (3001 < 9, 0^{+} FFP < C30 + FFP < C321 > C322 - C321 > CR5>) /* tr \\ 3002 < 9, 0^{+} FFP < C30 + FFP < C321 > C322 - C321 > CR5>) /* tr \\ 3003 < 9, 0^{+} FFP < C30 + FFP < C321 > C322 - C321 > CR5>) /* tr \\ 3004 < 9, 0^{+} FFP < C30 + FFP < C321 > C322 - C321 > CR5>) /* tr \\ 3004 < 9, 0^{+} FFP < C30 + FFP < C321 > C322 - C321 > CR5>) /* tr \\ 3004 < 9, 0^{+} FFP < C30 + FFP < C322 > C332 - C321 > CR5>) /* tr \\ 3006 < 9, 0^{+} FFP < C30 + FFP < C322 > C332 - C324 > CR5>) /* tr \\ 3006 < 9, 0^{+} FFP < C30 + FFP < C324 > C333 - C324 > CR5>) /* tr \\ 3006 < 9, 0^{+} FFP < C30 + FFP < C324 > C333 - C324 > CR5>) /* tr \\ 3006 < 9, 0^{+} FFP < C30 + FFP < C324 > C333 - C324 > CR5>) /* tr \\ 3001 < 9, 0^{+} FFP < C30 + FFP < C322 > C332 - C324 > CR5>) /* tr \\ 3010 < 9, 0^{+} FFP < C30 + FFP < C322 > C332 - C324 > CR5>) /* tr \\ 3010 < 9, 0^{+} FFP < C30 + FFP < C322 > C332 - C328 > CR5>) /* tr \\ 3011 < 9, 0^{+} FFP < C30 + FFP < C321 > C321 - C321 > CR5>) /* tr \\ 3011 < 9, 0^{+} FFP < C30 + FFP < C321 > C321 - C321 > CR5>) /* tr \\ 3011 < 9, 0^{+} FFP < C30 + FFP < C321 > C321 - C321 > CR5>) /* tr \\ 3011 < 9, 0^{+} FFP < C30 + FFP < C321 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 0 - FFP < C421 > C422 - C421 > CR2 >) /* tr \\ 4000 0, 0 < < 0 - FFP < C421 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 0 - FFP < C421 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 0 - FFP < C422 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 0 - FFP < C422 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 0 - FFP < C422 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 0 - FFP < C422 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 0 - FFP < C422 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 0 - FFP < C422 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 0 - FFP < C422 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 0 - FFP < C422 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 0 -$ | |
| CATT GATT CATT CATT CATT CATT CATT CATT | $ \left(\begin{array}{c} 2014 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{PEPP} < C2211 > C2212 - C2211 > CR4>) /* ty \\ 2016 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{PEPP} < C225 > C2213 - C225 > CR5>) /* clad \\ \text{itrol rod 3} \\ (3001 < 9.0^{0} \text{PEPP} < 3.0^{0} \text{PEPP} < C225 > C2213 - C225 > CR5>) /* tr \\ 3002 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C225 > C222 - C221 > CR5>) /* tr \\ (3003 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C225 > C222 - C221 > CR5>) /* tr \\ (3004 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C221 > C223 - C231 > CR5>) /* tr \\ (3004 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C222 > C232 - C231 > CR5>) /* tr \\ (3005 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C222 > C232 - C231 > CR5>) /* tr \\ (3006 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C224 > C233 - C234 > CR5>) /* tr \\ (3006 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C224 > C233 - C234 > CR5>) /* tr \\ (3007 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C224 > C232 - C232 > CC85) /* tr \\ (3006 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C224 > C232 - C232 > CR5>) /* tr \\ (3007 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C224 > C232 - C232 > CR5>) /* tr \\ (3010 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C322 > C232 + C232 > CR5>) /* tr \\ (3011 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C322 > C232 + C232 > CR5>) /* tr \\ (3011 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C321 > C2321 > C232 > CR5>) /* tr \\ (3011 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C321 > C2321 > C2321 > CR5>) /* tr \\ (3011 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C321 > C2321 > C232 > CR5>) /* tr \\ (3011 < 9.0^{0} \text{PEPP} < C30^{0} \text{PEPP} < C321 > C232 > C232 > CR5>) /* tr \\ (3011 < 0.0^{0} \text{C6} 0^{0} \text{PEPP} < C321 > C2321 > C232 > C232 > CR5>) /* tr \\ (3001 < 0.0^{0} \text{C6} 0^{0} \text{PEPP} < C321 > C242 - C21 > CR5>) /* tr \\ (3001 < 0.0^{0} \text{C6} 0^{0} \text{PEPP} < C321 > C242 - C21 > CR5>) /* tr \\ (4000 & 0.0^{0} \text{C6} 0^{0} \text{PEPP} < C321 > C242 - C21 > CR5>) /* tr \\ (4000 & 0.0^{0} \text{C6} 0^{0} \text{PEPP} < C321 > C242 - C21 > CR5>) /* tr \\ (4000 & 0.0^{0} \text{C6} 0^{0} \text{PEPP} < C321 > C242 - C242 > CR5>) /* tr \\ (4000 & 0.0^{0} \text{C6} 0^{0} \text{PEP} < C321 $ | |
| CATT of CALT CALT of CALT CALT of CALT CALT of CALT CALT of CALT CALT of CALT CALT of CALT CALT CALT CALT CALT CALT CALT CALT | $ \left(\begin{array}{c} 2014 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C2211 > C2212-C2211 > CR4>) /* ty \\ 2016 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C222 > C2213-C223 > CR5>) /* clad \\ \text{itrol rod 3} \\ (3001 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C223 > C322-C321 > CR5>) /* tr \\ 3002 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* tr \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* tr \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* tr \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C322-C321 > CR5>) /* tr \\ (3004 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C322-C321 > CR5>) /* tr \\ (3005 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C321-C323 > CR4>) /* sp \\ (3006 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* tr \\ (3007 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* tr \\ (3007 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* tr \\ (3001 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* tr \\ (3010 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* tr \\ (3011 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C332-C324 > CR5>) /* tr \\ (3012 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C322 > C3231-C321 > CR4>) /* tr \\ (3014 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C3211 > C3212 > C321 > CR4>) /* tr \\ (3014 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C422-C421 > CR5>) /* tr \\ (3015 < 9.0^{\text{PEPP} < 3.0^{\text{PEPP}} < C321 > C422-C421 > CR5>) /* tr \\ (4002 0.0 < < 6.0^{\text{PEPP} < C421 > C422-C421 > CR2>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422-C421 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 > C422 - C421 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C422 > C422 - C424 > CR5>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C422 > C422 - C421 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C422 > C422 - C424 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C422 > C422 - C421 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C422 > C422 - C421 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C422 > C422 - C421 > CR4>) /* tr \\ (4000 0.0 < < 6.0^{\text{PEPP} < C421 >$ | |
| CATT GAT CATT CATT CATT CATT CATT CATT CATT CATT | <pre>(2014 < 9.0*PEP> < 3.0*PEP> <22212 < C2212 - C2212 < CR4>) /* v (2015 < 9.0*PEP> < 3.0*PEP> <c225 -="" <="" c2213="" c225="" cr5="">) /* clad ntrol rod 3 (3001 < 9.0*PEP> <-3.0*PEP> <c225 -="" <="" c2213="" c225="" cr5="">) /* clad strol rod 3 (3001 < 9.0*PEP> <-3.0*PEP> <c225 -="" <="" c2213="" c225="" cr5="">) /* v (3002 < 9.0*PEP> <-3.0*PEP> <c225 -="" <="" c321="" c322="" cr5="">) /* v (3003 < 9.0*PEP> <-3.0*PEP> <c225 -="" <="" c321="" c322="" cr5="">) /* v (3004 < 9.0*PEP> <-3.0*PEP> <c321 -="" <="" c321="" c322="" cr5="">) /* v (3005 < 9.0*PEP> <-3.0*PEP> <c322 -="" <="" c321="" c323="" cr4="">) /* v (3005 < 9.0*PEP> <-3.0*PEP> <c322 -="" <="" c321="" c323="" cr4="">) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c322 -="" <="" c324="" c332="" cr5="">) /* v (3007 < 9.0*PEP> <-3.0*PEP> <c322 -="" <="" c324="" c332="" cr5="">) /* v (3007 < 9.0*PEP> <-3.0*PEP> <c322 -="" <="" c324="" c332="" cr5="">) /* v (3006 < 9.0*PEP> <-3.0*PEP> <c322 -="" <="" c324="" c332="" cr5="">) /* v (3001 < 9.0*PEP> <-3.0*PEP> <c322 -="" <="" c324="" c332="" cr5="">) /* v (3001 < 9.0*PEP> <-3.0*PEP> <c322 -="" <="" c324="" c332="" cr5="">) /* v (3011 < 9.0*PEP> <-3.0*PEP> <c322 -="" <="" c324="" c332="" cr5="">) /* v (3011 < 9.0*PEP> <-3.0*PEP> <c322 -="" <="" c321="" c331="" cr5="">) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c322 -="" <="" c321="" cr5="">) /* v (3015 < 9.0*PEP> <-3.0*PEP> <c322 -="" <="" c321="" cr5="">) /* v (4001 </c322></c322></c322></c322></c322></c322></c322></c322></c322></c322></c322></c322></c321></c225></c225></c225></c225></c225></pre> | |
