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**SCALE-4 Analysis of Pressurized Water  
Reactor Critical Configurations:  
Volume 2 — Sequoyah  
Unit 2 Cycle 3**

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DEPARTMENT OF ENERGY

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Computational Physics and Engineering Division

**SCALE-4 ANALYSIS OF PRESSURIZED WATER REACTOR CRITICAL  
CONFIGURATIONS: VOLUME 2 — SEQUOYAH UNIT 2 CYCLE 3**

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## ABSTRACT

The requirements of ANSI/ANS 8.1 specify that calculational methods for away-from-reactor criticality safety analyses be validated against experimental measurements. If credit for the negative reactivity of the depleted (or spent) fuel isotopics is desired, it is necessary to benchmark computational methods against spent fuel critical configurations. This report summarizes a portion of the ongoing effort to benchmark away-from-reactor criticality analysis methods using critical configurations from commercial pressurized-water reactors.

The analysis methodology selected for all the calculations reported herein is based on the codes and data provided in the SCALE-4 code system. The isotopic densities for the spent fuel assemblies in the critical configurations were calculated using the SAS2H analytical sequence of the SCALE-4 system. The sources of data and the procedures for deriving SAS2H input parameters are described in detail. The SNIKR code module was used to extract the necessary isotopic densities from the SAS2H results and provide the data in the format required by the SCALE criticality analysis modules. The CSASN analytical sequence in SCALE-4 was used to perform resonance processing of the cross sections. The KENO V.a module of SCALE-4 was used to calculate the effective multiplication factor ( $k_{\text{eff}}$ ) of each case. The SCALE-4 27-group burnup library containing ENDF/B-IV (actinides) and ENDF/B-V (fission products) data was used for all the calculations.

This volume of the report documents the SCALE system analysis of three reactor critical configurations for the Sequoyah Unit 2 Cycle 3. This unit and cycle were chosen because of the relevance in spent fuel benchmark applications: (1) the unit had a significantly long downtime of 2.7 years during the middle of cycle (MOC) 3, and (2) the core consisted entirely of burned fuel at the MOC restart. The first benchmark critical calculation was the MOC restart at hot, full-power (HFP) critical conditions. The other two benchmark critical calculations were the beginning-of-cycle (BOC) startup at both hot, zero-power (HZP) and HFP critical conditions. These latter calculations were used to check for consistency in the calculated results for different burnups and downtimes. The  $k_{\text{eff}}$  results were in the range of 1.00014 to 1.00259 with a standard deviation of less than 0.001.



## 1. INTRODUCTION

In the past, criticality analysis of pressurized-water-reactor (PWR) fuel in storage or transport has assumed that the fuel is fresh with the maximum allowable initial enrichment. This assumption has led to the design of widely spaced and/or highly poisoned storage and transport arrays. If credit is assumed for fuel burnup, more compact and economical arrays can be designed. Such reliance on the reduced reactivity of spent fuel for criticality control is referred to as "burnup credit." If burnup credit is applied in the design of a cask for use in the transport of spent light-water-reactor (LWR) fuel to a repository, a significant reduction both in the cost of transport and in the risk to the public can be realized.<sup>1</sup> These benefits caused the U.S. Department of Energy (DOE) to initiate a program to investigate the technical issues associated with burnup credit in spent fuel cask design. These efforts have been led by Sandia National Laboratories (SNL) and carried out as part of the Cask Systems Development Program within the Office of Civilian Radioactive Waste Management. This five-volume report documents work performed at Oak Ridge National Laboratory (ORNL) as part of a larger effort to demonstrate an acceptable approach for validating computational tools to be used in burnup credit cask design.

The computational tools of interest for burnup credit cask design are initially those currently used and accepted for spent fuel characterization (prediction of isotopics) and criticality safety (prediction of the effective multiplication factor,  $k_{\text{eff}}$ ) in away-from-reactor (AFR) applications. The criticality analysis tools accepted for fresh fuel cask design have typically been validated per the requirements of the ANSI/ANS-8.1 criticality safety standard<sup>2</sup> (i.e., comparison against experimental data). Numerous critical experiments for fresh PWR-type fuel in storage and transport configurations exist and can be used as part of a validation data base. However, there are no critical experiments with burned PWR-type fuel in storage and transport configurations that can be directly used to extend the data base to the realm of burned fuel. Thus, as part of the effort to extend the validation of existing criticality analysis tools to the domain of burned fuel, it was decided to investigate the performance of AFR analysis methods in the prediction of measured reactor critical configurations. While elements of a reactor critical analysis do not directly correspond to analyses of spent fuel assemblies in transportation and storage casks (e.g., elevated temperatures in reactor configurations or poison plates in cask designs), comparison against measured critical configurations can be used to validate aspects of spent fuel cask configurations which are not addressed in other experiments (i.e., fission-product interactions and the prediction of time-dependent actinide and fission-product inventories). Reactor critical configurations contain a diverse range of nuclides, including fissile and fertile actinides, fission products, and activation products. Thus, nuclear reactor core criticals can be used to test the ability of a methodology to generate accurate burned fuel isotopics and handle the reactivity effects of complex heterogeneous systems containing burned fuel.

This report describes the data and procedures used to predict the multiplication factor for several measured critical core configurations using a select set of AFR analysis codes. The analyses were performed for precise state points at beginning of cycle (BOC) (mixture of fresh and burned fuel) and at measured state points throughout the cycle depletion (all burned fuel). Self-consistency among the reactor criticals in the prediction of  $k_{\text{eff}}$  will allow the determination of the bias of the approach taken in representing the effect of those materials not present in fresh fuel.

To date, the SCALE code system<sup>3</sup> developed at ORNL has been the primary computational tool used by DOE to investigate technical issues related to burnup credit.<sup>4</sup> SCALE is a well-established code system that has been widely used in AFR applications for spent fuel characterization via the SAS2H/ORIGEN-S analysis sequence<sup>5</sup> and criticality safety analyses via the CSAS/KENO V.a analysis sequence.<sup>6</sup> The isotopic composition of the spent fuel is derived from a SAS2H/ORIGEN-S calculation that simulates two-dimensional (2-D) effects in a one-dimensional (1-D) model of an LWR fuel assembly. The depletion model is a spatially independent point model using cross sections and neutron flux parameters derived from the 1-D fuel assembly model. The KENO V.a Monte Carlo code<sup>7</sup> is used to calculate the neutron multiplication factor for complex multidimensional systems. KENO V.a has a large degree of flexibility in its geometrical modeling capabilities which enables spent fuel arrays and container geometries to be modeled in explicit detail. The SCALE-4 27-group burnup library containing ENDF/B-IV (actinides) and ENDF/B-V (fission products) data was used for all calculations.

Early efforts to analyze reactor criticals<sup>8</sup> using the SCALE modules concentrated on using utility-generated isotopic data although some analyses were performed using isotopics calculated with SAS2H. Based on this initial work, a consistent SCALE-based analysis methodology that simplifies both the data requirements and the calculational procedure was developed. The criteria used to select the reactor critical configurations were (1) applicability to the PWR fuel to be used in burnup credit cask design (e.g., long downtimes for decay of short-lived isotopes, large percentages of burned fuel in the configuration), the need to verify consistency in calculated results for different reactor conditions, and the need to provide a comparison with the results of ref. 8. Acceptable performance of the SCALE system in the prediction of  $k_{\text{eff}}$  will be judged relative to established SCALE performance for fresh fuel systems; if agreement is seen within the range typical for fresh fuel systems, then it will be concluded that the methodology described herein is valid in terms of its treatment of depletion and decay calculations and fission-product interactions, within the range of application defined by the reactor conditions.

The purpose of this volume of the report is to describe the analysis of three reactor critical configurations from the Tennessee Valley Authority's Sequoyah Unit 2 Cycle 3. This particular unit and cycle were chosen because the unit had a significantly long downtime of 2.7 years during the middle-of-cycle (MOC) 3, and no fresh fuel was loaded into the reactor prior to restart. The 2.7-year downtime prior to restart ensures that the decay of short-lived nuclides have occurred to a similar level of insignificance as found in the minimum-cooled (5-year) spent fuel planned for transport. A methodology resulting in proper characterization of in-core depletion and post-discharge decay is necessary in order to accurately predict criticality for this configuration. Successful prediction of the critical condition may therefore be used as an indication of the validity of this methodology for spent fuel applications where long decay times are involved. The first benchmark critical calculation was the MOC restart at hot, full-power (HFP) critical conditions. The other two benchmark critical calculations were the BOC startup at both hot, zero-power (HZP) and HFP critical conditions. These latter calculations were used to check for consistency in the calculated results for different burnup, downtime, temperature, and xenon conditions.

Section 2 of this volume presents an overview of the methodology employed in the reactor critical analyses. Section 3 provides the details of the analysis performed for Sequoyah 2 Cycle 3. The results and conclusions are discussed in Sect. 4.

## 2. OVERVIEW OF THE METHODOLOGY

An essential part of any analysis validation effort is to use the same codes, input options, and technical approach for the validation study as that used for the application. To this end, a straightforward calculational strategy was established that minimizes the data required to characterize the spent fuel and is appropriate for use by a cask designer performing criticality analysis for spent fuel assemblies. The methodology applied in reactor critical analyses can be broken into five steps: (1) grouping of fuel assemblies into similar-content groups and similar-burnup subgroups; (2) calculation of burnup-dependent isotopics for each group; (3) interpolation of decay calculations from results of the previous step to obtain both individual assembly and subgroup isotopics; (4) cross-section processing based on subgroup isotopics; and (5) preparation of a KENO V.a model based on the actual core geometry, individual assembly isotopics, and subgroup-evaluated cross sections. The model developed in step 5 is used to calculate the effective multiplication factor,  $k_{\text{eff}}$ , for the reactor.

Figure 1 provides a graphical overview of these steps, showing the relationships between the data and codes used in each stage of the calculation. The first step shown in the figure represents the process of collecting assembly information from reactor documentation. Eighth-core symmetry is assumed to reduce the number of unique assemblies models, such that the burnup of each assembly in an eighth-core segment represents the average burnup of all assemblies located in the corresponding symmetric position across the core. Using the reactor information, “groups” of assemblies are identified which are of cognate background (i.e., same initial loading and burn cycles). These assembly groups are then further categorized into “subgroups” consisting of assemblies within a group with similar ( $\pm 2$  GWd/MTU) burnups.

The second step shown in the figure involves the calculation of isotopic contents using the decay and depletion steps of the SAS2H calculational sequence of SCALE. Calculations are performed for each assembly group based on the initial fresh fuel content and operating history of the group. Output consists of calculated isotopic contents for each of a number of user specified timesteps.

In the third step, the SNIKR code package (not a part of the SCALE system) is used to interpolate between isotopics for appropriate timesteps in order to obtain the assembly-specific isotopic contents for each assembly to be used in the KENO V.a core model. (SNIKR is a simple tool used to automate the task of extracting, interpolating, and formatting data; however, this process can be performed manually.) SNIKR is also used to calculate the isotopics for the average burnup of each assembly subgroup.

The results of step 3 are used in step four to create fuel pin models based on the average composition of an assembly subgroup; the CSASN sequence in SCALE is then used to calculate the problem-dependent group-weighted cross sections for each subgroup. The SCALE module WAX is then used to combine all subgroup-based cross sections into a single working library, where cross-section identifiers are assigned such that each numeric identifier indicates both a specific isotope and the subgroup upon which it was based.

Finally, in the fifth step, a KENO V.a model is created based on the core geometry, again assuming eighth-core symmetry. Thus, while a full-core model is prepared, each eighth-core segment of the core is identical in composition to the other eighth-core segments. (A full-core model in KENO V.a is more computationally efficient than an eighth-core model with reflective boundary

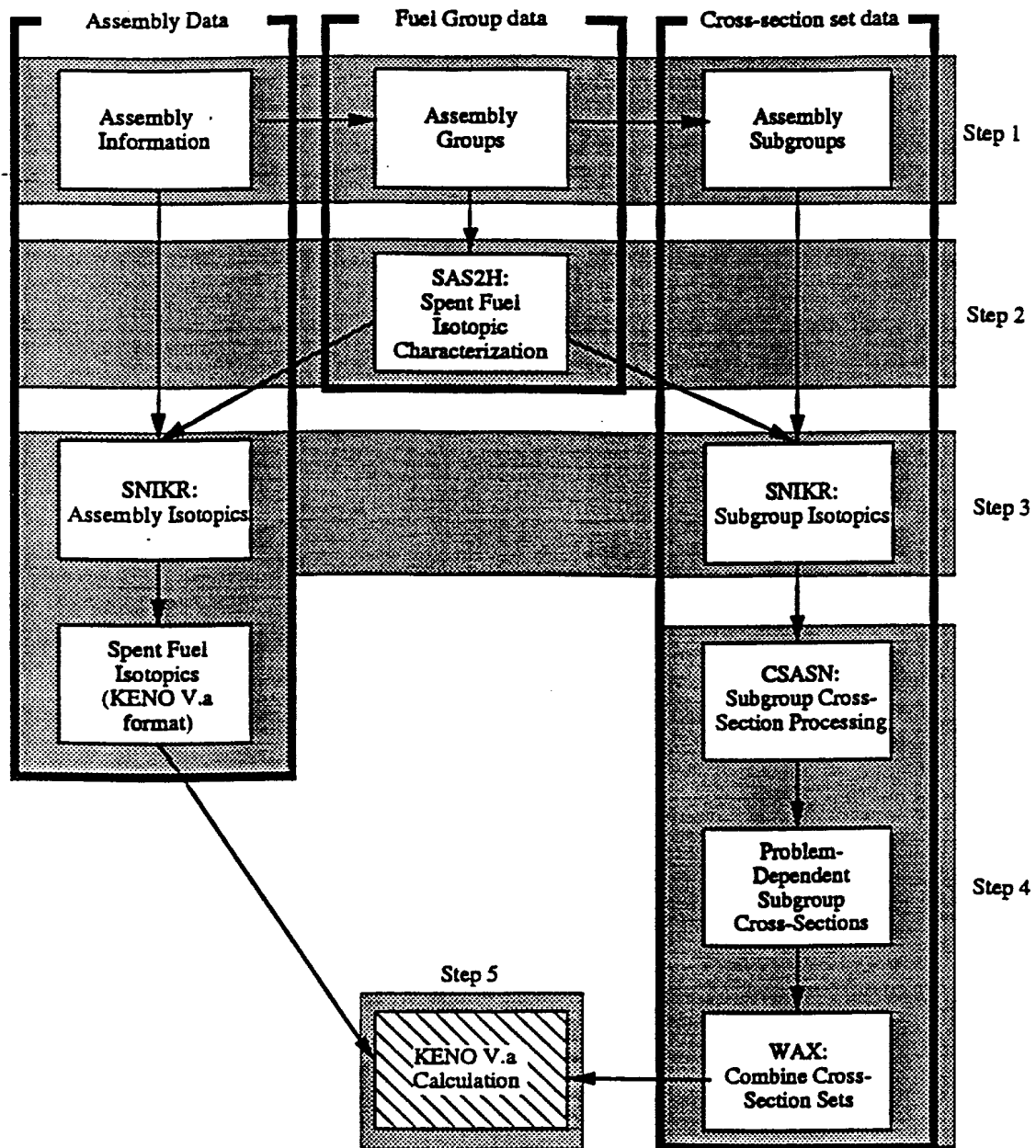


Fig. 1. Overview of the reactor critical calculation procedure.

conditions.) Fuel assemblies are assumed to be uniform in composition (all fuel pins are comprised of the same material), and isotopics are obtained from the burnup-specific results obtained in step 3. Assembly isotopes are assigned cross-section identifiers corresponding to the appropriate subgroup-based cross sections derived in step 4. Remaining core information is obtained from the reactor documentation. Calculations are then performed to determine the value of  $k_{\text{eff}}$  for the reactor model and to verify that the solution has converged. The specifics of each step as applied in the Sequoyah 2 Cycle 3 analysis are given in Sect. 3.

## 2.1 FUEL ASSEMBLY GROUPS

Since many assemblies in a reactor begin with identical initial compositions and experience simultaneous operating histories, these similar fuel assemblies can be collected effectively into groups, with one depletion calculation performed for each group. It is assumed that at a given burnup, all assemblies within a group have the same isotopic content. If the isotopic content of a group is known as a function of burnup, then one can interpolate to obtain the specific isotopics for a given assembly burnup. This interpolation is discussed further in Sect. 2.3.

A minimum granularity for grouping is to collect fuel assemblies by reactor fuel batch. In the nomenclature generally applied by commercial PWR core designers, a fuel batch is typically comprised of a single enrichment fuel, all loaded at the same time, and all residing in-core for the same fuel cycles. Three fuel batches (i.e., enrichments) are usually present in the first operating cycle of a reactor. These batches are typically designated by the numbers 1, 2, 3. Prior to each subsequent cycle of operation, one new batch of fuel is usually added and some of the depleted fuel assemblies are removed. Each new batch of fuel is assigned a number unique to that reactor. If the new fuel assemblies to be loaded consist of more than one enrichment, they may be assigned as a "split batch," using the same number with a different letter appended to each enrichment. For example, if two enrichments were to be added to Cycle 2, the fuel assemblies of one enrichment would be designated as batch 4A, and those of the other enrichment would be designated as batch 4B. Hence, if a given batch of assemblies has experienced identical operating periods, downtimes, and roughly the same power history, the batch meets the minimum requirements for a calculational fuel group. However, within a given fuel batch, additional fuel groups (i.e., separate depletion calculations) may be required when absorber materials [i.e., burnable poison rods (BPRs) or control rods] are present in certain assemblies within a fuel batch.

As discussed, within a fuel group it is possible to interpolate between a series of burnups to determine the isotopic concentrations corresponding to a specific burnup. This interpolation procedure can be used to calculate the contents of each individual assembly. Based on these assembly isotopics, it is possible to generate a content-specific cross-section set for each assembly. However, since nuclide cross sections vary slowly with burnup (after the initial startup of approximately 150 MWd/MTU) the analysis methodology can be accurately simplified by preparing problem-dependent cross sections for a set of similar assemblies with similar burnups. Unfortunately, due to specific power variations related to the assembly locations in the core it is possible to have a relatively wide range of burnups within a single fuel group. Thus, it may be necessary to divide fuel groups into subgroups or cross-section sets based on burnup such that all assemblies included in a cross-section set are within a limited burnup range; the number of cross-section sets will depend on the range of

burnups contained in the fuel group. Calculations reported in Sect. 3.8 of this report indicate that cross-section sets with burnup ranges of no more than 2 GWd/MTU can be adequately represented by the average burnup value within the cross-section set.

## 2.2 DEPLETION CALCULATIONS

Depletion calculations were performed using the SAS2H<sup>5</sup> sequence of the SCALE-4 code system and the 27-group burnup library. The SAS2H sequence invokes the ORIGEN-S<sup>9</sup> code in order to perform depletion and decay calculations. The SAS2H procedure uses a 1-D two-part spectrum calculation (part 1 is a pin-cell model; part 2 is an assembly model) at selected times in the irradiation history to generate burnup-dependent cross sections based on the given design and operating parameters. At the end of each burnup step, cross sections for default and any user-specified isotopes are reevaluated based on the new isotopic composition. The purpose of these calculations is to predict the isotopic content of each fuel group as a function of its operating history. For fuel groups comprised of fresh (unburned) fuel at the time of the critical measurements, SAS2H calculations are not necessary; the isotopic content is based on that of the fresh fuel specifications.

Although it is necessary to model the presence of BPRs for the cycle for which the criticality calculation is to be performed, previous studies<sup>10,11</sup> have shown that the history of the assembly with respect to the insertion and removal of BPRs in early reactor cycles is small enough to be neglected ( $<1\% \Delta k/k$ ). In order to model the influence of the BPRs in the cycle of interest, an effective cell is derived. This effective cell conserves the mass of the nuclides comprising the BPRs, guide tube, and fuel rods. In this effective cell, the densities of the isotopes remain unchanged, but the rod diameters of the glass and stainless steel in the BPRs are modified appropriately for the 1-D assembly model required by SAS2H.

Since within a fuel group it is assumed that isotopic content is a function of burnup only, it is possible to calculate the content of the fuel at a given burnup by interpolation between SAS2H/ORIGEN-S isotopics provided at each burnup step. The manner of interpolation is discussed in the following subsection. SAS2H provides the capability to obtain the isotopic composition of a fuel at specified burnup intervals given the initial composition of the fuel, clad, and moderator, design parameters of the fuel rod and lattice, and power history. In order to provide sufficient points for interpolation, the burnup history was broken into equal intervals of no more than 5 GWd/MTU. (This should not be confused with the 2-GWd/MTU interval used to establish assembly subgroups. The 5-GWd/MTU interval represents an interpolation range over which isotopic concentrations are assumed to vary smoothly.) The fuel groups were depleted at least 1.2 times the maximum burnup ( $B_{\max}$ ) of the fuel group. Note that it is generally sufficient to calculate burnups out to the maximum burnup in a group, as this will bound all burnups in the group. A value of  $1.2 \cdot B_{\max}$  was used in order to allow for the capability of modeling axial burnup variations where volume-averaged center region burnups may be up to 1.2 times larger than the assembly average. However, axial burnup variations are not included in the models presented in this report.

To make it possible to interpolate between burnup steps and account for downtime between cycles, a simplification is made in the burnup model. Since the burnup actually accumulated during each cycle varies for each fuel assembly in a group, the downtime was split and applied at the end of each burnup interval. This practice ensures that the spent fuel isotopics for all fuel assemblies



contain the impact of the reactor cycle downtime when interpolation on burnup is performed. The ratio of uptime to downtime for each operating cycle was used to determine the downtime for each burnup interval. Average values for specific power were computed from the fuel group average burnups and the total uptime for the cycle. The average soluble boron concentrations were based on boron letdown curves for each operating cycle. Isotopics for assembly-specific burnups may then be obtained via interpolation between calculated isotopics at the end of each burnup interval (prior to downtime). This approach is illustrated in Fig. 2. The top portion of the picture shows the "actual" burnup histories for two hypothetical assemblies in a fuel group. Note that in this example the number of cycles and downtimes are the same, but that burnup in each assembly is different within each cycle. The lower portion of the figure demonstrates how the burnup of each assembly is represented in a SAS2H depletion, using a single calculation to represent the entire fuel group. Each cycle is broken down into multiple burnup intervals, each followed by a downtime (for the first two cycles). The final cycle is calculated with a sufficient number of burnup intervals to exceed the maximum burnup (31 MWd/MTU in Assembly A of Fig. 2) by 20%. The isotopics are then available at fixed time intervals, from which interpolation can be performed for assembly specific burnups. Note that the burnup in each of the first two cycles is selected so as to represent average cycle burnups for the group. Any downtime immediately before the reactor critical conditions was not included in the SAS2H depletion, but it was explicitly modeled as described in Sect. 2.3.

As discussed earlier, group-weighted cross sections are calculated as a function of burnup within the SAS2H sequence using flux weighting performed by XSDRNPM for each specified burnup step. Cross sections are updated for a default set of isotopes built into the SAS2H sequence, plus any additional nuclides specified by the user. Table 1 shows the default set plus 44 additional actinides and fission products specified for reactor depletion cases. Also included is oxygen, which is present in significant quantities in  $\text{UO}_2$  fuel. These nuclides represent a combination of the most important nuclides for burnup credit calculations and for reactor physics calculations. The selection of burnup credit nuclides is based on availability of experimentally measured isotopic concentrations and on sensitivity studies performed for a large number of nuclides under various spent fuel transportation/storage conditions, as described in ref. 12. The reactor physics nuclides are additional isotopes which are not important in a transportation sense, but have been determined to be important for depletion, decay, and criticality calculations under reactor operating conditions (e.g.,  $^{135}\text{Xe}$  builds in rapidly during reactor operation, but decays away with a 9.1-h half-life, and is therefore unimportant in 5-year cooled spent fuel). These nuclides were identified in earlier work.<sup>10,13</sup>

Any additional cross sections required for depletion calculations are obtained from the more than 1000 nuclides available within the ORIGEN-S 1-group LWR library and are adjusted with burnup using the ORIGEN-S spectral parameters (THERM, RES, and FAST<sup>9</sup> calculated using fluxes calculated by XSDRNPM. The ORIGEN-S 1-group LWR library available in SCALE-4 has been updated to use cross sections from the SCALE-4 27-group burnup library for all 193 nuclides in that library, by extracting 1-group cross sections from the output of a low-burnup LWR-type fuel model using all burnup library nuclides as input.

Note that ORIGEN-S tracks all decay chains, and does not account for the loss of volatile isotopes; however, this is not felt to have a significant effect on isotopic calculations.

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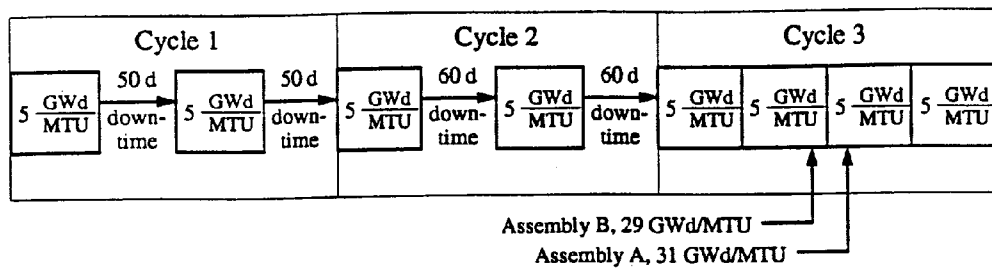
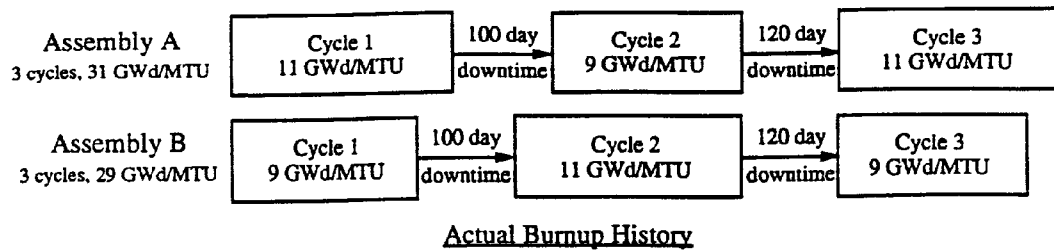


Fig. 2. SAS2H burnup model of assemblies within a fuel group.

Table 1. Nuclides updated by SAS2H

<sup>234</sup> U <sup>a</sup>	<sup>243</sup> Am <sup>a</sup>	<sup>94</sup> Nb	<sup>132</sup> Xe	<sup>145</sup> Nd
<sup>235</sup> U <sup>a</sup>	<sup>242</sup> Cm <sup>a</sup>	<sup>16</sup> O <sup>b</sup>	<sup>135</sup> Xe <sup>a</sup>	<sup>147</sup> Nd
<sup>236</sup> U <sup>a</sup>	<sup>243</sup> Cm <sup>a</sup>	<sup>99</sup> Tc	<sup>136</sup> Xe	<sup>147</sup> Pm
<sup>238</sup> U <sup>a</sup>	<sup>244</sup> Cm <sup>a</sup>	<sup>101</sup> Ru	<sup>133</sup> Cs <sup>a</sup>	<sup>148</sup> Pm
<sup>237</sup> Np <sup>a</sup>	<sup>83</sup> Kr	<sup>106</sup> Ru	<sup>134</sup> Cs	<sup>147</sup> Sm
<sup>238</sup> Pu <sup>a</sup>	<sup>85</sup> Kr	<sup>103</sup> Rh	<sup>135</sup> Cs	<sup>149</sup> Sm
<sup>239</sup> Pu <sup>a</sup>	<sup>90</sup> Sr	<sup>105</sup> Rh	<sup>137</sup> Cs	<sup>150</sup> Sm
<sup>240</sup> Pu <sup>a</sup>	<sup>89</sup> Y	<sup>105</sup> Pd	<sup>136</sup> Ba	<sup>151</sup> Sm
<sup>241</sup> Pu <sup>a</sup>	<sup>95</sup> Mo	<sup>108</sup> Pd	<sup>139</sup> La	<sup>152</sup> Sm
<sup>242</sup> Pu <sup>a</sup>	<sup>93</sup> Zr	<sup>109</sup> Ag	<sup>144</sup> Ce	<sup>153</sup> Eu
<sup>241</sup> Am <sup>a</sup>	<sup>94</sup> Zr	<sup>124</sup> Sb	<sup>141</sup> Pr	<sup>154</sup> Eu
<sup>242m</sup> Am <sup>a</sup>	<sup>95</sup> Zr	<sup>131</sup> Xe	<sup>143</sup> Pr	<sup>155</sup> Eu
			<sup>143</sup> Nd	<sup>155</sup> Gd

<sup>a</sup>Automatically updated by SAS2H.

<sup>b</sup>Not an actinide or fission product, but present in UO<sub>2</sub> fuel.

## 2.3 NUCLIDE CONCENTRATIONS FOR REACTOR CRITICALITY CALCULATIONS

As has been indicated in previous sections, the isotopic content may be determined for each assembly or cross-section set by interpolating between burnups for which SAS2H/ ORIGEN-S depletion calculations have been performed, based on the final burnup of the fuel. The nuclide concentrations output at this point then represent the composition prior to shutdown or discharge. For a criticality condition obtained after the shutdown of the last cycle, it is necessary to perform decay calculations to account for the change in composition due to radioactive decay during the downtime prior to criticality.

The actual number densities used in the criticality calculations are derived from the SAS2H calculation for a given fuel batch using a newly developed interface module, SAS2H Nuclide Inventories for KENO Runs (SNIKR). This module was developed to enable the user to interpolate number densities from a SAS2H calculation as a function of burnup and to perform the necessary decay calculations to model cooling time for use in spent fuel critical calculations. SNIKR has not been incorporated into SCALE at this time. Thus, input descriptions and code listings have been included in Appendix C.

The current version of SNIKR has been written to be executed as a sequence of computational routines. In the first phase, SNIKR1, burnup-dependent nuclide inventories are read from a dataset produced from a SAS2H calculation. SNIKR1 uses a Lagrangian interpolation scheme to calculate nuclide concentrations for a specified burnup. In the Lagrangian interpolation scheme, a polynomial of degree one less than the number of data points to be fit is used to represent the number density for each nuclide as a function of burnup. Comparisons have been made against results using nuclide concentrations calculated directly from SAS2H for a specified burnup to examine the

effect of the interpolation procedure on pin-cell  $k_{\infty}$  (i.e., 1-D infinite-lattice calculation) values. The results of these comparisons indicated agreement to within 0.1%  $\Delta k/k$  in the  $k_{\infty}$  values calculated using isotopics derived from the two methods.

SNIKR1 then sets up the input needed to decay these burnup-specific isotopics to the requested cooling time using the ORIGEN-S point-depletion code. The second phase of SNIKR executes the ORIGEN-S module in the SCALE code system. Phase 3, SNIKR3, reads the number densities produced by ORIGEN-S for the requested cooling time and extracts the nuclides to be used in the depleted fuel for the burnup credit criticality analysis. Number densities for these nuclides are then written to output files in the SCALE standard composition input format and the KENO V.a mixing table data format for use in CSASN and KENO V.a calculations, respectively. Typically, the term "SNIKR" is used to refer to the three-step sequence of calculations described above.

SNIKR extracts concentrations for the set of nuclides specified by the user. The set of nuclides selected for the reactor critical benchmark calculations consists of the 48 nuclides listed in Table 2. These nuclides are a subset of those in Table 1, with the exception of  $^{103}\text{Ru}$ ,  $^{135}\text{I}$ ,  $^{148}\text{Nd}$ , and  $^{149}\text{Pm}$ . The cross sections of these four nuclides are small enough or change slowly enough with burnup that omitting them from the cross-section update in SAS2H has a negligible effect and are therefore not needed in the SAS2H calculation. In addition to the 25 nuclides selected for use in burnup credit analysis in ref. 4, the list in Table 2 includes the other nuclides included in an earlier burnup credit feasibility study<sup>1</sup> together with nuclides modeled explicitly in the burnup credit work of refs. 10 and 13.

## 2.4 CROSS-SECTION PROCESSING BY CROSS-SECTION SET

The CSASN<sup>6</sup> sequence of the SCALE system is used to compute problem-dependent fuel pin cross sections based on the isotopic content and geometry of a lattice fuel cell. Based on a 1-D fuel pin model, CSASN invokes BONAMI-S<sup>14</sup> to perform resonance shielding calculations using Bondarenko factors, followed by NITAWL-II<sup>15</sup> calculations to perform resolved resonance range cross-section processing using the Nordheim Integral Treatment.

CSASN cross-section processing is applied only to cross-section-set-averaged nuclide concentrations. As discussed earlier in Sect. 2.1, effective cross sections are not strongly coupled to burnup; hence it is sufficient to compute cross sections for the average burnup of a cross-section set, provided the range of burnups in the cross-section set is not too large ( $<2$  GWd/MTU). Nuclide concentrations for use in the CSASN calculation are provided in the SCALE standard composition format in the output from the SNIKR cross-section set calculations.

Because fission-product nuclides represent only a small fraction of the total number density of the fuel, fission-product cross sections are relatively insensitive to the varying isotopic content and need only be calculated for one cross-section set. This situation is also true of many fuel activation products and minor actinides; however, cross sections for seven actinides are known to have a more significant burnup dependence. These isotopes, referred to as the "seven burnup-sensitive actinides," are  $^{234}\text{U}$ ,  $^{235}\text{U}$ ,  $^{236}\text{U}$ ,  $^{238}\text{U}$ ,  $^{239}\text{Pu}$ ,  $^{240}\text{Pu}$ , and  $^{241}\text{Pu}$ . CSASN cross-section set fuel pin models include the appropriate SNIKR-computed concentrations for each of these isotopes; the remaining nuclides are included only in the highest burnup cross-section set. The highest burnup is chosen because it will result in the lowest resonance absorption, and therefore results in a higher and more conservative  $k_{\text{eff}}$ ; however, the effect is extremely small ( $<0.1\%$   $\Delta k/k$ ).

Table 2. Set of fuel nuclides used in KENO V.a calculations

$^{234}\text{U}^a$	$^{83}\text{Kr}^d$	$^{141}\text{Pr}^b$
$^{235}\text{U}^a$	$^{93}\text{Zr}^b$	$^{143}\text{Nd}^a$
$^{236}\text{U}^a$	$^{95}\text{Mo}^a$	$^{145}\text{Nd}^a$
$^{238}\text{U}^a$	$^{99}\text{Tc}^a$	$^{147}\text{Nd}^c$
$^{237}\text{Np}^b$	$^{101}\text{Ru}^b$	$^{148}\text{Nd}^c$
$^{238}\text{Pu}^a$	$^{103}\text{Ru}^c$	$^{147}\text{Pm}^b$
$^{239}\text{Pu}^a$	$^{103}\text{Rh}^a$	$^{148}\text{Pm}^c$
$^{240}\text{Pu}^a$	$^{105}\text{Rh}^c$	$^{149}\text{Pm}^c$
$^{241}\text{Pu}^a$	$^{105}\text{Pd}^b$	$^{147}\text{Sm}^a$
$^{242}\text{Pu}^a$	$^{108}\text{Pd}^b$	$^{149}\text{Sm}^a$
$^{241}\text{Am}^a$	$^{109}\text{Ag}^b$	$^{150}\text{Sm}^a$
$^{243}\text{Am}^b$	$^{135}\text{I}^c$	$^{151}\text{Sm}^a$
$^{244}\text{Cm}^b$	$^{131}\text{Xe}^d$	$^{152}\text{Sm}^a$
$\text{O}^a$	$^{135}\text{Xe}^c$	$^{153}\text{Eu}^a$
	$^{133}\text{Cs}^a$	$^{154}\text{Eu}^b$
	$^{134}\text{Cs}^d$	$^{155}\text{Eu}^b$
	$^{135}\text{Cs}^a$	$^{155}\text{Gd}^a$

<sup>a</sup>The 25 nuclides to be used in burnup credit analysis (ref. 4).

<sup>b</sup>Additional burnup credit nuclides from ref. 1.

<sup>c</sup>Additional reactor physics nuclides from Virginia Power's PDQ calculations (ref. 10).

<sup>d</sup>Additional reactor physics nuclides from Yankee Atomic's CASMO-3/SIMULATE-3 calculations (ref. 13).

Once cross sections are computed for each cross-section set, the SCALE utility module WAX<sup>16</sup> is used to combine all CSASN cross-section set working libraries into a single working library for subsequent use by KENO V.a. All cross sections from the highest burnup cross-section set (containing all fission and activation isotopes) are copied into the combined library. For each of the remaining cross-section set libraries, only the seven burnup-dependent actinides are copied. In addition, for each of the seven burnup-dependent actinides in each cross-section set, the cross-section ID number is modified by prefixing the cross-section set number to the cross-section ID so that the KENO V.a core model can reference the appropriate cross section for each cross-section set. The cross sections with modified ID numbers are then copied into the combined library.

## 2.5 PREPARATION OF THE KENO V.a CORE MODEL

The geometry of the core model is based on the technical specifications of the core geometry; the detailed mechanics of the geometry model are discussed later. Using one-eighth-core symmetry, it is possible to build a full-core model using a relatively small number of unique assemblies. For each assembly type, nuclide concentrations are obtained from assembly-specific SNIKR output in

KENO V.a mixing table format; thus there are unique mixture data for each assembly type in the model. Within each set of mixing table data, the nuclide ID number of each of the seven burnup-dependent actinides is prefixed by the cross-section set number that represents that assembly (this step can be done automatically by SNIKR) so that the effective cross sections computed for the corresponding cross-section set are utilized. These cross sections are located in the working library, prepared as described in the previous subsection.

### 3. PREPARATION OF THE SEQUOYAH 2 CYCLE 3 CORE MODEL

The previous section has given an overview of the technical procedure used in setting up the Sequoyah 2 Cycle 3 reactor critical calculations in order to provide a broad overview of the entire process before concentrating on the details. This section describes the Sequoyah 2 Cycle 3 core, then details the specifics of each step used to set up a model for this core, based on the geometry, contents, and operating history of the core up to the restart at the middle of the third cycle. Rather than follow the five steps used previously to outline the procedure, this section will describe each distinct aspect of the process, as illustrated by the individual boxes in Fig. 1.

Discussion of the KENO V.a criticality calculation results will be provided in Sect. 4 of this report.

#### 3.1 CORE DESCRIPTION

Data describing the Sequoyah Unit 2 core and assembly data for cycles 1–3 were obtained from several sources, including cycle operations data, the plant Final Safety Analysis Report, and data generated by TVA calculations. Because much of these data are not readily available as public information, all data required to perform this analysis are included in Appendix A and in the following description.

The Sequoyah 2 Cycle 3 core consisted of 193 Westinghouse fuel assemblies, each comprised of a  $17 \times 17$  lattice containing 264 fuel rods, 24 control rod guide tubes, and one instrument tube. The core configuration is shown in Fig. 3, where each square represents an assembly position. At-power reactivity control is maintained using four control banks and two shutdown banks of full-length Ag-In-Cd control rod clusters, 44 BPR clusters containing a total of 656 BPRs, and soluble boron. Within each assembly, the lattice positions of guide tubes and/or BPRs are located as illustrated in Fig. 4. The loading of the BPR clusters in Cycle 3 is shown in Fig. 5.

The critical conditions modeled in this report are based on HZP and HFP conditions at BOC-3 and HFP conditions at the MOC-3 restart. The MOC restart critical configuration of Sequoyah Unit 2 Cycle 3, after a 2.73-year downtime, was selected as a benchmark critical for use in burnup credit validation because there was a significantly long downtime prior to restart and no fresh fuel was loaded into the reactor prior to restart. The BOC startup configurations for Cycle 3 at HZP and HFP were utilized as additional benchmarks to provide a check for consistency in the calculated results for different burnups and downtimes. The downtime between Cycles 2 and 3 was 154 days (0.42 year).

The HZP and HFP criticals at BOC and the HFP critical at MOC were selected in part because the control rod position for each is at or near all rods out (ARO). The ARO condition is advantageous because it reduces the complexity of the calculational model. Partially inserted control rods would require additional axial regions in the KENO V.a model. The control rods consist of very strong localized neutron absorber materials (silver, indium, cadmium). The advantages of the HZP case are that the temperature is uniform and there is no xenon. In the HFP cases the temperature and xenon distributions are not uniform throughout the core, but are a function of the relative power produced by each fuel assembly. Since this information was not readily available, uniform temperature and xenon distributions were assumed in the HFP KENO V.a models. The critical conditions at BOC-3 and MOC-3 are given in Table 3.

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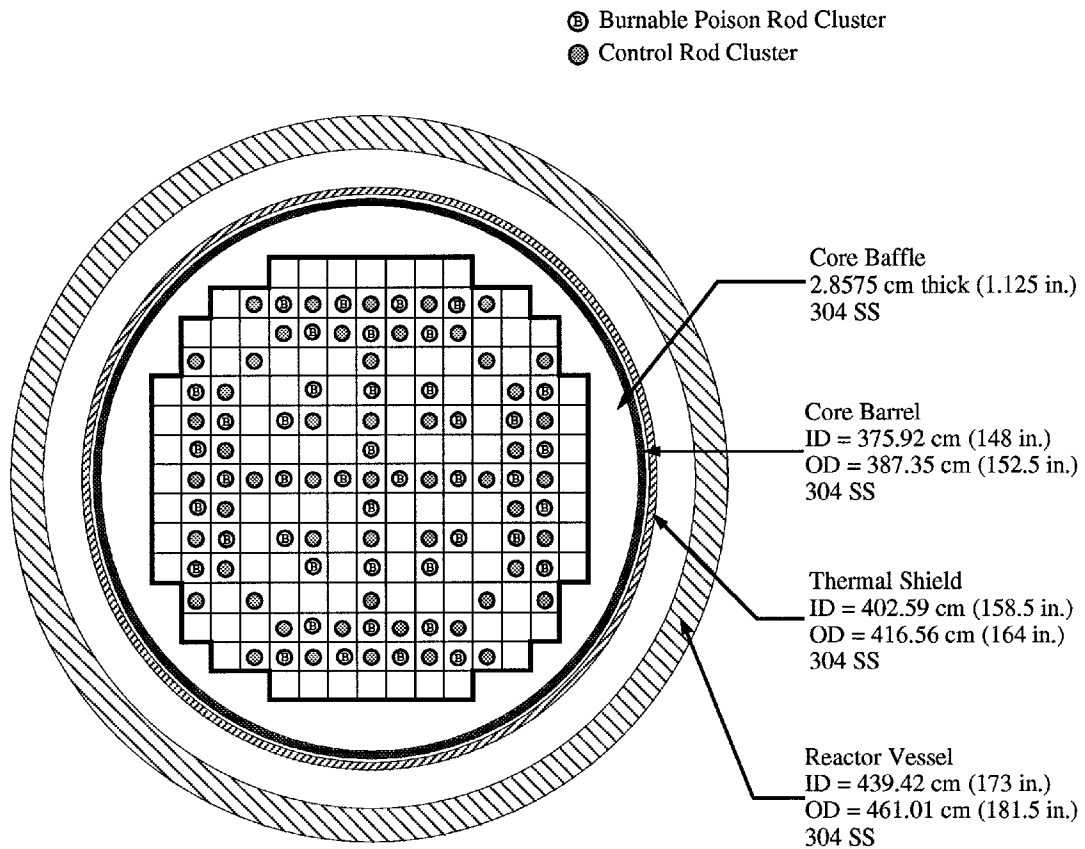
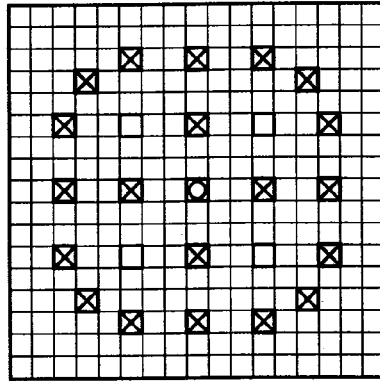


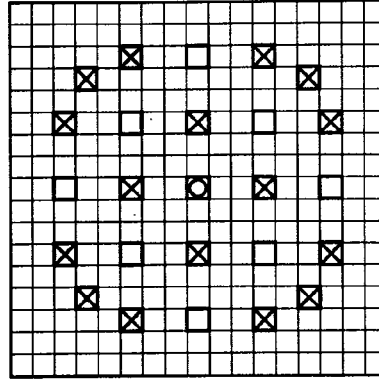
Fig. 3. Sequoyah Unit 2 Cycle 3 core configuration.