| CATT GATT CATT CATT CATT CATT CATT CATT | $ \left(\begin{array}{c} 2014 < 9, 0^{+} PFP < 3, 0^{+} FFP < C2212 < C2213 - C2213 - C2213 < CR4>) /* tp \\ 2016 < 9, 0^{+} FFP < 3, 0^{+} FFP < C225 < C2213 - C225 < CR5>) /* clad \\ ntrol rod 3 \\ (3001 < 9, 0^{+} FFP < C30 + FFP < C321 > C322 - C321 > CR5>) /* tr \\ 3002 < 9, 0^{+} FFP < C30 + FFP < C321 > C322 - C321 > CR5>) /* tr \\ 3003 < 9, 0^{+} FFP < C30 + FFP < C321 > C322 - C321 > CR5>) /* tr \\ 3004 < 9, 0^{+} FFP < C30 + FFP < C321 > C322 - C321 > CR5>) /* tr \\ 3005 < 9, 0^{+} FFP < C30 + FFP < C322 > C321 - C323 > CR5>) /* tr \\ 3006 < 9, 0^{+} FFP < C30 + FFP < C322 > C332 - C324 > CR5>) /* tr \\ 3006 < 9, 0^{+} FFP < C30 + FFP < C324 > C332 - C324 > CR5>) /* tr \\ 3006 < 9, 0^{+} FFP < C30 + FFP < C324 > C332 - C324 > CR5>) /* tr \\ 3007 < 9, 0^{+} FFP < C30 + FFP < C324 > C332 - C324 > CR5>) /* tr \\ 3007 < 9, 0^{+} FFP < C30 + FFP < C324 > C332 - C324 > CR5>) /* tr \\ 3010 < 9, 0^{+} FFP < C30 + FFP < C324 > C332 - C324 > CR5>) /* tr \\ 3010 < 9, 0^{+} FFP < C30 + FFP < C322 > C332 - C324 > CR5>) /* tr \\ 3011 < 9, 0^{+} FFP < C30 + FFP < C322 > C332 - C324 > CR5>) /* tr \\ 3011 < 9, 0^{+} FFP < C30 + FFP < C322 > C323 - C324 > CR5>) /* tr \\ 3011 < 9, 0^{+} FFP < C30 + FFP < C321 > C321 - C321 > CR5>) /* tr \\ 3011 < 9, 0^{+} FFP < C30 + FFP < C321 > C321 - C321 > CR5>) /* tr \\ 3016 < 9, 0^{+} FFP < C30 + FFP < C321 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 6, 0^{+} FFP < C421 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 6, 0^{+} FFP < C421 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 6, 0^{+} FFP < C421 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 6, 0^{+} FFP < C421 > C422 - C421 > CR5>) /* tr \\ 4000 0, 0 < < 6, 0^{+} FFP < C422 > C422 - C424 > CR5>) /* tr \\ 4000 0, 0 < < 6, 0^{+} FFP < C422 > C422 - C424 > CR5>) /* tr \\ 4000 0, 0 < < 6, 0^{+} FFP < C422 > C422 - C424 > CR5>) /* tr \\ 4000 0, 0 < < 6, 0^{+} FFP < C422 > C422 - C424 > CR5>) /* tr \\ 4000 0, 0 < < 6, 0^{+} FFP < C422 > C422 - C424 > CR5>) /* tr \\ 4000 0, 0 < < 6, 0^{+} FFP < C422 > C422 - C424 > CR5>) /* tr \\ 4000 0, 0 < < 6, 0^{$ | |
| CATT CATT CATT CATT CATT CATT CATT CATT | $ \left(\begin{array}{c} 2014 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C2212 < C2212 - C2213 < C221 > (CR4)) /* tp \\ 2016 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C225 < C2213 - C225 < CR5) /* elad \\ 10c0 1 cod 3 \\ (3001 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C221 > C322 - C321 > CR2) /* tr \\ 3003 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C221 > C322 - C321 > CR2) /* tr \\ 3003 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C321 > C322 - C321 > CR3) /* tr \\ 3004 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C321 > C322 - C321 > CR3) /* tr \\ 3005 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C322 > C321 - C323 > CR4) /* tr \\ 3005 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C322 > C321 - C323 > CR4) /* tr \\ 3006 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C322 > C332 - C324 > CR3) /* tr \\ 3006 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C324 > C333 - C324 > CR8) /* tr \\ 3007 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C322 > C332 - C324 > CR8) /* tr \\ 3010 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C322 > C332 - C324 > CR8) /* tr \\ 3010 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C322 > C332 - C328 > CR6) /* bfc \\ 3011 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C322 > C321 - C321 > CCR4) /* tr \\ 3013 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C321 > C321 > C321 > CCR4) /* tr \\ 3014 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C322 > C321 - C321 > CCR4) /* tr \\ 3015 < 9.0^{0}\text{PEPP} < 3.0^{0}\text{PEPP} < C322 > C321 - C322 > CR4) /* tr \\ 4000 0.0 < < 6.0^{0}\text{PEPP} < C421 > C422 - C421 > CR4) /* tr \\ 4000 0.0 < < 6.0^{0}\text{PEPP} < C421 > C422 - C421 > CR8) /* tr \\ 4000 0.0 < < 6.0^{0}\text{PEPP} < C421 > C422 - C421 > CR8) /* tr \\ 4000 0.0 < < 6.0^{0}\text{PEPP} < C422 > C422 - C421 > CR8) /* tr \\ 4000 0.0 < < 6.0^{0}\text{PEPP} < C422 > C422 - C421 > CR8) /* tr \\ 4000 0.0 < < 6.0^{0}\text{PEPP} < C422 > C422 - C421 > CR8) /* tr \\ 4000 0.0 < < 6.0^{0}\text{PEPP} < C422 > C422 - C421 > CR8) /* tr \\ 4000 0.0 < < 6.0^{0}\text{PEPP} < C422 > C422 - C421 > CR8) /* tr \\ 4000 0.0 < < 6.0^{0}\text{PEPP} < C422 > C422 - C421 > CR8) /* tr \\ 4000 0.0 < < 6.0^{0}\text{PEPP} < C422 > C422 - C421 > CR8) /* tr \\ 4000 0.0 < < 6.0^{0}\text{PEPP} < C422 > C422 - C421 > CR8) /$ | |

| CYL | (6009 <-9.0*PPP> | < 3.0*FPP> | <c6z5> <c6z4-c< th=""><th>6Z5> <cr4></cr4></th><th>) /* bp</th></c6z4-c<></c6z5> | 6Z5> <cr4></cr4> |) /* bp |
|---|--|---|--|---|--|
| CYL CYL | (6010 <-9.0*PPP> (6011 <-9.0*PPP> (6012 <-9.0*PPP> | < 3.0*FPP> < 3.0*FPP> < 3.0*FPP> | <pre> <c628> <c628-c <c628=""> <c629-c <c628=""> <c6210-c <="" pre=""></c6210-c></c629-c></c628-c></c628></pre> | 6Z8> <cr6></cr6> |) /* spz) /* b4c) /* v |
| CYL CYL | (6013 <-9.0*PPP> (6014 <-9.0*PPP> | < 3.0*FPP> < 3.0*FPP> | <c6z10> <c6z11 <c6z11> <c6z12< td=""><td>-C6Z10> <cr4 -C6Z11> <cr4< td=""><td>>) /* sp3 >) /* v</td></cr4<></cr4 </td></c6z12<></c6z11></c6z11 </c6z10> | -C6Z10> <cr4 -C6Z11> <cr4< td=""><td>>) /* sp3 >) /* v</td></cr4<></cr4 | >) /* sp3 >) /* v |
| CYL CYL | (6015 <-9.0*PPP> (6016 <-9.0*PPP> | < 3.0*FPP> < 3.0*FPP> | <pre><c6z12> <c6z13 <c6z5> <c6z13-< pre=""></c6z13-<></c6z5></c6z13 </c6z12></pre> | -C6Z12> <cr4 C6Z5> <cr5></cr5></cr4 | >) /* tp) /* clad |
| * sa CYL | (7001 < 4.5*PPP> | <-4.5*FPP> | <s1z1> <s1z2-s< td=""><td>1Z1> <cr1></cr1></td><td>) /* zr</td></s1z2-s<></s1z1> | 1Z1> <cr1></cr1> |) /* zr |
| CYL | (7002 < 4.5*PPP> (7003 < 4.5*PPP> (7004 < 4.5*PPP> | <-4.5*FPP> | <pre><s1z1> <s1z2-s <s1z1> <s1z2-s <s1z1> <s1z2-s <s1z1> <s1z2-s< pre=""></s1z2-s<></s1z1></s1z2-s </s1z1></s1z2-s </s1z1></s1z2-s </s1z1></pre> | 121> <cr2></cr2> |) /* v) /* UZrH |
| CYL | (7004 < 4.5*PPP> (7005 < 4.5*PPP> (7006 < 4.5*PPP> | <-4.5*FPP> | <pre><s1z1> <s1z1> = S1Z1= S <s1z3> <s1z1= <s1z3="" s=""> <s1z3= pre="" s<=""></s1z3=></s1z1=></s1z3></s1z1></s1z1></pre> | 1Z3> <cr4></cr4> |) /* sp1) /* v |
| CYL | (7007 < 4.5*PPP> (7008 < 4.5*PPP> | <-4.5*FPP> | <pre><s1z4> <s1z3-s <s1z4=""> <s1z3-s< pre=""></s1z3-s<></s1z3-s></s1z4></pre> | 1Z4> <cr8></cr8> |) /* st) /* v |
| CYL | (7009 < 4.5*PPP> (7010 < 4.5*PPP> | <-4.5*FPP> | <pre><s1z5> <s1z4-s <s1z7=""> <s1z8-s< pre=""></s1z8-s<></s1z4-s></s1z5></pre> | 1Z5> <cr4> 1Z7> <cr4></cr4></cr4> |) /* bp) /* sp2 |
| CYL | (7011 < 4.5*PPP> (7012 < 4.5*PPP> | <-4.5*FPP> | <pre><s1z8> <s1z9-s <s1z8=""> <s1z10-< pre=""></s1z10-<></s1z9-s></s1z8></pre> | 1Z8> <cr6> S1Z8> <cr4></cr4></cr6> |) /* b4c) /* v |
| CYL CYL | (7013 < 4.5*PPP> (7014 < 4.5*PPP> | <-4.5*FPP> <-4.5*FPP> | <pre><s1z10> <s1z11 <s1z11> <s1z12< pre=""></s1z12<></s1z11></s1z11 </s1z10></pre> | -S1Z10> <cr4 -S1Z11> <cr4< td=""><td>>) /* sp3 >) /* v</td></cr4<></cr4 | >) /* sp3 >) /* v |
| CYL CYL | (7015 < 4.5*PPP> (7016 < 4.5*PPP> | <-4.5*FPP> <-4.5*FPP> | <pre><s1z12> <s1z13 <s1z5> <s1z13-< pre=""></s1z13-<></s1z5></s1z13 </s1z12></pre> | -S1Z12> <cr4 S1Z5> <cr5></cr5></cr4 | >) /* tp) /* clad |
| * sa CYL | afety rod 2 (8001 <-9.0*PPP> | 0.0 | <s2z1> <s2z2-s2< td=""><td>Z1> <cr1></cr1></td><td>) /* zr</td></s2z2-s2<></s2z1> | Z1> <cr1></cr1> |) /* zr |
| CYL CYL | (8002 <-9.0*PPP> (8003 <-9.0*PPP> | 0.0 | <s2z1> <s2z2-s2 <s2z1> <s2z2-s2< td=""><td>Z1> <cr2> Z1> <cr3></cr3></cr2></td><td>) /* v) /* UZrH</td></s2z2-s2<></s2z1></s2z2-s2 </s2z1> | Z1> <cr2> Z1> <cr3></cr3></cr2> |) /* v) /* UZrH |
| CYL | (8004 <-9.0*PPP> (8005 <-9.0*PPP> | 0.0 | <\$221> <\$227-\$2 <\$223> <\$221-\$2 | Z1> <cr4> Z3> <cr4></cr4></cr4> |) /* v) /* spl |
| CYL | (8006 <-9.0*PPP> (8007 <-9.0*PPP> | 0.0 | <szz4> <szz3-sz <szz4> <szz3-sz< td=""><td>Z4> <cr7> Z4> <cr8></cr8></cr7></td><td>) /* v) /* st</td></szz3-sz<></szz4></szz3-sz </szz4> | Z4> <cr7> Z4> <cr8></cr8></cr7> |) /* v) /* st |
| CYL | (8008 <-9.0*PPP> (8009 <-9.0*PPP> | 0.0 | <pre><s2z4> <s2z3-s2 <s2z5=""> <s2z4-s2 <s2z5=""> <s2z4-s2< pre=""></s2z4-s2<></s2z4-s2></s2z3-s2></s2z4></pre> | Z4> <cr4> Z5> <cr4></cr4></cr4> |) /* bp |
| CYL | (8010 <-9.0*PPP> (8011 <-9.0*PPP> (8012 <-9.0*PPP> | 0.0 | <pre><s2z1> <s2z8=s2 <s2z8=""> <s2z9=s2 <s2z8=""> <s2z9=s2< pre=""></s2z9=s2<></s2z9=s2></s2z8=s2></s2z1></pre> | 272 <cr42 282 <cr62< td=""><td>) /* sp2) /* b4c</td></cr62<></cr42 |) /* sp2) /* b4c |
| CYL | (8012 < 9.0 PPP> (8013 <-9.0*PPP> (8014 <-9.0*PPP> | 0.0 | <s2z10> <s2z10 3<br=""><s2z10> <s2z11- <s2z11> <s2z12-< td=""><td>S2Z10> <cr4></cr4></td><td>) /* sp3</td></s2z12-<></s2z11></s2z11- </s2z10></s2z10></s2z10> | S2Z10> <cr4></cr4> |) /* sp3 |
| CYL | (8015 <-9.0*PPP> (8016 <-9.0*PPP> | 0.0 | <pre><s2z12> <s2z13- <s2z5> <s2z13-s< pre=""></s2z13-s<></s2z5></s2z13- </s2z12></pre> | S2Z12> <cr4> 2Z5> <cr5></cr5></cr4> |) /* tp) /* clad |
| * ta CYL | a rod (10001 < 9.0*PPP) | > 0.0 | <taz1> <taz2-ta< td=""><td>Z1> <ar1></ar1></td><td>) /* b4c</td></taz2-ta<></taz1> | Z1> <ar1></ar1> |) /* b4c |
| CYL CYL | (10002 < 9.0*PPP) (10003 < 9.0*PPP) | > 0.0 > 0.0 | <taz1> <taz2-ta <taz3> <taz1-ta< td=""><td>LZ1> <ar6> LZ3> <ar6></ar6></ar6></td><td>) /* v) /* spl</td></taz1-ta<></taz3></taz2-ta </taz1> | LZ1> <ar6> LZ3> <ar6></ar6></ar6> |) /* v) /* spl |
| CYL CYL | (10004 < 9.0*PPP) (10005 < 9.0*PPP) | > 0.0 > 0.0 | <taz4> <taz3-ta <taz4> <taz3-ta< td=""><td>.Z4> <ar4> .Z4> <ar5></ar5></ar4></td><td>) /* v) /* fol</td></taz3-ta<></taz4></taz3-ta </taz4> | .Z4> <ar4> .Z4> <ar5></ar5></ar4> |) /* v) /* fol |
| CYL CYL | (10006 < 9.0*PPP) (10007 < 9.0*PPP) | > 0.0 > 0.0 | <taz4> <taz3-ta <taz5> <taz4-ta< td=""><td>124> <ar6> 125> <ar6></ar6></ar6></td><td>) /* v) /* bp</td></taz4-ta<></taz5></taz3-ta </taz4> | 124> <ar6> 125> <ar6></ar6></ar6> |) /* v) /* bp |
| CYL CYL | (10008 < 9.0*PPP) (10009 < 9.0*PPP) | > 0.0 > 0.0 | <taz2> <taz6-ta <taz6> <taz7-ta< td=""><td>Z2> <ar6> Z6> <ar2></ar2></ar6></td><td>) /* sp2) /* v</td></taz7-ta<></taz6></taz6-ta </taz2> | Z2> <ar6> Z6> <ar2></ar2></ar6> |) /* sp2) /* v |
| CYL | (10010 < 9.0*PPP> (10011 < 9.0*PPP> | > 0.0 > 0.0 | <taz6> <taz7-ta <taz6> <taz7-ta< td=""><td>26> <ar3> 26> <ar6></ar6></ar3></td><td>) /* st) /* v</td></taz7-ta<></taz6></taz7-ta </taz6> | 26> <ar3> 26> <ar6></ar6></ar3> |) /* st) /* v |
| CYL CYL | (10012 < 9.0*PPP) (10013 < 9.0*PPP) | > 0.0 > 0.0 | <taz></taz> <taz8-ta <taz5> <taz8-ta< td=""><td>127> <ar6> 125> <ar7></ar7></ar6></td><td>) /* tp) /* clad</td></taz8-ta<></taz5></taz8-ta | 127> <ar6> 125> <ar7></ar7></ar6> |) /* tp) /* clad |
| CYL | (20001 <-4.5*PPP) (20002 <-4.5*PPP) | <-4.5*FPP: | <pre><tbz1> <tbz2-5 <tbz1=""> <tbz2-5< pre=""></tbz2-5<></tbz2-5></tbz1></pre> | TBZ1> <tr1></tr1> |) /* b4c |
| CYL | (20002 < 4.5 FFF) (20003 <-4.5*PPP) (20004 <-4 5*PPP) | <-4.5*FPP: | <pre><tbz3> <tbz1-: <tbz3> <tbz1-: <tbz4> <tbz3-:< pre=""></tbz3-:<></tbz4></tbz1-: </tbz3></tbz1-: </tbz3></pre> | TBZ3> <tr6></tr6> |) /* sp1 |
| CYL | (20005 <-4.5*PPP) (20006 <-4.5*PPP) | <pre>< 4.5 FFP < <-4.5*FPP < <-4.5*FPP</pre> | <pre>> <tbz4> <tbz3-'> <tbz4> <tbz3-'> <tbz4> <tbz3-' <="" pre=""></tbz3-'></tbz4></tbz3-'></tbz4></tbz3-'></tbz4></pre> | IBZ4> <ir4> IBZ4> <tr5> IBZ4> <tr6></tr6></tr5></ir4> |) /* fol |
| CYL CYL | (20007 <-4.5*PPP) (20008 <-4.5*PPP) | <pre><-4.5*FPP: <-4.5*FPP:</pre> | <pre>> <tbz5> <tbz4-'> <tbz2> <tbz6-'< pre=""></tbz6-'<></tbz2></tbz4-'></tbz5></pre> | TBZ5> <tr6> TBZ2> <tr6></tr6></tr6> |) /* bp) /* sp2 |
| CYL CYL | (20009 <-4.5*PPP) (20010 <-4.5*PPP) | <-4.5*FPP | <pre>> <tbz6> <tbz7-*> <tbz6> <tbz7-*< pre=""></tbz7-*<></tbz6></tbz7-*></tbz6></pre> | TBZ6> <tr2> TBZ6> <tr3></tr3></tr2> |) /* v) /* st |
| CYL CYL | (20011 <-4.5*PPP) (20012 <-4.5*PPP) | <pre><-4.5*FPP: <-4.5*FPP:</pre> | <pre>> <tbz6> <tbz7-*> <tbz7> <tbz8-*< pre=""></tbz8-*<></tbz7></tbz7-*></tbz6></pre> | TBZ6> <tr6> TBZ7> <tr6></tr6></tr6> |) /* v) /* tp |
| CYL * to | (20013 <-4.5*PPP: c rod | <-4.5*FPP: | > <tbz5> <tbz8-1< td=""><td>TBZ5> <tr7></tr7></td><td>) /* clad</td></tbz8-1<></tbz5> | TBZ5> <tr7></tr7> |) /* clad |
| CYL | (30001 <-4.5*PPP> (30002 <-4.5*PPP> | > < 4.5*FPP | <pre>> <tcz1> <tcz2-*> <tcz1> <tcz2-*< pre=""></tcz2-*<></tcz1></tcz2-*></tcz1></pre> | CZ1> <tr1> CZ1> <tr6></tr6></tr1> |) /* b4c) /* v |
| CYL | (30003 <-4.5*PPP) (30004 <-4.5*PPP) (30005 < 4.5*PPP) | < 4.5*FPP; < 4.5*FPP; | <pre>> <fc23> <fc21-: > <fc24> <fc23-: </fc23-: </fc24></fc21-: </fc23></pre> | TCZ3> <tr6> TCZ4> <tr4></tr4></tr6> |) /* spl) /* v |
| CYL | (30005 <-4.5*PPP) (30006 <-4.5*PPP) (30007 <-4.5*PPP) | < 4.5*FPP; < 4.5*FPP; < 4.5*FPP; | <pre>> <tcz4> <tcz3=: > <tcz4> <tcz3=: > <tcz4> <tcz3=: > <tcz4> <tcz3=:< pre=""></tcz3=:<></tcz4></tcz3=: </tcz4></tcz3=: </tcz4></tcz3=: </tcz4></pre> | ICZ4> <ir5> ICZ4> <ir6></ir6></ir5> |) /* IOI) /* V |
| CYL | (30008 <-4.5*PPP) (30008 <-4.5*PPP) (30009 <-4.5*PPP) | < 4.5*FPP | <pre>> <tcz3> <tcz4=: > <tcz2> <tcz6=: > <tcz6> <tcz7=:< pre=""></tcz7=:<></tcz6></tcz6=: </tcz2></tcz4=: </tcz3></pre> | ICZ2> <tr6> ICZ2> <tr6></tr6></tr6> |) /* sp2 |
| CYL CYL | (30010 <-4.5*PPP) (30011 <-4.5*PPP) | < 4.5*FPP | > <tcz6> <tcz7- > <tcz6> <tcz7-< td=""><td>ICZ6> <tr3> ICZ6> <tr6></tr6></tr3></td><td>) /* st) /* v</td></tcz7-<></tcz6></tcz7- </tcz6> | ICZ6> <tr3> ICZ6> <tr6></tr6></tr3> |) /* st) /* v |
| CYL CYL | (30012 <-4.5*PPP) (30013 <-4.5*PPP) | < 4.5*FPP2 < 4.5*FPP2 | <pre>> <tcz7> <tcz8-1> <tcz5> <tcz8-1 <="" pre=""></tcz8-1></tcz5></tcz8-1></tcz7></pre> | FCZ7> <tr6> FCZ5> <tr7></tr7></tr6> |) /* tp) /* clad |
| * la RHP | attice boundary (1000 0.0 0.0 | <fz1></fz1> | <fz2-fz1></fz2-fz1> | <dh1>)</dh1> | |
| RHP | (2000 0.0 0.0 (3000 0.0 0.0 | <fz2> <gbb></gbb></fz2> | <fz15-fz2> <fz1-gbb></fz1-gbb></fz15-fz2> | <dh1>) <dh1>)</dh1></dh1> | |
| RHP | (100 0.0 0.0 (100 0.0 0.0 | <fz1></fz1> | <fz2-fz1></fz2-fz1> | <fpp>)</fpp> | * Zr |
| CYL | (10 0.0 0.0) | <fz1> ·</fz1> | <fz2-fz1></fz2-fz1> | (FR2>) / | * v * UZrH |
| CYL | (12 0.0 0.0) (13 0.0 0.0) | <fz1> ·</fz1> | <fz2-fz1> <</fz2-fz1> | <pre>(FR4>) / (FR5>) /</pre> | * v * clad |
| * la RHP | attice 200 (200 0.0 0.0 | <fz2></fz2> | <fz15-fz2></fz15-fz2> | <fpp>)</fpp> | |
| RHP RHP | (210 0.0 0.0 (220 0.0 0.0 | <fz2> <gtb></gtb></fz2> | <gtb-fz2> <gtt-gtb></gtt-gtb></gtb-fz2> | <fpp>) <fpp>)</fpp></fpp> | |
| RHP CYL | (230 0.0 0.0 (20 0.0 0.0 | <gtt> <fz2></fz2></gtt> | <fz15-gtt> <fz10-fz2></fz10-fz2></fz15-gtt> | <fpp>) <fr7>)</fr7></fpp> | /* c |
| CYL CYL | (21 0.0 0.0 (22 0.0 0.0 | <fz2> < <fz11></fz11></fz2> | <fz11-fz2> <fz12-fz11></fz12-fz11></fz11-fz2> | <fr4>) <fr4>)</fr4></fr4> | /* v /* cap |
| CYL | (23 0.0 0.0 (24 0.0 0.0 | <fz2> < <fz12> </fz12></fz2> | <fz12-fz2> < <fz13-fz12></fz13-fz12></fz12-fz2> | <fr5>) <fr8>)</fr8></fr5> | /* clad /* cl |
| CYL | (25 0.0 0.0 | <r213> <f214></f214></r213> | <r214-r213> <r215-r214></r215-r214></r214-r213> | <rrs>) <fr8>)</fr8></rrs> | /* c3 |