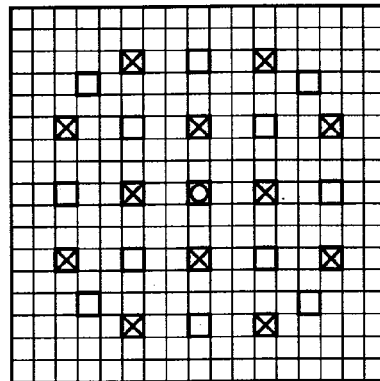
- ☒ BURNABLE POISON (BP) ROD  
□ GUIDE TUBE  
⊗ INSTRUMENT TUBE



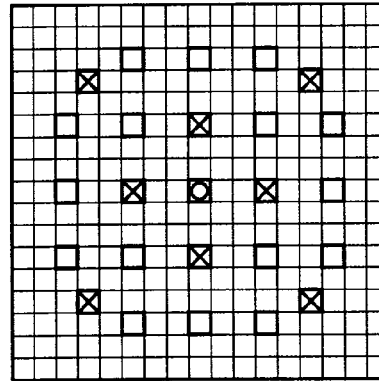
20 BP'S



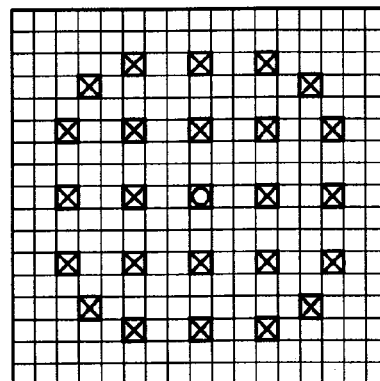
16 BP'S



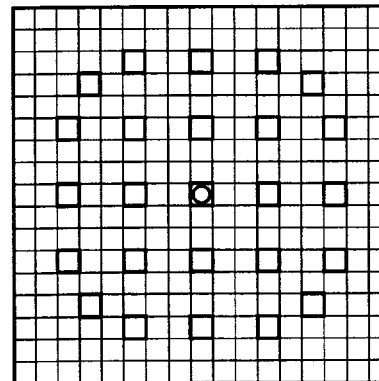
12 BP'S



8 BP'S



24 BP'S



NO BP'S

Fig. 4. Fuel assembly lattice arrangements in Sequoyah Unit 2 Cycle 3.

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1															
2					8		16		16		8				
3						20		12		20					
4															
5		8				12		24		12				8	
6			20		12						12		20		
7		16						16						16	
8			12		24		16		16		24		12		
9		16						16						16	
10			20		12						12		20		
11		8				12		24		12				8	
12															
13						20		12		20					
14					8		16		16		8				
15															
	NO. OF BP RODS														

656 BURNABLE POISON RODS  
(44BP CLUSTERS FRESH)

Fig. 5. Sequoyah Unit 2 Cycle 3 burnable poison loading configuration.

Table 3. Sequoyah Unit 2 Cycle 3 measured critical conditions at BOC and MOC

Time in cycle	Cycle burnup (MWd/MTU)	Control Bank D <sup>a</sup>		Critical boron (ppm)	Average temp. (°F)
		Power	position (cm inserted)		
BOC	0	HZP	0.0	1685	547
BOC	150	HFP	0.0	1150	582
MOC	8250	HFP	1.6	475	582

<sup>a</sup>Control Banks A through C are withdrawn.

For BOC-3, five fuel batches were present in the core. Fuel batches 2 and 3 were manufactured with 2.6 and 3.1 wt % <sup>235</sup>U, respectively. Both batches were loaded initially in Cycle 1. Batch 4, with an enrichment of 3.5 wt % <sup>235</sup>U, was initially loaded in Cycle 2. Batch 5 was split into two batches, 5A and 5B, with initial enrichments of 3.8 and 3.6 wt % <sup>235</sup>U, respectively. Batches 5A and 5B were loaded initially in Cycle 3. Full-core loading maps, assembly burnup data, and boron letdown curves for Cycles 1 through 3 are included in Appendix A. Table 4 provides a physical description of the significant aspects of the fuel design for all assemblies.

In order to simplify and to reduce the volume of input in the KENO V.a model, eighth-core symmetry was assumed in the isotopic input. This assumption reduces the number of unique fuel assemblies to 31 (Fig. 6). The loading pattern for Sequoyah Unit 2 Cycle 3 (Fig. A.6) is eighth-core symmetric except for fuel assembly location 31 on the core periphery in the eighth-core model (Fig. 6). Instead of a symmetric set of eight fuel assemblies from a single fuel region, two symmetric sets of four fuel assemblies from two fuel regions were loaded in those eight full-core locations. These are high-burnup assemblies in a high-neutron-leakage location and therefore have a negligible impact on the core  $k_{\text{eff}}$ .

The assembly burnups were averaged from Fig. A.6 for BOC and Table A.1 for MOC based on the eighth-core symmetry shown in Fig. 6. Assembly burnups listed throughout the remainder of this report are eighth-core average values.

### 3.2 SAS2H FUEL GROUPS

Assemblies of a given fuel batch are generally relocated within the core between cycles, resulting in a more evenly distributed burnup between assemblies because all fuel assemblies in a batch were loaded in the core during the same operating cycles. Because all fuel assemblies in a batch are loaded in the core during the same operating cycles, each assembly in a batch experiences the same operating (uptime/downtime) history. Thus, a starting point for the process of grouping similar-content assemblies is to begin with fuel batches. As indicated in Fig. 1, assembly group information was used in preparation of SAS2H input for depletion calculations. For BOC-3, the Sequoyah 2 core was comprised of five fuel batches. Because BPR clusters were loaded in certain assemblies in batches 5A and 5B, additional subdivision of these batches was necessary. Each of these two batches were divided into two fuel groups, one for fuel assemblies with BPR clusters and one for fuel

Table 4. Sequoyah PWR Unit 2 assembly design description

Parameter	Data
Assembly general data	
Number of assemblies	193
Fresh core loading, kgU	90,000
Designer	Westinghouse
Lattice	$17 \times 17$
Coolant pressure, psia	2250
Water temperature, K (°F)	579 (582) <sup>a</sup>
Water density, g/cm <sup>3</sup>	0.7149 <sup>a,b</sup>
Number of fuel rods	264
Number of guide tubes	24
Number of instrument tubes	1
Lattice pitch, cm (in.)	21.50364 (8.466)
Fuel rod data	
Type fuel pellet	UO <sub>2</sub>
Pellet stack density, % TD	94.85 <sup>c</sup>
Rod pitch, cm (in.)	1.25984 (0.496)
Rod OD, cm (in.)	0.94966 (0.374)
Rod ID, cm (in.)	0.83566 (0.329)
Pellet diameter, cm (in.)	0.81915 (0.3225)
Active fuel length, cm (in.)	365.8 (144)
Effective fuel temperature, K (°F)	901 (1162) <sup>a</sup>
Clad temperature, K (°F)	629 (670) <sup>a</sup>
Clad material	Zircaloy-4
Guide tube data	
Inner radius, cm (ID, in.)	0.5715 (0.45)
Outer radius, cm (OD, in.)	0.61214 (0.482)
Tube material	Zircaloy-4

<sup>a</sup>Average HFP value.<sup>b</sup>Interpolated from the water density vs pressure and temperature table in the SAS2H input guide (ref. 5).<sup>c</sup>Based on a fuel loading of 90,000 kgU.

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					26	21	15	8	15	21	26				
2			31	29	25	20	14	7	14	20	25	29	31		
3		31	30	28	24	19	13	6	13	19	24	28	30	31	
4		29	28	27	23	18	12	5	12	18	23	27	28	29	
5	26	25	24	23	22	17	11	4	11	17	22	23	24	25	26
6	21	20	19	18	17	16	10	3	10	16	17	18	19	20	21
7	15	14	13	12	11	10	9	2	9	10	11	12	13	14	15
8	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8
9	15	14	13	12	11	10	9	2	9	10	11	12	13	14	15
10	21	20	19	18	17	16	10	3	10	16	17	18	19	20	21
11	26	25	24	23	22	17	11	4	11	17	22	23	24	25	26
12		29	28	27	23	18	12	5	12	18	23	27	28	29	
13		31	30	28	24	19	13	6	13	19	24	28	30	31	
14			31	29	25	20	14	7	14	20	25	29	31		
15					26	21	15	8	15	21	26				

EIGHTH-CORE  
SYMMETRIC LOCATION

Fig. 6. Sequoyah Unit 2 eighth-core symmetric configuration.

assemblies without BPR clusters. The differences between the 1-D fuel cell model for these two types of fuel groups are discussed in Sects. 3.2.1 and 3.2.2. Each fuel group was modeled as a single unit in a SAS2H depletion calculation over the range of burnups represented by the assemblies in the group. Table 5 provides relevant information about each fuel group.

The initial uranium content of each group was determined from the initial  $^{235}\text{U}$  enrichment of the associated fuel batch. The following empirical relationship was used to determine relative isotopic content:<sup>17</sup>

$$\begin{aligned} w_{234} &= 0.007731(w_{235})^{1.0837}, \\ w_{236} &= 0.0046w_{235}, \\ w_{238} &= 100 - w_{234} - w_{235} - w_{236}, \end{aligned}$$

where  $w$  is the weight percentage of the given uranium isotope. Using this formulation, the fresh fuel isotopics for all enrichments were computed. The results are given in Table 6.

In addition to the heavy metal fuel material, light elements are also present in the fuel assembly in the fuel clad and grid. Elements whose masses are typically found to be in excess of 0.5 g/kgU, plus Mn and Co, are shown in Table 7, along with their estimated masses. These masses are required by SAS2H. They are not used in the neutronics model but are applied in determining the  $(n,\gamma)$  fraction of energy per fission.

Each SAS2H calculation also requires specification of the temperature of each material for use in cross-section Doppler broadening corrections. However, since material and, therefore, thermal properties change with exposure, and because an assembly's peak temperature is a function of its linear heat rate, the average temperature in the fuel (and to a lesser extent the average clad temperature) will change with burnup and location. The only thermal data available were average fuel, clad, and moderator temperatures as given in Table 4.

### 3.2.1 SAS2H Fuel Cell Without BPRs

The SAS2H fuel cell model input for the five fuel groups without BPR clusters was relatively simple. Requirements included the dimensions of the fuel rod, clad, control-rod guide tube, and lattice pitch and the number of lattice positions in each fuel assembly that are not occupied by fuel rods (i.e., control rod guide tubes or instrumentation tubes). From this basic information included in Table 4, SAS2H constructed a 1-D effective assembly model consisting of a guide tube surrounded by a fuel/moderator region with a volume proportional to the fuel/guide tube volume ratio in the assembly. Cross sections for the fuel region are obtained from a pin cell calculation. More details of this default SAS2H assembly model can be found in ref. 5.

### 3.2.2 SAS2H Fuel Cell With BPRs

For the two fuel groups with BPR clusters (fuel groups 5 and 7), an effective fuel cell was derived to incorporate the BPR cell together with the guide tube cell in SAS2H. In the effective cell, the densities of the isotopes or elements remained unchanged from their actual densities, but rod diameters of the glass and stainless steel in the BPRs were reduced to account for their absence in the

Table 5. Fuel group data for MOC-3

SAS2H fuel group	Sequoyah-2 fuel batch	Contain BPRs in Cycle 3	Cycles in-core	Av. B/U, MWd/MTU	Min. B/U, MWd/MTU	Max. B/U MWd/MTU	Enrichment, wt %
1	2	No	1,2,3	30,172	30,812	31,622	2.6
2	3	No	1,2,3	30,343	27,263	34,555	3.1
3	4	No	2,3	19,780	13,362	23,784	3.5
4	5A	No	3	7,742	7,306	8,177	3.8
5	5A	Yes	3	9,487	9,019	9,935	3.8
6	5B	No	3	7,713	7,366	8,060	3.6
7	5B	Yes	3	9,977	9,755	10,119	3.6

Table 6. Initial uranium isotopic content of fresh fuel

Fuel batch	Initial U isotopes, wt %			
	<sup>234</sup> U	<sup>235</sup> U	<sup>236</sup> U	<sup>238</sup> U
2	0.022	2.6	0.012	97.366
3	0.026	3.1	0.014	96.860
4	0.030	3.5	0.016	96.454
5A	0.033	3.8	0.017	96.150
5B	0.031	3.6	0.017	96.352

Table 7. Light-element masses used in SAS2H calculations

Element	Weight, g/kgU
O	135.0
Cr	5.9
Mn	0.33
Fe	12.9
Co	0.075
Ni	9.9
Zr	221.0
Nb	0.71
Sn	3.6

guide tube positions. The method of deriving the effective cell was such that the various material total masses were conserved.

The composition of the borosilicate glass as modeled is listed in Table 8 using data for typical borosilicate glass.<sup>18</sup> These data and atomic weights of the elements and isotopic abundance values<sup>19</sup> were applied in deriving the atomic densities of the borosilicate glass in Table 9. The glass density, 2.23 g/cm<sup>3</sup>, was also obtained from ref. 18.

The number of BPR assemblies in fuel groups 5 and 7 and the number of assemblies having specific combinations of BPRs and guide tubes are shown in Table 10. The total number of BPRs and guide tubes for each group is also given in the table. Applying these totals and the dimensions of the BPRs, guide tubes, and lattice pitch, a set of effective unit cell dimensions were computed. The radius bounding each material was calculated from the outer to inner zone boundary for each average material volume. For example, the water moderator average volume  $\bar{V}_w$  for fuel group 5 is

$$\bar{V}_w = (352)(V_T - V_{GT} - V_{BP})/576 + (224)(V_T - V_{GT})/576 ,$$

where

$$\begin{aligned} V_T &= \text{total cell volume} = (\text{pitch})^2 \times (\text{length}), \\ V_{GT} &= \text{guide tube volume (same as outer tube in BPR cell)}, \\ V_{BP} &= \text{BP rod total volume.} \end{aligned}$$

Then the inner radius of the water or the effective radius of the BP rod is

$$R_{BP} = \sqrt{(V_T - \bar{V}_w - V_{GT})/(\pi L)} ,$$

where  $L$  is the active fuel length used in computing the volumes. The guide tube dimensions remain the same because they are identical in both types of cells. Each average volume,  $V_{ave}$ , within the effective BP rod is calculated from the corresponding actual BP rod dimensions (and totals for group 5 from Table 10):

$$V_{ave} = (352\pi L)(B^2 - A^2)/576 , \tag{1}$$

where

$$\begin{aligned} A &= \text{the material's inner radius in an actual BP rod,} \\ B &= \text{the same material zone's outer radius.} \end{aligned}$$



Using the prior calculation of the effective outer radius,  $B_e$ , the effective inner radius,  $A_e$  is

$$A_e = \sqrt{B_e^2 - V_{ave}/(\pi L)} . \quad (2)$$

Equations (1) and (2) are repeatedly used for each material zone for the entire effective cell determination. Applying the above procedure, the effective cell mockup dimensions for fuel groups

Table 8. Borosilicate glass composition  
in BPR assemblies

Compound	Weight fraction
SiO <sub>2</sub>	0.805
B <sub>2</sub> O <sub>3</sub>	0.125
Na <sub>2</sub> O	0.038
K <sub>2</sub> O	0.004
Al <sub>2</sub> O <sub>3</sub>	0.022

Table 9. Borosilicate glass input atom densities<sup>a</sup>

Element	Isotope	Weight fraction	Density, [atoms/(barn·cm)]
O		0.5358	0.04497
Na		0.0282	0.00165
Al		0.0116	0.00058
Si		0.3763	0.01799
K		0.0033	0.00011
B		0.03882	
	<sup>10</sup> B		9.595E-4 <sup>b</sup>
	<sup>11</sup> B		3.863E-3
Total		0.99402	

<sup>a</sup>Applying weight fractions of compounds in Table 8 and 2.23 g/cm<sup>3</sup> glass density.

<sup>b</sup>Read as  $9.595 \times 10^{-4}$ .

Table 10. Number of BPRs and guide tubes in fuel groups 5 and 7

Fuel group	Fuel batch	Number of assemblies	<u>Number/assembly</u>		<u>Total number</u>		
			BP rods	Guide tubes	BP rods	Guide tubes	Nonfuel <sup>a</sup> locations
5	5A	8	20	4	160	32	192
5	5A	8	16	8	128	64	192
5	5A	8	8	16	64	128	192
Total		24			352	224	576
7	5B	4	24	0	96	0	96
7	5B	4	16	8	64	32	96
7	5B	12	12	12	144	144	288
Total		20			304	176	480

<sup>a</sup>Excluding instrument tube.

5 and 7 were computed as listed in Table 11. The densities listed in the table were used only in computing material mass for verification of data.

The total material masses of the actual BP rods plus that of the guide tubes were compared with the effective cell total masses. The data were used to verify the cell dimensions. In all cases identical weights were computed for the same materials, verifying that the effective cells conserve mass.

### 3.3 SIMILAR-BURNUP SUBGROUPING FOR CROSS-SECTION SETS

Although the assemblies of a given fuel group are identical in terms of initial composition, time in core, and operating history, there may be a relatively broad range of burnups within a fuel group. Even though effective cross sections are felt to be insensitive to minor variations in burnups, it is necessary to set a maximum range of burnups for which an average burnup is an acceptable approximation in determining cross sections. As demonstrated in Sect. 3.8, a range of no more than 2 GWd/MTU has been found to be acceptable; this value was used in subdividing fuel groups into similar-burnup cross-section sets. As shown in Fig. 1, cross-section set information is provided to SNIKR for subsequent use in setting up CSASN calculations. CSASN is used to compute effective cross sections for each cross-section set. Since cross sections had to be calculated at BOC-3 and MOC-3, fuel groups had to be subdivided into cross-section sets at both burnups.

In order to determine cross-section sets for each fuel group, the fuel assembly burnups in each group were sorted and divided into subgroups where the minimum-to-maximum burnup range was no larger than 2 GWd/MTU. Eighth-core-averaged assembly burnups are given in Table 12, along with fuel batch, SAS2H fuel group, and cross-section set information. The cross-section set

Table 11. Effective fuel cells with BPRs

Zone	Material	Density, g/cm <sup>3</sup>	SAS2H mixture number	<u>Radius in cell, cm</u>	
				Fuel group 5	Fuel group 7
1	Air	1.22E-3 <sup>a</sup>	7	0.16728	0.17030
2	SS-304	7.92	5	0.18019	0.18344
3	Air	1.22E-3	7	0.18863	0.19203
4	Glass	2.23	6	0.33358	0.33959
5	Air	1.22E-3	7	0.34152	0.34768
6	SS-304	7.92	5	0.37826	0.38507
7	Mod	0.7149	3	0.57150	0.57150
8	Zr-4	6.44	2	0.61214	0.61214
9	Mod	0.7149	3	0.71079	0.71079
10	Fuel	10.3682	500	2.43666	2.43666

<sup>a</sup>Read as  $1.22 \times 10^{-3}$ .

Table 12. Fuel assembly data for eighth-core geometry

Eighth-core location	Sequoyah fuel batch	SAS2H fuel group	Cross-section set		Average burnup (MWd/MTU)	
			BOC	MOC	BOC	MOC
1	3	2	2	2	21,182	29,434
2	5B	7	11	11	0	10,102
3	4	3	7	7	13,137	23,062
4	5B	7	11	11	0	9,787
5	2	1	1	1	23,637	30,812
6	5B	7	11	11	0	9,755
7	3	2	2	3	22,226	30,246
8	5B	6	10	10	0	8,060
9	3	2	4	4	26,859	34,555
10	4	3	7	7	13,298	22,810
11	4	3	7	7	14,229	23,784
12	4	3	6	6	11,846	21,023
13	3	2	2	2	21,645	29,506
14	5A	5	9	9	0	9,935
15	5A	4	8	8	0	8,177
16	3	2	3	3	23,043	31,051
17	5B	7	11	11	0	10,119
18	3	2	3	3	23,685	31,312
19	5A	5	9	9	0	9,506
20	3	2	2	2	20,877	28,554
21	5A	4	8	8	0	7,306
22	3	2	3	3	24,587	32,147
23	4	3	6	6	10,575	19,376
24	4	3	7	7	14,185	22,943
25	5A	5	9	9	0	9,019
26	4	3	5	5	8,618	13,362
27	2	1	1	1	25,339	31,622
28	4	3	6	6	10,711	18,755
29	4	3	5	5	8,550	14,546
30	5B	6	10	10	0	7,366
31	3	2	3	2	24,497	27,263

groupings are shown in Table 13. Tables 14 and 15 show the cross-section sets at BOC and MOC, respectively, with the actual burnup ranges for assemblies within each cross-section set, along with the mean average burnup of all assemblies in each cross-section set. Note that no subgrouping was necessary for fuel groups 4 through 7; these assemblies were fresh fuel when loaded at BOC-3.

### 3.4 SAS2H DEPLETION CALCULATIONS

SAS2H depletion calculations were required for all fuel groups since all fuel assemblies loaded at the MOC-3 restart consisted of spent fuel. In the standard composition section of the SAS2H input for each fuel group, the initial uranium isotopic contents for the  $\text{UO}_2$  fuel were as given in Table 6. Although not initially present in the fuel, the additional 44 nuclides from Table 1 were included at an atom density of  $1 \times 10^{-20}$  ( $^{135}\text{Xe}$  was specified with an initial density on the order of its equilibrium concentration, since it quickly reaches this equilibrium concentration shortly after startup), indicating to SAS2H that cross sections for these isotopes should be updated at the end of each burn cycle, as discussed previously in Sect. 2.2. The remainder of the fuel pin cell was described as Zircaloy clad in water, with temperature and geometry data as specified in Table 4. The active fuel length was specified as 784.35 cm/MTU based on the actual fuel length of 365.76 cm divided by the total weight of heavy metal of 0.46632 MTU; this modification gives results in units of burnup per MTU rather than burnup per assembly. Since SAS2H uses a 1-D assembly cell model, the fuel length is arbitrary and may be used as a conversion factor.

Table 16 gives the power history data used for each SAS2H fuel group. Note that a constant burnup per interval was used for each fuel group; this constant spacing is required by SNIKR when interpolating from SAS2H/ORIGEN output. Shorter burnup intervals were used for the fresh fuel loaded in Cycle 3 (batches 5A and 5B) in order to have a sufficient number of data points for SNIKR to interpolate. The number of intervals for each group was chosen so that the maximum assembly burnup was exceeded by at least 20%. The average specific power for each fuel group was calculated by dividing the group average burnup by the total uptimes for all cycles that the fuel was in the core. As explained previously in Sect. 2.2, the ratios of uptime to downtime for cycles 1 and 2 were used to determine the length of downtime following each burnup interval for the fuel in those cycles. No downtime was applied for any of the fuel groups during cycle 3, since SNIKR performed the downtime decay calculation via ORIGEN-S for the MOC-3 restart.

A copy of the SAS2H input for fuel group 1 is included in Appendix B. With the exception of the uranium isotopics, the burnup steps, and the BPR data, inputs for the other fuel group calculations were identical.

### 3.5 BURNUP-DEPENDENT INTERPOLATION OF ISOTOPICS

The atom density output files from each of the previous SAS2H calculations contain isotopic concentrations for the associated fuel group at each burnup step. Using the appropriate group output, SNIKR1 was used to interpolate between burnup intervals in order to estimate the isotopic concentration corresponding to the burnup of each assembly and cross-section set in the Sequoyah 2 models at BOC-3 and MOC-3. SNIKR1 then used these isotopics (which represented nuclide concentrations at the end of the depletion prior to the critical condition at BOC-3 or MOX-3) and prepared an ORIGEN-S decay calculation to obtain the concentration of the isotopes after the

Table 13. Cross-section sets for one-eighth-core assemblies

BOC			MOC		
Cross-section set No.	Assembly No.	Burnup (MWd/MTU)	Cross-section set No.	Assembly No.	Burnup (MWd/MTU)
1	5	23,637	1	5	30,812
	27	25,339		27	31,622
	Average	24,488		Average	31,217
2	1	21,182	2	1	29,434
	7	22,226		13	29,506
	13	21,645		20	28,555
	20	20,877		31	27,263
	Average	21,483		Average	28,713
3	16	23,043	3	7	30,246
	18	23,685		16	31,051
	22	24,587		18	31,312
	31	24,497		22	32,147
	Average	23,953		Average	31,213
4	9	26,859	4	9	34,555
	Average	26,859		Average	34,555
5	26	8,618	5	26	13,362
	29	8,550		29	14,546
	Average	8,584		Average	13,954
6	12	11,846	6	12	21,023
	23	10,575		23	19,376
	28	10,711		28	18,755
	Average	11,044		Average	19,718
7	3	13,137	7	3	23,062
	10	13,298		10	22,810
	11	14,229		11	23,784
	24	14,185		24	22,943
	Average	13,712		Average	23,162
8	15	0	8	15	8,177
	21	0		21	7,306
	Average	0		Average	7,742
9	14	0	9	14	9,935
	19	0		19	9,506
	25	0		25	9,019
	Average	0		Average	9,487
10	8	0	10	8	8,060
	30	0		30	7,366
	Average	0		Average	7,713
11	2	0	11	2	10,102
	4	0		4	9,787
	6	0		6	9,755
	17	0		17	10,119
	Average	0		Average	9,977

Table 14. Cross-section sets for Sequoyah Unit 2 Cycle 3 BOC

Cross-section set No.	Enrichment	BPRs	SAS2H fuel group	Average burnup (MWd/MTU)	Burnup range (MWd/MTU)	No. of assemblies
1	2.6	No	1	24,488	23,637 – 25,339	2
2	3.1	No	2	21,483	20,877 – 22,226	4
3	3.1	No	2	23,953	23,043 – 24,587	4
4	3.1	No	2	26,859	26,859	1
5	3.5	No	3	8,584	8,550 – 8,618	2
6	3.5	No	3	11,044	10,575 – 11,846	3
7	3.5	No	3	13,712	13,137 – 14,229	4
8	3.8	No	4	0	0	2
9	3.8	Yes	5	0	0	3
10	3.6	No	6	0	0	2
11	3.6	Yes	7	0	0	4

Table 15. Cross-section sets for Sequoyah Unit 2 Cycle 3 MOC

Cross-section set no.	Enrichment	BPRs	SAS2H fuel group	Average burnup (MWd/MTU)	Burnup range (MWd/MTU)	No. of assemblies
1	2.6	No	1	31,217	30,812 – 31,622	2
2	3.1	No	2	28,713	27,263 – 29,506	4
3	3.1	No	2	31,213	30,246 – 32,147	4
4	3.1	No	2	34,555	34,555	1
5	3.5	No	3	13,954	13,362 – 14,546	2
6	3.5	No	3	19,718	18,755 – 21,023	3
7	3.5	No	3	23,162	22,810 – 23,784	4
8	3.8	No	4	7,742	7,306 – 8,177	2
9	3.8	Yes	5	9,487		3
10	3.6	No	6	7,713	9,019 – 9,935	2
11	3.6	Yes	7	9,977	7,366 – 8,060	4
					9,755 – 10,119	

Table 16. SAS2H operating history data by fuel group and cycle

SAS2H fuel group	Reactor cycles	Average power (MW/MTU)	Actual uptime (d)	Actual downtime (d)	Number of intervals @ burnup per interval (GWd/MTU)	Modeled burn time per interval (d)	Modeled downtime per interval (d)	Cumulative burnup (GWd/MTU)
1	1 and 2	33.939	684	318	5@5	147.32	69.33	25
1	3 <sup>a</sup>	33.939	205	0	3@5	147.32	0	40
2	1 and 2	34.132	684	318	5@5	146.49	68.94	25
2	3 <sup>a</sup>	34.132	205	0	4@5	146.49	0	45
3	2	41.468	272	153	2@5	120.58	67.82	10
3	3 <sup>a</sup>	41.468	205	0	4@5	120.58	0	30
4	3 <sup>a</sup>	37.765	205	0	4@5	79.439	0	20
5	3 <sup>a</sup>	46.278	205	0	4@5	64.826	0	20
6	3 <sup>a</sup>	37.625	205	0	4@5	79.734	0	20
7	3 <sup>a</sup>	48.666	205	0	5@5	61.645	0	25

<sup>a</sup>To the MOC-3.



appropriate downtimes of 0.42 and 2.73 years prior to the BOC-3 startup and the MOC-3 restart, respectively. For the HFP cases, this step was followed by an ORIGEN-S depletion of 100 h at HFP in order to obtain the HFP equilibrium xenon concentration for each assembly. Since the assembly-average relative power distribution at the time of the restart was not available, each fuel assembly was assumed to be at the core-average power level for generating the equilibrium xenon concentrations. Because SNIKR1 set up the ORIGEN-S decay on a basis of atoms/b-cm, the power was converted from MW/MTU to MW/b-cm·MTU per atom. The conversion factor for Westinghouse  $17 \times 17$  fuel was calculated as  $5.51884\text{E-}6$ . The core average power level assumed for Sequoyah Unit 2 was 37.90 MW/MTU, or  $2.0916\text{E-}4$  MW/atom/b-cm. The necessary input files for the HFP depletion were the ORIGEN-S restart file from the downtime decay and the SAS2H cross-section library from the previous SAS2H depletion. After ORIGEN-S was executed, SNIKR3 read the ORIGEN-S output and prepared isotopic concentration tables in both SCALE standard composition input format and KENO mixing table format, for the selected set of isotopes listed previously in Table 2.

The SNIKR sequence consists of three codes, as previously described in Sect. 2.3, and requires two files. The first file is a SNIKR input file describing the calculation to be performed for a specific assembly or cross-section set; the second is the SAS2H output file containing the atom density data for the appropriate fuel group. SNIKR calculations are automated in a manner similar to SCALE calculational sequences such that the multistep calling of the individual code packages is transparent to the user. Appendix C lists a user input guide for SNIKR Version 1.0, which was used in these analyses, and FORTRAN listings of SNIKR1 and SNIKR3. The SAS2H and SNIKR calculations were performed on the ORNL IBM/MVS 3090 mainframe computer using SCALE-4.1.

SNIKR1 then used these isotopics (which represented nuclide concentrations at the end of the depletion prior to the critical condition at BOC-3 or MOC-3) and prepared an ORIGEN-S decay calculation to obtain the concentration of the isotopes after the appropriate downtimes of 0.42 and 2.73 years prior to the BOC-3 startup and the MOC-3 restart, respectively. Slightly different approaches are taken between preparation of assembly isotopics and cross-section set isotopics because the results are used in different applications. The following subsections describe each of the two methods.

### 3.5.1 Assembly Isotopics

In the KENO V.a model of Sequoyah Unit 2 Cycle 3, eighth-core-averaged assembly isotopics calculations are used to provide the nuclide concentrations for each assembly position. The assembly isotopics are based on the average burnup for the assembly, and all fuel rods within the assembly are assumed to possess the same isotopic composition. Hence, material numbers for each fuel rod in a given assembly are identical and correspond to a specific KENO V.a mixture number. This mixture is defined based on results of SNIKR calculations for the burnup of the corresponding assembly. In the Sequoyah KENO V.a model, mixture numbers 101 through 131 correspond to SNIKR calculations for assemblies 1 through 31, respectively. Eighth-core-averaged assembly burnups are given in Table 12, along with fuel-group and cross-section set information.

Sample SNIKR input files for BOC and MOC are listed in Tables D.1 and E.1, respectively. As discussed earlier in Sect. 2.4, cross-section set-dependent cross sections are required only for the seven burnup-dependent actinides. SNIKR places the cross-section ID modifier in front of the default cross-section ID for each of these isotopes (e.g.,  $^{238}\text{U}$ , with ID No. 92238, would be described as

292238 for all assemblies located in cross-section set 2). Burnable poison isotopics were similarly generated for each of the seven eighth-core fuel assembly locations where BPRs were present in Cycle 3. Sample input files are listed in Tables D.2 and E.2.

The SNIKR output file consists of three sections: a summary of the input and coarsely formatted ORIGEN-S results, isotopic concentrations in SCALE standard composition input format, and isotopic concentrations in KENO V.a mixing table input format. For each assembly calculation, only the latter was of interest; this section was copied and placed directly into KENO V.a input to describe the isotopic composition for the burnup of a specific assembly. A sample SNIKR output is listed in Appendix C.

### 3.5.2 Cross-Section Set Isotopics

Burnup-dependent cross sections were required for the seven burnup-dependent actinides. As was previously mentioned, cross-section set calculations were performed with CSASN in order to obtain the cross sections for these actinides for each cross-section set based on the average burnup. Cross-section set groupings are shown in Table 13; these groupings were selected based on the burnup range criterion of 2 GWd/MTU discussed earlier. SNIKR calculations were required for all cross-section sets except the fresh fuel sets 8 through 11 at BOC, HZP. With the exception of cross-section set 4, only the seven burnup-dependent actinides are needed for each set of burned fuel at BOC and MOC. Therefore, the 100-h HFP depletion following the downtime decay in ORIGEN-S was only performed for cross-section set 4, which included all the nuclides in Table 2 as well as those for all the nonfuel mixtures [clad, moderator, BPR (MOC only), and structural materials]. Example input files are shown in Tables D.3 and E.3.

The SNIKR output file is the same format as was produced for the assembly calculations; however, the region of output data which was of interest was different. The isotopic concentrations in SCALE standard composition input format were copied to a CSASN input file.

## 3.6 GENERATION OF CROSS SECTIONS USING CSASN

Problem-dependent cross-section libraries were produced using the CSASN sequence of SCALE; the details of this process were described in Sect. 2.4. For each cross-section set, a CSASN input deck containing cross-section set average isotopics was created. Because the physical geometries of all fuel pins were identical, input specifications were the same for all sets, with the exception of the isotopic compositions specified for each set. All cases were set up to use the SCALE ENDF/B-IV and ENDF/B-V based 27-group 27BURNUPLIB cross-section library. All calculations were LATTICECELL-type, with fuel in a Zircaloy clad, with dimensions as specified in Table 4. A borated-water moderator was specified, with the appropriate boron concentration. For HZP, all components were specified with a temperature of 559 K (547°F), corresponding to HZP conditions. For HFP, appropriate temperatures from Table 4 were specified for each component. The example inputs for HZP and HFP, respectively, are shown in Tables D.4 and E.4.

Isotopic concentrations were obtained from the earlier SNIKR cross-section set calculations. Since only the seven burnup-dependent actinides were required, except for set 4, all other actinides and fission products were deleted from the fuel mixture specifications for these cases. Cross-section sets 8 through 11, comprised only of fresh fuel at BOC, HZP, were specified using the fresh

isotopic compositions given in Table 6 for that case. The microscopic cross-section calculations for cross-section set 4 also included the other actinides and fission products in the fuel mixture, along with mixtures for the BPR nuclides (MOC only), moderator, and structural materials. The microscopic cross-section calculations for cross-section set 11 included the BPR nuclides at BOC. The example input for cross-section set 4 is included as Tables D.5 and E.5. The nuclide IDs and atom densities for each of these mixtures were copied from the CSASN output to the KENO V.a mixing table. Cross-section set 4 was selected for these calculations because its spent fuel isotopics represented the highest burnup assembly (26,859 MWd/MTU at BOC and 34,555 MWd/MTU at MOC) in the eighth-core model. The BPR nuclide concentrations at MOC were taken from the SNIKR/ORIGEN-S calculations previously performed for the BPR in eighth-core fuel assembly location 17, which was the highest burnup location (10,119 MWd/MTU) with BPRs. CSASN calculations were then performed, with the resulting microscopic working-format cross-section library saved for each cross-section set.

### 3.7 COMBINING CROSS-SECTION SET LIBRARIES USING WAX

The WAX program<sup>16</sup> was used to combine the 11 individual working-format libraries (one per cross-section set) into a single library for each of the three reactor criticals to be used in the KENO V.a core calculations. For cross-section set 4, selected to include the fission products and additional actinides, WAX copied all cross sections into the combined library. For the cross-section set selected for the BPR cross sections (set 11 at BOC and 4 at MOC), WAX copied those cross sections in addition to the seven burnup-dependent actinides. For the remaining cross-section sets, WAX copied only the cross sections for the seven burnup-dependent actinides. For each of these actinides, the cross-section ID was modified by adding the cross-section set number as a prefix, to be consistent with the numbering scheme used in the SNIKR-produced KENO V.a mixing-table-format isotopics for each assembly. Sample WAX input listings are provided in Tables D.6 and E.6. All CSASN and WAX calculations were performed with SCALE-4.1 on the ORNL IBM mainframe.

### 3.8 VALIDATION OF CROSS-SECTION SET ASSUMPTIONS

The methodology of cross-section generation employing cross-section sets resulted in each fuel assembly in the KENO V.a full-core model being modeled with microscopic cross sections generated with isotopics based on the average burnup for a cross-section set (i.e., a subgroup of fuel). In order to validate this methodology, the highest burnup assemblies at MOC in cross-section sets 3 and 6 were analyzed by executing an XSDRNPM<sup>20</sup> eigenvalue calculation in stand-alone mode and via the CSAS1X<sup>6</sup> sequence (BONAMI, NITAWL-II, XSDRNPM). The stand-alone calculations utilized the working-format libraries created by WAX that were based on cross-section set averaged isotopics. The CSAS1X calculations generated and used problem-specific microscopic cross sections based on the calculated assembly isotopics. Cross-section set 3 was selected for the validation because it represented the highest burnup cross-section set with a range of burnups. Cross-section-set 6 was also selected because it had the largest minimum-to-maximum burnup range (2.23 MWd/MTU). The individual assemblies N38 and P17 were selected because they represented the maximum burnup, and, hence, the maximum difference in isotopics from the average, for their respective cross-section sets. These cases should give the poorest agreement since the change in

microscopic cross sections should be greatest at higher burnups and for the largest difference in assembly-to-average burnup. Since assembly P17 had the largest difference at MOC, similar calculations were performed for it at BOC (HZIP and HFP). The results of these cases are compared in Table 17, which shows a maximum difference of 0.085%  $\Delta k/k$  due to the use of the cross sections at subgroup averaged conditions. This suggests that subgroup-averaged cross sections with a burnup range of up to 2 MWd/MTU give a reasonable approximation to burnup-specific cross sections. Input datasets for assembly P17 are included in Tables D.7 and D.8 and E.7 and E.8.

Table 17.  $k_{\infty}$  comparison for validation of cross-section methodology

Burnup	Power	Assembly ID	$k_{\infty}$		% Difference
			XSDRNPM stand-alone	CSAS1X sequence	
MOC	HFP	N38	0.896084	0.895497	0.065
MOC	HFP	P17	1.00332	1.00247	0.085
BOC	HZIP	P17	1.04580	1.04527	0.051
BOC	HFP	P17	1.04041	1.03985	0.054

### 3.9 PREPARATION OF KENO V.a CORE MODEL

The KENO V.a model used to determine  $k_{\text{eff}}$  for the Sequoyah 2 BOC-3 and MOC-3 cores consists of four parts. The first section of input contains code parameter specifications. The only significant aspect of this section is the use of 1003 generations of 1000 neutrons per generation; hence, the calculation was based on one million histories (three generations were automatically skipped by KENO V.a). Parameter specifications are followed by mixture specifications, geometry specifications, and plotting specifications. The latter set is unimportant in the criticality calculation and was simply used in debugging and verifying geometry input. The following subsections describe the details of the material and geometry specifications for this model.

#### 3.9.1 KENO V.a Mixture Specifications

In describing the composition of a fuel assembly, it has been assumed that all fuel rods in the assembly are identical and may be represented by the assembly-averaged burnup. No attempt was made to account for burnup asymmetries within an assembly, because this information was not readily available and should have little effect on the computed solution. Thus, only a single fuel rod description is necessary to describe all fuel rods in a given assembly. In addition, in this model, axial power distributions are ignored, and assemblies are represented by a model that assumes a constant (average) power distribution along the length of the assembly. Thus, the composition of fuel in an assembly is uniform and is represented by a single material specification. Based on the results of an axial end effects study,<sup>21</sup> this assumption has a minor effect ( $<0.1\%$   $\Delta k/k$ ) that is probably

conservative for the average burnup in these models. Because it is possible to take advantage of the one-eighth-core symmetry of the core, only 31 assemblies are required to represent all 193 assembly positions in the core. Hence, only 31 material mixtures are necessary for the full-core model. These come from the 31 assembly calculations performed earlier using SNIKR for mixtures 101 through 131. The portions of the SNIKR output copied into the KENO V.a input represent complete mixture specifications for each of the 31 materials.

Material specifications were also required for all remaining materials (i.e., clad, borated water, and BPR materials). Concentrations for each isotope were obtained from the output of the CSASN cross-section calculations. Mixture numbers 11 through 17 were used for the burnable poison materials. A unique mixture number was assigned the BPR in each eighth-core fuel assembly that contained BPRs. This unique mixture number was necessary for the MOC-3 case where the BPRs were partially depleted and varied with assembly burnup. Table 18 lists all materials included in the core model by mixture number.

Table 18. Mixtures in KENO V.a model

Mixture No.	Description
1	Clad
2	Stainless steel (BP clad, baffle)
3	Borated moderator
4	50% borated moderator, 50% stainless steel (top and bottom
5	reflector)
6	Stainless steel (core barrel)
7	Borated moderator (outside core barrel)
8	Stainless steel (thermal shield)
9	Borated moderator (outside thermal shield)
11-17	Stainless steel (reactor vessel)
101-131	Burnable poison, assemblies 2, 4, 6, 14, 17, 19, 25
	Fuel, assemblies 1-31

### 3.9.2 KENO V.a Geometry Specifications

A fuel rod was defined for each of the 31 one-eighth-core fuel assemblies based on the dimensions given in Table 4. Identical dimensions were used for all rod definitions. Fuel rods were assigned to unit numbers 101 to 131, respectively; the fuel region of each rod was linked to its corresponding material number (e.g., fuel rod 101 used material 101 for the fuel region). All rods were specified with a void gap and Zircaloy clad, centered in a water cuboid. Fuel rods and enclosing cuboids were modeled as having a length equal to that of the active fuel length of the rod (i.e., fuel assembly top and bottom structures were neglected). A 50/50 mixture of borated H<sub>2</sub>O and stainless

steel was used as a top and bottom reflector (25 cm thick) to account for structural materials above and below the active fuel region.