| CYL | (26 0.0 0.0 | | COMP_CONS | CTPR | (T h + |
| * 1. | (26 0.0 0.0 (27 0.0 0.0 (28 0.0 0.0 | <gtb> <gtb></gtb></gtb> | <gtt-gtb> < <gtt-gtb> <</gtt-gtb></gtt-gtb> | <gtrf>) <gtrc>)</gtrc></gtrf> | /* n_t /* h_c |
| * la RHP RHP | (26 0.0 0.0 (27 0.0 0.0 (28 0.0 0.0 attice 300 (300 0.0 0.0 (310 0.0 0.0 | <gtb> · <gtb> · <gbb> <gbb></gbb></gbb></gtb></gtb> | <gtt-gtb> < <gtt-gtb> < <fz1-gbb> < <fz7-gbb> <</fz7-gbb></fz1-gbb></gtt-gtb></gtt-gtb> | <gtrf>) (GTRC>) <fpp>) <fpp>)</fpp></fpp></gtrf> | /* h_t /* h_c |
| * 1a RHP RHP RHP CYL | (26 0.0 0.0 (27 0.0 0.0 (28 0.0 0.0 (300 0.0 0.0 (310 0.0 0.0 (320 0.0 0.0 (30 0.0 0.0 | <gtb> - <gtb> - <gbb> <gbb> <fz7> <fz9> -</fz9></fz7></gbb></gbb></gtb></gtb> | <pre><gtt-gtb> </gtt-gtb></pre> <gtt-gtb> <fz1-gbb> <fz7-gbb> <fz1-fz7> <fz8-fz9> </fz8-fz9></fz1-fz7></fz7-gbb></fz1-gbb></gtt-gtb> | <pre>(GTRF>) (GTRC>) (FPP>) (FPP>) (FPP>) (FPP>) (FP12>)</pre> | /* n_t /* h_c |
| * 1; RHP RHP CYL TRC | (26 0.0 0.0 (27 0.0 0.0 (28 0.0 0.0 attice 300 (300 0.0 0.0 (310 0.0 0.0 (320 0.0 0.0 (320 0.0 0.0 (31 0.0 0.0 | <gtb> < <gtb> <gbb> <gbb> <fz7> <fz8> 0.0</fz8></fz7></gbb></gbb></gtb></gtb> | <pre><gtt-gtb> </gtt-gtb></pre> <gtt-gtb> <pre></pre> <pre></pre></gtt-gtb> | <pre>(GTRF>) (GTRC>) (FPP>) (FPP>) (FPP>) (FP12>) 1>) /* (</pre> | /* h_c /* h_c /* c4 |
| * 1 RHP RHP CYL TRC CYL CYL | (26 0.0 0.0 (27 0.0 0.0 (28 0.0 0.0 (300 0.0 0.0 (310 0.0 0.0 (310 0.0 0.0 (320 0.0 0.0 (31 0.0 0.0 (32 0.0 0.0 (33 0.0 0.0 (33 0.0 0.0 | <gtb> </gtb> 0.0 | <pre><gtt-gtb> <gtt-gtb> <</gtt-gtb></gtt-gtb></pre> <pre></pre> | <pre>(GTRF>) (GTRC>) (GTRC>) (FPP>) (FPP>) (FPP>) (FR12>) 1>) /* ((FR11>) (FR11>))</pre> | /* h_c /* h_c /* c4 /* c2 /* c1 |
| * 1 RHP RHP CYL TRC CYL CYL CYL CYL | $ \left(\begin{array}{ccccc} 26 & 0.0 & 0.0 \\ (27 & 0.0 & 0.0 \\ (28 & 0.0 & 0.0 \\ (310 & 0.0 & 0.0 \\ (310 & 0.0 & 0.0 \\ (310 & 0.0 & 0.0 \\ (31 & 0.0 & 0.0 \\ (33 & 0.0 & 0.0 \\ (33 & 0.0 & 0.0 \\ (34 & 0.0 & 0.0 \\ (34 & 0.0 & 0.0 \\ (34 & 0.0 & 0.0 \\ (35 & 0.0 & 0.$ | <pre><gtb> <gtb> <gbb> <gbb> <gbb> <fz7> <fz8> 0.0 <fz8> 0.0 <fz7> <fz8> CF26> <fz5> </fz5></fz8></fz7></fz8></fz8></fz7></gbb></gbb></gbb></gtb></gtb></pre> | <pre>(GTT-GTB> (GTT-GTB> (FZ1-GBB) (FZ1-GBB) (FZ1-GBB) (FZ1-FZ7) (FZ8-FZ3) (FZ1-FZ7) (FZ6-FZ7) (FZ1-FZ5) (FZ1-FZ5)</pre> | CGTRF>) GGTRF>) GGTRF>) (FPP>) (FPP>) (FP12>) 1>) (FR11>) (FR11>) (FR10>) (FR5>) (FR4>) | /* h_c /* c4 /* c2 /* c1 /* c1 /* cap |
| * 1 RHP RHP CYL TRC CYL CYL CYL CYL CYL CYL | $\left(\begin{array}{ccccc} 26 & 0.0 & 0.0 \\ (27 & 0.0 & 0.0 \\ (28 & 0.0 & 0.0 \\ (300 & 0.0 & 0.0 \\ (310 & 0.0 & 0.0 \\ (320 & 0.0 & 0.0 \\ (320 & 0.0 & 0.0 \\ (31 & 0.0 & 0.0 \\ (31 & 0.0 & 0.0 \\ (31 & 0.0 & 0.0 \\ (34 & 0.0 & 0.0 \\ (34 & 0.0 & 0.0 \\ (35 & 0.0 & 0.0 \\ (36 & 0.0 & 0.0 \\ (37 & 0.0 & 0.$ | <pre><gtb> </gtb></pre> <gbb> <gbb> <fz8> <</fz8></gbb></gbb> | CGTT-GTB> CGTT-GTB> CFZ1-GBB> CFZ1-GBB> CFZ1-GBB> CFZ1-FZ3> CFZ2-FZ8> CFZ2-FZ8> CFZ2-FZ8> CFZ2-FZ8> CFZ2-FZ8> CFZ2-FZ8> CFZ1-FZ5> CFZ1-FZ4> CFZ1-FZ4> | GGTRC>) (GTRC>) (FPP>)) (FPP>)) (FR12>)) 1>) /* ((FR12>)) (FR10>)) | /* h_c /* c4 /* c2 /* c1 /* clad /* cap /* v /* c |
| * 1 RHP RHP CYL TRC CYL CYL CYL CYL CYL CYL CYL CYL CYL TRC | $\left(\begin{array}{ccccc} 26 & 0.0 & 0.0 \\ (27 & 0.0 & 0.0 \\ (28 & 0.0 & 0.0 \\ (300 & 0.0 & 0.0 \\ (310 & 0.0 & 0.0 \\ (320 & 0.0 & 0.0 \\ (320 & 0.0 & 0.0 \\ (31 & 0.0 & 0.0 \\ (31 & 0.0 & 0.0 \\ (31 & 0.0 & 0.0 \\ (34 & 0.0 & 0.0 \\ (34 & 0.0 & 0.0 \\ (35 & 0.0 & 0.0 \\ (35 & 0.0 & 0.0 \\ (38 & 0.0 & 0.0 \\ (38 & 0.0 & 0.0 \\ (38 & 0.0 & 0.0 \\ (38 & 0.0 & 0.0 \\ (38 & 0.0 & 0.0 \\ (39 & 0.0 & 0.0 \\ (39 & 0.0 & 0.0 \\ (39 & 0.0 & 0.0 \\ (39 & 0.0 & 0.0 \\ (39 & 0.0 & 0.0 \\ (39 & 0.0 & 0.0 \\ (30 & 0.0 & 0.0 \\ (39 & 0.0 & 0.0 \\ (30 & 0.0 & 0.0 \\ (39 & 0.0 & 0.0 \\ (30 & 0.0 & 0.$ | <ctb> <cgb> <cbb> <fz7> <fz8> 0.0 <fz7> <fz8> 0.0 <fz7> <fz8> 0.0 <fz7> <fz7> <fz7> <fz7> <fz7> <cf25> <cf24> <cf23> <gbt> 0.0</gbt></cf23></cf24></cf25></fz7></fz7></fz7></fz7></fz7></fz8></fz7></fz8></fz7></fz8></fz7></cbb></cgb></ctb> | CGTT-GTE> CGTT-GTE> CGTT-GTE> CFZ1-GBE> CFZ1-GBE> CFZ1-FZ3> CFZ4-FZ3> CFZ5-FZ6> CFZ1-FZ4> CFZ1-FZ4> CFZ1-FZ4> CFZ1-FZ3> CFZ1-FZ3> | CGTER>) (GTRC>) (FPP>) (FPP>) (FPP>) (FR12>) (FR4>) (FR7>) (FR6>) | /* h_c /* c4 /* c2 /* c2 /* c1 /* cap /* c /* c /* c /* c /* c |
| * 14 RHP RHP CYL TRC CYL CYL CYL CYL CYL CYL CYL CYL CYL CY | $\left(\begin{array}{cccccccccccccccccccccccccccccccccccc$ | <pre><gtb> GBB> GBB> <egb> <egb> <egb> <egb> <ez3> 0.0 <fz3> 0.0 <fz5> <ez5> <ez55 <ez5=""> <ez5> <ez55 <ez55="" <ez55<="" td=""><td>(GTT-GTE) (FT2-GBB) (FT2-GBB) (FT2-GBB) (FT2-GBB) (FT2-GBB) (FT2-FT2)</td><td>CGTEF>) (GTRC>) (FPP>)) (FPP>)) (FP12>)) 1>) /** (FR12>)) (FR4>)) (FR4>)) (FR5>)) (CBBEC>))</td><td>/* h_r /* c4 /* c4 /* c2 /* c1 /* c1 /* c2 /* c1 /* c2 /* c4 /* c2 /* c1 /* c2 /* c3 /* c2 /* c4 /* c4</td></ez55></ez5></ez55></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></ez5></fz5></fz3></ez3></egb></egb></egb></egb></gtb></pre> | (GTT-GTE) (FT2-GBB) (FT2-GBB) (FT2-GBB) (FT2-GBB) (FT2-GBB) (FT2-FT2) | CGTEF>) (GTRC>) (FPP>)) (FPP>)) (FP12>)) 1>) /** (FR12>)) (FR4>)) (FR4>)) (FR5>)) (CBBEC>)) | /* h_r /* c4 /* c4 /* c2 /* c1 /* c1 /* c2 /* c1 /* c2 /* c4 /* c2 /* c1 /* c2 /* c3 /* c2 /* c4 /* c4 |

| * | ++ | +++++++ | CR216 | : CCLA : | 10 : | 2016 -2015 -2014 -2 | 2013 |
|------------------|----------------------|--|----------------|----------------------|--------------|--|---------------------------|
| * | ++ | ++++++ | * | | | -2008 -2005 -2004 | /* clad |
| VOUT | : : -1 | 000 : -100000 /* outer void | CR301 | : CZIR : | 1 : | 3001 | /* zr |
| REF1 | : REFL : | 8 : 100000 -50000 -70000 -10000 -30000 | CR302 | : CVO1 : | 0: | 3002 -3001 3003 -3002 | /* void /* U-ZrH |
| | | -500 -510 -520 | CR304 | : CV02 : | 0 : | 3004 -3003 | /* vd |
| | | -1016 | CR305 | : CSP1 : | 10 : | 3005 | /* sp1 /* woid |
| | | -3016 | CR307 | : CSPT : | 9 : | 3007 -3006 | /* spacer tube |
| | | -4016 | CR308 | : CV04 : | 0: | 3008 -3007 | /* void /* bottom plug |
| | | -6016 | CR310 | : CSP2 : | 10 : | 3010 | /* sp2 |
| | | -7016 | CR311 CR312 | : CB4C : | 11 : | 3011 - 3011 | /* b4c /* woid |
| | | -10013 -20013 -30013 /* water reflector | CR313 | : CSP3 : | 10 : | 3013 | /* sp3 |
| * SHRD | : SHRD : | 9 : 50000 -51000 /* shroud | CR314 CR315 | : CVO6 : : CTPL : | 0: | 3014 3015 | /* void /* top plug |
| * | | | CR316 | : CCLA : | 10 : | 3016 -3015 -3014 -3 | 3013 |
| GRIT | : GRIT : | 9 : 60000 -2000 -60110 -60120 -60130 -60140 -60150 -60160 | | | | -3012 -3010 -3009 -3008 -3005 -3004 | /* clad |
| | | -60210 -60220 -60230 -60240 -60250 -60260 | * CP/01 | . C7TD . | 1. | 4001 | /* ~~ |
| | | -60410 -60420 -60430 -60440 -60450 -60460 | CR402 | : CV01 : | 0 : | 4002 -4001 | /* void |
| | | -60510 -60520 -60530 -60540 -60550 -60560 -60610 -60620 -60630 -60640 -60650 -60660 | CR403 | : CFUE : | 2 : | 4003 -4002 | /* U-ZrH /* vd |
| GRIB | : GRIB : | 9 : 61000 -3000 | CR405 | : CSP1 : | 10 : | 4005 | /* sp1 |
| | | -60111 -60121 -60131 -60141 -60151 -60161 -60211 -60221 -60231 -60241 -60251 -60261 | CR406 CR407 | : CV03 : | 9 : | 4006 | /* void /* spacer tube |
| | | -60311 -60321 -60331 -60341 -60351 -60361 | CR408 | : CVO4 : | 0 : | 4008 -4007 | /* void |
| | | -60411 -60421 -60431 -60441 -60451 -60461 -60511 -60521 -60531 -60541 -60551 -60561 | CR409 CR410 | : CBPL : : CSP2 : | 10 : 10 : | 4009 4010 | /* bottom plug /* sp2 |
| | | -60611 -60621 -60631 -60641 -60651 -60661 | CR411 | : CB4C : | 11 : | 4011 | /* b4c |
| | | -60112 -60122 -60132 -60142 -60152 -60162 -60212 -60222 -60232 -60242 -60252 -60262 | CR412 CR413 | : CV05 : : CSP3 : | 10 : | 4012 -4011 4013 | /* void /* sp3 |
| | | -60312 -60322 -60332 -60342 -60352 -60362 | CR414 | : CV06 : | 0: | 4014 | /* void |