Unit 161, representing a control rod guide tube, was created using the dimensions in Table 4, with water inside the tube and centered within a water cuboid. Burnable poison rods were created as Units 162 through 168. Each BPR was put inside a control rod guide tube.

The remaining array locations were appropriately filled with guide tubes or BPRs according to the full-core BPR loading configuration in Fig. 5 and the fuel assembly lattice arrangements in Fig. 4. Each array was surrounded by a thin layer of moderator in order to obtain an assembly lattice spacing of 21.50364 cm (8.466 in.).

The core baffle surrounding the outermost assemblies was created as a composite of several smaller segments, comprised of four different cuboid shapes. Units 41 to 44 were used to define these shapes. Figure 7 illustrates the use of these four unit types in modeling the core baffle. The figure also shows assembly position numbers for the full core, based on one-eighth-core symmetry and the numbering scheme shown in Fig. 6. Using these position numbers, arrays of assemblies and core baffle segments were used to define larger units, to minimize the number of KENO V.a "holes" placed in the global unit. Figure 8 illustrates the grouping of assemblies used. Global Unit 70 contained the core barrel, thermal shield, and reactor vessel. All other units were placed within Unit 70 using KENO V.a "holes." Note that core baffle components drawn in black in the figure represent individual components not included in these arrays and were entered as individual holes in the global array. Unit number assignments used in the model are given in Table 19.

This discussion completes the geometric description of the core. As a reference, a listing of the entire KENO V.a input for the BOC-3 HZP or HFP cases and the MOC-3 HFP case are included in Tables D.9, D.10, and E.9, respectively. All KENO V.a calculations were performed with SCALE-4.2 on an IBM RS-6000 workstation after the cross-section libraries created with WAX had been transferred from the ORNL IBM mainframe.

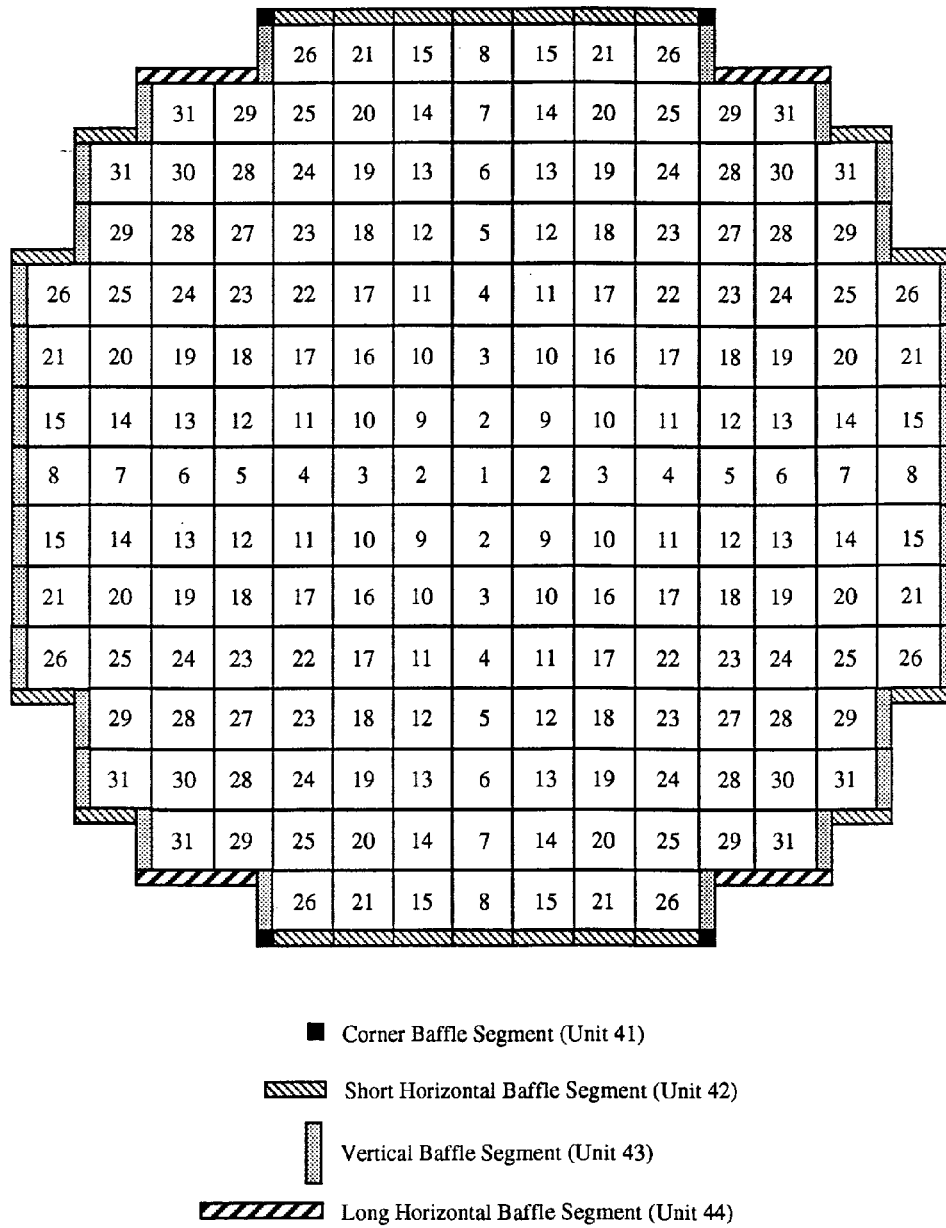


Fig. 7. Full-core assembly positions and core baffle configuration.

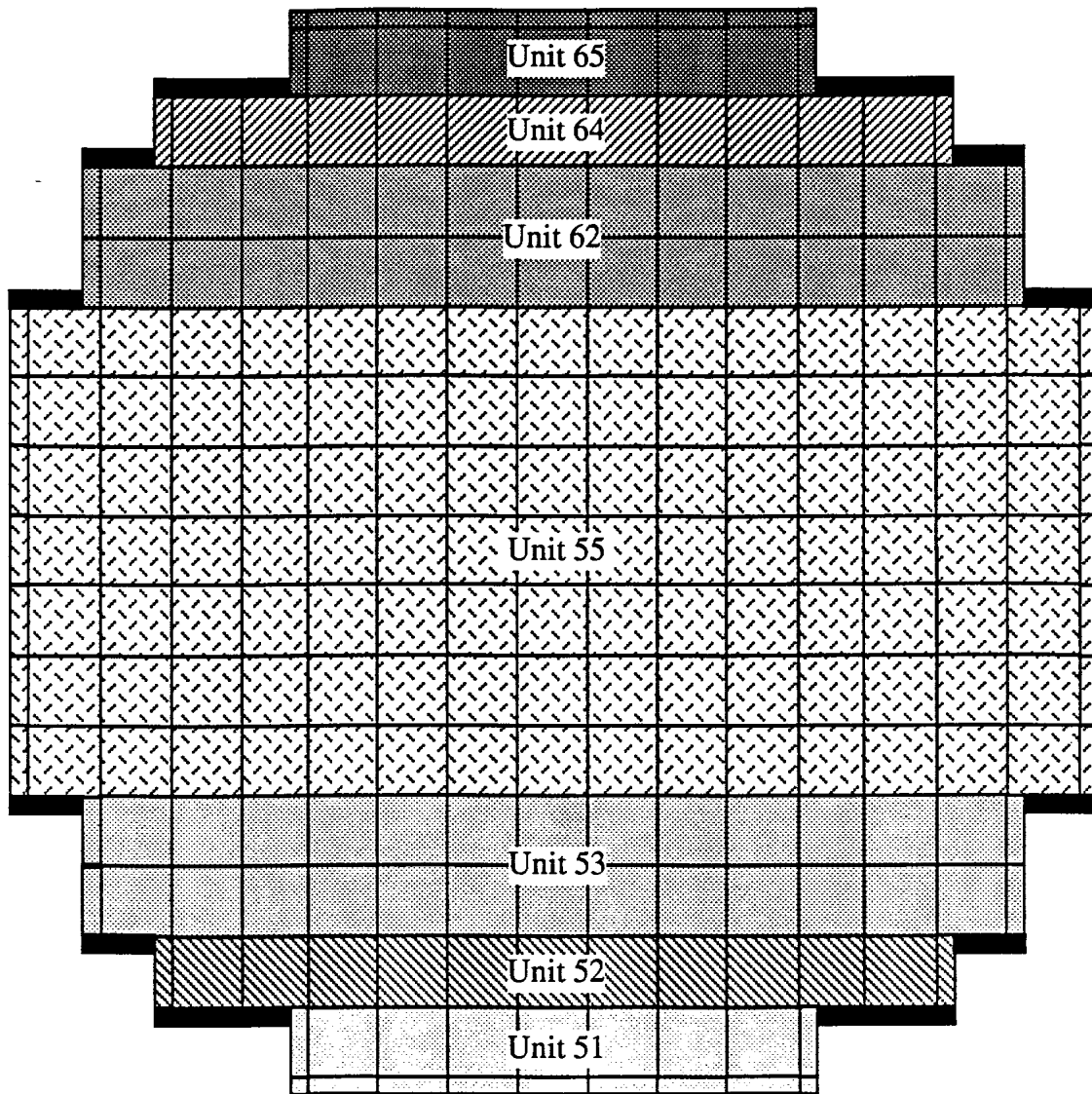


Fig. 8. KENO V.a unit definitions based on component arrays.



Table 19. Unit numbers used in Sequoyah KENO V.a core model

Unit No.	Description
1-31	Fuel assemblies for positions 1 to 31, respectively
41	$2.8575 \times 2.8575$ cm (corner) segment of core baffle
42	$21.50364 \times 2.8575$ cm (horizontal) segment of core baffle
43	$2.8575 \times 21.50364$ cm (vertical) segment of core baffle
44	$43.00728 \times 2.8575$ cm (horizontal) segment of core baffle
51	"Bottom" of baffle + row 1 of assemblies + vertical baffle ends
52	Row 2 of assemblies + vertical baffle ends
53	Rows 3 and 4 of assemblies + vertical baffle ends
54	Rows 5-11 of assemblies + vertical baffle ends
62	Rows 12 and 13 of assemblies + vertical baffle ends
64	Row 14 of assemblies + vertical baffle ends
65	Row 15 of assemblies + vertical baffle ends + "top" of baffle
70 (GLOBAL)	Reactor vessel + thermal shield + core barrel + vertical baffle ends
101-131	Fuel rods for assemblies 1-31, respectively
161	Water-filled control rod guide tube
162-168	BPRs in control rod guide tubes

## 4. RESULTS AND CONCLUSIONS

The KENO V.a criticality calculations for the Sequoyah 2 Cycle 3 BOC and MOC models described in this report yielded values for  $k_{\text{eff}}$  from 1.0039 to 1.0067, as shown in Table 20. These results display great consistency for different burnup, power, xenon, and temperature conditions. The range of conditions for these reactor criticals are listed in Table 21. The MOC-3 case is unique among the reactor critical calculations reported in all the volumes of this report because it is the only core that contains all spent fuel. These results are based on 1000 generations of 1000 neutrons per generation, for a total of  $1 \times 10^6$  histories. Included in Table 20 is the average fission group reported by SCALE, which represents the average neutron energy at which fission occurs. Numerical experiments with a different starting random number and different starting source shape and location indicate that these solutions are well converged and adequate source sampling achieved (see ref. 7 for discussion of what constitutes convergence).

The results in Table 20 were based on  $P_3$  scattering; however, a test case using (default)  $P_1$  scattering showed no significant change (within 0.1%) in  $k_{\text{eff}}$ . This result is as would be expected, since angular fluxes throughout a reactor core would be expected to be relatively uniform except near the outer boundary of the core.

Relative fission density distributions computed by KENO V.a are shown in Figs. 9, 10, and 11 for a one-eighth-core average. These may be interpreted as relative power densities, and show the approximate shape expected for an operating PWR core, indicating no major anomalies in the core assembly model. The use of uniform temperature and xenon distributions for the HFP cases causes the KENO V.a distributions to be less uniform over the inner-core regions due to the lack of xenon and temperature feedback mechanisms. Note that while  $k_{\text{eff}}$ , a total system parameter, is considered to be well converged, individual assembly fission distributions are based on substantially fewer histories, especially in outer-core regions, and therefore are subject to significantly higher uncertainties.

The results of these calculations demonstrate that even with a relatively simple core model and eighth-core and assembly-averaged burnups, it is possible to closely predict, in a best-estimate fashion, the critical condition after a long decay period for a lattice primarily comprised of spent fuel assemblies. Results are also consistent with SCALE validation calculations performed based on experiments using mixed-oxide fuel rods in square lattice configurations.<sup>22</sup> Hence, one may conclude that the methodology applied in performing these reactor critical calculations is valid for performing criticality safety analyses for systems with spent fuel.

Table 20. KENO V.a calculated results for Sequoyah Unit 2 Cycle 3

Burnup	Power	Boron (ppm)	$k_{\text{eff}}$	Average energy group where fission occurs <sup>a</sup>	Neutron histories
BOC	HZP	1685	$1.0039 \pm 0.0005$	$20.4868 \pm 0.0037$	1,000,000
BOC	HFP	1150	$1.0067 \pm 0.0005$	$20.3822 \pm 0.0035$	1,000,000
MOC	HFP	475	$1.0046 \pm 0.0005$	$20.4437 \pm 0.0037$	1,000,000

<sup>a</sup>The energy range for group 20 is 0.8 to 0.4 eV.

Table 21. Range of conditions for Sequoyah reactor criticals

Case	Core avg. burnup (MWd/MTU)	Power (MW)	Mod. temp. (°F)	Fuel temp. (°F)	Xenon worth (% $\Delta k/k$ )
BOC,HZP	10,998	0	547	547	0
BOC,HFP	11,148	3,411	582	1162	2.64
MOC,HFP	19,248	3,411	582	1162	2.95

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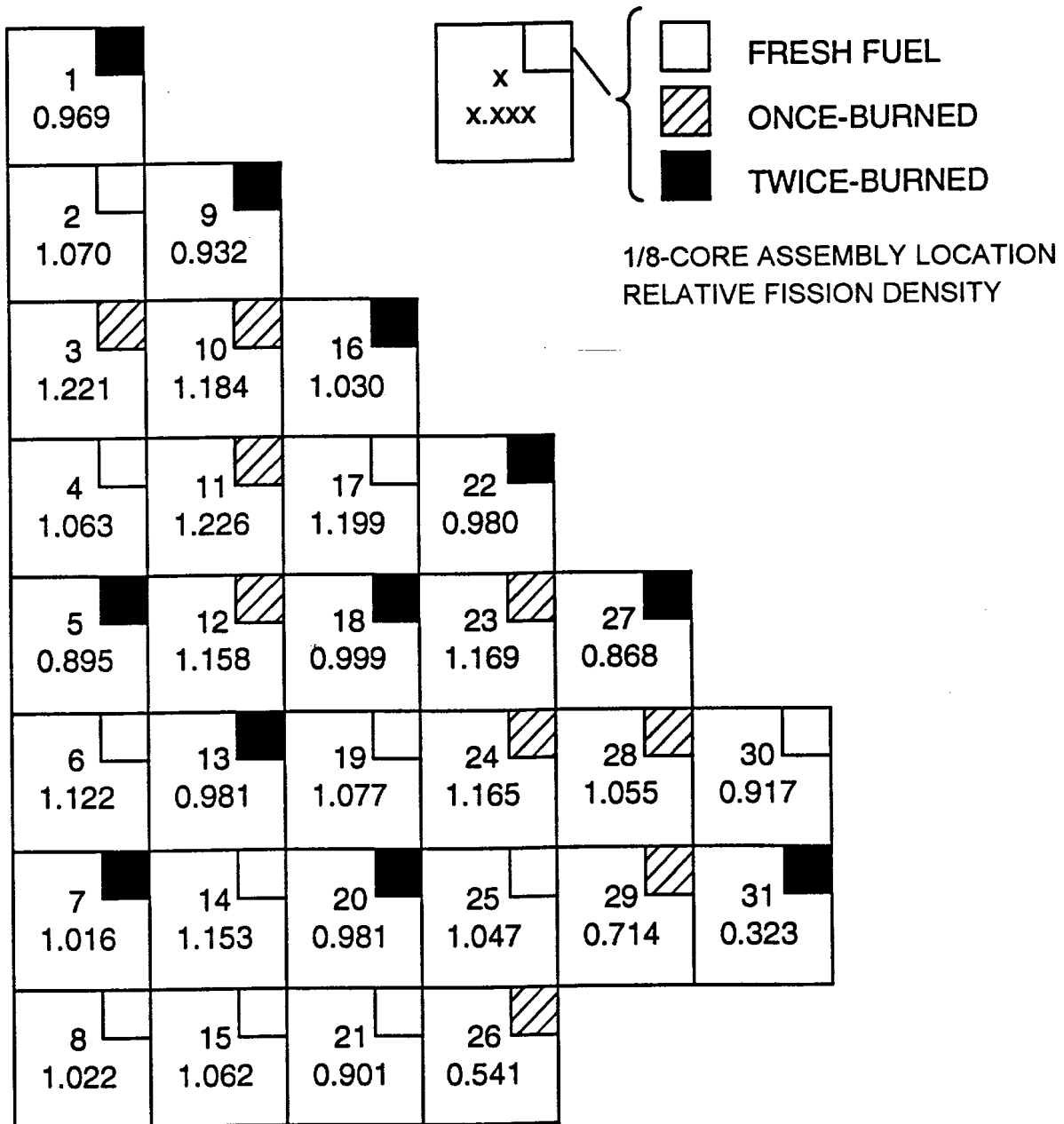


Fig. 9. BOC, HZP eighth-core relative fission density distribution.

ORNL-DWG 92M-8307R

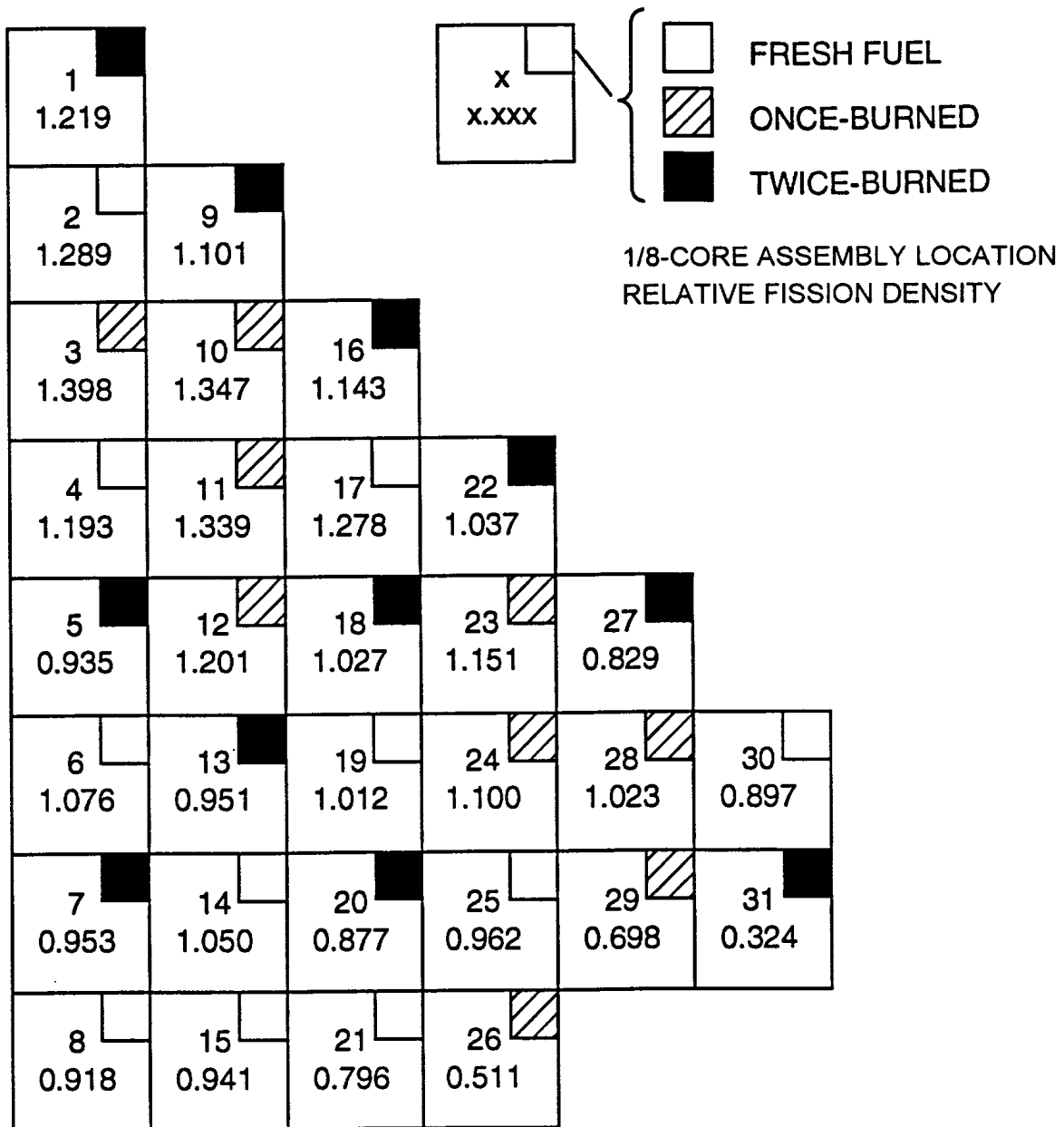


Fig. 10. BOC, HFP eighth-core relative fission density distribution.

ORNL-DWG 92M-8872R

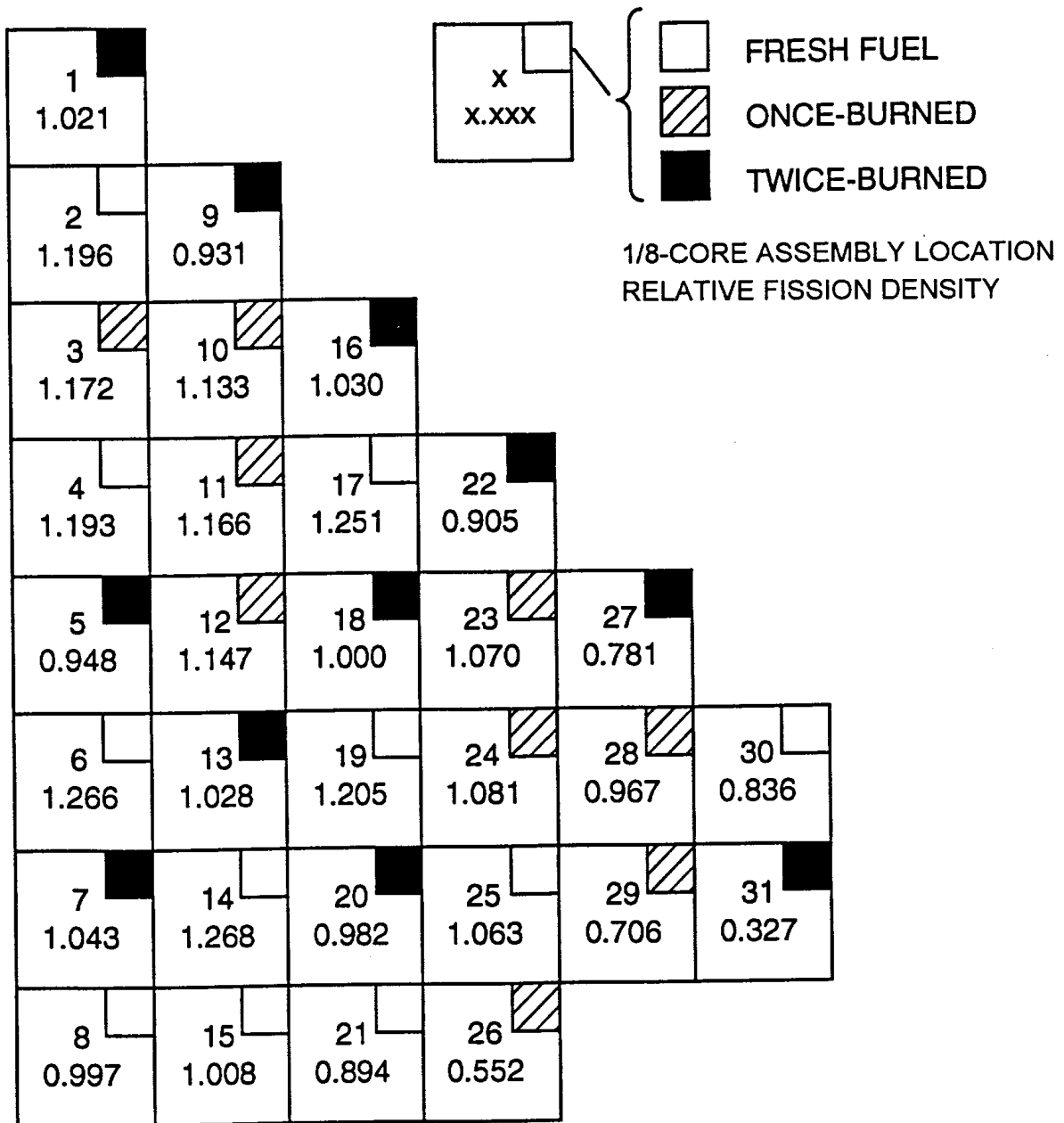


Fig. 11. MOC, HFP eighth-core relative fission density distribution.

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## **APPENDIX A**

### **SEQUOYAH UNIT 2 CYCLE DATA**

Source data provided by the Tennessee Valley Authority are presented here for completeness. The boron letdown curves of the soluble boron in the coolant of Sequoyah Unit 2 Cycles 1, 2, and 3, are shown in Figs. A.1, A.2, and A.3, respectively. The initial core loading patterns of Cycles 1, 2, and 3 are shown in Figs. A.4, A.5, and A.6, respectively. The final burnup distributions in the core after Cycles 1 and 2 are shown in Figs. A.7 and A.8, respectively. The fuel assembly burnup data at the restart after the long downtime during the MOC 3 are listed in Table A.1. The startup and shutdown dates of each cycle, in addition to the operating history derived for the cycle, are shown in Table A.2. The average operating specific power and cycle times for each fuel region or batch were computed from the data in these two tables.

Table A.1. Fuel assembly burnups at MOC restart  
during Cycle 3 of Sequoyah Unit 2

Assembly	Burnup (MWd/MTU)	Assembly	Burnup, (MWd/MTU)	Assembly	Burnup, (MWd/MTU)
M06	28334.64	N31	28601.57	P26	23449.75
M08	28058.42	N32	28769.80	P27	13244.69
M17	28084.44	N33	29434.07	P28	20724.66
M29	31431.33	N34	31510.97	P29	18724.36
M34	31425.06	N35	32191.32	P30	23068.39
M37	30775.18	N36	27462.70	P31	13445.33
M39	31057.30	N38	32286.77	P32	19320.21
M48	27849.47	N39	31067.26	P33	19461.05
M53	31907.16	N40	28294.71	P34	19235.61
M55	31726.18	N41	30100.28	P35	22289.99
M56	30841.37	N42	28916.20	P36	19599.64
M62	30575.21	N43	34879.55	P37	20960.71
N01	31336.13	N44	28955.16	P38	23811.87
N02	30266.71	N45	28564.19	P39	14660.20
N04	28315.73	N47	31393.15	P40	19069.01
N05	30047.02	N48	29079.95	P41	22573.95
N06	31297.18	P01	13379.10	P42	22775.40
N07	29936.54	P02	22627.31	P43	22713.77
N08	27178.31	P03	14716.69	P44	18493.12
N09	30891.21	P04	21040.94	P45	23665.38
N10	30027.35	P05	14317.43	P46	14411.91
N11	34352.87	P06	14454.71	P47	20752.01
N12	28742.42	P07	19252.41	P48	22780.55
N13	30340.93	P08	24039.36	P49	23058.93
N14	31234.53	P09	22527.44	P50	19393.28
N15	32133.50	P10	23216.63	P51	23098.32
N16	28983.91	P11	18747.10	P52	18755.48
N17	31189.20	P12	23058.35	P53	18671.76
N18	26962.14	P13	21170.84	P54	22473.72
N19	27450.28	P14	14477.76	P55	13701.58
N20	30195.02	P15	23046.13	P56	23952.18
N21	31157.55	P16	14721.86	P57	23190.65
N22	28608.63	P17	21463.13	P58	23781.21
N23	30181.72	P18	18554.67	P59	18859.13
N24	34314.05	P19	22893.55	P60	23395.62
N25	31978.07	P20	13151.23	P61	13220.31
N26	34671.84	P21	19463.08	P62	22818.84
N27	31012.63	P22	23213.02	P63	13519.25
N28	31323.14	P23	14608.13	P64	20986.34
N29	31285.50	P24	13237.36	P65	23738.82
N30	28535.38	P25	23582.14	P66	23697.95

Table A.1. (continued)

Assembly	Burnup, (MWd/MTU)	Assembly	Burnup, (MWd/MTU)	Assembly	Burnup, (MWd/MTU)
P67	19450.90	R23	9540.92	R46	10030.23
P68	21087.32	R24	9496.20	R47	8099.91
R01	9586.54	R25	9963.45	R48	10130.89
R02	9887.52	R26	8097.04	R49	10065.96
R03	7173.81	R27	7305.21	R50	9763.38
R04	9966.34	R28	7246.30	R51	10089.86
R05	7171.60	R29	8971.77	R52	9853.37
R06	8191.27	R30	9285.65	R53	9801.75
R07	7433.94	R31	7414.78	R54	10116.01
R08	8860.19	R32	8170.96	R55	10181.53
R09	9378.10	R33	9563.64	R56	10117.24
R10	9973.42	R34	9898.35	R57	10139.73
R11	8187.45	R35	8849.43	R58	8038.00
R12	7263.07	R36	9684.70	R59	10121.54
R13	8309.52	R37	9949.55	R60	10137.20
R14	7441.79	R38	9013.34	R61	7343.88
R15	8095.25	R39	9955.53	R62	7305.68
R16	9276.32	R40	9887.93	R63	7467.84
R17	9385.01	R41	10084.14	R64	9823.81
R18	8110.23	R42	10145.03	R65	7348.38
R19	9415.90	R43	8044.55	R66	9674.22
R20	8936.58	R44	8056.49	R67	9835.56
R21	8960.10	R45	9731.26	R68	9688.21
R22	8256.64				

Table A.2. Sequoyah Unit 2 operating history for  
Cycles 1 and 2 and to Cycle 3 mid-cycle restart

Cycle	Startup	Shutdown	<u>Cycle times, days</u>		
			Up	Down	Total
1	6/1/82	7/17/83	412	165	577
2	1/1/84	9/28/84	272	153	425
3A <sup>a</sup>	3/1/85	8/21/85	205	0	205

<sup>a</sup>Cycle 3 history split at the long 997-day shutdown.  
Cycle 3B startup date was 5/14/88.

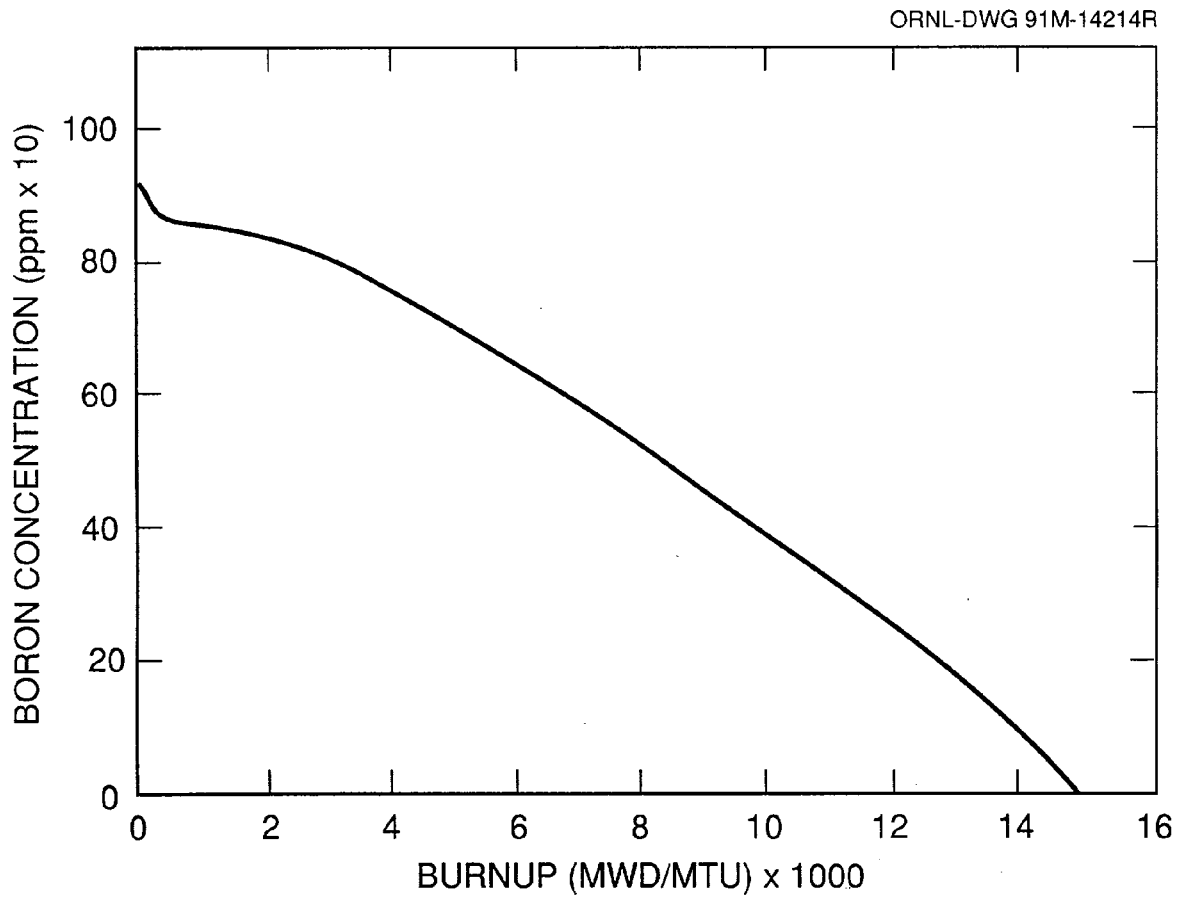


Fig. A.1. Sequoyah Unit 2, Cycle 1, boron letdown curve.

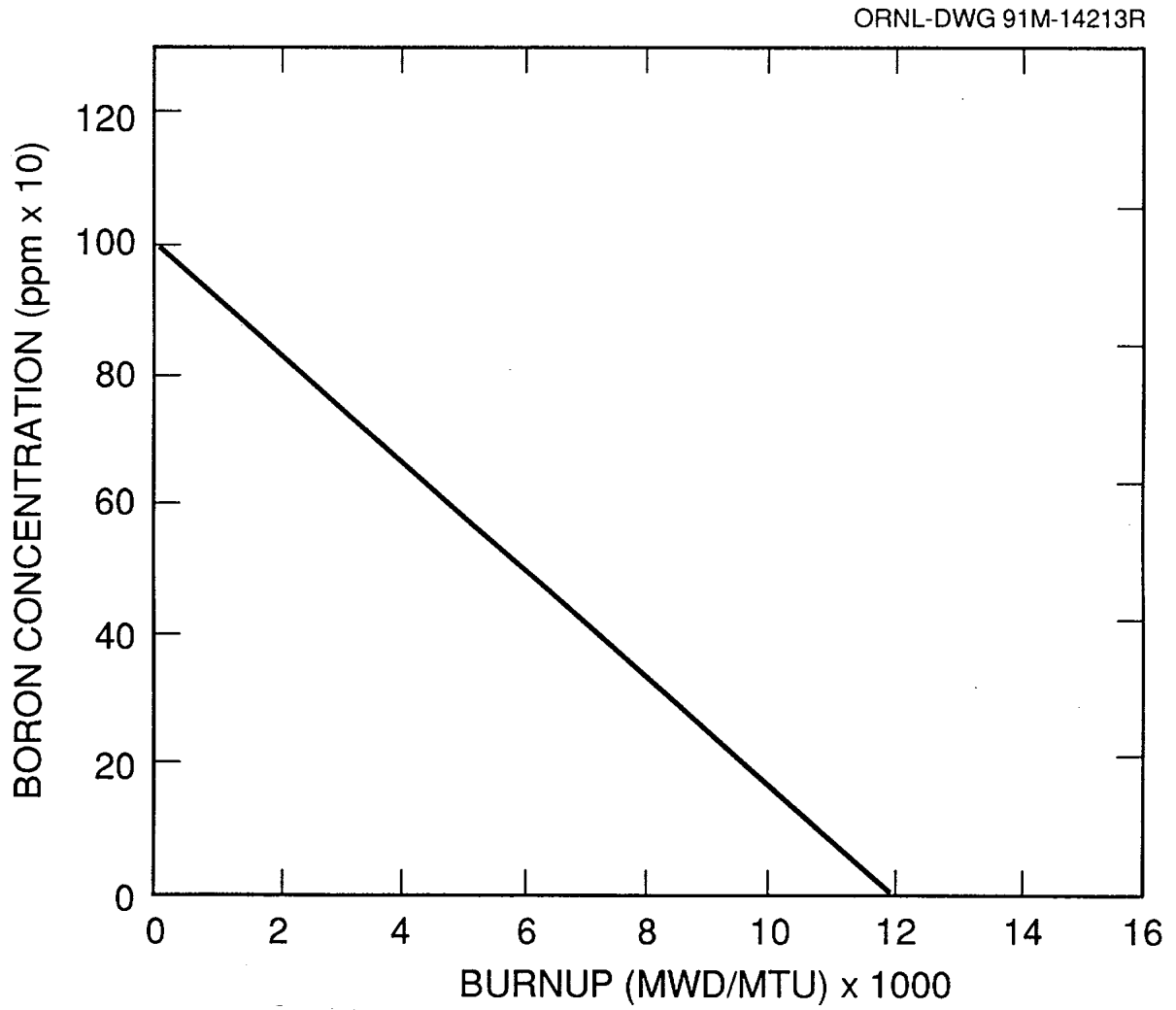


Fig. A.2. Sequoyah Unit 2, Cycle 2, normalized boron letdown curve.



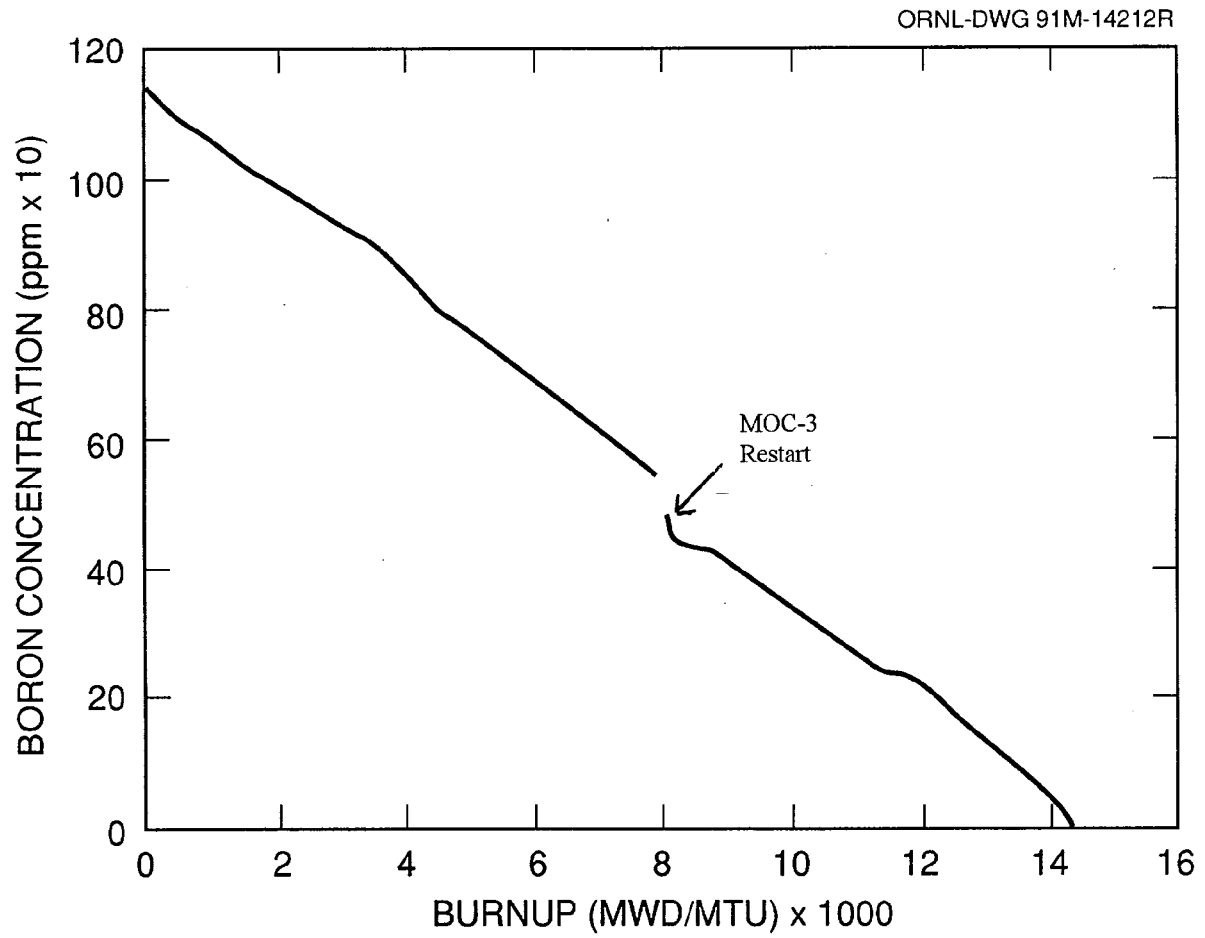


Fig. A.3. Sequoyah Unit 2, Cycle 3, boron letdown curve.

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					N33 3	N02 3	N47 3	N27 3	N01 3	N07 3	N12 3				
2			N30 3	N15 3	M08 2	L31 1	M67 2	L47 1	M20 2	L12 1	M29 2	N18 3	N04 3		
3		N40 3	N24 3	M41 2	L32 1	M14 2	L70 1	M37 2	L67 1	M05 2	L30 1	M66 2	N11 3	N45 3	
4		N08 3	M35 2	L55 1	M31 2	L45 1	M16 2	L15 1	M50 2	L71 1	M10 2	L72 1	M19 2	N38 3	
5	N42 3	M34 2	L69 1	M18 2	L56 1	M71 2	L11 1	M24 2	L41 1	M68 2	L68 1	M58 2	L57 1	M48 2	N37 3
6	N20 3	L42 1	M54 2	L17 1	M04 2	L13 1	M15 2	L54 1	M72 2	L66 1	M43 2	L07 1	M27 2	L29 1	N13 3
7	N06 3	M40 2	L21 1	M49 2	L38 1	M25 2	L44 1	L43 1	L73 1	M42 2	L52 1	M07 2	L39 1	M03 2	N28 3
8	N09 3	L49 1	M56 2	L06 1	M33 2	L64 1	L65 1	L62 1	L22 1	L26 1	M22 2	L27 1	M39 2	L61 1	N14 3
9	N29 3	M36 2	L14 1	M09 2	L36 1	M61 2	L58 1	L28 1	L46 1	M59 2	L53 1	M02 2	L51 1	M32 2	N34 3
10	N23 3	L34 1	M69 2	L59 1	M44 2	L19 1	M13 2	L33 1	M11 2	L10 1	M60 2	L23 1	M47 2	L40 1	N10 3
11	N46 3	M06 2	L08 1	M52 2	L09 1	M23 2	L56 1	M63 2	L60 1	M57 2	L02 1	M28 2	L16 1	M53 2	N44 3
12		N35 3	M70 2	L25 1	M46 2	L20 1	M38 2	L05 1	M65 2	L03 1	M64 2	L35 1	M12 2	N19 3	
13		N31 3	N43 3	M01 2	L18 1	M21 2	L04 1	M62 2	L37 1	M51 2	L01 1	M26 2	N26 3	N32 3	
14			N16 3	N36 3	M55 2	L63 1	M45 2	L24 1	M30 2	L48 1	M17 2	N25 3	N22 3		
15					N48 3	N41 3	N17 3	N39 3	N21 3	N05 3	N03 3				

ASSEMBLY ID  
REGION ID

REGION 1 - 2.1 WT % (73 ASSEMBLIES)  
REGION 2 - 2.6 WT % (73 ASSEMBLIES)  
REGION 3 - 3.1 WT % (48 ASSEMBLIES)

Fig. A.4. Sequoyah Unit 2, Cycle 1, initial core loading pattern.

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					P06 0 4	P29 0 4	P33 0 4	M62 16163 2	P50 0 4	P52 0 4	P03 0 4				
2			P63 0 4	P13 0 4	P43 0 4	M09 17607 2	P45 0 4	L34 14393 1	P38 0 4	M02 17751 2	P41 0 4	P28 0 4	P31 0 4		
3		P01 0 4	P49 0 4	M17 14023 2	M31 17630 2	P26 0 4	M43 17189 2	N02 10148 3	M04 17475 3	P15 0 4	M10 17244 2	M55 14089 2	P57 0 4	P55 0 4	
4		P47 0 4	M53 14231 2	N26 14965 3	N22 17890 3	M15 17488 2	M14 16841 2	M70 15295 2	M05 16533 2	M72 17239 2	N16 7829 3	N43 14991 3	M06 14261 2	P68 0 4	
5	P46 0 4	P42 0 4	M18 17193 2	N32 7965 3	M63 17128 2	N03 8489 3	N18 12259 3	N39 10870 3	N15 12700 3	N48 8567 2	M33 17060 2	N31 7812 3	M58 17432 2	P54 0 4	P14 0 4
6	P59 0 4	M50 17488 2	P12 0 4	M25 17222 2	N44 8539 3	M66 15035 2	N21 11551 3	M03 15872 2	N17 11409 3	M12 15569 2	N46 8617 3	M42 17158 2	P30 0 4	M16 17401 2	P53 0 4
7	P36 0 4	P56 0 4	M23 17113 2	M54 16471 2	N35 12607 3	N34 11803 3	M4 15255 2	N41 10059 3	M40 15562 2	N29 11507 3	N19 12739 3	M27 16930 2	M57 17096 2	P58 0 4	P67 0 4
8	M39 16779 2	L48 14554 1	N23 10129 3	M26 15394 2	N14 11173 3	M67 15576 2	N10 10281 3	L40 14682 1	N20 10137 3	M30 15514 2	N09 10869 3	M41 15339 2	N13 10197 3	L31 14447 1	M56 16397 2
9	P07 0 4	P66 0 4	M71 17631 2	M69 16431 2	N08 12420 3	N28 11708 3	M32 15842 2	N07 10020 3	M20 15454 3	N06 11568 3	N38 12691 3	M47 16883 2	M68 17488 2	P08 0 4	P21 0 4
10	P11 0 4	M65 17416 2	P22 0 4	M61 16942 2	N37 8555 2	N35 15235 2	N01 11630 3	M36 15507 2	N47 11627 3	M01 15484 3	N42 8431 3	M59 17391 2	P35 0 4	M38 17488 2	P34 0 4
11	P16 0 4	P51 0 4	M52 17175 2	N45 7917 3	M22 17359 2	N12 8343 3	N25 12502 3	N27 10981 3	N36 12648 3	N33 8547 3	M24 17540 2	N40 7804 3	M28 17386 2	P60 0 4	P39 0 4
12		P37 0 4	M48 14098 2	N11 14794 3	N04 7754 3	M13 17028 2	M21 16656 2	M19 15350 2	M51 16622 2	M11 17256 2	N30 7959 3	N24 14849 3	N34 13850 2	P17 0 4	
13		P27 0 4	P10 0 4	M29 13757 2	M46 17431 2	P09 0 4	M60 17401 2	N05 10185 3	M44 17123 2	P19 0 4	M64 17520 2	M08 14176 2	P48 0 4	P61 0 4	
14			P20 0 4	P04 0 4	P02 0 4	M49 17447 2	P25 0 4	L29 14572 1	P65 0 4	M07 17817 2	P62 0 4	P64 0 4	P24 0 4		
15	ASSEMBLY ID BURNUP (MWD/MTU) REGION ID				P23 0 4	P44 0 4	P40 0 4	M37 16618 2	P32 0 4	P18 0 4	P05 0 4				

REGION 1 - 2.10 WT % (14530 MWD/MTU)

REGION 2 - 2.60 WT % (16443 MWD/MTU)

REGION 3 - 3.10 WT % (10606 MWD/MTU)

REGION 4 - 3.50 WT % ( 0 MWD/MTU)

ASSEMBLY P-39 HAS PINS - 3.46 W/O REMAINING PINS - 3.50 W/O

Fig. A.5. Sequoyah Unit 2, Cycle 2, initial core loading pattern.

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					P24 8588 4	R03 0 5A	R15 0 5A	R43 0 5B	R18 0 5A	R28 0 5A	P20 8504 4				
2			N19 24708 3	P14 8432 4	R29 0 5A	N31 20907 3	R02 0 5A	N02 22277 3	R37 0 5A	N32 21137 3	R08 0 5A	P46 8569 4	M06 25854 2		
3		M17 25632 2	R62 0 5B	P29 10650 4	P30 14318 4	R23 0 5A	N41 22240 3	R64 0 5B	N48 21137 3	R24 0 5A	P12 14416 4	P52 10789 4	R65 0 5B	N36 24667 3	
4		P23 8669 4	P59 10867 4	M53 25660 2	P32 10509 4	N29 23628 3	P13 12073 4	M37 23638 2	P28 11611 4	N34 23874 3	P40 10310 4	M55 25442 2	P53 10610 4	P05 8364 4	
5	P61 8478 4	R20 0 5A	P09 13902 4	P21 10759 4	N25 24426 3	R48 0 5B	P58 14196 4	R50 0 5B	P56 14405 4	R56 0 5B	N35 24587 3	P07 10475 4	P19 14149 4	R21 0 5A	P27 8544 4
6	R14 0 5A	N04 20675 3	R17 0 5A	N01 23727 3	R57 0 5B	N27 22976 3	P62 13234 4	P49 13183 4	P02 13208 4	N14 23260 3	R42 0 5B	N47 23736 3	R01 0 5A	N30 20871 3	R27 0 5A
7	R13 0 5A	R10 0 5A	N44 21177 3	P47 11656 4	P25 14021 4	P60 13801 4	N26 26976 3	R60 0 5B	N43 27144 3	P51 13561 4	P65 14123 4	P68 11862 4	N20 22278 3	R34 0 5A	R32 0 5A
8	R44 0 5B	N23 22226 3	R66 0 5B	M56 23661 2	R53 0 5B	P10 13158 4	R54 0 5B	N33 21182 3	R51 0 5B	P57 13279 4	R52 0 5B	P39 23878 2	R67 0 5B	N13 22332 3	R47 0 5B
9	R26 0 5A	R40 0 5A	N10 22311 3	P37 11774 4	P45 14153 4	P45 13020 4	N11 26708 3	R49 0 5B	N24 26609 3	P42 13269 4	P38 14238 4	P17 12216 4	N42 20955 3	R25 0 5A	R22 0 5A
10	R31 0 5A	N22 20879 3	R09 0 5A	N21 23558 3	R41 0 5B	N09 22945 3	P41 13171 4	P48 12927 4	P43 13123 4	N39 22991 3	R55 0 5B	N17 23481 3	R36 0 5A	N16 21008 3	R07 0 5A
11	P55 8852 4	R16 0 5A	P26 14367 4	P67 10623 4	N38 24745 3	R46 0 5B	P08 14513 4	R45 0 5B	P66 14181 4	R59 0 5B	N15 24588 3	P36 10706 4	P15 14207 4	R30 0 5A	P01 8526 4
12		P06 8390 4	P11 10731 4	M29 25171 2	P50 10648 4	N06 23718 3	P04 11783 4	M62 23370 2	P64 11789 4	N28 23755 3	P33 10573 4	M34 25081 2	P34 11010 4	P03 8523 4	
13		N18 24230 3	R61 0 5B	P44 10538 4	P35 13772 4	R19 0 5A	N12 20933 3	R68 0 5B	N07 22129 3	R33 0 5A	P22 14346 4	P18 10491 4	R63 0 5B	M08 25480 2	
14			M48 25378 2	P39 8756 4	R35 0 5A	N40 20701 3	R39 0 5A	N05 22068 3	R04 0 5A	N45 20839 3	R38 0 5A	P16 8695 4	N08 24784 3		
15					P31 8646 4	R05 0 5A	R11 0 5A	R58 0 5B	R06 0 5A	R12 0 5A	P63 8605 4	ASSEMBLY ID BURNUP (MWD/MTU) REGION			

REGION 2 - 2.60 WT % (24854 MWD/MTU)

REGION 3 - 2.60 WT % (23016 MWD/MTU)

REGION 4 - 3.10 WT% (11598 MWD/MTU)

REGION 5A - 3.80 WT % ( 0 MWD/MTU)

REGION 5B - 3.60 WT % ( 0 MWD/MTU)

ASSEMBLY P-39 HAS 19 PINS - 3.4 W/O REMAINING PINS - 3.50 W/O

Fig. A.6. Sequoyah Unit 2, Cycle 3, initial core loading pattern.

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					N33 8547	N02 10148	N47 11627	N27 10981	N01 11630	N07 10020	N12 8343				
2			N30 7959	N15 12700	M08 14170	L31 14447	M67 15576	L47 14983	M20 15454	L12 14186	M29 13757	N18 12259	N04 7754		
3		N40 7804	N24 14849	M41 15339	L32 16094	M14 16841	L70 16674	M37 16618	L67 16592	M05 16533	L30 15619	M66 15035	N11 14794	N45 7917	
4		N08 12420	M35 15235	L55 16347	M31 17630	L45 17305	M16 17401	L15 17050	M50 17488	L71 17120	M10 17244	L72 16374	M19 15350	N38 12691	
5	N42 8431	M34 13849	L69 15839	M18 17193	L56 17458	M71 17631	L11 17496	M24 17540	L41 17588	M68 17487	L68 17442	M58 17432	L57 15593	M48 14098	N37 8555
6	N20 10137	L42 14293	M54 16470	L17 16907	M04 17475	L13 17327	M15 17487	L54 17254	M72 17239	L66 17152	M43 17189	L07 17185	M27 16930	L29 14572	N13 10197
7	N06 11568	M40 15562	L21 16350	M49 17447	L38 17211	M25 17222	L44 17054	L43 16300	L73 17075	M42 17158	L52 17300	M07 17817	L39 16854	M03 15872	N28 11708
8	N09 10869	L49 14947	M56 16397	L06 16979	M33 17060	L64 17103	L65 16260	L62 16807	L22 16196	L26 17118	M22 17359	L27 17157	M39 16779	L61 15216	N14 11173
9	N29 11507	M36 15506	L14 16421	M09 17607	L36 16981	M61 16942	L58 16789	L28 16095	L46 17202	M59 17391	L53 17474	M02 17751	L51 16782	M32 15842	N34 11803
10	N23 10129	L34 14393	M69 16431	L59 17069	M44 17123	L19 16882	M13 17028	L33 16969	M11 17256	L10 17239	M60 17405	L23 17224	M47 16883	L46 14682	N16 10280
11	N46 8617	M06 14281	L08 16155	M52 17175	L09 17087	M23 17113	L50 17026	M63 17128	L60 17000	M57 17096	L02 17299	M28 17386	L16 16013	M53 14231	N44 8589
12		N35 12606	M70 15295	L25 16398	M46 17431	L20 17145	M38 17488	L05 16694	M65 17416	L03 17039	M64 17520	L35 16492	M12 15569	N19 12739	
13		N31 7812	N43 14991	M01 15484	L18 16036	M21 16656	L04 16246	M62 16163	L37 16324	M51 16622	L01 15982	M26 15394	N26 14965	N32 7965	
14			N16 7829	N36 12648	M55 14089	L63 14413	M45 15255	L24 14737	M30 15514	L48 14554	M17 14023	N25 12502	N22 7890		
15															
	ASSEMBLY ID BURNUP (MWD/MTU)				N48 8566	N41 10059	N17 11409	N39 10870	N21 11551	N05 10184	N03 8489				
					REGION 1 - 16440 MWD/MTU										
					REGION 2 - 16443 MWD/MTU										
					REGION 3 - 10606 MWD/MTU										
					BURNUP TILT										
					1.0009   1.0011										
					0.9948   1.0032										

Fig. A.7. Sequoyah Unit 2, Cycle 1, final burnup distribution.

Fig. A.8. Sequoyah Unit 2, Cycle 2, final burnup distribution.

## **APPENDIX B**

### **SAS2H CASE INPUT EXAMPLE**

This appendix gives an example of one of the seven SAS2H cases. It gives a list of the JCL and data for SAS2H batch No. 7.

```

//OWHTVAB7 JOB (35899),'6011BLDG,X10-HERMANN',MSGCLASS=T,TIME=40
//*
//* *****
//* *
//* * .FISS-PROD, ACTINIDE ISOTOPICS OF SEQUOYAH PWR. *
//* *
//* * AT MAY, 1988 STARTUP OF UNIT 2 *
//* *
//* * CASE FOR BATCH 7 LOADING, TVA SEQUOYAH 17X17 PWR *
//* *
//* * THIS PROJECT SPONSORED BY: *
//* *
//* * M. C. BRADY, ORNL *
//* * T. L. SANDERS, SANDIA NATL LAB *
//* *
//* * COMPUTED BY: O.W. HERMANN, ORNL JULY, 1991 *
//* *
//* *****
//*
//*
//PROCLIB DD DISP=SHR,DSN=TZA.PROCLIB.CNTL
//*
//OUT1 OUTPUT DEFAULT=YES,JESDS=ALL,CHARS=ST15,FCB=10,FORMS=L7BL,
// DEST=NX10A,COPIES=1
//UT1 OUTPUT DEFAULT=YES,JESDS=ALL,
//* DEST=RM055,COPIES=1
//*
//*
//* SAVED ON OWH.BCRED.TVAB7
//* PRINT TO BE ON OWH.OWHTVAB7.OUTLIST
//*MAIN LINES=50
//*MAIN CLASS=STANDBY
//SPDA EXEC SPDASC
//SYSPRINT DD SYSOUT=*
//SYSIN DD *
T.OWH35899.TVAB7F55
/*
//POOL EXEC POOLSCR
//SYSPRINT DD SYSOUT=*
//SYSIN DD *
OWH.BATCH7.PWR17F33
OWH.BATCH7.PWR17F34
OWH.BATCH7.PWR17F35
OWH.BATCH7.PWR17F36
OWH.BATCH7.PWR17F37
OWH.BATCH7.PWR17F71
OWH.BATCH7.PWR17F72
/*
//S2 EXEC SCALE4,REGION=1600K,H6LIB=NULLFILE,TIME=40
//*
//GO.FT01F001 DD DCB=(RECFM=VBS,LRECL=X,BLKSIZE=9440,BUFL=10232)
//GO.FT04F001 DD DCB=(RECFM=VBS,LRECL=X,BLKSIZE=9440,BUFL=10232)
//GO.FT13F001 DD SYSOUT=*,DCB=(RECFM=FA,BLKSIZE=133,BUFL=150)
//GO.FT16F001 DD SPACE=(TRK,(200,80))
//GO.FT17F001 DD DCB=(RECFM=VBS,LRECL=X,BLKSIZE=9440,BUFL=10232)
//GO.FT18F001 DD DCB=(RECFM=VBS,LRECL=X,BLKSIZE=9440,BUFL=10232)
//GO.FT19F001 DD DCB=(RECFM=VBS,LRECL=X,BLKSIZE=9440,BUFL=10232)
//GO.FT21F001 DD DSN=OWH.PRESAS.PWR17,DISP=SHR
//GO.FT32F001 DD UNIT=SYSDA,SPACE=(TRK,(30,5)),
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=9440,BUFL=10232)
//GO.FT33F001 DD UNIT=DISK,SPACE=(TRK,(30,5)),
// DISP=(NEW,CATLG),DSN=OWH.BATCH7.PWR17F33,
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136)
//GO.FT34F001 DD UNIT=DISK,SPACE=(TRK,(30,5)),

```



```

// DISP=(NEW,CATLG),DSN=OWH.BATCH7.PWR17F34,
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136)
//GO.FT35F001 DD UNIT=DISK,SPACE=(TRK,(30,5)),
// DISP=(NEW,CATLG),DSN=OWH.BATCH7.PWR17F35,
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136)
//GO.FT36F001 DD UNIT=DISK,SPACE=(TRK,(30,5)),
// DISP=(NEW,CATLG),DSN=OWH.BATCH7.PWR17F36,
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136)
//GO.FT37F001 DD UNIT=DISK,SPACE=(TRK,(30,5)),
// DISP=(NEW,CATLG),DSN=OWH.BATCH7.PWR17F37,
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136)
//* NOTE ABOVE BLOCKSIZE/BUFL CHANGED TO SCALE DEFAULT.....
//GO.FT70F001 DD SPACE=(TRK,(10,8)),UNIT=SYSDA,
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=9440,BUFL=10232)
//GO.FT71F001 DD UNIT=DISK,SPACE=(TRK,(20,5)),
// DISP=(NEW,CATLG),DSN=OWH.BATCH7.PWR17F71,
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=9440,BUFL=10232)
//GO.FT72F001 DD UNIT=DISK,SPACE=(TRK,(10,5)),
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=6400),
// DISP=(NEW,CATLG),DSN=OWH.BATCH7.PWR17F72
//GO.FT74F001 DD UNIT=SYSDA,
// SPACE=(800,(2,2),RLSE),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//GO.FT53F001 DD UNIT=SYSDA,SPACE=(TRK,(90,5)),
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=3664,BUFL=4088)
//GO.FT55F001 DD UNIT=SPDA,SPACE=(TRK,(2,1)),
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=3664,BUFL=4088),
// DISP=(NEW,CATLG),DSN=T.OWH35899.TVAB7F55
//GO.SYSIN DD *
=SAS2 PARM='HALT05,SKIPSHIPDATA'
SAS2H: TVA, SQN UNIT 2, CYC 3, BATCH 7, BURNUP CREDIT CRITICAL CHECK
27BURNUPLIB LATTICECELL
,
' MIXTURES OF FUEL-PIN-UNIT-CELL:
,
UO2 1 0.9485 901 92234 0.031 92235 3.60 92236 0.017 92238 96.352 END
KR-83 1 0 1-20 901 END
KR-85 1 0 1-20 901 END
SR-90 1 0 1-20 901 END
Y-89 1 0 1-20 901 END
MO-95 1 0 1-20 901 END
ZR-93 1 0 1-20 901 END
ZR-94 1 0 1-20 901 END
ZR-95 1 0 1-20 901 END
NB-94 1 0 1-20 901 END
TC-99 1 0 1-20 901 END
RH-103 1 0 1-20 901 END
RH-105 1 0 1-20 901 END
RU-101 1 0 1-20 901 END
RU-106 1 0 1-20 901 END
PD-105 1 0 1-20 901 END
PD-108 1 0 1-20 901 END
AG-109 1 0 1-20 901 END
SB-124 1 0 1-20 901 END
XE-131 1 0 1-20 901 END
XE-132 1 0 1-20 901 END
XE-135 1 0 1.2-8 901 END
XE-136 1 0 1-20 901 END
CS-134 1 0 1-20 901 END
CS-135 1 0 1-20 901 END
CS-137 1 0 1-20 901 END

```

```

BA-136      1 0 1-20 901  END
LA-139      1 0 1-20 901  END
PR-141      1 0 1-20 901  END

PR-143      1 0 1-20 901  END
CE-144      1 0 1-20 901  END
ND-143      1 0 1-20 901  END
ND-145      1 0 1-20 901  END
PM-147      1 0 1-20 901  END
PM-148      1 0 1-20 901  END
ND-147      1 0 1-20 901  END
SM-147      1 0 1-20 901  END
SM-149      1 0 1-20 901  END
SM-150      1 0 1-20 901  END
SM-151      1 0 1-20 901  END
SM-152      1 0 1-20 901  END
GD-155      1 0 1-20 901  END
EU-153      1 0 1-20 901  END
EU-154      1 0 1-20 901  END
EU-155      1 0 1-20 901  END
ZIRCALLOY   2 1 628  END
H2O  3 DEN=0.7149 1 579  END
ARBM-BORMOD 0.7149 1 1 0 0 5000 100 3 860.0E-6 579  END
/
/      860 PM(WT) BORON
/  - - - - -
SS304  5 1 579  END
O       6 0 0.04497 579  END
NA      6 0 0.00165 579  END
AL      6 0 0.00058 579  END
SI      6 0 0.01799 579  END
K       6 0 0.00011 579  END
B-10    6 0 9.595-4 579  END
B-11    6 0 3.863-3 579  END
N       7 0 5-5 579  END
END COMP
/
/  - - - - -
/
/      FUEL-PIN-CELL GEOMETRY:
/
SQUAREPITCH 1.25984 0.81915 1 3 0.94966 2 0.83566 0  END
/
/  - - - - -
/
MORE DATA  SZF=0.6  END
/
/      ASSEMBLY AND CYCLE PARAMETERS:
/
NPIN/ASSM=264 FUELNGHT=784.35 NCYCLES=5  NLIB/CYC=1
PRINTLEVEL=4 LIGHTEL=9  INPLEVEL=2  NUMZONES=10
NUMINSTR=1  FACMESH=0.65  END
/
/      MIXTURES (BY MIX-NO.) WITHIN RADII (CM):
/
7 0.17030 5 0.18344 7 0.19203 6 0.33959 7 0.34768
5 0.38507 3 0.5715 2 0.61214 3 0.710788 500 2.43666
/
POWER=48.666 BURN=61.645 DOWN=0  END
POWER=48.666 BURN=61.645 DOWN=0  END
POWER=48.666 BURN=61.645 DOWN=0  END

```

```
POWER=48.666 BURN=61.645 DOWN=0      END
POWER=48.666 BURN=61.645 DOWN=0      END
,
```

```
  O 135  CR  5.9  MN  0.33
FE 12.9  CO 0.075 NI  9.9
ZR 221  NB  0.71  SN  3.6
```

```
,
/ - - - - -
/ .....END OF INPUT.....
END
```



## **APPENDIX C**

### **SNIKR VERSION 1.0 DOCUMENTATION**

This appendix includes a User's Input Guide, FORTRAN Listings, and Sample Output.

**SNIKR VERSION 1.0 USER'S INPUT GUIDE**

Each entry below must begin in column 1. Recommended values are given in parentheses.

Line 1	SNIKR1
Line 2	Title card for SNIKR1 (80-character maximum)
Line 3	READ BURNUP
Line 4	N72=ii (I2 format) Unit number for SAS2H atom density file (72)
Line 5	NOUT=ii (I2 format) Unit number for SNIKR1 output file (70)
Line 6	BURN=xxxxxx.x (F8.1 format) Desired burnup in MWd/MTU for interpolation
Line 7	NCYC=ii (I2 format) Number of cycles in SAS2H depletion
Line 8	END BURNUP
Line 9	READ DECAY
Line 10	NORS=ii (I2 format) Unit number for ORIGEN-S input file created by SNIKR1 (74)
Line 11	N71=ii (I2 format) Unit number to which ORIGEN-S will write the restart file containing the isotopic data at the requested cooling times. This file will then be read by SNIKR3 (71)
Line 12	COOLTME=xxx.xx (F6.2 format) Cooling time in years at which isotopics are desired
Line 13	LIGHTTEL=ii (I2 format) Number of light element nuclides for which isotopics are desired. Data will be read after "END DECAY." This option allows the user to extract light-element data in addition to actinide and fission-product data and/or to adjust the concentrations of light-element nuclides.
Line 14	END DECAY

If  $\text{LIGHTEL} > 0$ , enter the following data for each light-element nuclide (free format):

- a. Nuclide ID number
- b. Atom density of nuclide
- c. Option flag
  - 1= replace SAS2H atom density with value entered above
  - 2= replace SAS2H atom density only if SAS2H value is zero
  - 3= add the atom density to the SAS2H value. Using this option and an atom density of zero above will extract data from SAS2H without modification.

- Line 15      SNIKR3
- Line 16      Title card for SNIKR3 (80-character maximum)
- Line 17      READ MXFUEL
- Line 18      N71=ii (I2 format)  
Unit number from which SNIKR3 will read the ORIGEN-S restart file containing the isotopic data at the requested cooling times (71)
- Line 19      NICE=ii (I2 format)  
Unit number to which SNIKR3 writes the data for input to ICE (75)
- Line 20      NOUT3=ii (I2 format)  
Unit number to which SNIKR3 writes the data in SCALE standard composition and KENO V.a mixing table input formats (73)
- Line 21      NCOOL=ii (I2 format)  
Cooling time step in ORIGEN-S output from which isotopic data are to be extracted
- Line 22      FISPROD=iii (I3 format)  
Actinide and fission-product nuclides for which isotopic data are to be extracted  
     0=    25 burnup credit nuclides from ref. 4  
    -1=    37 burnup credit nuclides from ref. 1  
    -2=    48 nuclides used in reactor critical calculations (Table 2)  
    -3=    193 nuclides (all nuclides in 27-group burnup library)  
     N=    Read N nuclides specified by user after "END MXFUEL"
- Line 23      MIXF=iiii (I4 format)  
Mixture number for SCALE standard composition input
- Line 24      IDMOD=ii (I2 format)  
Fuel nuclide ID modifier for seven burnup-dependent actinides

Line 25       END MXFUEL

If FISPROD > 0, enter the nuclide IDs here. (Format 10(1X,I5))



## SNIKR1 FORTRAN Listing

```

C
C
PROGRAM SNIKR1
COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IACF,IFP,ITOT,NCYC
COMMON /UNTOS/ N72,NOUT,N71,NORS,NICE
COMMON /IDENT/ IDLITL(40),IDCRIT(200),IDDK(2000)
COMMON /ADENS/ ADLITL(40),LTYP(40),ADCRIT(200),ADDK(2000)
COMMON /TITLE/ ITTL(20)
DIMENSION TSTEP(10)
C READ INPUT TO SNIKR NEEDED TO SET UP ORS RUNS
DATA TSTEP/0.08,0.25,0.5,1.0,2.0,3.0,5.0,10,15,20/
CALL RDINPT1
C
C WRITE INPUT TO NOUT
C
WRITE(NOUT,120)ITTL
WRITE(NOUT,130)N72
WRITE(NOUT,140)NOUT
WRITE(NOUT,150)BURN
WRITE(NOUT,160)BCONV
WRITE(NOUT,170)NCYC
WRITE(NOUT,180)NORS
WRITE(NOUT,190)COOL
WRITE(NOUT,190)NLITL
120 FORMAT(20A4)
130 FORMAT(4X,I2)
140 FORMAT(5X,I2)
150 FORMAT(5X,F8.1)
160 FORMAT(6X,F6.4)
170 FORMAT(5X,I2)
180 FORMAT(8X,F6.2)
190 FORMAT(8X,I2)
C
C RETRIEVE NUMBER DENSITIES FROM SAS2H OUTPUT (N71) FOR BURN
CALL DENSITY
C WRITE(NOUT,110)(IDDK(I),ADDK(I),I=1,ITOT)
C 110 FORMAT(4(I8,2X,1P,E10.4))
C
C IF THE REQUESTED BURNUP OR COOLING TIME IS 0, IT IS NOT NECESSARY
C TO PERFORM THE ORIGIN-S STEP
IF(BURN.EQ.0.0.OR.COOL.EQ.0.0)GO TO 1000
C SET UP ORIGIN-S RUN TO DECAY ISOTOPICS FOR REQUESTED COOL TIME
CALL TYMSTP(NCOOL,TSTEP)
WRITE(NOUT,100)NCOOL
100 FORMAT('***NEEDED FOR PHASE 3 INPUT***' NCOOL= ',I2,')
CALL LITEL(0)
CALL WRTORS(TSTEP)
GO TO 2000
C *****CHECK FILE NOUT FOR MESSAGES
1000 CONTINUE
NCOOL=0
CALL RDINPT3(NCOOL)
CALL LITEL(0)
CALL CLECT(1)
CALL WRTICE
C
C WRITE NUMBER DENSITIES FOR MIXING IN KENO TO ...NOUT3
CALL WRTKENO
2000 STOP
END
C-----
C
C READ INPUT DATA FOR PHASE ONE CALCULATIONS, READING SAS2H OUTPUT
C AND SETTING UP ORIGIN-S DECAY ONLY CASE

```

```

C
C-----
      SUBROUTINE RDINPT1
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IACT,IFP,ITOT,NCYC
      COMMON /UNT NOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRIT(200),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTP(40),ADCRIT(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)
      CHARACTER*6 ICHK
      N5=5
      READ(N5,110)ICLK
C READ AND CHECK IF APPROPRIATE PHASE INPUT - SNIKR1
      IF(ICLK.NE.'SNIKR1')STOP 5101
C READ TITLE CARD
      READ(N5,120)ITTL
C READ LABEL AND CHECK TO BE SURE BURN DATA IS NEXT
      READ(N5,110)ICLK
      IF(ICLK.NE.'READ B')STOP 5102
C READ N72, UNIT NUMBER FOR SAS2H FILE 72 OUTPUT TO BE READ FROM
      READ(N5,130)N72
C READ NOUT, UNIT NUMBER FOR OUTPUT TO BE WRITTEN TO
      READ(N5,140)NOUT
C READ BURNUP IN MWD/MTU THAT NUMBER DENSITIES ARE TO BE RETRIEVED FROM N72
      READ(N5,150)BURN
C READ METAL (MTU/ASSEMBLY), BCONV IS CONVERSION FACTOR FOR BURNUPS
C READ FROM N72
C READ(N5,160)BCONV
C **** MODIFIED SNIKR, NOW READ FROM SAS2H OUTPUT
C
C READ NCYC, NUMBER OF BURN CYCLES USED TO PRODUCE SAS2H OUTPUT ON N72
      READ(N5,170)NCYC
C READ AND CHECK THAT THIS IS END OF BURNUP DATA
      READ(N5,110)ICLK
      IF(ICLK.NE.'END BU')STOP 5103
C READ AND CHECK THAT DECAY DATA BEGINS WITH NEXT CARD
      READ(N5,110)ICLK
      IF(ICLK.NE.'READ D')STOP 5104
C READ NORIS, UNIT NUMBER FOR ORIGIN-S INPUT TO BE WRITTEN
      READ(N5,140)NORS
C READ N71, UNIT NUMBER FOR ORIGIN-S OUTPUT TO BE WRITTEN FOR PHASE 3
      READ(N5,130)N71
C READ COOLING TIME IN YEARS TO BE USED TO SET UP ORIGIN-S DECAY CASE
      READ(N5,180)COOL
C READ THE NUMBER OF LIGHT ELEMENTS TO BE SPECIFIED IN THE DECAY CASE
      READ(N5,190)NLITL
C READ AND CHECK THAT THIS IS THE END OF DECAY DATA
      READ(N5,110)ICLK
      IF(ICLK.NE.'END DE')STOP 5105
C IF NLITL IS GREATER THAN ZERO READ IN ID'S OF LIGHT ELEMENTS
      IF(NLITL.EQ.0)GO TO 1000
      READ(N5,*)(IDLITL(I),ADLITL(I),LTP(I),I=1,NLITL)
1000 CONTINUE
C
C WRITE INPUT TO NOUT
C
C WRITE(NOUT,120)ITTL
C WRITE(NOUT,130)N72
C WRITE(NOUT,140)NOUT
C WRITE(NOUT,150)BURN
C WRITE(NOUT,160)BCONV
C WRITE(NOUT,170)NCYC
C WRITE(NOUT,140)NORS
C WRITE(NOUT,180)COOL
C WRITE(NOUT,190)NLITL
      RETURN
110 FORMAT(A6)
120 FORMAT(20A4)

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130 FORMAT(4X,I2)
140 FORMAT(5X,I2)
150 FORMAT(5X,F8.1)
160 FORMAT(6X,F6.4)
170 FORMAT(5X,I2)
180 FORMAT(8X,F6.2)
190 FORMAT(8X,I2)
C 195 FORMAT(1X,I5,E10.4,2X,I1)
      END
C
C RETURNS IDDK AND ADDK ARRAYS FOR THE APPROPRIATE BURNUP, BURN
C
C-----
      SUBROUTINE DENSITY
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IACT,IFP,ITOT,NCYC
      COMMON /UNTNOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRIT(200),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTYP(40),ADCRIT(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)
      DIMENSION RDBURN(10),IDPLT(26),A(2000),B(2000),AD(2000,10)
      DATA IDPLT/92234,92235,92236,92238,94238,94239,94240,94241,
&94242,95241,8016,42095,43099,45103,55133,55135,60143,60145,
&62147,62149,62150,62151,62152,63153,64155,13027/
      NC=-1
      NBN=0
1000  NC=NC+1
      NBN=NBN+1
      CALL RDF72(NC,AD,RDBRN)
C
C CONVERT RDBRN FROM MWD/ASSY TO MWD/MTU
C
      RDBRN=RDBRN/BCONV
      WRITE(NOUT,130)RDBRN
      RDBURN(NBN)=RDBRN
      IF(NC.LT.NCYC)GO TO 1000
C *****
C THIS SECTION TEMPORARY TO PLOT NUMBER DENSITY WITH BURNUP
      DO 3 J=1,26
      WRITE(NOUT,332)IDPLT(J)
      IDPLT(J)=IDPLT(J)*10
      DO 2 I=1,ITOT
      IF(IDDK(I).NE.IDPLT(J)) GO TO 2
      DO 1 K=1,NBN
1      WRITE(NOUT,333)RDBURN(K),AD(I,K)
2      CONTINUE
3      CONTINUE
333  FORMAT(F8.1,1X,',',1X,1P,E11.3)
332  FORMAT('PAIRS OF BURNUP(MWD/MTU) AND NUMBER DENSITY FOR ',I10)
C *****
      SMACT0=0.
      I1=ILE+1
      I2=ILE+IACT
      DO 31 I=I1,I2
31  SMACT0=SMACT0+AD(I,1)
      WRITE(NOUT,105)SMACT0
105  FORMAT('SMACT0=',1PE10.4)
      IF(BURN.EQ.0.0)THEN
      IBN=0
      GO TO 1500
      END IF
      IF(BURN.GE.RDBURN(2))GO TO 15
      WRITE(NOUT,110)
      WRITE(NOUT,120)BURN,RDBURN(2)
      IBN=2
      GO TO 1500
15  CONTINUE
      IF(BURN.GT.RDBURN(NBN)) THEN

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```

      IBN=NB
      WRITE(NOUT,110)
      WRITE(NOUT,140) BURN,RDBURN(NB)
      GO TO 1500
      END IF
      DO 20 I=1,NB
      BDIFF=ABS(RDBURN(I)-BURN)/BURN
      IF(BDIFF.LT.0.01) THEN
      IBN=I
      GO TO 1500
      END IF
      IF(RDBURN(I).GT.BURN) GO TO 1250
      ILOW=I
20    CONTINUE
1250  CONTINUE
      IHI=ILOW+1
C@@@*****BEGIN LINEAR INTERPOLATION*****
C      DO 25 K=1,ITOT
C      A(K)=AD(K,ILOW)
C      DO 25 B(K)=AD(K,IHI)
C      CALL INTERP(A,B,RDBURN(ILOW),RDBURN(IHI))
C*****END LINEAR INTERPOLATION*****
C@@@*****BEGIN LAGRANGIAN INTERPOLATION*****
      DO 27 I=1,ITOT
      DO 26 J=2,NB
26    A(J-1)=AD(I,J)
      DO 28 K=2,NB
28    B(K-1)=RDBURN(K)
      NBINT=NB-1
      CALL LAGINT(B,A,NBINT,BURN,CONC)
27    ADDK(I)=CONC
C*****END LAGRANGIAN INTERPOLATION*****
      RETURN
1500  CONTINUE
C      WRITE(NOUT,160)
C      WRITE(NOUT,150) (IDDK(I),AD(I,IBN),I=1,ITOT)
      DO 30 J=1,ITOT
30    ADDK(J)=AD(J,IBN)
C      WRITE(NOUT,150) (IDDK(I),ADDK(I),I=1,ITOT)
      RETURN
110  FORMAT('$$WARNING -----')
120  FORMAT('REQUESTED BURNUP OF ',F10.3,' GWD/MTU IS LESS THAN FIRST'
&/'CYCLE BURNUP OF ',F10.3,'. FIRST CYCLE BURNUP HAS BEEN USED')
130  FORMAT('RDBRN=',F10.3)
140  FORMAT('REQUESTED BURNUP OF ',F10.3,' GWD/MTU IS GREATER THAN LAST'
&/'CYCLE BURNUP OF ',F10.3,'. FINAL CYCLE BURNUP HAS BEEN USED')
C 150  FORMAT(4(I8,2X,1P,E10.4))
C 160  FORMAT('PAST 1500')
      END
C-----
      SUBROUTINE RDF72(NC,AD,RDBURN)
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IAC,IFP,ITOT,NCYC
      COMMON /UNTOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRIT(200),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTYP(40),ADCRIT(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)
      DIMENSION AD(2000,10)
      CHARACTER*4 ITEST,TTL72(20)
      NCT=NC+1
      IND=3
C
C  READ THE FOLLOWING QUANTITIES FROM FILE 72 IN ADDITION TO NUCLIDE
C  ID AND NUMBER DENSITY
C      1) LPASS, LIBRARY PASS NO. USED FOR ORIGEN-S CASE
C      2) MTIME, POSITION NO. OF DATA FROM UNIT NO. 71
C      3) TW, TIME FROM START OF ASSEMBLY BURNUP, D
C      4) DUM1

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```

C      5) RDBURN, ACCUMULATED BURNUP AT TW, MWD/ASSEMBLY
C      6) SPWR, SPECIFIC POWER OF CYCLE, KW/KG U
C      7) DUM3
C      8) BCONV, INITIAL METRIC TON U WEIGHT PER ASSEMBLY
C
      READ(N72,100,END=2000)LPASS,MTIME,TW,DUM1,RDBURN,SPWR,DUM3,BCONV
      IF(NCT.EQ.1)WRITE(NOUT,99)
99  FORMAT(/,
&'1) LPASS, LIBRARY PASS NO. USED FOR ORIGEN-S CASE',
&'2) MTIME, POSITION NO. OF DATA FROM UNIT NO. 71',
&'3) TW, TIME FROM START OF ASSEMBLY BURNUP, D',
&'4) DUM1',
&'5) RDBURN, ACCUMULATED BURNUP AT TW, MWD/ASSEMBLY',
&'6) SPWR, SPECIFIC POWER OF CYCLE, KW/KG U',
&'7) DUM3',
&'8) BCONV, INITIAL METRIC TON U WEIGHT PER ASSEMBLY')
      WRITE(NOUT,100) LPASS,MTIME,TW,DUM1,RDBURN,SPWR,DUM3,BCONV
      IF(LPASS.EQ.NCYC)IND=1
      IF(LPASS.NE.NC)THEN
        WRITE(NOUT,101)NC,LPASS,NCYC
101  FORMAT('NC=',I2,' LPASS=',I2,' NCYC=',I2,' MTIME=',I2,' IND=',I2)
      STOP 7210
      END IF
      IF(MTIME.NE.IND)THEN
        WRITE(NOUT,101)NC,LPASS,NCYC,MTIME,IND
        IF(NC.EQ.NCYC.AND.MTIME.EQ.3)GO TO 5
        STOP 7220
      END IF
5    CONTINUE
      READ(N72,110) ITOT,ILE,IACT,IFP
      ISUM=ILE+IACT+IFP
      IF(ISUM.NE.ITOT)STOP 7230
      DO 10 I=1,4
10   READ(N72,140)
      READ(N72,120)(IDDK(I),AD(I,NCT),I=1,ITOT)
C    WRITE(NOUT,102)NCT,LPASS,NCYC
C 102  FORMAT('NCT=',I2,' LPASS=',I2,' NCYC=',I2,' AD ARRAY')
C    WRITE(NOUT,120)(IDDK(I),AD(I,NCT),I=ILE,ILE+16)
      READ(N72,125)TTL72
      WRITE(NOUT,125)TTL72
C    WRITE(NOUT,160)RDBURN,NCT
1000  READ(N72,130)ITEST
      IF(ITEST.NE.'----')GO TO 1000
      RETURN
2000  CONTINUE
      WRITE(NOUT,150)
      RETURN
100  FORMAT(2I10,6(1X,1P,E9.3))
110  FORMAT(4I10)
120  FORMAT(4(I8,2X,1P,E10.4))
125  FORMAT(20A4)
130  FORMAT(A4)
140  FORMAT( )
150  FORMAT('***EOF ERROR READING FILE 72***')
C 160  FORMAT('RDBURN(F72)=' ,F10.3,' NCT=',I2)
      END
C-----
      SUBROUTINE LAGINT(X,Y,N,XINT,YOUT)
C  THIS SUBROUTINE PERFORMS LAGRANGIAN INTERPOLATION WITHIN A SET OF
C  (X,Y) PAIRS TO GIVE THE Y VALUE CORRESPONDING TO XINT. THE DEGREE OF
C  THE INTERPOLATING POLYNOMIAL IS ONE LESS THAN THE NUMBER OF POINTS
C  SUPPLIED. TAKEN FROM GERALD'S "APPLIED NUMERICAL ANALYSIS" PG 181
C  PARAMETERS ARE:
C    X - ARRAY OF VALUES OF THE INDEPENDENT VARIABLE
C    Y - ARRAY OF FUNCTION VALUES CORRESPONDING TO X
C    N - NUMBER OF POINTS
C    XINT - THE X-VALUE FOR WHICH ESTIMATE OF Y IS DESIRED
C    YOUT - THE Y-VALUE RETURNED TO CALLER