| | | -60412 -60422 -60432 -60442 -60452 -60462 -60512 -60522 -60532 -60542 -60552 -60562 | CR415 CR416 | : CTPL : : CCLA : | 10 : | 4015 -4015 -4014 -4 | /* top plug 1013 |
| * | | -60612 -60622 -60632 -60642 -60652 -60662 | | | | -4012 -4010 -4009 | /* clad |
| REF2 | : REFL : | 8 : 70000 -2000 -10000 /* water reflector | * | | | 4000 4000 -4004 | , ciau |
| REF3 | : REFL : | 8 : 51000 -60000 -61000 -1000 -2000 -3000 /* arid wh 1 | CR501 CR502 | : CZIR : | 1 : | 5001 5002 -5001 | /* zr /* void |
| REFG11 | : REFL : | 8 : 60110 OR 60111 OR 60112 /* grid wh 1 | CR502 | : CFUE : | 2 : | 5003 -5002 | /* U-ZrH |
| REFG12 REFG13 | : REFL : | 8 : 60120 OR 60121 OR 60122 /* grid wh 1 8 : 60130 OR 60131 OR 60132 /* grid wh 1 | CR504 | : CV02 : | 0: | 5004 -5003 5005 | /* vd /* sp1 |
| REFG14 | : REFL : | 8 : 60140 OR 60141 OR 60142 /* grid wh 1 | CR506 | : CV03 : | 0 : | 5006 | /* void |
| REFG15 REFG16 | : REFL : | 8 : 60150 OR 60151 OR 60152 /* grid wh 1 8 : 60160 OR 60161 OR 60162 /* grid wh 1 | CR507 | : CSPT : | 9: | 5007 -5006 | /* spacer tube /* woid |
| REFG21 | : REFL : | 8 : 60210 OR 60211 OR 60212 /* grid wh 2 | CR509 | : CBPL : | 10 : | 5009 | /* bottom plug |
| REFG22 REFG23 | : REFL : : REFL : | 8 : 60220 OR 60221 OR 60222 /* grid wh 2 8 : 60230 OR 60231 OR 60232 /* grid wh 2 | CR510 CR511 | : CSP2 : : CB4C : | 10 : 11 : | 5010 5011 | /* sp2 /* b4c |
| REFG24 | : REFL : | 8 : 60240 OR 60241 OR 60242 /* grid wh 2 | CR512 | : CV05 : | 0 : | 5012 -5011 | /* void |
| REFG25 REFG26 | : REFL : : REFL : | 8 : 60250 OR 60251 OR 60252 /* grid wh 2 8 : 60260 OR 60261 OR 60262 /* grid wh 2 | CR513 CR514 | : CSP3 : : CV06 : | 10 : | 5013 5014 | /* sp3 /* void |
| REFG31 | : REFL : | 8 : 60310 OR 60311 OR 60312 /* grid wh 3 | CR515 | : CTPL : | 10 : | 5015 | /* top plug |
| REFG32 REFG33 | : REFL : : REFL : | 8 : 60320 OR 60321 OR 60322 /* grid wh 3 8 : 60330 OR 60331 OR 60332 /* grid wh 3 | CR516 | : CCLA : | 10 : | -5012 -5010 -5009 | 013 |
| REFG34 | : REFL : | 8 : 60340 OR 60341 OR 60342 /* grid wh 3 | | | | -5008 -5005 -5004 | /* clad |
| REFG36 | : REFL : | 8 : 60360 OR 60361 OR 60362 /* grid wh 3 | CR601 | : CZIR : | 1 : | 6001 | /* zr |
| REFG41 REFG42 | : REFL : | 8 : 60410 OR 60411 OR 60412 /* grid wh 4 8 : 60420 OR 60421 OR 60422 /* grid wh 4 | CR602 | : CV01 : | 0: | 6002 -6001 6003 -6002 | /* void /* U-Z+H |
| REFG43 | : REFL : | 8 : 60430 OR 60431 OR 60432 /* grid wh 4 | CR604 | : CV02 : | 0 : | 6004 -6003 | /* vd |
| REFG44 REFG45 | : REFL : | 8 : 60440 OR 60441 OR 60442 /* grid wh 4 8 : 60450 OR 60451 OR 60452 /* grid wh 4 | CR605 | : CSP1 : | 10 : | 6005 6006 | /* sp1 /* void |
| REFG46 | : REFL : | 8 : 60460 OR 60461 OR 60462 /* grid wh 4 | CR607 | : CSPT : | 9 : | 6007 -6006 | /* spacer tube |
| REFG51 REFG52 | : REFL : | 8 : 60510 OR 60511 OR 60512 /* grid wh 5 8 : 60520 OR 60521 OR 60522 /* grid wh 5 | CR608 | : CVO4 : | 0: | 6008 -6007 | /* void /* bottom plug |
| REFG53 | : REFL : | 8 : 60530 OR 60531 OR 60532 /* grid wh 5 | CR610 | : CSP2 : | 10 : | 6010 | /* sp2 |
| REFG54 REFG55 | : REFL : | 8 : 60540 OR 60541 OR 60542 /* grid wh 5 8 : 60550 OR 60551 OR 60552 /* grid wh 5 | CR611 CR612 | : CB4C : | 11 : | 6011 6012 -6011 | /* b4c /* void |
| REFG56 | : REFL : | 8 : 60560 OR 60561 OR 60562 /* grid wh 5 | CR613 | : CSP3 : | 10 : | 6013 | /* sp3 |
| REFG61 REFG62 | : REFL : : REFL : | 8 : 60610 OR 60611 OR 60612 /* grid wh 6 8 : 60620 OR 60621 OR 60622 /* grid wh 6 | CR614 CR615 | : CV06 : : CTPL : | 0: | 6014 6015 | /* void /* top plug |
| REFG63 | : REFL : | 8 : 60630 OR 60631 OR 60632 /* grid wh 6 | CR616 | : CCLA : | 10 : | 6016 -6015 -6014 -6 | 5013 |
| REFG64 REFG65 | : REFL : : REFL : | 8 : 60640 OR 60641 OR 60642 /* grid wh 6 8 : 60650 OR 60651 OR 60652 /* grid wh 6 | | | | -6012 -6010 -6009 -6008 -6005 -6004 | /* clad |
| REFG66 | : REFL : | 8 : 60660 OR 60661 OR 60662 /* grid wh 6 | * CD101 | . C7TD . | 1. | 7001 | /* ~* |
| ETB1 | : VOIH : | 0 : 20000 /* void hex | SR101 SR102 | : CV01 : | 0 : | 7002 -7001 | /* void |
| ETB2 ETB3 | : EBTU : : VOIC : | 9 : 10000 -20000 /* tube hex 0 : 40000 /* void cvl | SR103 SR104 | : CFUE : : CVO2 : | 2: | 7003 -7002 7004 -7003 | /* U-ZrH /* vd |
| ETB4 | : EBTU : | 9 : 30000 -40000 /* tube cyl | SR105 | : CSP1 : | 10 : | 7005 | /* sp1 |
| * GTTA | : GUTU : | 10 : 500 -501 /* gt TA | SR106 SR107 | : CVO3 : : CSPT : | 0 : 9 : | 7006 7007 -7006 | /* void /* spacer tube |
| REF4 | : REFL : | 8 : 501 -10013 /* water reflector | SR108 | : CVO4 : | 0 : | 7008 -7007 | /* void |
| GTTB | : GUTU : | 10 : 510 -511 /* qt TB | SR109 SR110 | : CBPL : : CSP2 : | 10 : 10 : | 7009 | /* sp2 |
| REF5 | : REFL : | 8 : 511 -20013 /* water reflector | SR111 | : CB4C : | 11 : | 7011 | /* b4c |
| GTTC | : GUTU : | 10 : 520 -521 /* gt TC | SR112 SR113 | : CSP3 : | 10 : | 7013 | /* sp3 |
| REF5 | : REFL : | 8 : 521 -30013 /* water reflector | SR114 | : CV06 : | 0: | 7014 | /* void /* top plum |
| CR101 | : CZIR : | 1 : 1001 /* zr | SR115 SR116 | : CCLA : | 10 : | 7016 -7015 -7014 -7 | 7013 |
| CR102 CR103 | : CVO1 : : CFUE : | 0 : 1002 -1001 /* void 2 : 1003 -1002 /* II-ZrH | | | | -7012 -7010 -7009 -7008 -7005 -7004 | /* clad |
| CR104 | : CV02 : | 0 : 1004 -1003 /* vd | * | | | 0001 | |
| CR105 CR106 | : CSP1 : : CVO3 : | 0 : 1006 /* spl | SR201 SR202 | : CZIR : : CV01 : | 1 : 0 : | 8002 -8001 | /^ zr /* void |
| CR107 | : CSPT : | 9: 1007 -1006 /* spacer tube | SR203 | : CFUE : | 2: | 8003 -8002 | /* U-ZrH /* vrd |
| CR108 | : CBPL : | 10 : 1009 /* bottom plug | SR204 SR205 | : CSP1 : | 10 : | 8005 | /* sp1 |
| CR110 | : CSP2 : | 10 : 1010 /* sp2 | SR206 | : CV03 : | 0: | 8006 | /* void |
| CR112 | : CV05 : | 0 : 1012 -1011 /* void | SR208 | : CV04 : | 0 : | 8008 -8007 | /* void |
| CR113 CR114 | : CSP3 : | 10 : 1013 /* sp3 0 : 1014 /* void | SR209 | : CBPL : | 10 : 10 · | 8009 8010 | /* bottom plug /* sp2 |
| CR115 | : CTPL : | 10 : 1015 /* top plug | SR210 | : CB4C : | 11 : | 8011 | /* b4c |
| CR116 | : CCLA : | 10 : 1016 -1015 -1014 -1013 -1012 -1010 -1009 | SR212 SR213 | : CV05 : | 0 : 10 · | 8012 -8011 8013 | /* void /* sp3 |
| | | -1008 -1005 -1004 /* clad | SR213 | : CV06 : | 0 : | 8014 | /* void |
| * CR201 | : CZIR : | 1 : 2001 /* zr | SR215 SR216 | : CTPL : : CCLA : | 10 : 10 ; | 8015 8016 -8015 -8014 -8 | /* top plug 3013 |
| CR202 | : CV01 : | 0 : 2002 -2001 /* void | | | | -8012 -8010 -8009 | (+ -1-3 |
| CR203 CR204 | : CFUE : : CVO2 : | ∠ : 2003 -2002 /* U-ZrH 0 : 2004 -2003 /* vd | * | | | -8008 -8005 -8004 | / * clad |
| CR205 | : CSP1 : | 10 : 2005 /* sp1 | TA101 | : TB4C : | 12 : | 10001 | /* b4c |
| CR205 CR207 | : CSPT : | 9: 2007 -2006 /* spacer tube | TA102 TA103 | : TSP1 : | 9: | 10003 | /* sp1 |
| CR208 | : CV04 : | 0 : 2008 -2007 /* void | TA104 | : TV02 : | 0: | 10004 | /* void |
| CR210 | : CSP2 : | 10 : 2010 /* sp2 | TA105 | : TVO3 : | 0 : | 10006 -10005 | /* void |
| CR211 | : CB4C : | 11 : 2011 /* b4c 0 : 2012 -2011 /* word | TA107 | : TBPL : | 9: | 10007 | /* bottom plug /* sp2 |
| CR212 CR213 | : CSP3 : | 10 : 2013 /* sp3 | TA108 | : TV04 : | 0: | 10009 | /* void |
| CR214 CR215 | : CV06 : | 0 : 2014 /* void 10 : 2015 /* top plug | TA110 TA111 | : TSPT : : TV05 · | 9 : 0 · | 10010 -10009 10011 -10010 | /* spacer tube /* void |
| | | · · · · · · · · · · · · · · · · · · · | | | | | |

JAEA-Research 2025-001

| * TB101 | . ICHA | : | 9 9 | : 1001 : 1001 _ | .2 /* top plug .3 -10002 -10003 -10006 10007 -10008 -10011 10012 /* clad |
|--|---|--|---|--|--|
| | : TB4C | : | 12 | : 200 | 01 /* b4c |
| TB102 | : TV01 | : | 0 | : 2000 | 2 -20001 /* void |
| TB103 TB104 | : TSP1 : TVO2 | - | 9 | : 2000 |)3 /* spl)4 /* void |
| TB105 | : TFOL | : | 9 | : 2000 | 05 -20004 /* follower tube |
| TB106 TB107 | : TVO3 : TBPL | : | 0 9 | : 2000 |)6 -20005 /* void)7 /* bottom plug |