```

```

      DIMENSION X(10),Y(10)
C *****
C 8/16/91 - MODIFIED ORIGINAL SUBROUTINE TO CHECK FOR ZERO OR NEAR
C ZERO NUMBER DENSITIES BEFORE INTERPOLATING
      NC0=0
      NM1=N-1
      DO 5 I=1,N
      IF(Y(I).GT.1.0E-25)GO TO 5
      NC0=NC0+1
5      CONTINUE
      IF(NC0.LT.NM1)GO TO 8
      YOUT=0.0
      RETURN
8      CONTINUE
C *****
      YOUT=0.0
      DO 20 I=1,N
      TERM=Y(I)
      DO 10 J=1,N
      IF(I.EQ.J)GO TO 10
      TERM=TERM*(XINT-X(J))/(X(I)-X(J))
10     CONTINUE
      YOUT=YOUT+TERM
20     CONTINUE
      IF(YOUT.LE.1.0E-25)YOUT=0.0
      RETURN
      END
C-----
      SUBROUTINE INTERP(A1,A2,B1,B2)
C
C THIS ROUTINE LINEARLY INTERPOLATES ATOM DENSITY AS A
C FUNCTION OF BURNUP
C
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IAC,IFP,ITOT,NCYC
      COMMON /UNTNOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRIT(200),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTYP(40),ADCRIT(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)
      DIMENSION A1(2000),A2(2000)
      DB=B2-B1
      DELB=B2-BURN
      DO 10 I=1,ITOT
      SLOPE=(A2(I)-A1(I))/DB
      ADDK(I)=A2(I)-SLOPE*DELB
      IF(ADDK(I).LT.0.0)STOP 7299
      IF(IDDK(I).NE.922350)GO TO 10
      WRITE(NOUT,111)B1,A1(I),B2,A2(I),SLOPE,DELB
      WRITE(NOUT,112)ADDK(I)
10     CONTINUE
111    FORMAT('B1=',F8.1,' A1=',E11.4,' B2=',F8.1,' A2=',E11.4,
&' SLOPE=',E11.4,' DELB=',E11.4)
112    FORMAT('VALUE FOR LINEAR INTERP FOR 92235',1X,E11.4)
      RETURN
      END
C-----
      SUBROUTINE TYMSTP(NCOOL,TSTEP)
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IAC,IFP,ITOT,NCYC
      COMMON /UNTNOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRIT(200),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTYP(40),ADCRIT(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)
      DIMENSION TSTEP(10)
C
C THIS ROUTINE WILL CHECK REQUESTED COOLING TIME AGAINST THE
C DEFAULT TSTEP ARRAY AND MAKE ANY CHANGES THAT ARE NECESSARY
C TO ACCOMMODATE THE USER'S REQUEST

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C
C IF THE USER REQUEST A DECAY STEP NOT IN THE DEFAULT LIST,
C THE TIME STEP NEAREST THE REQUESTED COOLING TIME WILL BE
C ALTERED. THE LONGEST COOLING TIME ALLOWED IS 20 YEARS.
C
      COOLMX=20
      DO 10 I=1,10
        IF(COOL.NE.TSTEP(I))GO TO 10
        NCOOL=I
        RETURN
10    CONTINUE
      IF(COOL.LE.COOLMX)GO TO 20
      WRITE(NOUT,100)COOL,COOLMX
      STOP 801
20    CONTINUE
      DO 30 J=1,9
        IF(TSTEP(J).LT.COOL.AND.COOL.LT.TSTEP(J+1))THEN
          JCOOL=J
          GO TO 40
        END IF
30    CONTINUE
      TSTEP(10)=COOL
      NCOOL=10
      RETURN
40    F1=COOL-TSTEP(JCOOL)
      F2=TSTEP(JCOOL+1)-COOL
      IF(F1.GT.F2)JCOOL=JCOOL+1
      TSTEP(JCOOL)=COOL
      NCOOL=JCOOL
      RETURN
100   FORMAT('REQUESTED COOLING TIME ',F7.2,' LARGER THAN MAXIMUM OF ',
&F4.1,' YEARS')
      END
C-----
      SUBROUTINE LITEL(IFLAG)
C
C THIS SUBROUTINE CHECKS TO SEE IF ANY
C LIGHT ELEMENTS ARE REQUESTED BY THE
C USER, IF OXYGEN IS NOT EXPLICITLY
C REQUESTED IT IS ADDED.
C
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IACF,IFP,ITOT,NCYC
      COMMON /UNTOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRIT(200),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTYP(40),ADCRIT(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)
C
      IF(NLITL.NE.0)GO TO 10
      NLITL=1
      IDLITL(1)=8016
      LTYP(1)=1
      GO TO 30
10    CONTINUE
      DO 20 I=1,NLITL
        IF(IDLITL(I).EQ.8016)GO TO 35
20    CONTINUE
      NLITL=NLITL+1
      IDLITL(NLITL)=8016
      LTYP(NLITL)=1
30    CONTINUE
      IF(IFLAG.EQ.1)GO TO 45
      ADLITL(NLITL)=2.0*SMACT0
      WRITE(NOUT,110)ADLITL(NLITL)
110   FORMAT('ADLITL(NLITL)=',1PE10.4)
35    CONTINUE
      DO 40 I=1,NLITL
        DO 40 J=1,ILE

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      IDLT=IDLITL(I)*10
      IF(IDLT.NE.IDDK(J))GO TO 40
      WRITE(NOUT,150)IDDK(J),ADDK(J)
      IF(LTYP(I).EQ.1)ADDK(J)=ADLITL(I)
      IF(LTYP(I).EQ.2.AND.ADDK(J).EQ.0.)ADDK(J)=ADLITL(I)
      IF(LTYP(I).EQ.3.AND.ADDK(J).NE.0.)ADDK(J)=ADDK(J)+ADLITL(I)
      WRITE(NOUT,140)IDLT,ADLITL(I)
      WRITE(NOUT,150)IDDK(J),ADDK(J)
40    CONTINUE
45    CONTINUE
      DO 50 I=1,NLITL
50    IF(IDLITL(I).EQ.8016)WRITE(NOUT,120)ADLITL(I)
      DO 60 J=1,ITOT
60    IF(IDDK(J).EQ.80160)WRITE(NOUT,130)J,IDDK(J),ADDK(J)
      RETURN
120  FORMAT('ADLITL FOR 8016= ',1PE10.4)
130  FORMAT(I2,I10,' ADDK FOR 8016=',1PE10.4)
140  FORMAT('LITEL ARRAY',2X,I6,2X,1PE10.4)
150  FORMAT('DECAY ARRAY',2X,I6,2X,1PE10.4)
      END
C-----
      SUBROUTINE WRTORS(TSTEP)
C
C  ABURN IS THE ASSEMBLY BURNUP (MWD/ASSEMBLY), N71 IS THE
C  FILE THE BINARY OUTPUT FILE IS TO BE WRITTEN TO, TSTEP
C  IS THE ARRAY CONTAINING THE DECAY TIME INTERVALS, AND
C  TBURN IS THE TOTAL BURNUP (GWD/MTU)
C
C  THIS ROUTINE WRITES THE INPUT TO THE ORIGEN-S
C  DECAY CASE - ***PRESENTLY IN CARD IMAGE FORM TO
C  UNIT 'NORS' FOR INPUT TO ORS, WILL CHANGE TO WRITE
C  BINARY INPUT FOR DRIVER TO CALL ORIGEN-S
C
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IACT,IFP,ITOT,NCYC
      COMMON /UNTNOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRIT(200),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTYP(40),ADCRIT(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)
      DIMENSION TSTEP(10)
C  CONVERT BURNUP TO GWD/MTU - TBURN
      TBURN=BURN/1000.
C  CONVERT BURNUP TO MWD/ASSEMBLY - ABURN
      ABURN=BURN*BCONV
      WRITE(NORS,203) N71
      WRITE(NORS,204) ABURN
      WRITE(NORS,205)
      WRITE(NORS,206)ITOT
      WRITE(NORS,207)TBURN
      WRITE(NORS,208)
      WRITE(NORS,209)(TSTEP(K),K=1,10)
      WRITE(NORS,211)
      WRITE(NORS,201)
      WRITE(NORS,220)(IDDK(K),ADDK(K),K=1,ITOT)
      WRITE(NORS,202)
      WRITE(NORS,220)(IDDK(K),ADDK(K),K=1,ITOT)
      WRITE(NORS,212)ILE,IACT,IFP
      WRITE(NORS,214)
      WRITE(NORS,213)
      RETURN
201  FORMAT('73U'/' (3(I8,12X))')
202  FORMAT('74U'/' (3(10X,1P,E10.4))')
203  FORMAT('#ORIGENS'/'0$$ A11 ',I2,' E 1T')
204  FORMAT('DECAY ONLY CASES FOR SNIKR AT BURNUP ',1P,E9.3,
&' MWD/ASSEMBLY')
205  FORMAT('2T'/'35$$ 0 4T')
206  FORMAT('56$$ A5 1 1 A13 ',I4,' 5 3 0 4 E 5T')

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207 FORMAT('BURNUP - ',1P,E9.3,' GWD/MTU')
208 FORMAT('UNITS - ATOMS/BARN-CM')
209 FORMAT('60** ',10(1X,F5.2))
211 FORMAT('65$$ 1 A22 1 A43 1 E')
212 FORMAT('75$$ ',I3,'R1 ',I3,'R2 ',I3,'R3'/'6T')
213 FORMAT('56$$ F0 T'/'END')
214 FORMAT('56$$ 0 -10 A10 0 E T')
220 FORMAT(3(I8,2X,1P,E10.4))
      END
C-----
      SUBROUTINE RDINPT3(NCOOL)
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IACT,IFP,ITOT,NCYC
      COMMON /UNTNOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRIT(210),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTYF(40),ADCRIT(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)
      CHARACTER*6 ICHK
      DIMENSION IDAT1(25),IDAT2(37),IDAT3(49),IDAT4(193)
      DATA IDAT1/92234,92235,92236,92238,94238,94239,94240,94241,
&94242,95241,8016,42095,43099,45103,55133,55135,60143,60145,
&62147,62149,62150,62151,62152,63153,64155/
      DATA IDAT2/92234,92235,92236,92238,93237,94238,94239,94240,94241,
&94242,95241,95243,96244,8016,40093,42095,43099,44101,45103,46105,
&46108,47109,55133,55135,59141,60143,60145,61147,62147,62149,
&62150,62151,62152,63153,63154,63155,64155/
      DATA IDAT3/92234,92235,92236,92238,93237,94238,94239,94240,94241,
&94242,95241,95243,96244,8016,36083,40093,42095,43099,
&44101,44103,45103,45105,46105,46108,47109,53135,54131,54135,
&55133,55134,55135,59141,60143,60145,60147,60148,61147,61148,
&61149,62147,62149,62150,62151,62152,63153,63154,63155,64155,
&99999/
      DATA IDAT4/ 32072,32073,32074,32076,33075,34076,34077,34078,34080,
&34082,35079,35081,36080,36082,36083,36084,36085,36086,37085,37086,
&37087,38086,38087,38088,38089,38090,39089,39090,39091,40090,40091,
&40092,40093,40094,40095,40096,41093,41094,41095, 8016,42095,42096,
&42097,42098,42099,42100,43099,44099,44100,44101,44102,44104,44105,
&44106,46104,46105,46106,46107,46108,46110,47107,47109,47111,48108,
&48110,48111,48112,48113,48114, 48116,49113,49115,50115,50116,
&50117,50118,50119,50120,50122,50123,50124,50125,50126,51121,51123,
&51124,51125,51126,52122,52123,52124,52125,52126, 52128,
&52130,52132,53127,53129,53130,53131,54128,54129,54130,54131,54132,
&54133,54134,54136,55133,55134,55135,55136,55137,56134,56135,56136,
&56137,56138,56140,57139,57140,58140,58141,58142,58143,58144,59141,
&59142,59143,60142,60143,60144,60145,60146,60150,61151,62147,62148,
&62150,62151,62152,62153,62154,63151,63152,63156,63157,64154,64156,
&64157,64158,64160,65159,65160,66160,66161,66162,66163,66164,67165,
&68166,68167,44103,45103,45105,53135,54135,60147,60148,61147,61148,
&62149,61149,63153,63154,63155, 64155,90232,91233,92233,92234,
&92235,92236,92238,93237,94238,94239,94240,94241,94242,95241,
&95243,96244/
      N5=5
      READ(N5,110)ICHK
C READ AND CHECK IF APPROPRIATE PHASE INPUT - SNIKR3
      IF(ICHK.NE.'SNIKR3')STOP 5301
C READ TITLE CARD
      READ(N5,120)ITTL
C READ LABEL AND CHECK TO BE SURE MXFUEL DATA IS NEXT
      READ(N5,110)ICHK
      IF(ICHK.NE.'READ M')STOP 5302
C READ N72, UNIT NUMBER FOR ORIGIN-S FILE 71 OUTPUT TO BE READ FROM
      READ(N5,130)N71
C READ NICE, UNIT NUMBER FOR ICE INPUT TO BE WRITTEN TO
      READ(N5,140)NICE
C READ NOUT, UNIT NUMBER FOR OUTPUT TO BE WRITTEN TO
      READ(N5,140)NOUT
C READ NCOOL, NUMBER OF COOLING STEP FOR WHICH DENSITIES ARE TO BE READ
      IF(NCOOL.GT.0)READ(N5,110)

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      IF(NCOOL.EQ.0)READ(N5,145)NCOOL
C   READ FLAG NFIS TO DETERMINE WHICH FUEL NUCLIDES WILL BE USED IN
C   KENO CALCULATIONS:
C       =0   USE TTC713 INTERSECTION WITH SID BIERMAN'S NUCS
C       =-1  USE TTC713
C       =-2  USE TTC713 U SID U VEPCO U CASMO
C       =-3  USE ALL 27BURNUPLIB NUCLIDES
C       =N   READ IN USER'S CHOICE OF NUCLIDES
      READ(N5,150)NFIS
      IF(NFIS.EQ.0)THEN
        NCRIT=25
        DO 10 I=1,NCRIT
10      IDCRIT(I)=IDAT1(I)
        GO TO 500
        END IF
        IF(NFIS.EQ.-1)THEN
          NCRIT=37
          DO 20 I=1,NCRIT
20      IDCRIT(I)=IDAT2(I)
          GO TO 500
          END IF
          IF(NFIS.EQ.-2)THEN
            NCRIT=49
            DO 21 I=1,NCRIT
21      IDCRIT(I)=IDAT3(I)
            GO TO 500
            END IF
            IF(NFIS.EQ.-3)THEN
              NCRIT=193
              DO 31 I=1,NCRIT
31      IDCRIT(I)=IDAT4(I)
              GO TO 500
              END IF
              IF(NFIS.GT.0)NCRIT=NFIS
500    CONTINUE
C   READ MIXTURE NUMBER TO BE USED FOR FUEL OF THIS BURN IN KENO CALCULATIONS
      READ(N5,160)MIXF
C   READ INTEGER MODIFIER FOR FUEL NUCLIDE ID'S FOR USE IN ICE RUN
      READ(N5,145>IDMOD
C   READ AND CHECK THAT THIS IS END OF FUEL MIX DATA
      READ(N5,110)ICLK
      IF(ICLK.NE.'END MX')STOP 5303
C   IF FISPROD IS GREATER THAN ZERO READ IN ID'S OF ELEMENTS IN FUEL FOR
C   CRITICALITY CALCULATIONS
      IF(NFIS.LE.0)GO TO 1000
      READ(N5,170)(IDCRIT(I),I=1,NCRIT)
1000  CONTINUE
C
C   WRITE INPUT TO NOUT
C
      WRITE(NOUT,120)ITTL
      WRITE(NOUT,130)N71
      WRITE(NOUT,140)NICE
      WRITE(NOUT,140)NOUT
      WRITE(NOUT,145)NCOOL
      WRITE(NOUT,150)NFIS
      WRITE(NOUT,160)MIXF
      WRITE(NOUT,145>IDMOD
      WRITE(NOUT,170)(IDCRIT(I),I=1,NCRIT)
110  FORMAT(A6)
120  FORMAT(20A4)
130  FORMAT(4X,I2)
140  FORMAT(5X,I2)
145  FORMAT(6X,I2)
150  FORMAT(8X,I3)
160  FORMAT(5X,I4)
170  FORMAT(10(1X,I5))
      RETURN

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      END
C-----
      SUBROUTINE CLECT(IFLAG)
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IAC,IFP,ITOT,NCYC
      COMMON /UNTOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRIT(200),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTY(40),ADCRIT(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)
      DIMENSION IDLFP(165)
      DATA IDLFP/ 32072,32073,32074,32076,33075,34076,34077,34078,34080,
&34082,35079,35081,36080,36082,36083,36084,36085,36086,37085,37086,
&37087,38086,38087,38088,38089,38090,39089,39090,39091,40090,40091,
&40092,40093,40094,40095,40096,41093,41094,41095,42094,42095,42096,
&42097,42098,42099,42100,43099,44099,44100,44101,44102,44104,44105,
&44106,46104,46105,46106,46107,46108,46110,47107,47109,47111,48108,
&48110,48111,48112,48113,48114,48115,48116,49113,49115,50115,50116,
&50117,50118,50119,50120,50122,50123,50124,50125,50126,51121,51123,
&51124,51125,51126,52122,52123,52124,52125,52126,52127,52128,52129,
&52130,52132,53127,53129,53130,53131,54128,54129,54130,54131,54132,
&54133,54134,54136,55133,55134,55135,55136,55137,56134,56135,56136,
&56137,56138,56140,57139,57140,58140,58141,58142,58143,58144,59141,
&59142,59143,60142,60143,60144,60145,60146,60150,61151,62147,62148,
&62150,62151,62152,62153,62154,63151,63152,63156,63157,64154,64156,
&64157,64158,64160,65159,65160,66160,66161,66162,66163,66164,67165,
&68166,68167/
      NLFP=165
C
C EXTRACT NUCLIDES NEEDED FOR CRITICALITY CALCULATIONS FOR THIS
C BURNUP AND COOLING TIME. TAKE REQUESTED LIGHT ELEMENTS FROM
C THE LIGHT ELEMENT LIBRARY (1ST ILE ENTRIES IN IDDK/ADDK),
C ACTINIDES FROM THE ACTINIDE DATA (NEXT IAC ENTRIES IN IDDK/ADDK),
C AND FISSION PRODUCTS FROM THE FINAL IFP ENTRIES IN IDDK/ADDK)
C
C NLITL WILL BE AT LEAST 1, TO ACCOUNT FOR OXYGEN. THE ONLY
C SITUATION THAT WILL ALLOW IT TO BE LARGER THAN 1 IS IF THE
C USER HAS CHOSEN TO INPUT A SET OF ISOTOPICS DIFFERENT FROM
C THE BURNUP CREDIT NUCLIDES (IE., TTC-0713 OR BIERMAN'S) AND
C HAS CHOSEN TO ENTER MORE LIGHT ELEMENTS THAN JUST OXYGEN
C
C IF IFLAG=1 CHANGE ALL IDDK BY FACTOR OF 10 (FROM 72 NOT 71)
      IF(IFLAG.EQ.0)GO TO 20
      DO 10 I=1,ITOT
10  IDDK(I)=IDDK(I)/10
20  CONTINUE
      DO 40 I=1,NLITL
      DO 30 J=1,ILE
      IF(IDDK(J).NE.IDLITL(I)) GO TO 30
      ADLITL(I)=ADDK(J)
      GO TO 40
30  CONTINUE
      WRITE(NOUT,102)IDLITL(I),N71
102  FORMAT('0'/'*****ERROR, NO MATCH FOR LIGHT ELEMENT ',I8,
&' WAS FOUND ON UNIT ',I2)
      STOP 7102
40  CONTINUE
      NLFP1=ILE+1
      DO 70 I=1,NCRIT
      IF(IDCRIT(I).EQ.99999)GO TO 70
      ADCRIT(I)=0.0
      DO 60 J=NLFP1,ITOT
      IF(IDDK(J).NE.IDCRIT(I)) GO TO 60
      ADCRIT(I)=ADDK(J)
      GO TO 70
60  CONTINUE
      DO 65 K=1,NLITL
      IF(IDCRIT(I).EQ.IDLITL(K))GO TO 70
65  CONTINUE

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      WRITE(NOUT,103)IDCRIT(I),N71
103  FORMAT('0'/'*****ERROR, NO MATCH FOR NUCLIDE ',I8,
      &' WAS FOUND ON UNIT ',I2)
      STOP 7103
70  CONTINUE
C  ADD CONTRIBUTION FROM LIGHT ELEMENT AND ACTINIDE/FISSION PRODUCT LIBR
      DO 80 I=1,NLITL
      DO 80 J=1,NCRIT
      IF(IDCRIT(J).NE.IDLITL(I))GO TO 80
      ADCRIT(J)=ADCRIT(J)+ADLITL(I)
80  CONTINUE
C  COMPUTE NUMBER DENSITY FOR LUMPED-FISSION PRODUCT IF REQUESTED
C  ONLY AVAILABLE FOR NFIS=-2 (FOR MIKEY'S USE ONLY)***
      ADLFP=0.0
      IFP0=ILE+IACT
C  DO WE NEED TO CALCULATE A LUMPED FISSION PRODUCT
C  CHECK TO SEE IF IDCRIT=99999, IF SO CALCULATE LFP
C  ALSO (IF ICKFP=1) CHECK TO SEE IF ANY NUCLIDE IN IDCRIT IS ALSO
C  IN IDLFP, IF SO SET IDLFP TO ZERO
C
C  ICKFP=0 WILL CALCULATE THE VIRGINIA POWER LUMPED FISSION PRODUCT
C  EXPLICITLY
      ICKFP=0
C
C  ICKFP=1 CALCULATES VP LFP MINUS FP IN IDCRIT ARRAY ###DON'T USE NOW
C
      ICKFP=1
      K99=0
      DO 92 KL=1,NCRIT
      IF(IDCRIT(KL).EQ.99999)K99=KL
      IF(ICKFP.EQ.0)GO TO 92
      DO 90 J=1,NLFP
      IF(IDLFP(J).NE.IDCRIT(KL))GO TO 90
      WRITE(NOUT,110)IDLFP(J)
      IDLFP(J)=0
      GO TO 92
90  CONTINUE
92  CONTINUE
110  FORMAT(I10,' NUCLIDE WAS IN IDLFP AND IDCRIT')
C  NO LFP CALCULATION IS REQUIRED IF K99=0
      IF(K99.EQ.0)RETURN
      DO 95 I=1,IFP
      J=IFP0+I
      DO 94 KJ=1,NLFP
      IF(IDDK(J).NE.IDLFP(KJ))GO TO 94
      ADLFP=ADLFP+ADDK(J)
      GO TO 95
94  CONTINUE
95  CONTINUE
      ADCRIT(K99)=ADLFP
      RETURN
      END
C
C
C
C-----
      SUBROUTINE WRTICE
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IACT,IFP,ITOT,NCYC
      COMMON /UNTNOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRIT(200),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTY(40),ADCRIT(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)
      DIMENSION I2(200),I5(200),I11(201),IDACT(7)
      CHARACTER*4 DUM,T,ICE,END
      DATA IDACT/92234,92235,92236,92238,94239,94240,94241/
C
      T = ' T '
      ICE = '#ICE'

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      END = 'END '
      MIX=1
C
      WRITE(NICE,110)ICE
      WRITE(NICE,110)ITTL
110    FORMAT(20A4)
C
      DUM = '1$$ '
      WRITE(NICE,110)DUM
      II = 0
      I4 = 10
      KOPT = 4
      WRITE(NICE,120)MIX,NCRIT,II,II,II,I4,KOPT
120    FORMAT(6I12)
      WRITE(NICE,110)T
C
      DO 10 I=1,NCRIT
10     I2(I)=1
C
      DUM = '2$$ '
      WRITE(NICE,110)DUM
      WRITE(NICE,120)(I2(I),I=1,NCRIT)
C
      IF(IDMOD.EQ.0)GO TO 35
      DO 30 J=1,7
      DO 30 I=1,NCRIT
      IF(IDCRI(I).NE.IDACT(J))GO TO 30
      IDCRI(I)=IDCRI(I)+100000*IDMOD
30     CONTINUE
35     CONTINUE
C
      DUM = '3$$ '
      WRITE(NICE,110)DUM
      WRITE(NICE,120)(IDCRI(I),I=1,NCRIT)
C
      DUM = '4** '
      WRITE(NICE,110)DUM
      WRITE(NICE,130)(ADCRI(I),I=1,NCRIT)
130    FORMAT(1P,6E12.4)
C
      I5(1)=4
      DUM = '5$$ '
      WRITE(NICE,110)DUM
      WRITE(NICE,120)(I5(I),I=1,MIX)
      WRITE(NICE,110)T
C
      DUM= '7$$ '
      WRITE(NICE,110)DUM
      WRITE(NICE,140)
      WRITE(NICE,110)T
140    FORMAT('  A8 2 E')
C
      I11(1)=1
      I11(2)=MIXF
      DUM = '11$$ '
      WRITE(NICE,110)DUM
      WRITE(NICE,120)(I11(I),I=1,MIX+1)
      WRITE(NICE,110)T
      WRITE(NICE,110)END
C
      RETURN
      END
C-----
      SUBROUTINE WRTKENO
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IACT,IFP,ITOT,NCYC
      COMMON /UNTNOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRI(200),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTYP(40),ADCRI(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)

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CHARACTER*2 INAME(105),ICS(200)
DIMENSION MASS(200),IDACT(7)
DATA IDACT/92234,92235,92236,92238,94239,94240,94241/
DATA INAME/' H','HE','LI','BE',' B',' C',' N',' O',' F','NE','NA',
& 'MG','AL','SI',' P',' S',
& 'CL','AR',' K','CA','SC','TI',' V','CR','MN','FE','CO',
& 'NI','CU','ZN','GA','GE','AS','SE','BR','KR','RB',
& 'SR',' Y','ZR','NB','MO','TC','RU','RH','PD','AG','CD',
& 'IN','SN','SB','TE',' I','XE','CS','BA','LA','CE',
& 'PR','ND','PM','SM','EU','GD','TB','DY','HO','ER',
& 'TM','YB','LU','HF','TA',' W','RE','OS','IR','PT',
& 'AU','HG','TL','PB','BI','PO','AT','RN','FR','RA',
& 'AC','TH','PA',' U','NP','PU','AM','CM','BK','CF',
& 'ES','FM','MD','NO','LR','RF','HA'/
DO 15 K=1,NCRIT
IF(IDCRT(K).EQ.99999)GO TO 15
IZ=IDCRIT(K)/1000
MASS(K)=IDCRIT(K)-IZ*1000
IDFF=IZ/100
IF(IDFF.GT.0)IZ=IZ-IDFF*100
ICS(K)=INAME(IZ)
15 CONTINUE
DO 20 I=1,4
20 WRITE(NOUT,101)
WRITE(NOUT,202)
WRITE(NOUT,101)
DO 30 J=1,NCRIT
IF(IDCRT(J).EQ.99999)GO TO 30
IF(ICS(J).EQ.' O')THEN
WRITE(NOUT,206)ICS(J),MIXF,ADCRIT(J)
GO TO 30
END IF
IF(MASS(J).LT.10)WRITE(NOUT,203)ICS(J),MASS(J),MIXF,ADCRIT(J)
IF(MASS(J).GE.10.AND.MASS(J).LT.100)WRITE(NOUT,204)ICS(J),
&MASS(J),MIXF,ADCRIT(J)
IF(MASS(J).GE.100)WRITE(NOUT,205)ICS(J),MASS(J),MIXF,ADCRIT(J)
30 CONTINUE
C
IF(IDMOD.EQ.0)GO TO 5
DO 3 J=1,7
DO 3 I=1,NCRIT
IF(IDCRT(I).NE.IDACT(J))GO TO 3
IDCRIT(I)=IDCRIT(I)+100000*IDMOD
3 CONTINUE
5 CONTINUE
C
DO 10 I=1,4
10 WRITE(NOUT,101)
WRITE(NOUT,102)
WRITE(NOUT,101)
WRITE(NOUT,104)MIXF
WRITE(NOUT,103)(IDCRIT(J),ADCRIT(J),J=1,NCRIT)
RETURN
101 FORMAT(A4)
102 FORMAT(' FOR USE WHEN MIXING IN KENO')
103 FORMAT(I9,2X,1P,E10.4)
104 FORMAT(' MIX=',I4)
202 FORMAT(' FOR USE IN CSAS')
203 FORMAT(2X,A2,'-',I1,4X,I3,2X,'0',2X,1P,E10.4,' END')
204 FORMAT(2X,A2,'-',I2,3X,I3,2X,'0',2X,1P,E10.4,' END')
205 FORMAT(2X,A2,'-',I3,2X,I3,2X,'0',2X,1P,E10.4,' END')
206 FORMAT(2X,A2,6X,I3,2X,'0',2X,1P,E10.4,' END')
END
C-----

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## SNIKR3 FORTRAN Listing

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C
  PROGRAM SNIKR3
    COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACTO
    COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IAC,IFP,ITOT,NCYC
    COMMON /UNT NOS/ N72,NOUT,N71,NORS,NICE
    COMMON /IDENT/ IDLITL(40),IDCRIT(210),IDDK(2000)
    COMMON /ADENS/ ADLITL(40),LTYP(40),ADCRIT(200),ADDK(2000)
    COMMON /TITLE/ ITTL(20)
    DIMENSION TYM(20)
C  READ SNIKR1 INPUT AGAIN
    CALL RDINPT1
C  READ INPUT TO SNIKR NEEDED TO SET UP ICE RUN
    NCOOL=0
    CALL RDINPT3(NCOOL)
C  RETRIEVE NUMBER DENSITIES AT COOLTIME FOR NUCLIDES TO BE USED IN
C  CRITICALITY ANALYSES
    NNCT=0
    NNCL=1
    IF(NCOOL.LT.0)THEN
      NCOOL=0
      NNCL=11
    END IF
1000 CONTINUE
    NNCT=NNCT+1
    NPOS=NCOOL+NNCT
    CALL RDF71(NPOS,TYM)
    REWIND N71
    CALL LITEL(1)
    CALL CLECT(0)
C  SET UP ICE RUN TO CREATE MIXTURE CROSS SECTIONS FOR KENO CALCS
C  FIRST REMOVE ANY NUCLIDES WITH NUMBER DENSITIES LESS THAN 1E-24
    WRITE(NOUT,107)NPOS
    WRITE(NOUT,108)TYM(NPOS)
    WRITE(NICE,107)NPOS
    WRITE(NICE,108)TYM(NPOS)
    CALL WRTICE
C  USE MIXED CROSS SECTIONS WRITTEN ON UNIT NICE IN KENO CALC
C  *****CHECK FILE NOUT FOR MESSAGES
C
C  WRITE NUMBER DENSITIES FOR MIXING IN KENO TO ...NOUT3
107 FORMAT('ISOTOPIC RESULTS FOR COOL STEP ',I2)
108 FORMAT('ORIGENS COOLING TIME (YR) =',F6.2)
    CALL WRTKENO
    IF(NNCT.LT.NNCL)GO TO 1000
    STOP
    END
C
C  READ INPUT DATA FOR PHASE ONE CALCULATIONS, READING SAS2H OUTPUT
C  AND SETTING UP ORIGEN-S DECAY ONLY CASE
C
C-----
  SUBROUTINE RDINPT1
    COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACTO
    COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IAC,IFP,ITOT,NCYC
    COMMON /UNT NOS/ N72,NOUT,N71,NORS,NICE
    COMMON /IDENT/ IDLITL(40),IDCRIT(210),IDDK(2000)
    COMMON /ADENS/ ADLITL(40),LTYP(40),ADCRIT(200),ADDK(2000)
    COMMON /TITLE/ ITTL(20)
    CHARACTER*6 ICHK
    N5=5
    READ(N5,110)ICHK
C  READ AND CHECK IF APPROPRIATE PHASE INPUT - SNIKR1
    IF(ICHK.NE.'SNIKR1')STOP 5101
C  READ TITLE CARD
    READ(N5,120)ITTL

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C  READ LABEL AND CHECK TO BE SURE BURN DATA IS NEXT
      READ(N5,110)ICLK
      IF(ICK.NE.'READ B')STOP 5102
C  READ N72, UNIT NUMBER FOR SAS2H FILE 72 OUTPUT TO BE READ FROM
      READ(N5,130)N72
C  READ NOUT, UNIT NUMBER FOR OUTPUT TO BE WRITTEN TO
      READ(N5,140)NOUT
C  READ BURNUP IN MWD/MTU THAT NUMBER DENSITIES ARE TO BE RETRIEVED FROM N72
      READ(N5,150)BURN
C  READ METAL (MTU/ASSEMBLY), BCONV IS CONVERSION FACTOR FOR BURNUPS
C  READ FROM N72
      READ(N5,160)BCONV
C  **** MODIFIED SNIKR, NOW READ FROM SAS2H OUTPUT
C
C  READ NCYC, NUMBER OF BURN CYCLES USED TO PRODUCE SAS2H OUTPUT ON N72
      READ(N5,170)NCYC
C  READ AND CHECK THAT THIS IS END OF BURNUP DATA
      READ(N5,110)ICLK
      IF(ICK.NE.'END BU')STOP 5103
C  READ AND CHECK THAT DECAY DATA BEGINS WITH NEXT CARD
      READ(N5,110)ICLK
      IF(ICK.NE.'READ D')STOP 5104
C  READ NORS, UNIT NUMBER FOR ORIGEN-S INPUT TO BE WRITTEN
      READ(N5,140)NORS
C  READ N71, UNIT NUMBER FOR ORIGEN-S INPUT TO BE WRITTEN FOR PHASE 3
      READ(N5,130)N71
C  READ COOLING TIME IN YEARS TO BE USED TO SET UP ORIGEN-S DECAY CASE
      READ(N5,180)COOL
C  READ THE NUMBER OF LIGHT ELEMENTS TO BE SPECIFIED IN THE DECAY CASE
      READ(N5,190)NLITL
C  READ AND CHECK THAT THIS IS THE END OF DECAY DATA
      READ(N5,110)ICLK
      IF(ICK.NE.'END DE')STOP 5105
C  IF NLITL IS GREATER THAN ZERO READ IN ID'S OF LIGHT ELEMENTS
      IF(NLITL.EQ.0)GO TO 1000
      READ(N5,195)(IDLITL(I),ADLITL(I),LTYPI,I=1,NLITL)
1000 CONTINUE
C
C  WRITE INPUT TO NOUT
C
C      WRITE(NOUT,120)ITTL
C      WRITE(NOUT,130)N72
C      WRITE(NOUT,140)NOUT
C      WRITE(NOUT,150)BURN
C      WRITE(NOUT,160)BCONV
C      WRITE(NOUT,170)NCYC
C      WRITE(NOUT,140)NORS
C      WRITE(NOUT,180)COOL
C      WRITE(NOUT,190)NLITL
C      RETURN
110 FORMAT(A6)
120 FORMAT(20A4)
130 FORMAT(4X,I2)
140 FORMAT(5X,I2)
150 FORMAT(5X,F8.1)
160 FORMAT(6X,F6.4)
170 FORMAT(5X,I2)
180 FORMAT(8X,F6.2)
190 FORMAT(8X,I2)
195 FORMAT(1X,I5,1P,E10.4,0P,2X,I1)
      END
C
C
C-----
      SUBROUTINE RDINPT3(NCOOL)
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IACI,IFP,ITOT,NCYC
      COMMON /UNTNOS/ N72,NOUT,N71,NORS,NICE

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COMMON /IDENT/ IDLITL(40),IDCRIT(210),IDDK(2000)
COMMON /ADENS/ ADLITL(40),LTYP(40),ADCRIT(200),ADDK(2000)
COMMON /TITLE/ ITTL(20)
CHARACTER*6 ICHK
DIMENSION IDAT1(25),IDAT2(37),IDAT3(49),IDAT4(193)
DATA IDAT1/92234,92235,92236,92238,94238,94239,94240,94241,
&94242,95241,8016,42095,43099,45103,55133,55135,60143,60145,
&62147,62149,62150,62151,62152,63153,64155/
DATA IDAT2/92234,92235,92236,92238,93237,94238,94239,94240,94241,
&94242,95241,95243,96244,8016,40093,42095,43099,44101,45103,46105,
&46108,47109,55133,55135,59141,60143,60145,61147,62147,62149,
&62150,62151,62152,63153,63154,63155,64155/
DATA IDAT3/92234,92235,92236,92238,93237,94238,94239,94240,94241,
&94242,95241,95243,96244,8016,36083,40093,42095,43099,
&44101,44103,45103,45105,46105,46108,47109,53135,54131,54135,
&55133,55134,55135,59141,60143,60145,60147,60148,61147,61148,
&61149,62147,62149,62150,62151,62152,63153,63154,63155,64155,
&999999/
DATA IDAT4/ 32072,32073,32074,32076,33075,34076,34077,34078,34080,
&34082,35079,35081,36080,36082,36083,36084,36085,36086,37085,37086,
&37087,38086,38087,38088,38089,38090,39089,39090,39091,40090,40091,
&40092,40093,40094,40095,40096,41093,41094,41095, 8016,42095,42096,
&42097,42098,42099,42100,43099,44099,44100,44101,44102,44104,44105,
&44106,46104,46105,46106,46107,46108,46110,47107,47109,47111,48108,
&48110,48111,48112,48113,48114, 48116,49113,49115,50115,50116,
&50117,50118,50119,50120,50122,50123,50124,50125,50126,51121,51123,
&51124,51125,51126,52122,52123,52124,52125,52126, 52128,
&52130,52132,53127,53129,53130,53131,54128,54129,54130,54131,54132,
&54133,54134,54136,55133,55134,55135,55136,55137,56134,56135,56136,
&56137,56138,56140,57139,57140,58140,58141,58142,58143,58144,59141,
&59142,59143,60142,60143,60144,60145,60146,60150,61151,62147,62148,
&62150,62151,62152,62153,62154,63151,63152,63156,63157,64154,64156,
&64157,64158,64160,65159,65160,66160,66161,66162,66163,66164,67165,
&68166,68167,44103,45103,45105,53135,54135,60147,60148,61147,61148,
&62149,61149,63153,63154,63155, 64155,90232,91233,92233,92234,
&92235,92236,92238,93237,94238,94239,94240,94241,94242,95241,
&95243,96244/
N5=5
READ(N5,110)ICLK
C READ AND CHECK IF APPROPRIATE PHASE INPUT - SNIKR3
IF(ICLK.NE.'SNIKR3')STOP 5301
C READ TITLE CARD
READ(N5,120)ITTL
C READ LABEL AND CHECK TO BE SURE MXFUEL DATA IS NEXT
READ(N5,110)ICLK
IF(ICLK.NE.'READ M')STOP 5302
C READ N72, UNIT NUMBER FOR ORIGEN-S FILE 71 OUTPUT TO BE READ FROM
READ(N5,130)N71
C READ NICE, UNIT NUMBER FOR ICE INPUT TO BE WRITTEN TO
READ(N5,140)NICE
C READ NOUT, UNIT NUMBER FOR OUTPUT TO BE WRITTEN TO
READ(N5,140)NOUT
C READ NCOOL, NUMBER OF COOLING STEP FOR WHICH DENSITIES ARE TO BE READ
IF(NCOOL.GT.0)READ(N5,110)
IF(NCOOL.EQ.0)READ(N5,145)NCOOL
C READ FLAG NFIS TO DETERMINE WHICH FUEL NUCLIDES WILL BE USED IN
C KENO CALCULATIONS:
C =0 USE TTC713 INTERSECTION WITH SID BIERMAN'S NUCS
C =-1 USE TTC713
C =-2 USE TTC713 U SID U VEPKO U CASMO
C =-3 USE ALL 27BURNUPLIB NUCLIDES
C =N READ IN USER'S CHOICE OF NUCLIDES
C READ(N5,150)NFIS
IF(NFIS.EQ.0)THEN
NCRIT=25
DO 10 I=1,NCRIT
10 IDCRIT(I)=IDAT1(I)
GO TO 500

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      END IF
      IF(NFIS.EQ.-1)THEN
        NCRIT=37
        DO 20 I=1,NCRIT
20      IDCRT(I)=IDAT2(I)
        GO TO 500
      END IF
      IF(NFIS.EQ.-2)THEN
        NCRIT=49
        DO 21 I=1,NCRIT
21      IDCRT(I)=IDAT3(I)
        GO TO 500
      END IF
      IF(NFIS.EQ.-3)THEN
        NCRIT=193
        DO 31 I=1,NCRIT
31      IDCRT(I)=IDAT4(I)
        GO TO 500
      END IF
      IF(NFIS.GT.0)NCRIT=NFIS
500  CONTINUE
C  READ MIXTURE NUMBER TO BE USED FOR FUEL OF THIS BURN IN KENO CALCULATIONS
      READ(N5,160)MIXF
C  READ INTEGER MODIFIER FOR FUEL NUCLIDE ID'S FOR USE IN ICE RUN
      READ(N5,145)IDMOD
C  READ AND CHECK THAT THIS IS END OF FUEL MIX DATA
      READ(N5,110)ICLK
      IF(ICLK.NE.'END MX')STOP 5303
C  IF FISPROD IS GREATER THAN ZERO READ IN ID'S OF ELEMENTS IN FUEL FOR
C  CRITICALITY CALCULATIONS
      IF(NFIS.LE.0)GO TO 1000
      READ(N5,170)(IDCRT(I),I=1,NCRIT)
1000 CONTINUE
C
C  WRITE INPUT TO NOUT
C
      WRITE(NOUT,120)ITTL
      WRITE(NOUT,130)N71
      WRITE(NOUT,140)NICE
      WRITE(NOUT,140)NOUT
      WRITE(NOUT,145)NCOOL
      WRITE(NOUT,150)NFIS
      WRITE(NOUT,160)MIXF
      WRITE(NOUT,145)IDMOD
      WRITE(NOUT,170)(IDCRT(I),I=1,NCRIT)
110  FORMAT(A6)
120  FORMAT(20A4)
130  FORMAT(4X,I2)
140  FORMAT(5X,I2)
145  FORMAT(6X,I2)
150  FORMAT(8X,I3)
160  FORMAT(5X,I4)
170  FORMAT(10(1X,I5))
      RETURN
      END
C-----
      SUBROUTINE RDF71(NPOS,TYM)
C
C  THIS ROUTINE READS ATOM DENSITIES FROM THE BINARY OUTPUT
C  FILE ON UNIT 'N71' WRITTEN FROM ORIGEN-S FOR THE DECAY TIME
C  CORRESPONDING TO THE POSITION, NPOS(EQUAL TO NCOOL+1, WHERE
C  NCOOL IS RETURNED FROM SUBROUTINE TYMSTP), AND AT THE
C  REQUESTED BURNUP, BURN.
C
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IAC,IFP,ITOT,NCYC
      COMMON /UNTNOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRT(210),IDDK(2000)

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COMMON /ADENS/ ADLITL(40),LTP(40),ADCRIT(200),ADDK(2000)
COMMON /TITLE/ ITTL(20)
DIMENSION TYM(20)

C
C IDDK AND ADDK ARE ARRAYS CONTAINING THE ID'S AND NUMBER DENSITIES FOR
C ALL NUCLIDES USED IN THE ORIGEN-S DECAY
C CASE. IN THIS ROUTINE THEY ARE USED TO RETRIEVE DATA FROM UNIT N71
C BEFORE IT IS CONDENSED INTO THE ADCRIT ARRAY WHICH WILL CONTAIN NUMBER
C DENSITIES CORRESPONDING TO THE ID'S GIVEN IN IDCRIT. IDCRIT CONTAINS
C IDS FOR THE NUCLIDES TO BE USED IN THE CRITICALITY ANALYSIS. THE
C DENSITIES STORED IN ADCRIT ARE BURNUP DEPENDENT.
C
C FILES NEEDED IN THIS SUBROUTINE SHOULD BE OPENED BY THE MAIN PROGRAM
C
10 READ(N71,END=100)ITOT,ILE,IAC,IFP,ND1,ND2,NSTEP,
   &N1,N2,N3,N4,N5,N6,N7,N8,N9,N10,N11,N12,N13,N14,N15,
   &N16,N17,N18,N19,N20,N21,N22,N23,R1,R2,R3,R4,TYM(NPOS)
   WRITE(NOUT,102)ITOT,ILE,IAC,IFP,NSTEP,TYM(NPOS)
   IF(NSTEP.EQ.NPOS) THEN
     READ(N71,END=100) (IDDK(I),I=1,ITOT), (ADDK(I),I=1,ITOT)
     DO 15 I=1,ITOT
15      IDDK(I)=IDDK(I)/10
         IA1=ILE+1
         IA2=ILE+IAC
         WRITE(NOUT,103) (IDDK(I),ADDK(I),I=IA1,IA2)
         GO TO 20
     ENDIF
     READ(N71,END=100)IDUMY
     GO TO 10
100  WRITE(NOUT,101)N71
101  FORMAT('0'/'*****ERROR READING UNIT ',I2)
     STOP 7101
20   CONTINUE
102  FORMAT(5(1X,I4),F6.2)
103  FORMAT(4(I8,2X,1P,E10.4))
     RETURN
     END

C-----
SUBROUTINE LITEL(IFLAG)
C
C THIS SUBROUTINE CHECKS TO SEE IF ANY
C LIGHT ELEMENTS ARE REQUESTED BY THE
C USER, IF OXYGEN IS NOT EXPLICITLY
C REQUESTED IT IS ADDED.
C
COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IAC,IFP,ITOT,NCYC
COMMON /UNTNOS/ N72,NOUT,N71,NORS,NICE
COMMON /IDENT/ IDLITL(40),IDCRIT(210),IDDK(2000)
COMMON /ADENS/ ADLITL(40),LTP(40),ADCRIT(200),ADDK(2000)
COMMON /TITLE/ ITTL(20)

C
IF(NLITL.NE.0)GO TO 10
NLITL=1
IDLITL(1)=8016
LTP(1)=1
GO TO 30
10 CONTINUE
DO 20 I=1,NLITL
IF(IDLITL(I).EQ.8016)GO TO 35
20 CONTINUE
NLITL=NLITL+1
IDLITL(NLITL)=8016
LTP(NLITL)=1
30 CONTINUE
IF(IFLAG.EQ.1)GO TO 45
ADLITL(NLITL)=2.0*SMACT0
WRITE(NOUT,110)ADLITL(NLITL)

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110  FORMAT('ADLITL(NLITL)=',1PE10.4)
35  CONTINUE
    DO 40 I=1,NLITL
    DO 40 J=1,ILE
      IDLT=IDLITL(I)*10
      IF(IDLT.NE.IDDK(J))GO TO 40
      WRITE(NOUT,150)IDDK(J),ADDK(J)
      IF(LTYP(I).EQ.1)ADDK(J)=ADLITL(I)
      IF(LTYP(I).EQ.2.AND.ADDK(J).EQ.0.)ADDK(J)=ADLITL(I)
      IF(LTYP(I).EQ.3.AND.ADDK(J).NE.0.)ADDK(J)=ADDK(J)+ADLITL(I)
      WRITE(NOUT,140)IDLT,ADLITL(I)
      WRITE(NOUT,150)IDDK(J),ADDK(J)
40  CONTINUE
45  CONTINUE
    DO 50 I=1,NLITL
50  IF(IDLITL(I).EQ.8016)WRITE(NOUT,120)ADLITL(I)
    DO 60 J=1,ITOT
60  IF(IDDK(J).EQ.80160)WRITE(NOUT,130)J,IDDK(J),ADDK(J)
    RETURN
120  FORMAT('ADLITL FOR 8016= ',1PE10.4)
130  FORMAT(I2,I10,' ADDK FOR 8016=',1PE10.4)
140  FORMAT('LITEL ARRAY',2X,I6,2X,1PE10.4)
150  FORMAT('DECAY ARRAY',2X,I6,2X,1PE10.4)
    END
C-----
      SUBROUTINE CLECT(IFLAG)
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACTO
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IACT,IFP,ITOT,NCYC
      COMMON /UNT NOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRIT(210),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTYP(40),ADCRIT(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)
      DIMENSION IDLFP(165)
      DATA IDLFP/ 32072,32073,32074,32076,33075,34076,34077,34078,34080,
&34082,35079,35081,36080,36082,36083,36084,36085,36086,37085,37086,
&37087,38086,38087,38088,38089,38090,39089,39090,39091,40090,40091,
&40092,40093,40094,40095,40096,41093,41094,41095,42094,42095,42096,
&42097,42098,42099,42100,43099,44099,44100,44101,44102,44104,44105,
&44106,46104,46105,46106,46107,46108,46110,47107,47109,47111,48108,
&48110,48111,48112,48113,48114,48601,48116,49113,49115,50115,50116,
&50117,50118,50119,50120,50122,50123,50124,50125,50126,51121,51123,
&51124,51125,51126,52122,52123,52124,52125,52126,52601,52128,52611,
&52130,52132,53127,53129,53130,53131,54128,54129,54130,54131,54132,
&54133,54134,54136,55133,55134,55135,55136,55137,56134,56135,56136,
&56137,56138,56140,57139,57140,58140,58141,58142,58143,58144,59141,
&59142,59143,60142,60143,60144,60145,60146,60150,61151,62147,62148,
&62150,62151,62152,62153,62154,63151,63152,63156,63157,64154,64156,
&64157,64158,64160,65159,65160,66160,66161,66162,66163,66164,67165,
&68166,68167/
      NLFP=165
C
C  EXTRACT NUCLIDES NEEDED FOR CRITICALITY CALCULATIONS FOR THIS
C  BURNUP AND COOLING TIME.  TAKE REQUESTED LIGHT ELEMENTS FROM
C  THE LIGHT ELEMENT LIBRARY (1ST ILE ENTRIES IN IDDK/ADDK),
C  ACTINIDES FROM THE ACTINIDE DATA (NEXT IACT ENTRIES IN IDDK/ADDK),
C  AND FISSION PRODUCTS FROM THE FINAL IFP ENTRIES IN IDDK/ADDK)
C
C  NLITL WILL BE AT LEAST 1, TO ACCOUNT FOR OXYGEN.  THE ONLY
C  SITUATION THAT WILL ALLOW IT TO BE LARGER THAN 1 IS IF THE
C  USER HAS CHOSEN TO INPUT A SET OF ISOTOPICS DIFFERENT FROM
C  THE BURNUP CREDIT NUCLIDES (IE., TTC-0713 OR BIERMAN'S) AND
C  HAS CHOSEN TO ENTER MORE LIGHT ELEMENTS THAN JUST OXYGEN
C
C  IF IFLAG=1 CHANGE ALL IDDK BY FACTOR OF 10 (FROM 72 NOT 71)
    IF(IFLAG.EQ.0)GO TO 20
    DO 10 I=1,ITOT
10  IDDK(I)=IDDK(I)/10
20  CONTINUE