| TB108 | : TSP2 | : | 9 | : 2000 |)8 /* sp2 |
| TB110 | : TSPT | - | 9 | : 2001 | 10 -20009 /* spacer tube |
| TB111 TB112 | : TV05 | : | 0 9 | : 2001 | .1 -20010 /* void |
| TB113 | : TCLA | : | 9 | : 2001 | 3 -20002 -20003 -20006 |
| | | | | - | 20007 -20008 -20011 20012 /* clad |
| * | | | 1.0 | 200 | 01 (+). 4- |
| TC101 | : TV01 | : | 0 | : 3000 | 02 -30001 /* void |
| TC103 | : TSP1 | : | 9 | : 3000 |)3 /* sp1 |
| TC105 | : TFOL | : | 9 | : 3000 | 05 -30004 /* follower tube |
| TC106 TC107 | : TVO3 : TBPL | : | 0 9 | : 3000 : 3000 | 06 -30005 /* void 07 /* bottom plug |
| TC108 | : TSP2 | : | 9 | : 3000 |)8 /* sp2 |
| TC110 | : TSPT | | 9 | : 3001 | 10 -30009 /* spacer tube |
| TC111 TC112 | : TV05 | : | 0 9 | : 3001 | .1 -30010 /* void |
| TC113 | : TCLA | | 9 | : 3001 | 3 -30002 -30003 -30006 |
| | | | | - | 30007 -30008 -30011 30012 /* clad |
| * | | . 1 | 0.0 | . 10 | 10000 |
| LAT2 | : LAT2 | : -2 | 00 | -10 | -1016 -2016 -3016 -4016 -5016 -6016 -7016 -8016 013 -20013 -30013 /* U-ZrH 00 -10000 -30000 |
| | | | | -10 -60110 -60210 -60310 -60410 -60510 | 500 -510 -520 -1016 -2016 -2016 -4016 -5016 -5016 -6016 -7016 -60120 -60130 -60140 -60150 -60160 -60120 -60130 -60140 -60150 -60260 -60220 -60230 -60240 -60350 -60360 -60420 -60430 -60440 -60450 -60360 -60520 -60530 -60540 -60550 -60560 |
| LAT3 | : LAT3 | : -3 | 00 | : 30 | /* over U-ZrH 1016 2016 2016 3016 4016 5016 -5016 -6016 -7016 -0015 |
| | | | | -10 -60111 -60211 -60311 -60411 -60511 | -8016 013 -20013 -30013 -60121 -60131 -60141 -60151 -60161 -60221 -60231 -60241 -60251 -60261 -60321 -60331 -60341 -60351 -60361 -60421 -60431 -60441 -60451 -60561 -60521 -605541 -60551 -60561 |
| | | | | -60611 -60112 -60212 -60312 -60412 -60512 -60612 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60322 -60332 -60322 -60322 -60362 -60422 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60552 -60554 -605562 -60622 -60642 -60552 -60564 |
| * *]2++i~~ | . 100 | | | -60611 -60112 -60212 -60312 -60412 -60512 -60612 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60332 -60242 -60352 -60362 -60322 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60552 -60554 -605562 -60622 -60632 -60642 -60552 -60662 -/* under U-ZrH |
| * * lattice | 2 100 | | | -60611 -60112 -60212 -60312 -60412 -60512 -60612 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60232 -60242 -60252 -60262 -60322 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60552 -60554 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH |
| * * lattice #CELL ID C101 | ≥ 100 (1) TYPE : | :(HEXA : -9 | .) 99 | -60611 -60112 -60212 -60312 -60412 -60512 -60612 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60232 -60242 -60252 -60262 -60322 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-2rH |
| * * lattice * #CELL ID C101 C102 C103 | 2 100 (1) TYPE : MODE : CLAT | :(HEXA : -9 |) 99 7 3 | -60611 -60112 -60212 -60312 -60412 -60512 -60612 : -10 : 1 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60232 -60242 -60252 -60262 -60322 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60662 /* under U-ZrH |
| * * lattice * Cl01 Cl02 Cl03 Cl04 c104 | 2 100 (1) TYPE : : MODF : CLAT : VOD1 | :(HEXA : -9 ::) : |) 99 7 3 0 | -60611 -60112 -60212 -60312 -60412 -60512 -60612 : -10 : 1 : 1 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60322 -60332 -60342 -60352 -60362 -60432 -60332 -60342 -60352 -60362 -60432 -60432 -60442 -60552 -60562 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH |
| * lattice * lattice CELL ID C101 C102 C103 C104 C105 C106 | e 100 (1) TYPE : MODF : CLAI : VODJ : FUEI : VODJ | :(HEXA : -9 : : : : | .) 99 7 3 0 2 0 | -60611 -60112 -60212 -60312 -60412 -60512 -60612 : 1 : 1 : 1 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH |
| * * lattice * total Clo1 Clo2 Clo3 Clo4 Clo5 Clo6 Clo5 Clo6 Clo7 Clo5 Clo6 Clo7 Clo5 Clo7 Clo5 Clo7 Clo7 Clo7 Clo7 Clo7 Clo7 Clo7 Clo7 | 100 (1) TYPE : MODF : CLAT : VODJ : FUEI : VODJ : ZIRC | (HEXA : -9 : : : : : : : : |) 99 7 3 0 2 0 1 | -60611 -60112 -60212 -60312 -60412 -60512 -60612 : 1 : 1 : 1 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60322 -60332 -60342 -60352 -60362 -60422 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60562 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60652 -60662 /* under U-ZrH |
| * * dattice Ccl01 C102 C103 C104 C105 C106 C107 #END CEL1 * | 100 (1) TYPE : MODF : CLAT : VODJ : FUEI : VODJ : ZIRC | (HEXA : -9 : : : : | .) 99 7 3 0 2 0 1 | -60611 -60112 -60212 -60312 -60412 -60512 -60612 : 1 : 1 : 1 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60422 -60532 -60542 -60552 -60562 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH |
| * * lattice * CI01 C102 C103 C104 C105 C106 C107 * * CELL IDI * C101 C102 C103 C104 C105 C107 | e 100 (1) TYPE : MODE : CLAR : VODJ : FUEL : VODZ : ZIRC (2) TYPE | : (HEXA : -9 : : : : : : : : : : : : |) 99 3 0 2 0 1 | -60611 -60112 -60212 -60312 -60312 -60512 -60612 : 1 : 1 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60322 -60332 -60342 -60352 -60362 -60432 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH |
| * * lattice Cl01 Cl02 Cl03 Cl04 Cl05 Cl06 Cl07 #END CELI * #CELL ID/ C201 C201 C201 | e 100 (1) TYPE : MODF : CLAT : VODJ : FUEI : VOZ : ZIRC : : : : : : : : : : : : : : : : : : : | C (HEXA) : -9 : : : : : : : : : : : : : |) 99 7 3 0 2 0 1) 99 8 | -60611 -60112 -60212 -60312 -60312 -60512 -60612 : 1 : 1 : 2 : 2 : -10 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60322 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH |
| * * * * * * * * * * * * * * | 100 TYPE MODE CLAI FUEI VOD2 ZIRC ZIRC XEFI REFI | 2 (HEXA : -9 : : : : : : : : : : : -9 |) 99 7 3 0 2 0 1) 99 8 | -60611 -60112 -60112 -60312 -60412 -60512 -60612 -60612 - : 1 : 1 : 2 : 2 : -10 : 1 : 1 : 2 : 2 : -10 : 1 : 1 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 : 2 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH 00 -14 /* moderator 14 -13 /* cladding 13 -12 /* void 12 -11 /* u-zrh 10 /* zr |
| * * lattice * CELL ID C101 C102 C103 C104 C105 C107 #END CELL * #CELL ID C201 END CELL * #CELL ID * * * * * * * * * * * * * | 100 (1) TYPE : MODE : CLAT : VODI : FUEL : VODI : ZIRC : REFI : REFI : 3) TYPE | 2 (HEXA : -9 : : : : : : : : : (HEXA : -9 : : : : : : | .) 99 3 0 2 0 1 .) 99 8 .) | -60611 -60112 -60212 -60312 -60412 -60512 -60612 -60612 - : 1 : 1 : 2 : 2 : -10 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60322 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60652 -60662 /* under U-ZrH |
| * lattice * cELL ID C101 C102 C103 C104 C105 C106 C107 * cELL ID C201 * enc CELI * * cELL ID C201 C202 * cELI ID C201 C202 * cELI ID C201 C202 * cELI ID C202 C203 C104 C203 C204 C203 C204 | 100 (1) TYPE : MODF : CLAT : VODJ : FUEI : VODZ : ZIRC : ZIRC : REFI : REFI : REFI : REFI : REFI : REFI | AXEH) 2 : - : - : - : - : - : - : - | .) 99 7 3 0 2 0 1 .) 99 8 .) 99 8 .) 99 8 | -60611 -60112 -60212 -60312 -60412 -60512 -60612 -60612 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60322 -60332 -60342 -60352 -60362 -60432 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH |
| * * lattice * CIO1 CIO2 CIO3 CIO4 CIO5 CIO6 CIO7 * #END CELI * CCLI ID C202 #END CELI C302 C302 END CELI C302 C3 | 100 TYPE MODE CLAH VODI FUEI VODI ZIRC ZIRC TYPE REFI XEFI | <pre>2 (HEXA) 2</pre> |) 999 20 1) 999 8) 998 | -60611 -60112 -60212 -60312 -60312 -60512 -60612 -60512 -60612 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60322 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 -60622 -60632 -60642 -60652 -60662 -7* under U-ZrH /* under U-ZrH |