```

```

      DO 40 I=1,NLITL
      DO 30 J=1,ILE
      IF(IDDK(J).NE.IDLITL(I)) GO TO 30
      ADLITL(I)=ADDK(J)
      GO TO 40
30    CONTINUE
      WRITE(NOUT,102)IDLITL(I),N71
102   FORMAT('0'/'****ERROR, NO MATCH FOR LIGHT ELEMENT ',I8,
&' WAS FOUND ON UNIT ',I2)
      STOP 7102
40    CONTINUE
      NLP1=ILE+1
      DO 70 I=1,NCRIT
      IF(IDCRT(I).EQ.99999)GO TO 70
      ADCRT(I)=0.0
      DO 60 J=NLP1,ITOT
      IF(IDDK(J).NE.IDCRT(I)) GO TO 60
      ADCRT(I)=ADDK(J)
      GO TO 70
60    CONTINUE
      DO 65 K=1,NLITL
      IF(IDCRT(I).EQ.IDLITL(K))GO TO 70
65    CONTINUE
      WRITE(NOUT,103)IDCRT(I),N71
103   FORMAT('0'/'****ERROR, NO MATCH FOR NUCLIDE ',I8,
&' WAS FOUND ON UNIT ',I2)
      STOP 7103
70    CONTINUE
C    ADD CONTRIBUTION FROM LIGHT ELEMENT AND ACTINIDE/FISSION PRODUCT LIBR
      DO 80 I=1,NLITL
      DO 80 J=1,NCRIT
      IF(IDCRT(J).NE.IDLITL(I))GO TO 80
      ADCRT(J)=ADCRT(J)+ADLITL(I)
80    CONTINUE
C    COMPUTE NUMBER DENSITY FOR LUMPED-FISSION PRODUCT IF REQUESTED
C    ONLY AVAILABLE FOR NFIS=-2 (FOR MIKEY'S USE ONLY)***
      ADLFP=0.0
      IFP0=ILE+IACT
C    DO WE NEED TO CALCULATE A LUMPED FISSION PRODUCT
C    CHECK TO SEE IF IDCRT=99999, IF SO CALCULATE LFP
C    ALSO (IF ICKFP=1) CHECK TO SEE IF ANY NUCLIDE IN IDCRT IS ALSO
C    IN IDLFP, IF SO SET IDLFP TO ZERO
C
C    ICKFP=0 WILL CALCULATE THE VIRGINIA POWER LUMPED FISSION PRODUCT
C    EXPLICITLY
      ICKFP=0
C
C    ICKFP=1 CALCULATES VP LFP MINUS FP IN IDCRT ARRAY ###DON'T USE NOW
C
      ICKFP=1
      K99=0
      DO 92 KL=1,NCRIT
      IF(IDCRT(KL).EQ.99999)K99=KL
      IF(ICKFP.EQ.0)GO TO 92
      DO 90 J=1,NLFP
      IF(IDLFP(J).NE.IDCRT(KL))GO TO 90
      WRITE(NOUT,110)IDLFP(J)
      IDLFP(J)=0
      GO TO 92
90    CONTINUE
92    CONTINUE
110   FORMAT(I10,' NUCLIDE WAS IN IDLFP AND IDCRT')
C    NO LFP CALCULATION IS REQUIRED IF K99=0
      IF(K99.EQ.0)RETURN
      DO 95 I=1,IFP
      J=IFP0+I
      DO 94 KJ=1,NLFP
      IF(IDDK(J).NE.IDLFP(KJ))GO TO 94
      ADLFP=ADLFP+ADDK(J)

```

```

      GO TO 95
94      CONTINUE
95      CONTINUE
      ADCRIT(K99)=ADLFP
      RETURN
      END
C
C
C
C-----
      SUBROUTINE WRTICE
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IAC,IFP,ITOT,NCYC
      COMMON /UNTNOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRIT(210),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTYP(40),ADCRIT(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)
      DIMENSION I2(200),I5(200),I11(201),IDACT(7)
      CHARACTER*4 DUM,T,ICE,END
      DATA IDACT/92234,92235,92236,92238,94239,94240,94241/
C
      T = ' T '
      ICE = '#ICE'
      END = 'END '
      MIX=1
C
      WRITE(NICE,110)ICE
      WRITE(NICE,110)ITTL
110     FORMAT(20A4)
C
      DUM = '1$$ '
      WRITE(NICE,110)DUM
      II = 0
      I4 = 10
      KOPT = 4
      WRITE(NICE,120)MIX,NCRIT,II,II,II,I4,KOPT
120     FORMAT(6I12)
      WRITE(NICE,110)T
C
      DO 10 I=1,NCRIT
10      I2(I)=1
C
      DUM = '2$$ '
      WRITE(NICE,110)DUM
      WRITE(NICE,120)(I2(I),I=1,NCRIT)
C
      IF(IDMOD.EQ.0)GO TO 35
      DO 30 J=1,7
      DO 30 I=1,NCRIT
      IF(IDCRIT(I).NE.IDACT(J))GO TO 30
      IDCRIT(I)=IDCRIT(I)+100000*IDMOD
30      CONTINUE
35      CONTINUE
C
      DUM = '3$$ '
      WRITE(NICE,110)DUM
      WRITE(NICE,120)(IDCRIT(I),I=1,NCRIT)
C
      DUM = '4** '
      WRITE(NICE,110)DUM
      WRITE(NICE,130)(ADCRIT(I),I=1,NCRIT)
130     FORMAT(1P,6E12.4)
C
      I5(1)=4
      DUM = '5$$ '
      WRITE(NICE,110)DUM
      WRITE(NICE,120)(I5(I),I=1,MIX)
      WRITE(NICE,110)T

```

```

C      DUM= '7$$ '
      WRITE(NICE,110)DUM
      WRITE(NICE,140)
      WRITE(NICE,110)T
140    FORMAT(' A8 2 E')
C
      I11(1)=1
      I11(2)=MIXF
      DUM = '11$$'
      WRITE(NICE,110)DUM
      WRITE(NICE,120)(I11(I),I=1,MIX+1)
      WRITE(NICE,110)T
      WRITE(NICE,110)END
C
      RETURN
      END
C-----
      SUBROUTINE WRTKENO
      COMMON /CONST/ BCONV,BURN,COOL,MIXF,IDMOD,SMACT0
      COMMON /INDEX/ NBURN,NCRIT,NLITL,ILE,IACT,IFP,ITOT,NCYC
      COMMON /UNTOS/ N72,NOUT,N71,NORS,NICE
      COMMON /IDENT/ IDLITL(40),IDCRIT(210),IDDK(2000)
      COMMON /ADENS/ ADLITL(40),LTYF(40),ADCRIT(200),ADDK(2000)
      COMMON /TITLE/ ITTL(20)
      CHARACTER*2 INAME(105),ICS(200)
      DIMENSION MASS(200),IDACT(7)
      DATA IDACT/92234,92235,92236,92238,94239,94240,94241/
      DATA INAME/' H','HE','LI','BE',' B',' C',' N',' O',' F','NE','NA',
& 'MG','AL','SI',' P',' S',
& 'CL','AR',' K','CA','SC','TI',' V','CR','MN','FE','CO',
& 'NI','CU','ZN','GA','GE','AS','SE','BR','KR','RB',
& 'SR',' Y','ZR','NB','MO','TC','RU','RH','PD','AG','CD',
& 'IN','SN','SB','TE',' I','XE','CS','BA','LA','CE',
& 'PR','ND','PM','SM','EU','GD','TB','DY','HO','ER',
& 'TM','YB','LU','HF','TA',' W','RE','OS','IR','PT',
& 'AU','HG','TL','PB','BI','PO','AT','RN','FR','RA',
& 'AC','TH','PA',' U','NP','PU','AM','CM','BK','CF',
& 'ES','FM','MD','NO','LR','RF','HA'/
      DO 15 K=1,NCRIT
      IF(IDCRIT(K).EQ.99999)GO TO 15
      IZ=IDCRIT(K)/1000
      MASS(K)=IDCRIT(K)-IZ*1000
      IDFF=IZ/100
      IF(IDFF.GT.0)IZ=IZ-IDFF*100
      ICS(K)=INAME(IZ)
15    CONTINUE
      DO 20 I=1,4
20    WRITE(NOUT,101)
      WRITE(NOUT,202)
      WRITE(NOUT,101)
      DO 30 J=1,NCRIT
      IF(IDCRIT(J).EQ.99999)GO TO 30
      IF(ICS(J).EQ.' O')THEN
      WRITE(NOUT,206)ICS(J),MIXF,ADCRIT(J)
      GO TO 30
      END IF
      IF(MASS(J).LT.10)WRITE(NOUT,203)ICS(J),MASS(J),MIXF,ADCRIT(J)
      IF(MASS(J).GE.10.AND.MASS(J).LT.100)WRITE(NOUT,204)ICS(J),
&MASS(J),MIXF,ADCRIT(J)
      IF(MASS(J).GE.100)WRITE(NOUT,205)ICS(J),MASS(J),MIXF,ADCRIT(J)
30    CONTINUE
C
      IF(IDMOD.EQ.0)GO TO 5
      DO 3 J=1,7
      DO 3 I=1,NCRIT
      IF(IDCRIT(I).NE.IDACT(J))GO TO 3
      IDCRIT(I)=IDCRIT(I)+100000*IDMOD

```

```

      3  CONTINUE
      5  CONTINUE
C
      DO 10 I=1,4
100    WRITE(NOUT,101)
      WRITE(NOUT,102)
      WRITE(NOUT,101)
      WRITE(NOUT,104)MIXF
      WRITE(NOUT,103)(IDCRIT(J),ADCRIT(J),J=1,NCRIT)
      RETURN
101    FORMAT(A4)
102    FORMAT(' FOR USE WHEN MIXING IN KENO')
103    FORMAT(I9,2X,1P,E10.4)
104    FORMAT(' MIX=',I4)
202    FORMAT(' FOR USE IN CSAS')
203    FORMAT(2X,A2,'-',I1,4X,I3,2X,'0',2X,1P,E10.4,' END')
204    FORMAT(2X,A2,'-',I2,3X,I3,2X,'0',2X,1P,E10.4,' END')
205    FORMAT(2X,A2,'-',I3,2X,I3,2X,'0',2X,1P,E10.4,' END')
206    FORMAT(2X,A2,6X,I3,2X,'0',2X,1P,E10.4,' END')
      END

```



## Sample SNIKR Output

SQ2C3 QC LOC #12 REGION4 (BATCH3) 11846 MWD/MTU

71  
75  
73  
3  
-2  
1  
6

92234 92235 92236 92238 93237 94238 94239 94240 94241 94242  
95241 95243 96244 8016 36083 40093 42095 43099 44101 44103  
45103 45105 46105 46108 47109 53135 54131 54135 55133 55134  
55135 59141 60143 60145 60147 60148 61147 61148 61149 62147  
62149 62150 62151 62152 63153 63154 63155 64155 99999

1609 687 101 821 1 0.00  
1609 687 101 821 2 0.08  
1609 687 101 821 3 0.25  
1609 687 101 821 4 0.42

2004	1.7546E-08	81207	2.2649E-23	81208	6.0945E-21	81209	2.7145E-27
82206	1.6190E-22	82207	7.2645E-19	82208	1.0385E-15	82209	1.1150E-23
82210	3.5479E-20	82211	1.7190E-22	82212	3.5272E-18	82214	5.1503E-24
83209	4.1341E-20	83210	2.1845E-23	83211	1.0142E-23	83212	3.3455E-19
83213	2.6077E-24	83214	3.8243E-24	84210	2.5939E-22	84211	1.1466E-28
84212	1.7582E-29	84213	3.9123E-33	84214	5.2613E-31	84215	1.4126E-28
84216	1.3813E-23	84218	5.8626E-25	85217	3.0752E-29	86219	3.1427E-25
86220	5.1199E-21	86222	1.0583E-21	87221	2.7419E-25	87223	1.6849E-24
88223	7.8401E-20	88224	2.9119E-17	88225	1.2463E-21	88226	1.6175E-16
88228	4.5320E-23	89225	8.2258E-22	89227	6.4138E-17	89228	5.5122E-27
90227	1.3488E-19	90228	5.5369E-15	90229	2.3507E-16	90230	2.3315E-11
90231	2.2535E-15	90232	1.6510E-12	90233	0.0000E+00	90234	3.2742E-13
91231	3.9834E-12	91232	3.8656E-50	91233	1.0234E-13	91234	1.1039E-17
91234	6.0684E-18	92232	7.9907E-13	92233	3.9544E-11	92234	6.0022E-06
92235	5.4479E-04	92236	5.4020E-05	92237	2.5875E-13	92238	2.2171E-02
92239	0.0000E+00	92240	0.0000E+00	93236	1.5376E-11	93237	2.9762E-06
93238	3.8429E-16	93239	3.6947E-14	93240	0.0000E+00	93240	0.0000E+00
94236	1.7284E-15	94238	3.0350E-07	94239	9.7107E-05	94240	1.5501E-05
94241	7.4661E-06	94242	6.3159E-07	94243	0.0000E+00	94244	0.0000E+00
94245	0.0000E+00	95241	2.4382E-07	95242	2.0995E-09	95242	2.5121E-14
95243	4.2291E-08	95244	0.0000E+00	95245	0.0000E+00	96242	7.5179E-09
96243	1.5893E-10	96244	2.9530E-09	96245	4.9999E-11	96246	1.2941E-12
96247	0.0000E+00	96248	0.0000E+00	96249	0.0000E+00	96250	0.0000E+00
97249	0.0000E+00	97250	0.0000E+00	98249	0.0000E+00	98250	0.0000E+00
98251	0.0000E+00	98252	0.0000E+00	98253	0.0000E+00	98254	0.0000E+00
99253	0.0000E+00						

ADLITL FOR 8016= 0.0000E+00

ISOTOPIC RESULTS FOR COOL STEP 4

ORIGENS COOLING TIME (YR) = 0.42

FOR USE IN CSAS

U-234	1	0	6.0022E-06	END
U-235	1	0	5.4479E-04	END
U-236	1	0	5.4020E-05	END
U-238	1	0	2.2171E-02	END
NP-237	1	0	2.9762E-06	END
PU-238	1	0	3.0350E-07	END
PU-239	1	0	9.7107E-05	END
PU-240	1	0	1.5501E-05	END
PU-241	1	0	7.4661E-06	END
PU-242	1	0	6.3159E-07	END

AM-241	1	0	2.4382E-07	END
AM-243	1	0	4.2291E-08	END
CM-244	1	0	2.9530E-09	END
O	1	0	4.6385E-02	END
KR-83	1	0	1.3232E-06	END
ZR-93	1	0	1.7074E-05	END
MO-95	1	0	1.5972E-05	END
TC-99	1	0	1.7261E-05	END
RU-101	1	0	1.5200E-05	END
RU-103	1	0	1.4686E-07	END
RH-103	1	0	9.9860E-06	END
RH-105	1	0	2.6076E-39	END
PD-105	1	0	5.1564E-06	END
PD-108	1	0	1.3155E-06	END
AG-109	1	0	9.3884E-07	END
I-135	1	0	0.0000E+00	END
XE-131	1	0	8.0469E-06	END
XE-135	1	0	0.0000E+00	END
CS-133	1	0	1.8970E-05	END
CS-134	1	0	6.2227E-07	END
CS-135	1	0	5.4754E-06	END
PR-141	1	0	1.6396E-05	END
ND-143	1	0	1.5116E-05	END
ND-145	1	0	1.0599E-05	END
ND-147	1	0	2.4061E-11	END
ND-148	1	0	4.9465E-06	END
PM-147	1	0	4.1512E-06	END
PM-148	1	0	1.8042E-11	END
PM-149	1	0	6.8058E-29	END
SM-147	1	0	1.1179E-06	END
SM-149	1	0	1.4939E-07	END
SM-150	1	0	3.8662E-06	END
SM-151	1	0	4.1625E-07	END
SM-152	1	0	1.7197E-06	END
EU-153	1	0	9.3994E-07	END
EU-154	1	0	1.5726E-07	END
EU-155	1	0	9.7692E-08	END
GD-155	1	0	6.6207E-09	END

FOR USE WHEN MIXING IN KENO

MIX=	1
692234	6.0022E-06
692235	5.4479E-04
692236	5.4020E-05
692238	2.2171E-02
93237	2.9762E-06
94238	3.0350E-07
694239	9.7107E-05
694240	1.5501E-05
694241	7.4661E-06
94242	6.3159E-07
95241	2.4382E-07
95243	4.2291E-08
96244	2.9530E-09
8016	4.6385E-02
36083	1.3232E-06
40093	1.7074E-05
42095	1.5972E-05
43099	1.7261E-05
44101	1.5200E-05

44103	1.4686E-07
45103	9.9860E-06
45105	2.6076E-39
46105	5.1564E-06
46108	1.3155E-06
47109	9.3884E-07
53135	0.0000E+00
54131	8.0469E-06
54135	0.0000E+00
55133	1.8970E-05
55134	6.2227E-07
55135	5.4754E-06
59141	1.6396E-05
60143	1.5116E-05
60145	1.0599E-05
60147	2.4061E-11
60148	4.9465E-06
61147	4.1512E-06
61148	1.8042E-11
61149	6.8058E-29
62147	1.1179E-06
62149	1.4939E-07
62150	3.8662E-06
62151	4.1625E-07
62152	1.7197E-06
63153	9.3994E-07
63154	1.5726E-07
63155	9.7692E-08
64155	6.6207E-09
99999	5.6395E-04



## **APPENDIX D**

### **KENO-V.a BOC MODEL SETUP INPUT EXAMPLES**

This appendix gives examples of the input for the different calculational steps for setting up the Sequoyah Unit 2 Cycle 3 KENO-V.a models for BOC (HZIP and HFP).

Table D.1. SNIKR/ORIGEN-S input for fresh  
fuel batch/assembly isotopics

---

```
//ST5R5AX9 JOB (35899),'S M BOWMAN 6011',TIME=1,
// NOTIFY=ST5,MSGCLASS=T
// *MAIN CLASS=SHORT
//PROCLIB DD DISP=SHR,DSN=TZA.PROCLIB.CNTL
//A EXEC FORTVCLG,REGION=2048K
//FORT.SYSPRINT DD SYSOUT=*
//FORT.SYSIN DD DSN=ST5.SNIKR1A.FORT,DISP=SHR
// *
// *#####
// * #####NEED JCL FOR UNITS N72,NOUT,NORS,NOUT3,NICE
// *#####
//GO.FT05F001 DD *
SNIKR1
SQ2 REGION5A 3.8 WT% 0 MWD/MTU      W/ BP  XSEC SET 9
READ BURNUP
N72=72
NOUT=70
BURN=0.0
NCYC= 4
END BURNUP
READ DECAY
NORS=74
N71=71
COOLTIME=0.0
LIGHTEL=0
END DECAY
//GO.FT70F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
//      DSN=X.ST535899.S2BR5AX9.NOUT1,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,CATLG)
//GO.FT72F001 DD UNIT=,SPACE=,LABEL=(,,IN),
//      DISP=SHR,DSN=OWH.BATCH5.PWR17F72,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=6400)
//GO.FT73F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
//      DSN=X.ST535899.S2BR5AX9.NOUT3,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,CATLG)
//GO.FT74F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
//      DSN=X.ST535899.S2BR5AX9.NORS,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,CATLG)
//GO.FT75F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
//      DSN=X.ST535899.S2BR5AX9.NICE,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,CATLG)
// *
// *C#####
// *C###EXECUTE ORS AT THIS POINT
// *C#####
//B EXEC SCALE41,REGION=1640K
//GO.FT05F001 DD SPACE=(480,(500,20))
//GO.FT13F001 DD SYSOUT=*,DCB=(RECFM=FA,BLKSIZE=133,BUFL=150)
//GO.FT40F001 DD DUMMY
//GO.FT71F001 DD UNIT=DISK,SPACE=(TRK,(5,10)),DISP=(NEW,CATLG),
//      DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136),
//      DSN=X.ST535899.S2BR5AX9.FT71
//GO.SYSIN DD DISP=(SHR),DSN=X.ST535899.S2BR5AX9.NORS
// *
// *C#####
// *C###EXECUTE ORS AT THIS POINT
// *C#####
// EXEC SCALE41
//GO.FT13F001 DD SYSOUT=*
//GO.FT31F001 DD DSN=OWH.BATCH5.PWR17F33,DISP=SHR,
//      LABEL=(,,IN)
//GO.FT71F001 DD DSN=X.ST535899.S2BR5AX9.FT71,DISP=SHR
//GO.SYSIN DD *
```

Table D.1. (continued)

---

```

#ORIGENS
0$$ A11 71 E T
OWH LIBRARY FOR SQ2 CYCLE 3 FUEL
3$$ 31 1 1 0 A16 0 A33 0 E T
35$$ 0 T
56$$ 6 6 A6 1 A10 0 A13 -1 A14 3 A15 3 A18 1 E T
SEQUOYAH 2 CYCLE 3 BOC STARTUP TO EQ XE
ATOMS / BN-CM
58** 2.092E-4 2.092E-4 2.092E-4 2.092E-4 2.092E-4 2.092E-4
60** 1 5 25 50 75 100
66$$ A1 1 A5 1 A9 1 E T
56$$ 0 0 A10 6 E T
56$$ F0 T
END
/*
//C EXEC FORTVCLG,REGION=2048K
//FORT.SYSPRINT DD DUMMY
//FORT.SYSIN DD DSN=ST5.SNIKR3.FORT,DISP=SHR
/*
/*#####
/* *####NEED JCL FOR UNITS N71,NOUT,NICE
/*#####
//GO.FT05F001 DD *
SNIKR1
SQ2 REGION5A 3.8 WT% 0 MWD/MTU W/ BP XSEC SET 9
READ BURNUP
N72=72
NOUT=70
BURN=0.0
NCYC= 4
END BURNUP
READ DECAY
NORS=74
N71=71
COOLTME=20.0
LIGHTEL=0
END DECAY
SNIKR3
SQ2 REGION5A 3.8 WT% 150 MWD/MTU EQXE W/ BP XSEC SET 9
READ MXFUEL
N71=71
NICE=75
NOUT=73
NCOOL= 1
FISPROD= -2
MIXF= 1
IDMOD= 9
END MXFUEL
//GO.FT71F001 DD UNIT=,SPACE=,LABEL=(,,IN),
// DISP=SHR,DSN=X.ST535899.S2BR5AX9.FT71,
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136)
//GO.FT73F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
// DSN=X.ST535899.S2BR5AX9.NOUT3,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=SHR
//GO.FT75F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
// DSN=X.ST535899.S2BR5AX9.NICE,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(SHR)

```

---

Table D.2. SNIKR/ORIGEN-S input for BP isotopics

---

```

//ST5RBP5B JOB (35899),'S M BOWMAN 6011',TIME=1,
// NOTIFY=ST5,MSGCLASS=T
//*MAIN CLASS=SHORT
//PROCLIB DD DISP=SHR,DSN=TZA.PROCLIB.CNTL
//C EXEC FORTVCLG,REGION=2048K
//FORT.SYSPRINT DD DUMMY
//FORT.SYSIN DD DSN=ST5.SNIKR3.FORT,DISP=SHR
//*
//*#####
//* #####NEED JCL FOR UNITS N71,NOUT,NICE
//*#####
//GO.FT05F001 DD *
SNIKR1
SQ2 REGION5A 3.8 WT% 0 MWD/MTU      W/ BP  XSEC SET 11
READ BURNUP
N72=72
NOUT=70
BURN=0.0
NCYC= 4
END BURNUP
READ DECAY
NORS=74
N71=71
COOLTIME=20.0
LIGHTEL= 5
END DECAY
      8016  0.04497  1
      11023  0.0  3
      13027  0.0  3
      5010  0.0  3
      5011  0.0  3
SNIKR3
SQ2 REGION5A 3.8 WT% 150 MWD/MTU EQXE W/ BP  XSEC SET 11
READ MXFUEL
N71=71
NICE=75
NOUT=73
NCOOL= 1
FISPROD= 5
MIXF= 1
IDMOD=11
END MXFUEL
      8016 11023 13027 5010 5011
//GO.FT71F001 DD UNIT=,SPACE=,LABEL=(,,IN),
//      DISP=SHR,DSN=X.ST535899.S2B5BX11.FT71,
//      DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136)
//GO.FT73F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
//      DSN=X.ST535899.S2BR5BBP.NOUT3,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,CATLG)
//GO.FT75F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
//      DSN=X.ST535899.S2B5BX11.NICE,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(SHR)

```

---



Table D.3. SNIKR/ORIGEN-S input for cross-section  
set 4 average isotopics

---

```

//ST5R3X4 JOB (35899),'S M BOWMAN 6011',TIME=1,
// NOTIFY=ST5,MSGCLASS=T
//*MAIN CLASS=SHORT
//PROCLIB DD DISP=SHR,DSN=TZA.PROCLIB.CNTL
//A EXEC FORTVCLG,REGION=2048K
//FORT.SYSPRINT DD DUMMY
//FORT.SYSIN DD DSN=ST5.SNIKR1.FORT,DISP=SHR
//*
//*#####
//* #####NEED JCL FOR UNITS N72,NOUT,NORS,NOUT3,NICE
//*#####
//GO.FT05F001 DD *
SNIKR1
SQ2 REGION3 3.1 WT% 26859 MWD/MTU XSEC SET 4
READ BURNUP
N72=72
NOUT=70
BURN=26859.0
NCYC= 9
END BURNUP
READ DECAY
NORS=74
N71=71
COOLTIME=0.422
LIGHTEL=0
END DECAY
//GO.FT70F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
// DSN=&&NOUT1,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,PASS)
//GO.FT72F001 DD UNIT=,SPACE=,LABEL=(,,IN),
// DISP=SHR,DSN=OWH.BATCH2.PWR17F72,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=6400)
//GO.FT73F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
// DSN=X.ST535899.S2BR3X4.NOUT3,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,CATLG)
//GO.FT74F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
// DSN=&&NORS,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,PASS)
//GO.FT75F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
// DSN=&&NICE,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,PASS)
//*
//*C#####
//*C###EXECUTE ORS AT THIS POINT
//*C#####
//B EXEC SCALE41,REGION=1640K
//GO.FT05F001 DD SPACE=(480,(500,20))
//GO.FT13F001 DD SYSOUT=*,DCB=(RECFM=FA,BLKSIZE=133,BUFL=150)
//GO.FT40F001 DD DUMMY
//GO.FT71F001 DD UNIT=DISK,SPACE=(TRK,(5,10)),DISP=(NEW,CATLG),
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136),
// DSN=X.ST535899.S2BR3X4.FT71
//GO.SYSIN DD DISP=(OLD,PASS),DSN=&&NORS
//*
//B2 EXEC SCALE41
//GO.FT13F001 DD SYSOUT=*
//GO.FT31F001 DD DSN=OWH.BATCH2.PWR17F39,DISP=SHR,
// LABEL=(,,IN)
//GO.FT71F001 DD DSN=X.ST535899.S2BR3X4.FT71,
// DISP=SHR
//GO.SYSIN DD *
#ORIGENS
0$$ A11 71 E T
OWH LIBRARY FOR SQ2 REGION 3 FUEL

```

---

Table D.3. (continued)

---

```

3$$$ 31 1 1 0 A33 0 E T
35$$$ 0 T
56$$$ 6 6 A6 1 A10 0 A13 -4 A14 3 A15 3 A18 1 E
57** 0 A3 1.E-5 1 E T
SEQUOYAH 2 CYCLE 3* STARTUP TO EQ XE
ATOMS / BN-CM
58** 2.0916E-4 2.0916E-4 2.0916E-4 2.0916E-4 2.0916E-4 2.0916E-4
60** 1 5 25 50 75 100
66$$$ A1 1 A5 1 A9 1 E T
56$$$ 0 0 A10 6 E T
56$$$ F0 T
END
/*
//C EXEC FORTVCLG,REGION=2048K
//FORT.SYSPRINT DD DUMMY
//FORT.SYSIN DD DSN=ST5.SNIKR3.FORT,DISP=SHR
/*
/*#####
/* #####NEED JCL FOR UNITS N71,NOUT,NICE
/*#####
//GO.FT05F001 DD *
SNIKR1
SQ2 REGION3 3.1 WT% 26859 MWD/MTU XSEC SET 4
READ BURNUP
N72=72
NOUT=70
BURN=26859.0
NCYC= 9
END BURNUP
READ DECAY
NORS=74
N71=71
COOLTME=20
LIGHTEL=0
END DECAY
SNIKR3
SQ2 REGION3 3.1 WT% 26859 MWD/MTU XSEC SET 4
READ MXFUEL
N71=71
NICE=75
NOUT=73
NCOOL= 4
FISPROD= -2
MIXF= 1
IDMOD= 0
END MXFUEL
//GO.FT71F001 DD UNIT=,SPACE=,LABEL=(,,IN),
// DISP=SHR,DSN=X.ST535899.S2BR3X4.FT71,
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136)
//GO.FT73F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
// DSN=X.ST535899.S2BR3X4.NOUT3,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=SHR
//GO.FT75F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
// DSN=&&NICE,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(OLD,DELETE)

```

---

Table D.4. CSASN input for cross-section sets  
with important actinides only

---

```
//ST5XS3 JOB (35899),'S BOWMAN 6011',MSGCLASS=T,TIME=10,
//  NOTIFY=ST5
// *MAIN CLASS=WHENEVER
//PROCLIB DD DSN=TZA.PROCLIB.CNTL,DISP=SHR
//  EXEC SCALE41,GOSIZE=2048K
//GO.FT04F001 DD DSN=X.ST535899.S2ZR3X3.XSEC,UNIT=DISK,DISP=(,CATLG)
//GO.SYSIN DD *
=CSASN
SEQUOYAH 2 REGION 3 XSEC SET 3 AT BOC, HZP
27BURNUP LATTICECELL
  U-234    1  0  4.2313E-06  559  END
  U-235    1  0  2.8132E-04  559  END
  U-236    1  0  8.0128E-05  559  END
  U-238    1  0  2.2031E-02  559  END
  PU-239    1  0  1.3118E-04  559  END
  PU-240    1  0  3.8578E-05  559  END
  PU-241    1  0  2.3754E-05  559  END
  O         1  0  4.6382E-02  559  END
  ZIRCALLOY 2  1          559  END
  H2O       3  DEN=.7540  1  559  END
  BORON     3  DEN=.7540 1685.E-6 559  END
END COMP
SQUAREPITCH 1.25984 .81915 1 3 .94966 2 .83566 0  END
END
```

---

Table D.5. CSASN input for cross-section set 4

```

//ST5XS4 JOB (35899), 'S BOWMAN 6011',MSGCLASS=T,TIME=10,
//  NOTIFY=ST5
// *MAIN CLASS=STANDBY
//PROCLIB DD DSN=TZA.PROCLIB.CNTL,DISP=SHR
// EXEC SCALE41,GOSIZE=2048K
//GO.FT04F001 DD DSN=X.ST535899.S2BR3X4.XSEC,UNIT=DISK,DISP=(,CATLG)
//GO.SYSIN DD *
=CSASN
SEQUOYAH 2 REGION 3 XSEC SET 4 (+ BP XSECS + STRUCTURAL MATERIAL XSECS)
27BURNUP LATTICECELL
  U-234 10 0 4.0182E-06 901 END
  U-235 10 0 2.4666E-04 901 END
  U-236 10 0 8.5145E-05 901 END
  U-238 10 0 2.1971E-02 901 END
  NP-237 10 0 8.9764E-06 901 END
  PU-238 10 0 2.4750E-06 901 END
  PU-239 10 0 1.3377E-04 901 END
  PU-240 10 0 4.3467E-05 901 END
  PU-241 10 0 2.7171E-05 901 END
  PU-242 10 0 6.9419E-06 901 END
  AM-241 10 0 1.3831E-06 901 END
  AM-243 10 0 1.2409E-06 901 END
  CM-244 10 0 2.4623E-07 901 END
  O 10 0 4.6382E-02 901 END
  KR-83 10 0 2.3990E-06 901 END
  ZR-93 10 0 3.5089E-05 901 END
  MO-95 10 0 3.5394E-05 901 END
  TC-99 10 0 3.6495E-05 901 END
  RU-101 10 0 3.4562E-05 901 END
  RU-103 10 0 3.4102E-07 901 END
  RH-103 10 0 2.1517E-05 901 END
  RH-105 10 0 5.7290E-08 901 END
  PD-105 10 0 1.6153E-05 901 END
  PD-108 10 0 5.5314E-06 901 END
  AG-109 10 0 3.5101E-06 901 END
  I-135 10 0 2.3182E-08 901 END
  XE-131 10 0 1.5918E-05 901 END
  XE-135 10 0 8.8543E-09 901 END
  CS-133 10 0 3.9726E-05 901 END
  CS-134 10 0 2.8519E-06 901 END
  CS-135 10 0 1.2962E-05 901 END
  PR-141 10 0 3.5854E-05 901 END
  ND-143 10 0 2.7666E-05 901 END
  ND-145 10 0 2.1806E-05 901 END
  ND-147 10 0 7.6173E-08 901 END
  ND-148 10 0 1.1105E-05 901 END
  PM-147 10 0 5.5714E-06 901 END
  PM-148 10 0 1.7779E-08 901 END
  PM-149 10 0 3.0426E-08 901 END
  SM-147 10 0 3.2564E-06 901 END
  SM-149 10 0 9.3322E-08 901 END
  SM-150 10 0 9.6438E-06 901 END
  SM-151 10 0 5.4368E-07 901 END
  SM-152 10 0 3.9323E-06 901 END
  EU-153 10 0 3.0888E-06 901 END
  EU-154 10 0 9.6313E-07 901 END
  EU-155 10 0 3.7167E-07 901 END
  GD-155 10 0 2.0264E-08 901 END
  ZIRCALLOY 1 1. 628.0 END
  SS304 2 1. 578.6 END
  H2O 3 DEN=.7149 1 578.6 END
  BORON 3 DEN=.7149 1150.E-6 578.6 END
  SS304 4 0.5 578.6 END
  H2O 4 DEN=.7149 0.5 578.6 END
  BORON 4 DEN=.7149 575.E-6 578.6 END

```

Table D.5. (continued)

---

```

SS304      5 1.      573.7 END  H2O      6  DEN=.7353 1.0      568.9 END
BORON      6  DEN=.7353 1150.E-6 568.9 END
SS304      7 1.      564.0 END

H2O        8  DEN=.7540 1.0      559.1 END
BORON      8  DEN=.7540 1150.E-6 559.1 END
SS304      9 1.      559.1 END
END COMP
SQUAREPITCH 1.25984 .81915 10 3 .94966 1 .83566 0  END
END

```

---

Table D.6. WAX input for cross-section library generation

---

```

//ST5WAXZ JOB (35899),'S.M.BOWMAN 6011',MSGCLASS=T,
// NOTIFY=ST5,TIME=5
//*MAIN CLASS=SHORT
//PROCLIB DD DSN=TZA.PROCLIB.CNTL,DISP=SHR
// EXEC SCALE41,GOSIZE=2048K
//GO.FT04F001 DD DSN=X.ST535899.S2C3HZP.XSECLIB,UNIT=DISK,DISP=(,CATLG)
//GO.FT33F001 DD DSN=X.ST535899.S2ZR2X1.XSEC,DISP=SHR
//GO.FT34F001 DD DSN=X.ST535899.S2ZR3X2.XSEC,DISP=SHR
//GO.FT35F001 DD DSN=X.ST535899.S2ZR3X3.XSEC,DISP=SHR
//GO.FT36F001 DD DSN=X.ST535899.S2ZR3X4.XSEC,DISP=SHR
//GO.FT37F001 DD DSN=X.ST535899.S2ZR4X5.XSEC,DISP=SHR
//GO.FT38F001 DD DSN=X.ST535899.S2ZR4X6.XSEC,DISP=SHR
//GO.FT39F001 DD DSN=X.ST535899.S2ZR4X7.XSEC,DISP=SHR
//GO.FT40F001 DD DSN=X.ST535899.S2ZR5AX8.XSEC,DISP=SHR
//GO.FT41F001 DD DSN=X.ST535899.S2ZR5AX9.XSEC,DISP=SHR
//GO.FT42F001 DD DSN=X.ST535899.S2Z5BX10.XSEC,DISP=SHR
//GO.FT43F001 DD DSN=X.ST535899.S2Z5BX11.XSEC,DISP=SHR
//GO.SYSIN DD *
=WAX
'WRITE FINAL LIBRARY TO UNIT 4 / BIGGEST INPUT LIB IS ON UNIT 36
0$$ 4 36
'INPUT XSEC'S FROM 11 LIBS
1$$ 11 T
'INPUT XSEC'S FOR FUEL XSEC SET 1
2$$ 33 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 192234 192235 192236 192238 194239 194240 194241 T
'INPUT XSEC'S FOR FUEL XSEC SET 2
2$$ 34 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 292234 292235 292236 292238 294239 294240 294241 T
'INPUT XSEC'S FOR FUEL XSEC SET 3
2$$ 35 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 392234 392235 392236 392238 394239 394240 394241 T
'INPUT XSEC'S FOR FUEL XSEC SET 4 + STRUCT. MAT'LS
2$$ 36 0 T
'INPUT XSEC'S FOR FUEL XSEC SET 5
2$$ 37 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 592234 592235 592236 592238 594239 594240 594241 T
'INPUT XSEC'S FOR FUEL XSEC SET 6
2$$ 38 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 692234 692235 692236 692238 694239 694240 694241 T
'INPUT XSEC'S FOR FUEL XSEC SET 7
2$$ 39 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 792234 792235 792236 792238 794239 794240 794241 T
'INPUT XSEC'S FOR FUEL XSEC SET 8
2$$ 40 4 T
3$$ 92234 92235 92236 92238
4$$ 892234 892235 892236 892238 T
'INPUT XSEC'S FOR FUEL XSEC SET 9
2$$ 41 4 T
3$$ 92234 92235 92236 92238
4$$ 992234 992235 992236 992238 T
'INPUT XSEC'S FOR FUEL XSEC SET 10
2$$ 42 4 T
3$$ 92234 92235 92236 92238
4$$ 1092234 1092235 1092236 1092238 T
'INPUT XSEC'S FOR FUEL XSEC SET 11 + BP
2$$ 43 9 T
3$$ 92234 92235 92236 92238
408016 11023 13027 405010 405011
4$$ 1192234 1192235 1192236 1192238
1108016 11023 13027 1105010 1105011 T
END

```

---

Table D.7. XSDRNPM input for assembly P17

---

```

//ST5XSP17 JOB (35899),'SM BOWMAN 6011',TIME=1,MSGCLASS=T,
//  NOTIFY=ST5
//*MAIN CLASS=SHORT
//PROCLIB DD DSN=TZA.PROCLIB.CNTL,DISP=SHR
//  EXEC SCALE41
//GO.FT04F001 DD DSN=X.ST535899.S2C3HZIP.XSECLIB,DISP=SHR,UNIT=
//GO.SYSIN DD *
=XSDRN
SQ2C3 ASSY P17 K-INF CALC FOR COMPARISON TO CSAS1X (HZIP)
1$$ 2 4 22 1 3 3 51 8 3 1 20 25 E
2$$ -2 -1 0 A7 -1 E 5** A4 0. 0. E T
13$$ 46R1 2 4R3
14$$
692234 692235 692236 692238 93237 94238
694239 694240 694241 94242 95241 95243
 96244 8016 36083 40093 42095 43099
 44101 44103 45103 45105 46105 46108
 47109      54131      55133 55134
 55135 59141 60143 60145 60147 60148
 61147 61148 61149 62147 62149 62150
 62151 62152 63153 63154 63155 64155
40302 1001 308016 5010 5011
15**
5.9701E-06 5.3771E-04 5.5260E-05 2.2165E-02 3.1074E-06 3.2748E-07
9.8844E-05 1.6146E-05 7.9052E-06 6.9291E-07 2.6182E-07 4.8102E-08
3.4758E-09 4.6385E-02 1.3581E-06 1.7568E-05 1.6497E-05 1.7772E-05
1.5674E-05 1.4761E-07 1.0294E-05 2.6383E-39 5.3647E-06 1.3828E-06
9.8527E-07 8.2755E-06 1.9529E-05 6.5999E-07 5.6470E-06 1.6896E-05
1.5521E-05 1.0906E-05 2.4055E-11 5.0992E-06 4.2283E-06 1.8432E-11
6.8547E-29 1.1661E-06 1.5041E-07 4.0050E-06 4.2147E-07 1.7774E-06
9.8229E-07 1.6818E-07 1.0161E-07 6.8895E-09
4.25156E-02 5.04213E-02 2.52107E-02 1.39851E-05 5.67754E-05 T
33## F1 T
35** 0 3.1722E-2 8.14931E-2 2.04787E-1
.328082 .377853
.409575 .410647 .413702 .416758 .417830 .425230 .44633 .46743
.47483 .487890 .505462 .532417 .592809 .6532 .680156 .697728 .710788
36$$ 6R1 4R2 4R3 8R4
39$$ 1 0 2 3 40$$ F3 T
END

```

---

Table D.8. CSAS1X input for assembly P17

---

```

//ST5CXP17 JOB (35899),'S BOWMAN 6011',MSGCLASS=T,TIME=10,
//  NOTIFY=ST5
//*MAIN CLASS=STANDBY
//PROCLIB DD DSN=TZA.PROCLIB.CNTL,DISP=SHR
//  EXEC SCALE41,GOSIZE=2048K
//GO.SYSIN DD *
=CSAS1X
SQ2C3 QC LOC #12 REGION4 (BATCH3) ASSY P17 12216 MWD/MTU (HZP)
27BURNUP LATTICECELL
  U-234      1 0 5.9701E-06 559 END
  U-235      1 0 5.3771E-04 559 END
  U-236      1 0 5.5260E-05 559 END
  U-238      1 0 2.2165E-02 559 END
  NP-237     1 0 3.1074E-06 559 END
  PU-238     1 0 3.2748E-07 559 END
  PU-239     1 0 9.8844E-05 559 END
  PU-240     1 0 1.6146E-05 559 END
  PU-241     1 0 7.9052E-06 559 END
  PU-242     1 0 6.9291E-07 559 END
  AM-241     1 0 2.6182E-07 559 END
  AM-243     1 0 4.8102E-08 559 END
  CM-244     1 0 3.4758E-09 559 END
  O          1 0 4.6385E-02 559 END
  KR-83      1 0 1.3581E-06 559 END
  ZR-93      1 0 1.7568E-05 559 END
  MO-95      1 0 1.6497E-05 559 END
  TC-99      1 0 1.7772E-05 559 END
  RU-101     1 0 1.5674E-05 559 END
  RU-103     1 0 1.4761E-07 559 END
  RH-103     1 0 1.0294E-05 559 END
  RH-105     1 0 2.6383E-39 559 END
  PD-105     1 0 5.3647E-06 559 END
  PD-108     1 0 1.3828E-06 559 END
  AG-109     1 0 9.8527E-07 559 END
  XE-131     1 0 8.2755E-06 559 END
  CS-133     1 0 1.9529E-05 559 END
  CS-134     1 0 6.5999E-07 559 END
  CS-135     1 0 5.6470E-06 559 END
  PR-141     1 0 1.6896E-05 559 END
  ND-143     1 0 1.5521E-05 559 END
  ND-145     1 0 1.0906E-05 559 END
  ND-147     1 0 2.4055E-11 559 END
  ND-148     1 0 5.0992E-06 559 END
  PM-147     1 0 4.2283E-06 559 END
  PM-148     1 0 1.8432E-11 559 END
  PM-149     1 0 6.8547E-29 559 END
  SM-147     1 0 1.1661E-06 559 END
  SM-149     1 0 1.5041E-07 559 END
  SM-150     1 0 4.0050E-06 559 END
  SM-151     1 0 4.2147E-07 559 END
  SM-152     1 0 1.7774E-06 559 END
  EU-153     1 0 9.8229E-07 559 END
  EU-154     1 0 1.6818E-07 559 END
  EU-155     1 0 1.0161E-07 559 END
  GD-155     1 0 6.8895E-09 559 END
ZIRCALLOY 2 1 559 END
H2O        3 DEN=.7540 1 559 END
BORON      3 DEN=.7540 1685.E-6 559 END
END COMP
SQUAREPITCH 1.25984 .81915 1 3 .94966 2 .83566 0 END
END

```

---



Table D.9. KENO V.a input file for BOC, HZP

```

//ST5S2BC3 JOB (35899),'S.M.BOWMAN 6011',MSGCLASS=T,
// NOTIFY=ST5,TIME=65
//*MAIN CLASS=WHENEVER
//PROCLIB DD DSN=TZA.PROCLIB.CNTL,DISP=SHR
//KENO EXEC SCALE41,REGION.GO=3500K
//GO.FT04F001 DD DISP=SHR,LABEL=(,,IN),
// DSN=X.ST535899.S2C3HZP.XSECLIB,UNIT=
//GO.FT05F001 DD VOL=SER=,UNIT=SYSDA,DISP=(NEW,PASS),
// SPACE=(4800,(0040,20)),DCB=BLKSIZE=4800
//GO.FT08F001 DD UNIT=SYSDA,SPACE=(CYL,(20,5)),
// DCB=(DSORG=DA,RECFM=F)
//GO.FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(20,5)),
// DCB=(DSORG=DA,RECFM=F)
//GO.FT34F001 DD DSN=X.ST535899.S2C3HZP.KENOVST,
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136),
// UNIT=DISK,SPACE=(TRK,(05,05)),DISP=(,CATLG)
//GO.SYSIN DD *
#KENOV
SEQUOYAH 2 CYCLE 3 BOC (1/8 CORE SYM) HZP, ARO NO XE
,
' *** *
' *** *
' *** * FULL CORE KENO5A REACTOR CONFIGURATION *
' *** * FOR SEQUOYAH UNIT-2 BOC-3 HZP, ARO NO XE *
' *** * 1 PLANE MODEL *
' *** *
' *** * BY *
' *** * STEVE BOWMAN *
' *** * OAK RIDGE NATIONAL LABORATORY *
' *** *
' *** * 1991 *
' *** *
,
READ PARM
RUN=YES PLT=YES NUB=YES FDN=YES TME=60.0 GEN=303 NPG=1000
WRS=34 RES=50
LIB=4 NB8=2400 NL8=880 END PARM

READ MIXT
MIX=101
'ASSY 1
'SQ2C3 QC LOC #1 REGION3 (BATCH2) 21182 MWD/MTU
292234 4.4307E-06
292235 3.1606E-04
292236 7.4846E-05
292238 2.2085E-02
93237 6.6045E-06
94238 1.3780E-06
294239 1.2624E-04
294240 3.3930E-05
294241 2.0381E-05
94242 3.8696E-06
95241 9.2072E-07
95243 5.3210E-07
96244 7.8203E-08
8016 4.6382E-02
36083 2.0371E-06
40093 2.8459E-05
42095 2.8396E-05
43099 2.9511E-05
44101 2.7172E-05
44103 1.4829E-07
45103 1.7573E-05
45105 2.8793E-39
46105 1.1718E-05

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Table D.9. (continued)

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46108	3.7376E-06
47109	2.4962E-06
54131	1.3265E-05
55133	3.2258E-05
55134	1.8822E-06
55135	1.0203E-05
59141	2.8616E-05
60143	2.3520E-05
60145	1.7707E-05
60147	1.9739E-11
60148	8.7464E-06
61147	5.2841E-06
61148	2.3220E-11
61149	6.4215E-29
62147	2.4620E-06
62149	1.4606E-07
62150	7.3767E-06
62151	4.9287E-07
62152	3.1496E-06
63153	2.2374E-06
63154	5.9034E-07
63155	2.4200E-07
64155	1.6722E-08

MIX=102

'ASSY 2

'SQ2C3 QC LOC #2 REGION5B (BATCH7) 0 MWD/MTU

1192234	7.30943E-06
1192235	8.45213E-04
1192236	3.97435E-06
1192238	2.23359E-02
8016	4.63849E-02

MIX=103

'ASSY 3

'SQ2C3 QC LOC #3 REGION4 (BATCH3) 13137 MWD/MTU

792234	5.8902E-06
792235	5.2041E-04
792236	5.8271E-05
792238	2.2150E-02
93237	3.4411E-06
94238	3.9179E-07
794239	1.0295E-04
794240	1.7758E-05
794241	9.0240E-06
94242	8.6043E-07
95241	3.0733E-07
95243	6.5047E-08
96244	5.0985E-09
8016	4.6385E-02
36083	1.4436E-06
40093	1.8789E-05
42095	1.7786E-05
43099	1.9040E-05
44101	1.6855E-05
44103	1.4989E-07
45103	1.1058E-05
45105	2.7127E-39
46105	5.8929E-06
46108	1.5563E-06
47109	1.1039E-06
54131	8.8381E-06
55133	2.0915E-05
55134	7.5914E-07
55135	6.0729E-06
59141	1.8139E-05

Table D.9. (continued)

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60143	1.6514E-05
60145	1.1662E-05
60147	2.4039E-11
60148	5.4788E-06
61147	4.4156E-06
61148	1.9379E-11
61149	6.9750E-29
62147	1.2822E-06
62149	1.5289E-07
62150	4.3560E-06
62151	4.3415E-07
62152	1.9200E-06
63153	1.0904E-06
63154	1.9711E-07
63155	1.1184E-07
64155	7.5917E-09

MIX=104  
'ASSY 4  
'SQ2C3 QC LOC #4 REGION5B (BATCH7) 0 MWD/MTU

1192234	7.30943E-06
1192235	8.45213E-04
1192236	3.97435E-06
1192238	2.23359E-02
8016	4.63849E-02

MIX=105  
'ASSY 5  
'SQ2C3 QC LOC #5 REGION2 (BATCH1) 23637 MWD/MTU

192234	3.4750E-06
192235	2.0727E-04
192236	7.0612E-05
192238	2.2123E-02
93237	7.4967E-06
94238	1.9426E-06
194239	1.2762E-04
194240	4.1420E-05
194241	2.4913E-05
94242	6.3540E-06
95241	1.1836E-06
95243	1.0568E-06
96244	1.9569E-07
8016	4.6379E-02
36083	2.0786E-06
40093	3.0416E-05
42095	3.0789E-05
43099	3.2275E-05
44101	3.0373E-05
44103	1.5765E-07
45103	1.9732E-05
45105	3.2209E-39
46105	1.4623E-05
46108	5.0951E-06
47109	3.2880E-06
54131	1.4333E-05
55133	3.5201E-05
55134	2.4098E-06
55135	1.0175E-05
59141	3.1426E-05
60143	2.4240E-05
60145	1.9048E-05
60147	1.9570E-11
60148	9.7186E-06
61147	5.2601E-06
61148	2.2900E-11
61149	6.7121E-29

Table D.9 (continued)

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62147	2.7039E-06
62149	1.3824E-07
62150	8.6070E-06
62151	4.8391E-07
62152	3.5814E-06
63153	2.7434E-06
63154	8.1551E-07
63155	3.1492E-07
64155	2.1500E-08
MIX=106	
'ASSY 6	
'SQ2C3 QC LOC #6 REGION5B (BATCH7) 0 MWD/MTU	
1192234	7.30943E-06
1192235	8.45213E-04
1192236	3.97435E-06
1192238	2.23359E-02
8016	4.63849E-02
MIX=107	
'ASSY 7	
'SQ2C3 QC LOC #7 REGION3 (BATCH2) 22226 MWD/MTU	
292234	4.3547E-06
292235	3.0258E-04
292236	7.6923E-05
292238	2.2065E-02
93237	7.0402E-06
94238	1.5511E-06
294239	1.2825E-04
294240	3.5708E-05
294241	2.1678E-05
94242	4.3618E-06
95241	1.0021E-06
95243	6.3270E-07
96244	9.8677E-08
8016	4.6382E-02
36083	2.1073E-06
40093	2.9681E-05
42095	2.9704E-05
43099	3.0820E-05
44101	2.8500E-05
44103	1.4997E-07
45103	1.8347E-05
45105	2.9348E-39
46105	1.2495E-05
46108	4.0402E-06
47109	2.6753E-06
54131	1.3788E-05
55133	3.3674E-05
55134	2.0483E-06
55135	1.0701E-05
59141	2.9959E-05
60143	2.4354E-05
60145	1.8464E-05
60147	1.9750E-11
60148	9.1699E-06
61147	5.3691E-06
61148	2.3644E-11
61149	6.4929E-29
62147	2.6046E-06
62149	1.4717E-07
62150	7.7840E-06
62151	5.0415E-07
62152	3.2941E-06
63153	2.3919E-06
63154	6.5181E-07

Table D.9. (continued)

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63155 2.6310E-07
64155 1.8201E-08
MIX=108
'ASSY 8
'SQ2C3 QC LOC #8 REGION5B (BATCH6) 0 MWD/MTU
1092234 7.30943E-06
1092235 8.45213E-04
1092236 3.97435E-06
1092238 2.23359E-02
8016 4.63849E-02
MIX=109
'ASSY 9
'SQ2C3 QC LOC #9 REGION3 (BATCH2) 26859 MWD/MTU
92234 4.0292E-06
92235 2.4836E-04
92236 8.4905E-05
92238 2.1974E-02
93237 8.9968E-06
94238 2.4662E-06
94239 1.3518E-04
94240 4.3184E-05
94241 2.7032E-05
94242 6.8496E-06
95241 1.3891E-06
95243 1.2199E-06
96244 2.4060E-07
8016 4.6382E-02
36083 2.3907E-06
40093 3.4941E-05
42095 3.5356E-05
43099 3.6464E-05
44101 3.4365E-05
44103 1.5546E-07
45103 2.1603E-05
45105 3.1615E-39
46105 1.6091E-05
46108 5.4801E-06
47109 3.4911E-06
54131 1.5956E-05
55133 3.9749E-05
55134 2.8114E-06
55135 1.2898E-05
59141 3.5846E-05
60143 2.7743E-05
60145 2.1710E-05
60147 1.9817E-11
60148 1.1042E-05
61147 5.6247E-06
61148 2.4940E-11
61149 6.7620E-29
62147 3.2506E-06
62149 1.5072E-07
62150 9.5805E-06
62151 5.5178E-07
62152 3.9115E-06
63153 3.0924E-06
63154 9.5083E-07
63155 3.6704E-07
64155 2.5546E-08
MIX=110
'ASSY 10
'SQ2C3 QC LOC #10 REGION4 (BATCH3) 13298 MWD/MTU
792234 5.8762E-06
792235 5.1744E-04
792236 5.8787E-05

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Table D.9 (continued)

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792238	2.2147E-02
93237	3.5005E-06
94238	4.0372E-07
794239	1.0364E-04
794240	1.8041E-05
794241	9.2230E-06
94242	8.9192E-07
95241	3.1538E-07
95243	6.8397E-08
96244	5.4352E-09
8016	4.6385E-02
36083	1.4584E-06
40093	1.9001E-05
42095	1.8010E-05
43099	1.9260E-05
44101	1.7061E-05
44103	1.5035E-07
45103	1.1191E-05
45105	2.7255E-39
46105	5.9867E-06
46108	1.5875E-06
47109	1.1250E-06
54131	8.9355E-06
55133	2.1156E-05
55134	7.7724E-07
55135	6.1472E-06
59141	1.8355E-05
60143	1.6686E-05
60145	1.1794E-05
60147	2.4037E-11
60148	5.5453E-06
61147	4.4477E-06
61148	1.9542E-11
61149	6.9959E-29
62147	1.3019E-06
62149	1.5332E-07
62150	4.4181E-06
62151	4.3633E-07
62152	1.9448E-06
63153	1.1097E-06
63154	2.0244E-07
63155	1.1371E-07
64155	7.7197E-09
MIX=111	
'ASSY 11	
'SQ2C3 QC LOC #11 REGION4 (BATCH3) 14229 MWD/MTU	
792234	5.7961E-06
792235	5.0051E-04
792236	6.1710E-05
792238	2.2131E-02
93237	3.8491E-06
94238	4.7685E-07
794239	1.0745E-04
794240	1.9677E-05
794241	1.0390E-05
94242	1.0871E-06
95241	3.6219E-07
95243	9.0219E-08
96244	7.7437E-09
8016	4.6385E-02
36083	1.5423E-06
40093	2.0219E-05
42095	1.9285E-05
43099	2.0530E-05
44101	1.8254E-05

Table D.9 (continued)

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44103	1.5338E-07
45103	1.1959E-05
45105	2.7979E-39
46105	6.5370E-06
46108	1.7726E-06
47109	1.2498E-06
54131	9.4935E-06
55133	2.2543E-05
55134	8.8638E-07
55135	6.5756E-06
59141	1.9606E-05
60143	1.7664E-05
60145	1.2549E-05
60147	2.4027E-11
60148	5.9288E-06
62152	2.0874E-06
63153	1.2233E-06
63154	2.3474E-07
63155	1.2497E-07
64155	8.4917E-09

MIX=112  
 'ASSY 12  
 'SQ2C3 QC LOC #12 REGION4 (BATCH3) 11846 MWD/MTU

69224	6.0022E-06
692235	5.4479E-04
692236	5.4020E-05
692238	2.2171E-02
93237	2.9762E-06
94238	3.0350E-07
694239	9.7107E-05
694240	1.5501E-05
694241	7.4661E-06
94242	6.3159E-07
95241	2.4382E-07
95243	4.2291E-08
96244	2.9530E-09
8016	4.6385E-02
36083	1.3232E-06
40093	1.7074E-05
42095	1.5972E-05
43099	1.7261E-05
44101	1.5200E-05
44103	1.4686E-07
45103	9.9860E-06
45105	2.6076E-39
46105	5.1564E-06
46108	1.3155E-06
47109	9.3884E-07
54131	8.0469E-06
55133	1.8970E-05
55134	6.2227E-07
55135	5.4754E-06
59141	1.6396E-05
60143	1.5116E-05
60145	1.0599E-05
60147	2.4061E-11
60148	4.9465E-06
61147	4.1512E-06

Table D.9 (continued)

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61148	1.8042E-11
61149	6.8058E-29
62147	1.1179E-06
62149	1.4939E-07
62150	3.8662E-06
62151	4.1625E-07
62152	1.7197E-06
63153	9.3994E-07
63154	1.5726E-07
63155	9.7692E-08
64155	6.6207E-09
MIX=113	
'ASSY 13	
'SQ2C3 QC LOC #13 REGION3 (BATCH2) 21645 MWD/MTU	
292234	4.3969E-06
292235	3.1002E-04
292236	7.5781E-05
292238	2.2076E-02
93237	6.7974E-06
94238	1.4532E-06
294239	1.2715E-04
294240	3.4722E-05
294241	2.0960E-05
94242	4.0846E-06
95241	9.5646E-07
95243	5.7534E-07
96244	8.6846E-08
8016	4.6382E-02
36083	2.0685E-06
40093	2.9002E-05
42095	2.8978E-05
43099	3.0093E-05
44101	2.7761E-05
44103	1.4905E-07
45103	1.7918E-05
45105	2.9041E-39
46105	1.2061E-05
46108	3.8707E-06
47109	2.5753E-06
54131	1.3498E-05
55133	3.2888E-05
55134	1.9556E-06
55135	1.0424E-05
59141	2.9212E-05
60143	2.3893E-05
60145	1.8044E-05
60147	1.9744E-11
60148	8.9343E-06
61147	5.3231E-06
61148	2.3414E-11
61149	6.4538E-29
62147	2.5250E-06
62149	1.4657E-07
62150	7.5574E-06
62151	4.9789E-07
62152	3.2139E-06
63153	2.3057E-06
63154	6.1730E-07
63155	2.5124E-07
64155	1.7369E-08
MIX=114	
'ASSY 14	
'SQ2C3 QC LOC #14 REGION5A (BATCH4) 0 MWD/MTU	
892234	7.78098E-06
892235	8.92167E-04



Table D.9 (continued)

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892236	3.97434E-06
892238	2.22890E-02
61148	1.8042E-11
61149	6.8058E-29
8016	4.63859E-02

MIX=115  
'ASSY 15  
'SQ2C3 QC LOC #15 REGION5A (BATCH4) 0 MWD/MTU

892234	7.78098E-06
892235	8.92167E-04
892236	3.97434E-06
892238	2.22890E-02
8016	4.63859E-02

MIX=116  
'ASSY 16  
'SQ2C3 QC LOC #16 REGION3 (BATCH2) 23043 MWD/MTU

392234	4.2960E-06
392235	2.9236E-04
392236	7.8474E-05
392238	2.2049E-02
93237	7.3832E-06
94238	1.6952E-06
394239	1.2969E-04
394240	3.7077E-05
394241	2.2671E-05
94242	4.7656E-06
95241	1.0678E-06
95243	7.1932E-07
96244	1.1729E-07
8016	4.6382E-02
36083	2.1606E-06
40093	3.0628E-05
42095	3.0718E-05
43099	3.1834E-05
44101	2.9537E-05
44103	1.5115E-07
45103	1.8941E-05
45105	2.9770E-39
46105	1.3112E-05
46108	4.2828E-06
47109	2.8168E-06
54131	1.4188E-05
55133	3.4768E-05
55134	2.1798E-06
55135	1.1090E-05
59141	3.1005E-05
60143	2.4989E-05
60145	1.9049E-05
60147	1.9759E-11
60148	9.5008E-06
61147	5.4278E-06
61148	2.3938E-11
61149	6.5458E-29
62147	2.7175E-06
62149	1.4795E-07
62150	8.1023E-06
62151	5.1281E-07
62152	3.4058E-06
63153	2.5140E-06
63154	7.0153E-07
63155	2.8022E-07
64155	1.9404E-08

MIX=117  
'ASSY 17

Table D.9 (continued)

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'SQ2C3 QC LOC #17 REGION5B (BATCH7) 0 MWD/MTU
  1192234 7.30943E-06
  1192235 8.45213E-04
  1192236 3.97435E-06
  1192238 2.23359E-02
    8016 4.63849E-02
MIX=118
'ASSY 18
'SQ2C3 QC LOC #18 REGION3 (BATCH2) 23685 MWD/MTU
  392234 4.2502E-06
  392235 2.8454E-04
  392236 7.9649E-05
  392238 2.2037E-02
    93237 7.6536E-06
    94238 1.8137E-06
  394239 1.3075E-04
  394240 3.8139E-05
  394241 2.3438E-05
    94242 5.0938E-06
    95241 1.1206E-06
    95243 7.9235E-07
    96244 1.3365E-07
    8016 4.6382E-02
    36083 2.2014E-06
    40093 3.1366E-05
    42095 3.1510E-05
    43099 3.2625E-05
    44101 3.0352E-05
    44103 1.5200E-07
    45103 1.9403E-05
    45105 3.0095E-39
    46105 1.3601E-05
    46108 4.4771E-06
    47109 2.9289E-06
    54131 1.4497E-05
    55133 3.5622E-05
    55134 2.2839E-06
    55135 1.1395E-05
    59141 3.1825E-05
    60143 2.5476E-05
    60145 1.9505E-05
    60147 1.9767E-11
    60148 9.7606E-06
    61147 5.4692E-06
    61148 2.4146E-11
    61149 6.5855E-29
    62147 2.8071E-06
    62149 1.4851E-07
    62150 8.3518E-06
    62151 5.1954E-07
    62152 3.4926E-06
    63153 2.6104E-06
    63154 7.4157E-07
    63155 2.9406E-07
    64155 2.0379E-08
MIX=119
'ASSY 19
'SQ2C3 QC LOC #19 REGION5A (BATCH5) 0 MWD/MTU
  992234 7.78098E-06
  992235 8.92167E-04
  992236 3.97434E-06
  992238 2.22890E-02
    8016 4.63859E-02
MIX=120
'ASSY 20

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Table D.9 (continued)

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'SQ2C3 QC LOC #20 REGION3 (BATCH2) 20877 MWD/MTU
292234 4.4530E-06
292235 3.2010E-04
292236 7.4219E-05
292238 2.2091E-02
93237 6.4778E-06
94238 1.3297E-06
294239 1.2563E-04
294240 3.3404E-05
294241 1.9997E-05
94242 3.7309E-06
95241 8.9745E-07
95243 5.0480E-07
96244 7.2872E-08
8016 4.6382E-02
36083 2.0161E-06
40093 2.8099E-05
42095 2.8012E-05
43099 2.9126E-05
44101 2.6783E-05
44103 1.4776E-07
45103 1.7345E-05
45105 2.8628E-39
46105 1.1493E-05
46108 3.6508E-06
47109 2.4444E-06
54131 1.3110E-05
55133 3.1842E-05
55134 1.8343E-06
55135 1.0058E-05
59141 2.8223E-05
60143 2.3271E-05
60145 1.7484E-05
60147 1.9737E-11
60148 8.6226E-06
61147 5.2572E-06
61148 2.3086E-11
61149 6.3999E-29
62147 2.4205E-06
62149 1.4571E-07
62150 7.2576E-06
62151 4.8954E-07
62152 3.1070E-06
63153 2.1925E-06
63154 5.7285E-07
63155 2.3601E-07
64155 1.6303E-08
MIX=121
'ASSY 21
'SQ2C3 QC LOC #21 REGION5A (BATCH4) 0 MWD/MTU
892234 7.78098E-06
892235 8.92167E-04
892236 3.97434E-06
892238 2.22890E-02
8016 4.63859E-02
MIX=122
'ASSY 22
'SQ2C3 QC LOC #22 REGION3 (BATCH2) 24587 MWD/MTU
392234 4.1866E-06
392235 2.7383E-04
392236 8.1235E-05
392238 2.2019E-02
93237 8.0346E-06
94238 1.9881E-06
394239 1.3215E-04

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Table D.9 (continued)

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394240	3.9607E-05
394241	2.4492E-05
94242	5.5707E-06
95241	1.1963E-06
95243	9.0251E-07
96244	1.5944E-07
8016	4.6382E-02
36083	2.2573E-06
40093	3.2393E-05
42095	3.2615E-05
43099	3.3729E-05
44101	3.1494E-05
44103	1.5308E-07
45103	2.0041E-05
45105	3.0541E-39
46105	1.4298E-05
46108	4.7549E-06
47109	3.0874E-06
54131	1.4924E-05
55133	3.6811E-05
55134	2.4312E-06
55135	1.1823E-05
59141	3.2973E-05
60143	2.6144E-05
60145	2.0140E-05
60147	1.9780E-11
60148	1.0125E-05
61147	5.5208E-06
61148	2.4407E-11
61149	6.6386E-29
62147	2.9337E-06
62149	1.4922E-07
62150	8.7017E-06
62151	5.2887E-07
62152	3.6134E-06
63153	2.7467E-06
63154	7.9914E-07
63155	3.1401E-07
64155	2.1789E-08
MIX=123	
'ASSY 23	
'SQ2C3 QC LOC #23 REGION4 (BATCH3) 10575 MWD/MTU	
692234	6.1134E-06
692235	5.6972E-04
692236	4.9632E-05
692238	2.2193E-02
93237	2.5388E-06
94238	2.2909E-07
694239	9.0728E-05
694240	1.3304E-05
694241	6.0121E-06
94242	4.4638E-07
95241	1.8396E-07
95243	2.6184E-08
96244	1.6055E-09
8016	4.6385E-02
36083	1.2005E-06
40093	1.5363E-05
42095	1.4145E-05
43099	1.5490E-05
44101	1.3569E-05
44103	1.4490E-07
45103	8.9234E-06
45105	2.4992E-39
46105	4.4589E-06

Table D.9 (continued)

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46108	1.0947E-06
47109	7.8506E-07
54131	7.2508E-06
55133	1.7032E-05
55134	5.0180E-07
55135	4.8845E-06
59141	1.4671E-05
60143	1.3696E-05
60145	9.5376E-06
60147	2.4091E-11
60148	4.4218E-06
61147	3.8760E-06
61148	1.6647E-11
61149	6.6353E-29
62147	9.4701E-07
62149	1.4573E-07
62150	3.3979E-06
62151	3.9763E-07
62152	1.5204E-06
63153	7.9945E-07
63154	1.2290E-07
63155	8.5109E-08
64155	5.7552E-09
MIX=124	
'ASSY 24	
'SQ2C3 QC LOC #24 REGION4 (BATCH3) 14185 MWD/MTU	
792234	5.7998E-06
792235	5.0130E-04
792236	6.1574E-05
792238	2.2132E-02
93237	3.8325E-06
94238	4.7323E-07
794239	1.0727E-04
794240	1.9599E-05
794241	1.0334E-05
94242	1.0774E-06
95241	3.5996E-07
95243	8.9090E-08
96244	7.6197E-09
8016	4.6385E-02
36083	1.5384E-06
40093	2.0162E-05
42095	1.9225E-05
43099	2.0470E-05
44101	1.8198E-05
44103	1.5323E-07
45103	1.1923E-05
45105	2.7946E-39
46105	6.5106E-06
46108	1.7637E-06
47109	1.2438E-06
54131	9.4673E-06
55133	2.2478E-05
55134	8.8108E-07
55135	6.5554E-06
59141	1.9547E-05
60143	1.7618E-05
60145	1.2513E-05
60147	2.4027E-11
60148	5.9106E-06
61147	4.6220E-06
61148	2.0421E-11
61149	7.1105E-29
62147	1.4065E-06
62149	1.5562E-07

Table D.9 (continued)

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62150	4.7644E-06
62151	4.4820E-07
62152	2.0807E-06
63153	1.2179E-06
63154	2.3315E-07
63155	1.2443E-07
64155	8.4543E-09
MIX=125	
'ASSY 25	
'SQ2C3 QC LOC #25 REGION5A (BATCH5) 0 MWD/MTU	
992234	7.78098E-06
992235	8.92167E-04
992236	3.97434E-06
992238	2.22890E-02
8016	4.63859E-02
MIX=126	
'ASSY 26	
'SQ2C3 QC LOC #26 REGION4 (BATCH3) 8618 MWD/MTU	
592234	6.2863E-06
592235	6.1004E-04
592236	4.2459E-05
592238	2.2224E-02
93237	1.9098E-06
94238	1.3766E-07
594239	7.9529E-05
594240	1.0002E-05
594241	3.9796E-06
94242	2.3416E-07
95241	1.0211E-07
95243	1.0938E-08
96244	4.9420E-10
8016	4.6385E-02
36083	1.0034E-06
40093	1.2678E-05
42095	1.1281E-05
43099	1.2726E-05
44101	1.1057E-05
44103	1.4248E-07
45103	7.2723E-06
45105	2.3206E-39
46105	3.4419E-06
46108	7.8786E-07
47109	5.6721E-07
54131	5.9917E-06
55133	1.4008E-05
55134	3.4241E-07
55135	3.9714E-06
59141	1.1994E-05
60143	1.1424E-05
60145	7.8702E-06
60147	2.4153E-11
60148	3.6120E-06
61147	3.4048E-06
61148	1.4262E-11
61149	6.3572E-29
62147	6.8218E-07
62149	1.3951E-07
62150	2.7000E-06
62151	3.6571E-07
62152	1.2102E-06
63153	5.9954E-07
63154	7.9139E-08
63155	6.7853E-08
64155	4.5674E-09

Table D.9 (continued)

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MIX=127
'ASSY 27
'SQ2C3 QC LOC #27 REGION2 (BATCH1) 25339 MWD/MTU
192234 3.3692E-06
192235 1.9090E-04
192236 7.2863E-05
192238 2.2088E-02
93237 8.1719E-06
94238 2.2915E-06
194239 1.2978E-04
194240 4.4173E-05
194241 2.6805E-05
94242 7.4285E-06
95241 1.3194E-06
95243 1.3298E-06
96244 2.6848E-07
8016 4.6379E-02
36083 2.1714E-06
40093 3.2263E-05
42095 3.2793E-05
43099 3.4313E-05
44101 3.2532E-05
44103 1.5975E-07
45103 2.0929E-05
45105 3.3031E-39
46105 1.6039E-05
46108 5.6846E-06
47109 3.6116E-06
54131 1.5104E-05
55133 3.7388E-05
55134 2.7043E-06
55135 1.0917E-05
59141 3.3554E-05
60143 2.5366E-05
60145 2.0200E-05
60147 1.9601E-11
60148 1.0404E-05
61147 5.3454E-06
61148 2.3336E-11
61149 6.8098E-29
62147 2.9248E-06
62149 1.3968E-07
62150 9.2838E-06
62151 5.0168E-07
62152 3.8107E-06
63153 3.0093E-06
63154 9.3312E-07
63155 3.5575E-07
64155 2.4345E-08
MIX=128
'ASSY 28
'SQ2C3 QC LOC #28 REGION4 (BATCH3) 10711 MWD/MTU
692234 6.1015E-06
692235 5.6701E-04
692236 5.0111E-05
692238 2.2190E-02
93237 2.5846E-06
94238 2.3648E-07
694239 9.1442E-05
694240 1.3537E-05
694241 6.1633E-06
94242 4.6436E-07
95241 1.9018E-07
95243 2.7644E-08
96244 1.7209E-09

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Table D.9 (continued)

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8016	4.6385E-02
36083	1.2138E-06
40093	1.5547E-05
42095	1.4343E-05
43099	1.5680E-05
44101	1.3743E-05
44103	1.4508E-07
45103	9.0374E-06
45105	2.5111E-39
46105	4.5321E-06
46108	1.1175E-06
47109	8.0107E-07
54131	7.3368E-06
55133	1.7241E-05
55134	5.1404E-07
55135	4.9479E-06
59141	1.4855E-05
60143	1.3851E-05
60145	9.6520E-06
60147	2.4087E-11
60148	4.4779E-06
61147	3.9064E-06
61148	1.6800E-11
61149	6.6538E-29
62147	9.6556E-07
62149	1.4613E-07
62150	3.4473E-06
62151	3.9968E-07
62152	1.5418E-06
63153	8.1411E-07
63154	1.2635E-07
63155	8.6399E-08
64155	5.8440E-09
MIX=129	
'ASSY 29	
'SQ2C3 QC LOC #29 REGION4 (BATCH3) 8550 MWD/MTU	
592234	6.2924E-06
592235	6.1148E-04
592236	4.2200E-05
592238	2.2226E-02
93237	1.8890E-06
94238	1.3498E-07
594239	7.9107E-05
594240	9.8894E-06
594241	3.9143E-06
94242	2.2827E-07
95241	9.9603E-08
95243	1.0576E-08
96244	4.7015E-10
8016	4.6385E-02
36083	9.9634E-07
40093	1.2583E-05
42095	1.1181E-05
43099	1.2629E-05
44101	1.0969E-05
44103	1.4237E-07
45103	7.2145E-06
45105	2.3141E-39
46105	3.4079E-06
46108	7.7795E-07
47109	5.6008E-07
54131	5.9472E-06
55133	1.3902E-05
55134	3.3739E-07
55135	3.9397E-06



Table D.9 (continued)

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59141	1.1900E-05
60143	1.1342E-05
60145	7.8115E-06
60147	2.4156E-11
60148	3.5838E-06
61147	3.3871E-06
61148	1.4172E-11
61149	6.3471E-29
62147	6.7334E-07
62149	1.3927E-07
62150	2.6761E-06
62151	3.6450E-07
62152	1.1993E-06
63153	5.9298E-07
63154	7.7811E-08
63155	6.7290E-08
64155	4.5287E-09
MIX=130	
'ASSY 30	
'SQ2C3 QC LOC #30 REGION5B (BATCH6) 0 MWD/MTU	
1092234	7.30943E-06
1092235	8.45213E-04
1092236	3.97435E-06
1092238	2.23359E-02
8016	4.63849E-02
MIX=131	
'ASSY 31	
'SQ2C3 QC LOC #31 REGION3 (BATCH2) 24497 MWD/MTU	
392234	4.1929E-06
392235	2.7489E-04
392236	8.1080E-05
392238	2.2021E-02
93237	7.9966E-06
94238	1.9702E-06
394239	1.3201E-04
394240	3.9461E-05
394241	2.4388E-05
94242	5.5223E-06
95241	1.1887E-06
95243	8.9112E-07
96244	1.5671E-07
8016	4.6382E-02
36083	2.2518E-06
40093	3.2291E-05
42095	3.2505E-05
43099	3.3619E-05
44101	3.1380E-05
44103	1.5298E-07
45103	1.9979E-05
45105	3.0497E-39
46105	1.4228E-05
46108	4.7269E-06
47109	3.0715E-06
54131	1.4882E-05
55133	3.6693E-05
55134	2.4165E-06
55135	1.1780E-05
59141	3.2858E-05
60143	2.6078E-05
60145	2.0077E-05
60147	1.9778E-11
60148	1.0089E-05
61147	5.5159E-06
61148	2.4383E-11

Table D.9. (continued)

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61149	6.6335E-29
62147	2.9211E-06
62149	1.4915E-07
62150	8.6668E-06
62151	5.2795E-07
62152	3.6015E-06
63153	2.7331E-06
63154	7.9332E-07
63155	3.1199E-07
64155	2.1646E-08
MIX=1	
40302	4.25156E-02
MIX=2	
24304	1.74286E-02
25055	1.73633E-03
26304	5.93579E-02
28304	7.72073E-03
MIX=3	
1001	5.04213E-02
308016	2.52107E-02
5010	1.39851E-05
5011	5.67754E-05
MIX=4	
424304	8.71428E-03
425055	8.68166E-04
426304	2.96789E-02
428304	3.86037E-03
401001	2.52107E-02
408016	1.26053E-02
405010	6.99255E-06
405011	2.83877E-05
MIX=5	
524304	1.74286E-02
525055	1.73633E-03
526304	5.93579E-02
528304	7.72073E-03
MIX=6	
601001	5.04213E-02
608016	2.52107E-02
605010	1.39851E-05
605011	5.67754E-05
MIX=7	
724304	1.74286E-02
725055	1.73633E-03
726304	5.93579E-02
728304	7.72073E-03
MIX=8	
801001	5.04213E-02
808016	2.52107E-02
805010	1.39851E-05
805011	5.67754E-05
MIX=9	
924304	1.74286E-02
925055	1.73633E-03
926304	5.93579E-02
928304	7.72073E-03
MIX=11	
'SQ2C3 BP FOR QC LOC #2 REGION5B (BATCH7)	
1108016	4.49700E-02
1105010	9.59500E-04
1105011	3.86300E-03
11023	1.65000E-03
13027	5.80000E-04

Table D.9 (continued)

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MIX=12
'SQ2C3 BP FOR QC LOC #4 REGION5B (BATCH7)
  1108016 4.49700E-02
  1105010 9.59500E-04
  1105011 3.86300E-03
  11023 1.65000E-03
  13027 5.80000E-04
MIX=13
'SQ2C3 BP FOR QC LOC #6 REGION5B (BATCH7)
  1108016 4.49700E-02
  1105010 9.59500E-04
  1105011 3.86300E-03
  11023 1.65000E-03
  13027 5.80000E-04
MIX=14
'SQ2C3 BP FOR QC LOC #14 REGION5A (BATCH5)
  1108016 4.49700E-02
  1105010 9.59500E-04
  1105011 3.86300E-03
  11023 1.65000E-03
  13027 5.80000E-04
MIX=15
'SQ2C3 BP FOR QC LOC #17 REGION5B (BATCH7)
  1108016 4.49700E-02
  1105010 9.59500E-04
  1105011 3.86300E-03
  11023 1.65000E-03
  13027 5.80000E-04
MIX=16
'SQ2C3 BP FOR QC LOC #19 REGION5A (BATCH5)
  1108016 4.49700E-02
  1105010 9.59500E-04
  1105011 3.86300E-03
  11023 1.65000E-03
  13027 5.80000E-04
MIX=17
'SQ2C3 BP FOR QC LOC #25 REGION5A (BATCH5)
  1108016 4.49700E-02
  1105010 9.59500E-04
  1105011 3.86300E-03
  11023 1.65000E-03
  13027 5.80000E-04
END MIXT

READ GEOM

'--- FUEL PINS
UNIT 101
CYLINDER 0101 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 102
CYLINDER 0102 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 103
CYLINDER 0103 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 104
CYLINDER 0104 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0

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Table D.9 (continued)

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CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 105					
CYLINDER	0105	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 106					
CYLINDER	0106	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 107					
CYLINDER	0107	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 108					
CYLINDER	0108	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 109					
CYLINDER	0109	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 110					
CYLINDER	0110	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 111					
CYLINDER	0111	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 112					
CYLINDER	0112	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 113					
CYLINDER	0113	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 114					
CYLINDER	0114	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 115					
CYLINDER	0115	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 116					
CYLINDER	0116	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 117					
CYLINDER	0117	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0

Table D.9 (continued)

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CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 118					
CYLINDER	0118	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 119					
CYLINDER	0119	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 120					
CYLINDER	0120	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 121					
CYLINDER	0121	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 122					
CYLINDER	0122	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 123					
CYLINDER	0123	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 124					
CYLINDER	0124	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 125					
CYLINDER	0125	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 126					
CYLINDER	0126	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 127					
CYLINDER	0127	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 128					
CYLINDER	0128	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 129					
CYLINDER	0129	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 130					
CYLINDER	0130	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0

Table D.9 (continued)

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CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 131
CYLINDER 0131 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0

'--- GUIDE TUBE
UNIT 161
CYLINDER 3 1 .57150 365.76 0.0
CYLINDER 1 1 .61214 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0

'--- BP RODS
UNIT 162
CYLINDER 0 1 0.21400 365.76 0.0
CYLINDER 2 1 0.23051 365.76 0.0
CYLINDER 0 1 0.24130 365.76 0.0
CYLINDER 11 1 0.42672 365.76 0.0
CYLINDER 0 1 0.43688 365.76 0.0
CYLINDER 2 1 0.48387 365.76 0.0
CYLINDER 3 1 0.57150 365.76 0.0
CYLINDER 1 1 0.61214 365.76 0.0
CUBOID 3 1 2P0.62992 2P0.62992 365.76 0.0
UNIT 163
CYLINDER 0 1 0.21400 365.76 0.0
CYLINDER 2 1 0.23051 365.76 0.0
CYLINDER 0 1 0.24130 365.76 0.0
CYLINDER 12 1 0.42672 365.76 0.0
CYLINDER 0 1 0.43688 365.76 0.0
CYLINDER 2 1 0.48387 365.76 0.0
CYLINDER 3 1 0.57150 365.76 0.0
CYLINDER 1 1 0.61214 365.76 0.0
CUBOID 3 1 2P0.62992 2P0.62992 365.76 0.0
UNIT 164
CYLINDER 0 1 0.21400 365.76 0.0
CYLINDER 2 1 0.23051 365.76 0.0
CYLINDER 0 1 0.24130 365.76 0.0
CYLINDER 13 1 0.42672 365.76 0.0
CYLINDER 0 1 0.43688 365.76 0.0
CYLINDER 2 1 0.48387 365.76 0.0
CYLINDER 3 1 0.57150 365.76 0.0
CYLINDER 1 1 0.61214 365.76 0.0
CUBOID 3 1 2P0.62992 2P0.62992 365.76 0.0
UNIT 165
CYLINDER 0 1 0.21400 365.76 0.0
CYLINDER 2 1 0.23051 365.76 0.0
CYLINDER 0 1 0.24130 365.76 0.0
CYLINDER 14 1 0.42672 365.76 0.0
CYLINDER 0 1 0.43688 365.76 0.0
CYLINDER 2 1 0.48387 365.76 0.0
CYLINDER 3 1 0.57150 365.76 0.0
CYLINDER 1 1 0.61214 365.76 0.0
CUBOID 3 1 2P0.62992 2P0.62992 365.76 0.0
UNIT 166
CYLINDER 0 1 0.21400 365.76 0.0
CYLINDER 2 1 0.23051 365.76 0.0
CYLINDER 0 1 0.24130 365.76 0.0
CYLINDER 15 1 0.42672 365.76 0.0
CYLINDER 0 1 0.43688 365.76 0.0
CYLINDER 2 1 0.48387 365.76 0.0
CYLINDER 3 1 0.57150 365.76 0.0
CYLINDER 1 1 0.61214 365.76 0.0

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Table D.9 (continued)

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CUBOID	3	1	2P0.62992	2P0.62992	365.76	0.0
UNIT 167						
CYLINDER	0	1	0.21400	365.76	0.0	
CYLINDER	2	1	0.23051	365.76	0.0	
CYLINDER	0	1	0.24130	365.76	0.0	
CYLINDER	16	1	0.42672	365.76	0.0	
CYLINDER	0	1	0.43688	365.76	0.0	
CYLINDER	2	1	0.48387	365.76	0.0	
CYLINDER	3	1	0.57150	365.76	0.0	
CYLINDER	1	1	0.61214	365.76	0.0	
CUBOID	3	1	2P0.62992	2P0.62992	365.76	0.0
UNIT 168						
CYLINDER	0	1	0.21400	365.76	0.0	
CYLINDER	2	1	0.23051	365.76	0.0	
CYLINDER	0	1	0.24130	365.76	0.0	
CYLINDER	17	1	0.42672	365.76	0.0	
CYLINDER	0	1	0.43688	365.76	0.0	
CYLINDER	2	1	0.48387	365.76	0.0	
CYLINDER	3	1	0.57150	365.76	0.0	
CYLINDER	1	1	0.61214	365.76	0.0	
CUBOID	3	1	2P0.62992	2P0.62992	365.76	0.0
'--- FUEL ASSY'S						
UNIT 1						
ARRAY	0101	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	
UNIT 2						
ARRAY	0102	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	
UNIT 3						
ARRAY	0103	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	
UNIT 4						
ARRAY	0104	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	
UNIT 5						
ARRAY	0105	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	
UNIT 6						
ARRAY	0106	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	
UNIT 7						
ARRAY	0107	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	
UNIT 8						
ARRAY	0108	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	
UNIT 9						
ARRAY	0109	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	
UNIT 10						
ARRAY	0110	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	
UNIT 11						
ARRAY	0111	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	
UNIT 12						
ARRAY	0112	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	
UNIT 13						
ARRAY	0113	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	
UNIT 14						
ARRAY	0114	2R-10.70864	0.0			
REFLECTOR	3	1	4R0.04318	2R0.0	1	

Table D.9 (continued)

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UNIT 15
ARRAY      0115 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 16
ARRAY      0116 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 17
ARRAY      0117 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 18
ARRAY      0118 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 19
ARRAY      0119 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 20
ARRAY      0120 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 21
ARRAY      0121 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 22
ARRAY      0122 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 23
ARRAY      0123 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 24
ARRAY      0124 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 25
ARRAY      0125 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 26
ARRAY      0126 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 27
ARRAY      0127 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 28
ARRAY      0128 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 29
ARRAY      0129 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 30
ARRAY      0130 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 31
ARRAY      0131 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1

'--- BAFFLE REGION
UNIT 41
CUBOID    2  1      0.0      -2.8575      0.0      -2.8575      365.76 0.0
UNIT 42
CUBOID    2  1    2P10.75182    2P1.42875                      365.76 0.0
UNIT 43
CUBOID    2  1      2.8575      0.0      21.50364      0.0      365.76 0.0
UNIT 44
CUBOID    2  1    2P21.50364    2P1.42875                      365.76 0.0

'---ROWS OF ASSY'S W/ BAFFLE REGIONS ON EACH END
UNIT 51

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Table D.9 (continued)

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COM=! ROW 1 !
ARRAY 1 -78.12024 -13.60932 0.0
UNIT 52
COM=! ROW 2 !
ARRAY 2 -121.12752 -10.75182 0.0
UNIT 53
COM=! ROWS 3 & 4 !
ARRAY 3 -142.63116 -21.50364 0.0
UNIT 55
COM=! ROWS 5 - 11 !
ARRAY 5 -164.1348 -75.26274 0.0
UNIT 62
COM=! ROWS 12 & 13 !
ARRAY 12 -142.63116 -21.50364 0.0
UNIT 64
COM=! ROW 14 !
ARRAY 14 -121.12752 -10.75182 0.0
UNIT 65
COM=! ROW 15 !
ARRAY 15 -78.12024 -10.75182 0.0

GLOBAL UNIT 70
CYLINDER 3 1 187.96 365.76 0.0
HOLE 55 0.0 0.0 0.0
HOLE 53 0.0 -96.76638 0.0
HOLE 62 0.0 96.76638 0.0
HOLE 52 0.0 -129.02184 0.0
HOLE 64 0.0 129.02184 0.0
HOLE 51 0.0 -150.52548 0.0
HOLE 65 0.0 150.52548 0.0
HOLE 44 -99.62388 141.20241 0
HOLE 44 -99.62388 -141.20241 0
HOLE 44 99.62388 141.20241 0
HOLE 44 99.62388 -141.20241 0
HOLE 42 -131.87936 119.69877 0
HOLE 42 -131.87936 -119.69877 0
HOLE 42 131.87934 119.69877 0
HOLE 42 131.87934 -119.69877 0
HOLE 42 -153.38300 76.69149 0
HOLE 42 -153.38300 -76.69149 0
HOLE 42 153.38298 76.69149 0
HOLE 42 153.38298 -76.69149 0
CYLINDER 4 1 187.96 390.76 -25.0
REFLECTOR 5 1 5.715 0.0 0.0 1
REFLECTOR 6 1 7.620 0.0 0.0 1
REFLECTOR 7 1 6.985 0.0 0.0 1
REFLECTOR 8 1 11.43 0.0 0.0 1
REFLECTOR 9 1 21.59 0.0 0.0 1
CUBOID 0 1 2P245.0 2P245.0 390.76 -25.0
END GEOM

READ ARRAY

'--- FUEL ASSY'S
ARA=101 NUX=17 NUY=17 NUZ=1 FILL F101
  A40 161 A43 161 A46 161 A55 161 A65 161
  A88 161 A91 161 A94 161 A97 161 A100 161
  A139 161 A142 161 A145 161 A148 161 A151 161
  A190 161 A193 161 A196 161 A199 161 A202 161
  A225 161 A235 161 A244 161 A247 161 A250 161 END FILL
'-- ASSY 2 16 BP
ARA=102 NUX=17 NUY=17 NUZ=1 FILL F102
  A40 162 A43 161 A46 162 A55 162 A65 162
  A88 162 A91 161 A94 162 A97 161 A100 162
  A139 161 A142 162 A145 161 A148 162 A151 161

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Table D.9 (continued)

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A190 162	A193 161	A196 162	A199 161	A202 162	
A225 162	A235 162	A244 162	A247 161	A250 162	END FILL
ARA=103	NUX=17	NUY=17	NUZ=1	FILL F103	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
'-- ASSY 4	24 BP				
ARA=104	NUX=17	NUY=17	NUZ=1	FILL F104	
A40 163	A43 163	A46 163	A55 163	A65 163	
A88 163	A91 163	A94 163	A97 163	A100 163	
A139 163	A142 163	A145 161	A148 163	A151 163	
A190 163	A193 163	A196 163	A199 163	A202 163	
A225 163	A235 163	A244 163	A247 163	A250 163	END FILL
ARA=105	NUX=17	NUY=17	NUZ=1	FILL F105	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
'-- ASSY 6	12 BP				
ARA=106	NUX=17	NUY=17	NUZ=1	FILL F106	
A40 164	A43 161	A46 164	A55 161	A65 161	
A88 164	A91 161	A94 164	A97 161	A100 164	
A139 161	A142 164	A145 161	A148 164	A151 161	
A190 164	A193 161	A196 164	A199 161	A202 164	
A225 161	A235 161	A244 164	A247 161	A250 164	END FILL
ARA=107	NUX=17	NUY=17	NUZ=1	FILL F107	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=108	NUX=17	NUY=17	NUZ=1	FILL F108	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=109	NUX=17	NUY=17	NUZ=1	FILL F109	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=110	NUX=17	NUY=17	NUZ=1	FILL F110	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=111	NUX=17	NUY=17	NUZ=1	FILL F111	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=112	NUX=17	NUY=17	NUZ=1	FILL F112	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=113	NUX=17	NUY=17	NUZ=1	FILL F113	

Table D.9 (continued)

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140	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
'-- ASSY 14 16 BP										
ARA=114		NUX=17	NUY=17	NUZ=1		FILL		F114		
A40	165	A43	161	A46	165	A55	165	A65	165	
A88	165	A91	161	A94	165	A97	161	A100	165	
A139	161	A142	165	A145	161	A148	165	A151	161	
A190	165	A193	161	A196	165	A199	161	A202	165	
A225	165	A235	165	A244	165	A247	161	A250	165	END FILL
ARA=115		NUX=17	NUY=17	NUZ=1		FILL		F115		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=116		NUX=17	NUY=17	NUZ=1		FILL		F116		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
'-- ASSY 17 12 BP										
ARA=117		NUX=17	NUY=17	NUZ=1		FILL		F117		
A40	166	A43	161	A46	166	A55	161	A65	161	
A88	166	A91	161	A94	166	A97	161	A100	166	
A139	161	A142	166	A145	161	A148	166	A151	161	
A190	166	A193	161	A196	166	A199	161	A202	166	
A225	161	A235	161	A244	166	A247	161	A250	166	END FILL
ARA=118		NUX=17	NUY=17	NUZ=1		FILL		F118		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
'-- ASSY 19 20 BP										
ARA=119		NUX=17	NUY=17	NUZ=1		FILL		F119		
A40	167	A43	167	A46	167	A55	167	A65	167	
A88	167	A91	161	A94	167	A97	161	A100	167	
A139	167	A142	167	A145	161	A148	167	A151	167	
A190	167	A193	161	A196	167	A199	161	A202	167	
A225	167	A235	167	A244	167	A247	167	A250	167	END FILL
ARA=120		NUX=17	NUY=17	NUZ=1		FILL		F120		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=121		NUX=17	NUY=17	NUZ=1		FILL		F121		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=122		NUX=17	NUY=17	NUZ=1		FILL		F122		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=123		NUX=17	NUY=17	NUZ=1		FILL		F123		
A40	161	A43	161	A46	161	A55	161	A65	161	

Table D.9 (continued)

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A88 161  A91 161  A94 161  A97 161  A100 161
A139 161 A142 161 A145 161 A148 161 A151 161
A190 161 A193 161 A196 161 A199 161 A202 161
A225 161 A235 161 A244 161 A247 161 A250 161  END FILL
ARA=124  NUX=17 NUY=17 NUZ=1  FILL F124
  A40 161  A43 161  A46 161  A55 161  A65 161
  A88 161  A91 161  A94 161  A97 161  A100 161
  A139 161 A142 161 A145 161 A148 161 A151 161
  A190 161 A193 161 A196 161 A199 161 A202 161
  A225 161 A235 161 A244 161 A247 161 A250 161  END FILL
'-- ASSY 25  8 BP
ARA=125  NUX=17 NUY=17 NUZ=1  FILL F125
  A40 161  A43 161  A46 161  A55 168  A65 168
  A88 161  A91 161  A94 168  A97 161  A100 161
  A139 161 A142 168 A145 161 A148 168 A151 161
  A190 161 A193 161 A196 168 A199 161 A202 161
  A225 168 A235 168 A244 161 A247 161 A250 161  END FILL
ARA=126  NUX=17 NUY=17 NUZ=1  FILL F126
  A40 161  A43 161  A46 161  A55 161  A65 161
  A88 161  A91 161  A94 161  A97 161  A100 161
  A139 161 A142 161 A145 161 A148 161 A151 161
  A190 161 A193 161 A196 161 A199 161 A202 161
  A225 161 A235 161 A244 161 A247 161 A250 161  END FILL
ARA=127  NUX=17 NUY=17 NUZ=1  FILL F127
  A40 161  A43 161  A46 161  A55 161  A65 161
  A88 161  A91 161  A94 161  A97 161  A100 161
  A139 161 A142 161 A145 161 A148 161 A151 161
  A190 161 A193 161 A196 161 A199 161 A202 161
  A225 161 A235 161 A244 161 A247 161 A250 161  END FILL
ARA=128  NUX=17 NUY=17 NUZ=1  FILL F128
  A40 161  A43 161  A46 161  A55 161  A65 161
  A88 161  A91 161  A94 161  A97 161  A100 161
  A139 161 A142 161 A145 161 A148 161 A151 161
  A190 161 A193 161 A196 161 A199 161 A202 161
  A225 161 A235 161 A244 161 A247 161 A250 161  END FILL
ARA=129  NUX=17 NUY=17 NUZ=1  FILL F129
  A40 161  A43 161  A46 161  A55 161  A65 161
  A88 161  A91 161  A94 161  A97 161  A100 161
  A139 161 A142 161 A145 161 A148 161 A151 161
  A190 161 A193 161 A196 161 A199 161 A202 161
  A225 161 A235 161 A244 161 A247 161 A250 161  END FILL
ARA=130  NUX=17 NUY=17 NUZ=1  FILL F130
  A40 161  A43 161  A46 161  A55 161  A65 161
  A88 161  A91 161  A94 161  A97 161  A100 161
  A139 161 A142 161 A145 161 A148 161 A151 161
  A190 161 A193 161 A196 161 A199 161 A202 161
  A225 161 A235 161 A244 161 A247 161 A250 161  END FILL
ARA=131  NUX=17 NUY=17 NUZ=1  FILL F131
  A40 161  A43 161  A46 161  A55 161  A65 161
  A88 161  A91 161  A94 161  A97 161  A100 161
  A139 161 A142 161 A145 161 A148 161 A151 161
  A190 161 A193 161 A196 161 A199 161 A202 161
  A225 161 A235 161 A244 161 A247 161 A250 161  END FILL

'--- ROWS OF FUEL ASSY'S
ARA=1  NUX=9  NUY=2  NUZ=1  FILL
      41 42 42 42 42 1B4
      43      26 21 15  8 1B4
END FILL
ARA=2  NUX=13 NUY=1  NUZ=1  FILL
      43      31 29 25 20 14  7 1B6
END FILL
ARA=3  NUX=15 NUY=2  NUZ=1  FILL
      43      31 30 28 24 19 13  6 1B7

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Table D.9 (continued)

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```

43      29 28 27 23 18 12   5 1B7
END FILL
ARA=5    NUX=17  NUY=7  NUZ=1    FILL
43      26 25 24 23 22 17 11   4 1B8
43      21 20 19 18 17 16 10   3 1B8
43      15 14 13 12 11 10   9   2 1B8
43      8  7  6  5  4  3  2   1 1B59
END FILL
ARA=12    NUX=15  NUY=2  NUZ=1    FILL
43      29 28 27 23 18 12   5 1B7
43      31 30 28 24 19 13   6 1B7
END FILL
ARA=14    NUX=13  NUY=1  NUZ=1    FILL
43      31 29 25 20 14   7 1B6
END FILL
ARA=15    NUX=9   NUY=2  NUZ=1    FILL
43      26 21 15   8 1B4
41 42 42 42 42 1B4
END FILL
END ARRAY
READ PLOT
TTL=! SEQUOYAH UNIT 2 CYCLE 3 FULL CORE BY GEOM UNIT !
PIC=UNIT
XUL=-200 YUL=200 XLR=200 YLR=-200 UAX=1 VDN=-1 NAX=130 END
TTL=! ASSEMBLY LOC 2 !
PIC=MAT NCH=! 12 45555556789999ABCDEFGHIJKLMNQRSTUWXYZ#>$-+)&#!
XUL=-11 YUL=32.5 XLR=11 YLR=10.5 UAX=1 VDN=-1 NAX=130 END
TTL=! SEQUOYAH UNIT 2 CYCLE 3 FULL CORE BY COMPOSITION!
PIC=MAT NCH=! 1/ 4/ / /5555555ABCDEFGHIJKLMNQRSTUWXYZ#>$-+)&#!
XUL=-200 YUL=200 XLR=200 YLR=-200 UAX=1 VDN=-1 NAX=130 END
END PLOT
END DATA
END