| * * * * * * * * * * * * * * | 100 (1) TYPE : MODE : CLAI : YODI : FUEI : VODI : EVEI : REFI : REFI : TYPE : REFI : (4) TYPE | <pre>C (HEXA) : -9 : : ::::::</pre> |) 99 30 20 1) 99 8) 99 8) | -60611 -60112 -60112 -60412 -60412 -60512 -60612 -60612 -60612 -60612 -70612 -70612 -70612 -70712 -7 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 -60622 -60632 -60642 -60652 -60662 -7* under U-ZrH /* under U-ZrH |
| * * lattice * CELL ID. C102 C103 C104 C105 C106 C106 C107 * C201 C201 C201 C202 FEND CELL ID. C302 * C302 * C401 C402 C401 C402 C401 C402 C401 | a 100 (1) TYPE : MODF : CLAT : VODD : VODD : ZIRC : : REFI : : REFI : : REFI : : REFI : : REFI : : . | <pre>C (HEXA) C (HEXA</pre> |)99730201)998)998)998)998 | -60611 -60112 -60112 -60412 -60412 -60412 -60412 -60412 -60412 -60412 -60412 -60412 -7 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60562 -60622 -60632 -60642 -60652 -60662 /* under U-ZrH |
| * * * * CELL ID C101 C102 C103 C104 C105 C106 C107 * * CELL ID C201 * * CELL ID C301 * * CELL ID C302 * * CELL ID C302 * * CELL ID C302 * * * CELL ID C401 C402 C402 C401 C402 C402 C402 C402 C402 C402 C402 C402 | 100 1) TYPE CLAIN CODE | C (HEXA : -9 : : : : : : : : : : : : : : : |) 99 20 1) 99 8) 99 8) 99 7 | -60611 -60112 -60112 -60312 -60412 -60512 -60612 -60612 -60612 -700512 -60612 -700512 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60322 -60332 -60342 -60352 -60362 -60432 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH |
| * * * * * * * * * * * * * * * * * * * | 100 TYPE MODE CLAL VODD VODD VODD VODD ZIRC (2) TYPE REFI (3) TYPE REFI (4) TYPE MODE (5) TYPE | C (HEXA : -9 : : : : : : : : : : : : : : : |) 997 30201) 998)) 998)) 998)) 997 | -60611 -60112 -60112 -60312 -60412 -60412 -60412 -60412 -60612 -60612 -60612 -60612 -60612 -60612 -60612 -60612 -60612 -60612 -60612 -60612 -60612 -60612 -60712 -70712 -7 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60322 -60332 -60342 -60352 -60362 -60432 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60652 -60662 -60622 -60632 -60642 -60652 -60662 /* under U-ZrH |
| * * lattice * CELL ID C101 C102 C103 C104 C105 C106 C107 * END CELL ID C201 C301 C302 * END CELL ID C401 C402 C402 * * C401 C402 C404 C402 C404 C4 | 100 TYFF : MODF : CLAL : VODJ : VODJ : VODJ : REFI : REFI : MODF : MODF : MODF : MODF : STOP : MODF : MODF : STOP : MODF : STOP <li: li="" stop<=""> : STOP <li: li="" stop<=""> <li:< td=""><td>AXEH) 2 - 4 - 5 - 5 - 7 - 7 - 7 - 7 - 7 - 7 - 7 - 7</td><td>) 99 30 20 1) 99 8) 99 8) 99 7) 99 9 9 9 9 9 9 9 9 9 9 9 9</td><td>-60611 -60112 -60112 -60312 -60412 -60412 -60512 -60512 -60512 -60512 -70512 -70512 -715 -715 -715 -715 -715 -715 -715 -715</td><td>-60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 -60622 -60632 -60642 -60552 -60662 -7* under U-ZrH /* under U-ZrH</td></li:<></li:></li:> | AXEH) 2 - 4 - 5 - 5 - 7 - 7 - 7 - 7 - 7 - 7 - 7 - 7 |) 99 30 20 1) 99 8) 99 8) 99 7) 99 9 9 9 9 9 9 9 9 9 9 9 9 | -60611 -60112 -60112 -60312 -60412 -60412 -60512 -60512 -60512 -60512 -70512 -70512 -715 -715 -715 -715 -715 -715 -715 -715 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 -60622 -60632 -60642 -60552 -60662 -7* under U-ZrH /* under U-ZrH |
| * * * * * * * * * * * * * * | <pre>> 100 TYPEY CALANT TYPEY CALANT TYPEY TYPE TYPE</pre> | <pre>AKH) 1 S (HEXA) S (HEXA) C (HEXA)</pre> |) 999 302 01) 9988) 9988) 9988) 9988) 9988) 9988) 9988) 9988) 9988) 9988) 9988) 9988) 9988) 9988) 9988) | -60611 -60112 -60112 -60312 -60312 -60412 -60412 -60412 -60412 -60412 - -60412 - - -60412 - - - - - - - - - - - - - - - - - - - | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH /* under U-ZrH /* cladding 13 -12 /* void 12 -11 /* u-zrh 11 -10 /* void 10 /* zr /* water reflector /* water reflector |
| * * lattice * CELL ID. C101 C102 C103 C104 C105 C106 C107 *END CELL * * CELL ID. C302 * * C201 C302 * * C201 C302 * * C201 C302 * * C201 C302 * * * C201 C302 * * * * * * * * * * * * * | 100 1) TYPE CIALAT VODDA VODDA VODDA VODA | <pre>C (HEXA) : -9 : : : -9 : : : -9 : : : -9 : : (HEXA + -9 : -9 : : : -9 : : : -9 : : : -9 : : : -9 : : : -9 : : : -9 : : : -9</pre> |) 997 302 01) 998) 998) 998) 997) 998) 997) 998) 997) 998) 997) 998) 997) 998) 997) 9988) 99888) 99888) 99888) 99888) 99888) 99888) 99888) 998888) 998888) 9988888) 9988888) 99888888) 99888888) 998888888) 998888) 99888888) 99888888) 9988888) 9988888888) 9988888888) 998888888) 9988888888)) 99888888888)) 9988888888)) 998888888888 | -60611 -60112 -60112 -60122 -60312 -60412 -60412 -60412 -60412 -60412 - -60412 - - -60412 - - - - - - - - - - - - - - - - - - - | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH /* under U-ZrH /* cladding 13 -12 /* void 12 -11 /* u-zrh 11 -10 /* void 10 /* zr /* water reflector /* water reflector |
| * * * * * * * * * * * * * * * * * * * | <pre>100 1) TYPE : MODF : CIALA : VODJ : VUDJ : VUDJ : VUDJ : VUDJ : REFI : REF</pre> | C (HEXA) C (HEX |) 99 30 20 1) 99 8) | -60611 -60112 -60122 -60312 -60412 -60412 -60412 -60512 -70 -71 -71 -71 -71 -71 -71 -71 -71 -71 -71 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60322 -60332 -60342 -60352 -60362 -60432 -60432 -60442 -60352 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH 00 -14 /* moderator /* under U-ZrH 10 /* void 12 -11 /* void 12 -11 /* void 10 /* zr 10 /* water reflector 10 /* moderator 10 /* moderator 10 /* water reflector |
| * | 100 TYPE MODE CLAL VODJ | <pre>C (HEXA) C (HEXA</pre> | | -60611 -60112 -6012 -60312 -60312 -60412 -60412 -60412 -60512 -60512 -60512 -60512 -60512 -60512 - -60512 - - -60512 - - - - - - - - - - - - - - - - - - - | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60322 -60332 -60342 -60352 -60362 -60432 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH |
| * * * * * * * * * * * * * * | 100 1) TYPE : MODE : CUAL : VODJ : VODJ : VODJ : VODJ : REFI : REFI : MODE : TYPE : MODE : MODE | <pre>AXAH): - 4 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5</pre> |) 99730201)998)998)998)998)998)997)998)9977 | -60611 -60112 -60122 -60312 -60312 -60412 -60512 -60512 -60512 -60512 -60512 -60512 -60512 -60512 -60512 -60612 : 1 : 1 : 1 : 1 : -11 : 1 : -11 : 1 : -11 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH /* under U-ZrH /* cladding 13 -12 /* void 12 -11 /* u-zrh 10 /* zr)00 /* water reflector)00 /* water reflector)00 /* water reflector)00 /* moderator)00 /* water reflector |
| * * * * * * * * * * * * * * | 100 TYPE MODE CLALA YODD FUEL YODD ZIRC REFI MODE STYPE MODE STYPE MODE STYPE YODD TYPE MODE TYPE MODE REFI YODD TYPE TYPE MODE TYPE STREFI MODE TYPE TYPE | AXAH): - : - : - : - : - : - : - : - : - : - : - : - : - : |) 99 7 3 0 2 0 1) 99 8 8) 99 9 7 8 8 8 8 8 8 8 9 9 9 9 9 9 9 9 9 9 9 9 9 | -60611 -60112 -60122 -60312 -60412 -60412 -60512 -70 -71 -71 -71 -71 -71 -71 -71 -71 -71 -71 | -60621 -60631 -60641 -60651 -60661 -60122 -60132 -60142 -60152 -60162 -60222 -60332 -60342 -60352 -60362 -60422 -60432 -60442 -60452 -60462 -60522 -60532 -60542 -60552 -60562 -60622 -60632 -60642 -60552 -60662 /* under U-ZrH /* udertor /* under U-ZrH /* cladding 13 -12 /* void 12 -11 /* u-zrh 11 -10 /* void 10 /* zr /* water reflector /* water reflector |

| C606 C607 C608 C609 | : : : | VOIO GRAO PLUO CAPO | : | 0 6 4 4 | : | 21 20 22 24 | -2 | 0 | | | /* /* /* /* | void graphite top plug top c1 top c2 |
|-------------------------------|-----------|------------------------------|-----------------|------------------|----------|----------------------|-----------|--------------|--------------|------------------|----------------------|--|
| C610 C611 C612 | : | CAPO CAPO GRIT | : | 4 4 9 | : | 25 26 220 | -2 | 27 | | | /* /* /* | top c3 top grid |
| #END CELL * #CELL ID(7) | | TYPE | (HEXA | , | | | | | | | | |
| C701 C702 | : | REFL | : -99 | 9 8 | : | -200 | | | | | /* | water reflector |
| C703 C704 | ÷ | REFL GRIT | : | 8 9 | : | 230 220 | | | | | /* /* /* | water reflector top grid |
| #END CELL * | | | | | | | | | | | | |
| #CELL ID(8) C801 | : | TYPE | (HEXA : -99 |) 99 | : | -200 | | | | | | |
| C802 C803 | : | REFL REFL | : | 8 8 | : | 210 27 | | | | | /* /* | water reflector water reflector |
| C804 C805 | : | REFL GRIT | : | 8 9 | : | 230 220 | -2 | 27 | | | /* /* | water reflector top grid |
| #END CELL * | | TWDE | (1157.5 | | | | | | | | | |
| C901 | : | DELL | : -99 | 99 | : | -200 | | | | | /* | water reflector |
| C903 | ÷ | REFL | : | 8 | ÷ | 28 | | | | | /* /* | water reflector |
| C905 | : | GRIT | : | 9 | : | 220 | -2 | 28 | | | ′/* | top grid |
| * * #CELL TD(1) | 2) | TYPE | C (HEX) | A.) | | | | | | | | |
| C1001 | : | REFL | : -9! | 99 8 | : | -200 | | | | | /* | water reflector |
| C1003 | ÷ | REFL | : | 8 | ÷ | 230 | | | | | /* /* | water reflector |
| #END CELL | • | 01121 | • | 2 | • | 220 | | | | | <i>′</i> | cop grid |
| * lattice 3 * | 300 |) | | | | | | | | | | |
| #CELL ID(11 C1101 | 1) | TYPI | E (HEX | A) 99 | | -300 | | | | | | |
| C1102 C1103 | ÷ | REFL MODU | : | 8 | - | 40 | -3 | 30 - 32 - | -31 | -34 | 1 | * water reflector /* moderator |
| C1104 C1105 | ÷ | CLAU | - | 3 | ÷ | 34 | - | 85 - 87 - | -36 | | /: | cladding |
| C1106 C1107 | ÷ | GRAU MOLU | : | 6 | - | 37 38 | | | | | /* /* | graphite mo |
| C1108 C1109 | ÷ | PLUU CAPU | : | 4 | - | 35 33 | | | | | /* /* | bottom plug bottom c1 |
| C1110 | ÷ | CAPU | : | 4 | ÷ | 32 | | | | | /* /* | bottom c2 bottom c3 |
| C1112 C1113 | ÷ | CAPU | - | 4 | - | 30 310 |) -: | 39 - | -40 | | '/* /* | bottom c4 * bottom grid |
| #END CELL * | | | | | | | | | | | | , , , , , , , , , , , , , , , , , , , |
| #CELL ID(12 C1201 | 2) | TYPE | E(HEX -9 | A) 99 | : | -300 | | | | | | |
| C1202 C1203 | : | REFL GRIB | : | 8 9 | : | 320 310 | | | | | /* /* | water reflector bottom grid |
| #END CELL * | | | | | | | | | | | | |
| #CELL ID(13 C1301 | 3) | TYPI | E(HEX. : -9! | A) 99 | : | -300 | | | | | | |
| C1302 C1303 | : | REFL REFL | : | 8 8 | : | 39 40 | | | | | /* /* | water reflector water reflector |
| C1304 C1305 | : | REFL GRIB | : | 8 9 | : | 320 310 |)) =: | 39 - | -40 | | /* | water reflector * bottom grid |
| #END CELL * | | | | | | | | | | | | |
| #CELL ID(14 C1401 | 4) : | TYPE | E(HEX : -9 | A) 99 | : | -300 | | | | | <i>.</i> . | |
| C1402 C1403 | : | REFL | : | 8 | : | 41 320 |) | 4.1 | | | /* | water reflector water reflector |
| #END CELL | • | GRID | • | 5 | • | 210 | , | 4 L | | | /- | bottom grid |
| +CELL ID(15 | 5) | TYPE | E (HEX | A) | | -300 | | | | | | |
| C1502 | ÷ | REFL | : -9: | 8 | : | 320 | | | | | /* /* | water reflector |
| #END CELL | • | GRID | • | 5 | • | 510 | | | | | <i>′</i> | bottom grid |
| * #TATIV DECI | 101 | | | | | | | | | | | |
| DEFINE @F | UE | 1 (FU | JEL M | ODF | CL | AD ZI | IRC | VOE | 01 VC | D2) | | |
| DEFINE @F | UE | 3 (FU | JEL C | FUE | MO | DR CI | LAD | ZIF | C VC | D1 VO | D2 TU |) |
| DELTINE (IN | | MODU | CLAU CSP1 | JG | RAU | PLUU | I CA | PU P2 | MOLU CB4C | GRIT CSP3 | GR: CTI | IB SHRD PL |
| | | CCLA TB4C | TSPI | | FOL | TBPI | . TS | P2 | TSPT | TTPL | TCI | |
| * SEND GEOMET | rr | , | | | | | | | | | | , |
| * \$TALLY | | - | | | | | | | | | | |
| & LABEL(FU | EL | CELI | L NEU | rrc | N F | LUX 1 | 120 | ENE | RGY | GROUP |) | |
| EVENT (TR NEUTRON | AC | к) | | | | | | | | | , | |
| DIMENSION REGION(@ | I (FU | REGI | ION F | ENE | RGY |) | | | | | | |
| IENERGY (| 11 | 1 2 12 | 3 13 1 | 4 | 5 15 | 6 16 | 7 17 | 8 18 | 9 19 | 10 20 | | |
| 1 | 21 31 | 22 32 | 23 2 33 3 | 4 4 | 25 35 | 26 36 | 27 37 | 28 38 | 29 39 | 30 40 | | |
| 4 | 41 51 | 42 52 | 43 4 53 5 | 4 4 | 45 55 | 46 56 | 47 57 | 48 58 | 49 59 | 50 60 | | |
| (| 61 71 | 62 72 | 63 6 73 7 | 4 4 | 65 75 | 66 76 | 67 77 | 68 78 | 69 79 | 70 80 | | |
| 8 | 31 91 | 82 92 | 83 8 93 9 | 4 4 | 85 95 | 86 96 | 87 97 | 88 98 | 89 99 | 90 100 | | |
| 1 | 01 11 | 102 112 | 103 1 113 1 | 04 | 105 | 5 106 5 116 | 10 11 | 7 1 7 1 | 08 1 18 1 | 09 110 19 120 |) | |
| & LABEL(FU | EI | CELI | L AND | CF | UE | NEUTH | RON | FLU | X 12 | 0 ENE | RGY | GROUP) |
| EVENT (TR NEUTRON | LAC | K) | | | | | | | | | | |
| DIMENSION REGION(@ | FU | REGI E3) | ION E | INE | RGY |) | | | | | | |
| IENERGY (| 11 | 1 2 12 | 3 13 1 | 4 | 5 15 | 6 16 | 7 17 | 8 18 | 9 19 | 10 20 | | |
| 1 | 21 31 | 22 32 | 23 2 33 3 | 4 | 25 35 | 26 36 | 27 37 | 28 38 | 29 39 | 30 40 | | |
| 4 | 41 51 | 42 52 | 43 4 53 5 | 4 | 45 55 | 46 56 | 47 57 | 48 58 | 49 59 | 50 60 | | |
| 6 | 61 | 62 | 63 6 | 4 | 65 | 66 | 67 | 68 | 69 | 70 | | |

JAEA-Research 2025-001

LABEL(FUEL AND CFUE NEUTRON FLUX 120 ENERGY GROUP) EVENT(TRACK) LABEL (FULL.) EVENT (TRACK) NEUTRON DIMENSION (RECION ENERGY) REGION (@FUE2) 11 12 13 14 15 1 12 22 23 24 25 2 31 32 33 34 35 2 41 42 43 44 45 -51 52 53 54 55 ~ 4 65 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120) LABEL (FUEL NEUTRON FLUX 120 ENERGY GROUP) EVENT (TRACK) EVENT(TRACK) NEUTRON DIMENSION (REGION ENERGY) REGION (TUGL) IENERGY (1 2 3 4 5 6 7 8 9 10 21 22 23 24 25 26 27 28 29 30 31 32 33 44 55 66 77 88 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 61 82 83 84 85 86 87 88 89 90 51 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120) NEUTE 111 112 113 114 115 116 117 118 119 12 LABEL (MOGR NEUTRON FLUX 120 ENERGY GROUP) EVENT(TRACK) NEUTRON DIMENSION (REGION ENERGY) REGION (MOGR) IENERGY (1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 77 78 78 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 11 111 112 113 114 115 116 117 118 119 12 LABEL (REFL NEUTRON FLUX 120 FMERCY GPOID > 111 112 113 114 115 116 117 118 119 120)
LABEL (REFL NEUTRON FLUX 120 ENERGY GROUP)
EVENT(TRACK)
NEUTRON
DIMENSION (REGION ENERGY)
REGION(REFL)
11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 78 79 80
61 62 63 64 65 66 67 68 69 70
71 72 73 74 75 76 77 78 79 80
61 82 83 84 85 86 87 78 88 89 90
0101 02 103 104 105 106 107 108 109 110
111 112 113 114 115 116 117 118 119 120) & LABEL(THE NUMBER OF NUFISSION PER SOURCE) EVERY(TRACK) NEUTRON DIMENSION (REGION) REGION(@FUE1) MACRO(NUFISSION) LABEL(THE NUMBER OF FISSION PER SOURCE) EVENT(TRACK) NEUTRON DIMENSION (REGION) REGION(@FUE1) MACRO(FISSION) LABEL (THE NUMBER OF NON-FISSION CAPTURE PER SOURCE) EVENT (TRACK) NEUTRON DIMENSION (REGION) REGION(@FUE1) REGION(@FUE1) MACRO(CAPTURE) LABEL(THE NUMBER OF NUFISSION PER SOURCE) EVENT(TRACK) NEUTRON NEUTRON DIMENSION (REGION) REGION(@FUE2) MACRO(NUFISSION) LABEL(THE NUMBER OF FISSION PER SOURCE) EVENT(TRACK) NEUTRON DIMENSION (REGION) REGION(@FUE2) MACRO(FISSION) LABEL (THE NUMBER OF NON-FISSION CAPTURE PER SOURCE) EVENT (TRACK) DIMENSION (REGION) REGION(@FUE2) MACRO(CAPTURE) æ LABEL(THE NUMBER OF NON-FISSION CAPTURE PER SOURCE) EVENT(TRACK) NUUTEON DIMENSION (REGION) REGION(@PUES) MACRO(CAPTURE) LABEL (THE NUMBER OF NON-FISSION CAPTURE PER SOURCE) EVENT (TRACK)

NEUTRON DIMENSION (REGION) REGION(FUEL) MACRO(CAPTURE) LABEL (THE NUMBER OF NON-FISSION CAPTURE PER SOURCE) EVENT (TRACK) DIMENTRON DIMENSION (REGION) REGION(CFUE) MACRO(CAPTURE) £ LABEL(THE NUMBER OF NON-FISSION CAPTURE PER SOURCE) EVENT(TRACK) EVENT(TRACK) NEUTRON DIMENSION (REGION) REGION(MODR) MACRO(CAPTURE) LABEL(THE NUMBER OF NON-FISSION CAPTURE PER SOURCE) EVENT(TRACK) NEUTRON DIMENSION (REGION) REGION(CLAD) MACRO(CAPTURE) LABEL(THE NUMBER OF NON-FISSION CAPTURE PER SOURCE) EVENT(TRACK) EVENII (INC.) NEUTRON DIMENSION (REGION) REGION (ZIRC) REGION(ZIRC) MACRO(CAPTURE) LABEL (THE NUMBER OF NON-FISSION CAPTURE PER SOURCE) EVENT (TRACK) NEUTRON DIMENSION (REGION) REGION(@NOCR) MACRO(CAPTURE) LABEL(THE NUMBER OF NON-FISSION CAPTURE PER SOURCE) EVENT(TRACK) NEUTRON NEUTRON DIMENSION (REGION) REGION(REFL) MACRO(CAPTURE) \$END TALLY KINETICS PARAMETERS *----+----\$PERTURBATION & ID(1) LD(1) LABEL(KINETICS PARAMETERS) BEFF \$END PERTURBATION *_____* SOURCE * NR =%NREG WGTF(<NR>(1.0))

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