```

---

Table D.10. KENO V.a input file for BOC, HFP

---

```

//ST5S2BC3 JOB (35899),'S.M.BOWMAN 6011',MSGCLASS=T,
//  NOTIFY=ST5,TIME=65
//*MAIN CLASS=STANDBY
//PROCLIB DD DSN=TZA.PROCLIB.CNTL,DISP=SHR
//KENO EXEC SCALE41,REGION.GO=3500K
//GO.FT04F001 DD DISP=SHR,LABEL=(,,IN),
//  DSN=X.ST535899.S2BOC3.XSECLIB,UNIT=
//GO.FT05F001 DD VOL=SER=,UNIT=SYSDA,DISP=(NEW,PASS),
//  SPACE=(4800,(0040,20)),DCB=BLKSIZE=4800
//GO.FT08F001 DD UNIT=SYSDA,SPACE=(CYL,(20,5)),
//  DCB=(DSORG=DA,RECFM=F)
//GO.FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(20,5)),
//  DCB=(DSORG=DA,RECFM=F)
//GO.FT34F001 DD DSN=X.ST535899.S2BOC3.KENOVST,
//  DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136),
//  UNIT=DISK,SPACE=(TRK,(05,05)),DISP=(,CATLG)
//GO.SYSIN DD *
#KENOV
SEQUOYAH 2 CYCLE 3 BOC (1/8 CORE SYM) HFP, ARO EQXE
'
' *** *
' *** *
' *** *          FULL CORE KENO5A REACTOR CONFIGURATION
' *** *          FOR SEQUOYAH UNIT-2 BOC-3      HFP, ARO EQXE
' *** *          1 PLANE  MODEL
' *** *
' *** *          BY
' *** *          STEVE BOWMAN
' *** *          OAK RIDGE NATIONAL LABORATORY
' *** *
' *** *          1991
' *** *
' *** *
'
READ PARM
RUN=YES PLT=YES NUB=YES FDN=YES TME=60.0 GEN=303 NPG=1000
WRS=34 RES=50
LIB=4 NB8=2400 NL8=880 END PARM

READ MIXT
MIX=101
'ASSY 1
'SQ2C3 QC LOC #1 REGION3 (BATCH2) 21182 MWD/MTU
292234 4.4190E-06
292235 3.1399E-04
292236 7.5168E-05
292238 2.2082E-02
93237 6.5936E-06
94238 1.3857E-06
294239 1.2501E-04
294240 3.4211E-05
294241 2.0576E-05
94242 3.9416E-06
95241 9.1843E-07
95243 5.4524E-07
96244 8.0661E-08
8016 4.6382E-02
36083 2.0472E-06
40093 2.8616E-05
42095 2.8441E-05
43099 2.9553E-05
44101 2.7371E-05
44103 3.2506E-07
45103 1.7506E-05
45105 5.2209E-08
46105 1.1776E-05

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Table D.10 (continued)

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46108	3.7826E-06
47109	2.5153E-06
53135	2.3243E-08
54131	1.3237E-05
54135	9.1618E-09
55133	3.2247E-05
55134	1.9162E-06
55135	1.0268E-05
59141	2.8626E-05
60143	2.3459E-05
60145	1.7811E-05
60147	7.5790E-08
60148	8.8097E-06
61147	5.2362E-06
61148	1.6107E-08
61149	2.9395E-08
62147	2.4698E-06
62149	9.2486E-08
62150	7.4398E-06
62151	4.8556E-07
62152	3.1714E-06
63153	2.2381E-06
63154	6.0034E-07
63155	2.4568E-07
64155	1.3393E-08

MIX=102  
 'ASSY 2  
 'SQ2C3 QC LOC #2 REGION5B (BATCH7) 150 MWD/MTU

1192234	7.2937E-06
1192235	8.4103E-04
1192236	4.7825E-06
1192238	2.2333E-02
93237	3.8204E-09
94238	1.2829E-12
1194239	9.4878E-07
1194240	3.8974E-09
1194241	3.3335E-11
94242	2.7115E-14
95241	4.2721E-15
95243	1.4624E-17
96244	5.4522E-21
8016	4.6385E-02
36083	1.8378E-08
40093	1.9501E-07
42095	1.3796E-10
43099	7.4366E-08
44101	1.8551E-07
44103	1.1430E-07
45103	4.1927E-09
45105	1.7776E-08
46105	2.1240E-08
46108	3.8457E-09
47109	1.5179E-09
53135	2.1941E-08
54131	1.5982E-08
54135	1.0344E-08
55133	3.2171E-08
55134	1.1684E-11
55135	7.2406E-08
59141	8.0712E-09
60143	9.4643E-09
60145	1.2947E-07
60147	7.2117E-08
60148	6.1479E-08
61147	9.7966E-09

Table D.10 (continued)

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61148	1.0528E-11
61149	2.1740E-08
62147	1.0043E-11
62149	1.4651E-08
62150	2.8236E-09
62151	9.8708E-09
62152	1.0542E-08
63153	3.1051E-09
63154	8.2076E-12
63155	1.3930E-09
64155	1.0519E-12

MIX=103  
'ASSY 3  
'SQ2C3 QC LOC #3 REGION4 (BATCH3) 13137 MWD/MTU

792234	5.8766E-06
792235	5.1750E-04
792236	5.8775E-05
792238	2.2147E-02
93237	3.4412E-06
94238	3.9637E-07
794239	1.0224E-04
794240	1.8030E-05
794241	9.2275E-06
94242	8.9130E-07
95241	3.0823E-07
95243	6.8056E-08
96244	5.3801E-09
8016	4.6385E-02
36083	1.4574E-06
40093	1.8965E-05
42095	1.7849E-05
43099	1.9098E-05
44101	1.7055E-05
44103	3.0527E-07
45103	1.1026E-05
45105	4.0897E-08
46105	5.9397E-06
46108	1.5868E-06
47109	1.1196E-06
53135	2.3375E-08
54131	8.8281E-06
54135	1.0056E-08
55133	2.0923E-05
55134	7.8112E-07
55135	6.1400E-06
59141	1.8152E-05
60143	1.6482E-05
60145	1.1779E-05
60147	7.5958E-08
60148	5.5431E-06
61147	4.3811E-06
61148	1.2089E-08
61149	2.7273E-08
62147	1.2918E-06
62149	1.0382E-07
62150	4.4194E-06
62151	4.2817E-07
62152	1.9441E-06
63153	1.0949E-06
63154	2.0262E-07
63155	1.1392E-07
64155	6.3246E-09

MIX=104  
'ASSY 4  
'SQ2C3 QC LOC #4 REGION5B (BATCH7) 150 MWD/MTU



Table D.10 (continued)

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1192234	7.2937E-06
1192235	8.4103E-04
1192236	4.7825E-06
1192238	2.2333E-02
93237	3.8204E-09
94238	1.2829E-12
1194239	9.4878E-07
1194240	3.8974E-09
1194241	3.3335E-11
94242	2.7115E-14
95241	4.2721E-15
95243	1.4624E-17
96244	5.4522E-21
8016	4.6385E-02
36083	1.8378E-08
40093	1.9501E-07
42095	1.3796E-10
43099	7.4366E-08
44101	1.8551E-07
44103	1.1430E-07
45103	4.1927E-09
45105	1.7776E-08
46105	2.1240E-08
46108	3.8457E-09
47109	1.5179E-09
53135	2.1941E-08
54131	1.5982E-08
54135	1.0344E-08
55133	3.2171E-08
55134	1.1684E-11
55135	7.2406E-08
59141	8.0712E-09
60143	9.4643E-09
60145	1.2947E-07
60147	7.2117E-08
60148	6.1479E-08
61147	9.7966E-09
61148	1.0528E-11
61149	2.1740E-08
62147	1.0043E-11
62149	1.4651E-08
62150	2.8236E-09
62151	9.8708E-09
62152	1.0542E-08
63153	3.1051E-09
63154	8.2076E-12
63155	1.3930E-09
64155	1.0519E-12
MIX=105	
'ASSY 5	
'SQ2C3 QC LOC #5 REGION2 (BATCH1) 23637 MWD/MTU	
192234	3.4649E-06
192235	2.0571E-04
192236	7.0830E-05
192238	2.2120E-02
93237	7.4794E-06
94238	1.9504E-06
194239	1.2613E-04
194240	4.1667E-05
194241	2.5120E-05
94242	6.4499E-06
95241	1.1780E-06
95243	1.0784E-06
96244	2.0089E-07
8016	4.6379E-02

Table D.10 (continued)

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36083	2.0869E-06
40093	3.0563E-05
42095	3.0828E-05
43099	3.2310E-05
44101	3.0572E-05
44103	3.4621E-07
45103	1.9647E-05
45105	5.8780E-08
46105	1.4687E-05
46108	5.1486E-06
47109	3.3084E-06
53135	2.3162E-08
54131	1.4297E-05
54135	8.0413E-09
55133	3.5181E-05
55134	2.4489E-06
55135	1.0233E-05
59141	3.1434E-05
60143	2.4165E-05
60145	1.9145E-05
60147	7.5555E-08
60148	9.7815E-06
61147	5.2085E-06
61148	1.7449E-08
61149	3.0568E-08
62147	2.7101E-06
62149	8.0682E-08
62150	8.6710E-06
62151	4.7609E-07
62152	3.6025E-06
63153	2.7412E-06
63154	8.2736E-07
63155	3.1939E-07
64155	1.6460E-08
MIX=106	
'ASSY 6	
'SQ2C3 QC LOC #6 REGION5B (BATCH7) 150 MWD/MTU	
1192234	7.2937E-06
1192235	8.4103E-04
1192236	4.7825E-06
1192238	2.2333E-02
93237	3.8204E-09
94238	1.2829E-12
1194239	9.4878E-07
1194240	3.8974E-09
1194241	3.3335E-11
94242	2.7115E-14
95241	4.2721E-15
95243	1.4624E-17
96244	5.4522E-21
8016	4.6385E-02
36083	1.8378E-08
40093	1.9501E-07
42095	1.3796E-10
43099	7.4366E-08
44101	1.8551E-07
44103	1.1430E-07
45103	4.1927E-09
45105	1.7776E-08
46105	2.1240E-08
46108	3.8457E-09
47109	1.5179E-09
53135	2.1941E-08
54131	1.5982E-08
54135	1.0344E-08

Table D.10. (continued)

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55133	3.2171E-08
55134	1.1684E-11
55135	7.2406E-08
59141	8.0712E-09
60143	9.4643E-09
60145	1.2947E-07
60147	7.2117E-08
60148	6.1479E-08
61147	9.7966E-09
61148	1.0528E-11
61149	2.1740E-08
62147	1.0043E-11
62149	1.4651E-08
62150	2.8236E-09
62151	9.8708E-09
62152	1.0542E-08
63153	3.1051E-09
63154	8.2076E-12
63155	1.3930E-09
64155	1.0519E-12

MIX=107  
 'ASSY 7  
 'SQ2C3 QC LOC #7 REGION3 (BATCH2) 22226 MWD/MTU

292234	4.3432E-06
292235	3.0059E-04
292236	7.7227E-05
292238	2.2062E-02
93237	7.0277E-06
94238	1.5592E-06
294239	1.2697E-04
294240	3.5975E-05
294241	2.1881E-05
94242	4.4379E-06
95241	9.9924E-07
95243	6.4740E-07
96244	1.0160E-07
8016	4.6382E-02
36083	2.1171E-06
40093	2.9836E-05
42095	2.9748E-05
43099	3.0859E-05
44101	2.8699E-05
44103	3.2851E-07
45103	1.8276E-05
45105	5.3240E-08
46105	1.2554E-05
46108	4.0865E-06
47109	2.6944E-06
53135	2.3230E-08
54131	1.3758E-05
54135	9.1190E-09
55133	3.3661E-05
55134	2.0837E-06
55135	1.0765E-05
59141	2.9969E-05
60143	2.4290E-05
60145	1.8566E-05
60147	7.5823E-08
60148	9.2331E-06
61147	5.3200E-06
61148	1.6469E-08
61149	2.9594E-08
62147	2.6122E-06
62149	9.2837E-08
62150	7.8472E-06

Table D.10 (continued)

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62151	4.9676E-07
62152	3.3155E-06
63153	2.3921E-06
63154	6.6224E-07
63155	2.6697E-07
64155	1.4561E-08

MIX=108  
'ASSY 8  
'SQ2C3 QC LOC #8 REGION5B (BATCH6) 150 MWD/MTU

1092234	7.2940E-06
1092235	8.4069E-04
1092236	4.8211E-06
1092238	2.2334E-02
93237	3.6241E-09
94238	1.2084E-12
1094239	9.0914E-07
1094240	3.7795E-09
1094241	3.1061E-11
94242	2.7474E-14
95241	3.9554E-15
95243	1.3989E-17
96244	5.0317E-21
8016	4.6385E-02
36083	1.9885E-08
40093	2.1093E-07
42095	1.4927E-10
43099	8.0272E-08
44101	1.9987E-07
44103	1.2227E-07
45103	4.4864E-09
45105	1.8702E-08
46105	2.2367E-08
46108	3.9555E-09
47109	1.5693E-09
53135	2.3648E-08
54131	1.7231E-08
54135	1.0103E-08
55133	3.4745E-08
55134	1.2160E-11
55135	6.9205E-08
59141	8.7191E-09
60143	1.0241E-08
60145	1.3980E-07
60147	7.7756E-08
60148	6.6220E-08
61147	1.0566E-08
61148	1.0947E-11
61149	2.3354E-08
62147	1.0834E-11
62149	1.5380E-08
62150	3.4011E-09
62151	1.0569E-08
62152	1.1270E-08
63153	3.3169E-09
63154	8.7351E-12
63155	1.4658E-09
64155	1.0980E-12

MIX=109  
'ASSY 9  
'SQ2C3 QC LOC #9 REGION3 (BATCH2) 26859 MWD/MTU

92234	4.0182E-06
92235	2.4667E-04
92236	8.5143E-05
92238	2.1971E-02
93237	8.9765E-06

Table D.10 (continued)

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94238	2.4750E-06
94239	1.3376E-04
94240	4.3430E-05
94241	2.7213E-05
94242	6.9413E-06
95241	1.3830E-06
95243	1.2417E-06
96244	2.4626E-07
8016	4.6382E-02
36083	2.3990E-06
40093	3.5089E-05
42095	3.5394E-05
43099	3.6495E-05
44101	3.4562E-05
44103	3.4111E-07
45103	2.1516E-05
45105	5.7350E-08
46105	1.6153E-05
46108	5.5315E-06
47109	3.5101E-06
53135	2.3176E-08
54131	1.5917E-05
54135	8.8843E-09
55133	3.9725E-05
55134	2.8523E-06
55135	1.2962E-05
59141	3.5854E-05
60143	2.7666E-05
60145	2.1806E-05
60147	7.6120E-08
60148	1.1105E-05
61147	5.5713E-06
61148	1.7796E-08
61149	3.0422E-08
62147	3.2565E-06
62149	9.3453E-08
62150	9.6436E-06
62151	5.4390E-07
62152	3.9317E-06
63153	3.0890E-06
63154	9.6307E-07
63155	3.7173E-07
64155	2.0296E-08
MIX=110	
'ASSY 10	
'SQ2C3 QC LOC #10 REGION4 (BATCH3) 13298 MWD/MTU	
792234	5.8626E-06
792235	5.1455E-04
792236	5.9287E-05
792238	2.2144E-02
93237	3.5005E-06
94238	4.0836E-07
794239	1.0292E-04
794240	1.8312E-05
794241	9.4290E-06
94242	9.2344E-07
95241	3.1628E-07
95243	7.1513E-08
96244	5.7312E-09
8016	4.6385E-02
36083	1.4721E-06
40093	1.9177E-05
42095	1.8073E-05
43099	1.9318E-05
44101	1.7261E-05

Table D.10 (continued)

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44103	3.0607E-07
45103	1.1159E-05
45105	4.1096E-08
46105	6.0337E-06
46108	1.6183E-06
47109	1.1408E-06
53135	2.3373E-08
54131	8.9252E-06
54135	1.0052E-08
55133	2.1164E-05
55134	7.9945E-07
55135	6.2142E-06
59141	1.8369E-05
60143	1.6653E-05
60145	1.1911E-05
60147	7.5950E-08
60148	5.6094E-06
61147	4.4128E-06
61148	1.2185E-08
61149	2.7311E-08
62147	1.3115E-06
62149	1.0404E-07
62150	4.4816E-06
62151	4.3033E-07
62152	1.9688E-06
63153	1.1142E-06
63154	2.0803E-07
63155	1.1581E-07
64155	6.4307E-09

MIX=111  
 'ASSY 11  
 'SQ2C3 QC LOC #11 REGION4 (BATCH3) 14229 MWD/MTU

792234	5.7826E-06
792235	4.9770E-04
792236	6.2192E-05
792238	2.2128E-02
93237	3.8482E-06
94238	4.8188E-07
794239	1.0666E-04
794240	1.9940E-05
794241	1.0610E-05
94242	1.1224E-06
95241	3.6309E-07
95243	9.3993E-08
96244	8.1342E-09
8016	4.6385E-02
36083	1.5556E-06
40093	2.0394E-05
42095	1.9348E-05
43099	2.0586E-05
44101	1.8454E-05
44103	3.1100E-07
45103	1.1923E-05
45105	4.2225E-08
46105	6.5852E-06
46108	1.8048E-06
47109	1.2660E-06
53135	2.3359E-08
54131	9.4813E-06
54135	1.0028E-08
55133	2.2549E-05
55134	9.0985E-07
55135	6.6426E-06
59141	1.9620E-05
60143	1.7628E-05

Table D.10 (continued)

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60145	1.2664E-05
60147	7.5914E-08
60148	5.9928E-06
61147	4.5936E-06
61148	1.2742E-08
61149	2.7526E-08
62147	1.4213E-06
62149	1.0529E-07
62150	4.8460E-06
62151	4.4267E-07
62152	2.1112E-06
63153	1.2277E-06
63154	2.4076E-07
63155	1.2722E-07
64155	7.0699E-09

MIX=112  
 'ASSY 12  
 'SQ2C3 QC LOC #12 REGION4 (BATCH3) 11846 MWD/MTU

692234	5.9884E-06
692235	5.4176E-04
692236	5.4550E-05
692238	2.2168E-02
93237	2.9774E-06
94238	3.0753E-07
694239	9.6495E-05
694240	1.5780E-05
694241	7.6493E-06
94242	6.5732E-07
95241	2.4473E-07
95243	4.4520E-08
96244	3.1362E-09
8016	4.6385E-02
36083	1.3375E-06
40093	1.7254E-05
42095	1.6037E-05
43099	1.7321E-05
44101	1.5400E-05
44103	2.9939E-07
45103	9.9586E-06
45105	3.9267E-08
46105	5.2016E-06
46108	1.3440E-06
47109	9.5381E-07
53135	2.3394E-08
54131	8.0396E-06
54135	1.0084E-08
55133	1.8980E-05
55134	6.4243E-07
55135	5.5426E-06
59141	1.6410E-05
60143	1.5087E-05
60145	1.0718E-05
60147	7.6023E-08
60148	5.0108E-06
61147	4.1196E-06
61148	1.1300E-08
61149	2.6973E-08
62147	1.1272E-06
62149	1.0196E-07
62150	3.9285E-06
62151	4.1048E-07
62152	1.7441E-06
63153	9.4469E-07
63154	1.6217E-07
63155	9.9586E-08

Table D.10 (continued)

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64155	5.5189E-09
MIX=113	
'ASSY 13	
'SQ2C3 QC	LOC #13 REGION3 (BATCH2) 21645 MWD/MTU
292234	4.3853E-06
292235	3.0798E-04
292236	7.6094E-05
292238	2.2073E-02
93237	6.7857E-06
94238	1.4611E-06
294239	1.2590E-04
294240	3.4997E-05
294241	2.1158E-05
94242	4.1584E-06
95241	9.5393E-07
95243	5.8915E-07
96244	8.9505E-08
8016	4.6382E-02
36083	2.0785E-06
40093	2.9159E-05
42095	2.9023E-05
43099	3.0134E-05
44101	2.7960E-05
44103	3.2662E-07
45103	1.7849E-05
45105	5.2670E-08
46105	1.2120E-05
46108	3.9163E-06
47109	2.5945E-06
53135	2.3237E-08
54131	1.3469E-05
54135	9.1427E-09
55133	3.2876E-05
55134	1.9902E-06
55135	1.0489E-05
59141	2.9222E-05
60143	2.3831E-05
60145	1.8147E-05
60147	7.5804E-08
60148	8.9976E-06
61147	5.2747E-06
61148	1.6272E-08
61149	2.9484E-08
62147	2.5328E-06
62149	9.2650E-08
62150	7.6206E-06
62151	4.9055E-07
62152	3.2355E-06
63153	2.3062E-06
63154	6.2750E-07
63155	2.5501E-07
64155	1.3905E-08
MIX=114	
'ASSY 14	
'SQ2C3 QC	LOC #14 REGION5A (BATCH4) 150 MWD/MTU
892234	7.7651E-06
892235	8.8764E-04
892236	4.8288E-06
892238	2.2287E-02
93237	3.5671E-09
94238	1.1530E-12
894239	8.8628E-07
894240	3.5597E-09
894241	2.8613E-11
94242	2.4058E-14



Table D.10 (continued)

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95241	3.6487E-15
95243	1.2021E-17
96244	4.2209E-21
8016	4.6386E-02
36083	1.9899E-08
40093	2.1105E-07
42095	1.4936E-10
43099	8.0303E-08
44101	1.9991E-07
44103	1.2220E-07
45103	4.4843E-09
45105	1.8686E-08
46105	2.2343E-08
46108	3.9332E-09
47109	1.5606E-09
53135	2.3655E-08
54131	1.7236E-08
54135	1.0569E-08
55133	3.4759E-08
55134	1.1873E-11
55135	7.2247E-08
59141	8.7230E-09
60143	1.0247E-08
60145	1.3986E-07
60147	7.7780E-08
60148	6.6232E-08
61147	1.0570E-08
61148	1.0683E-11
61149	2.3358E-08
62147	1.0838E-11
62149	1.5551E-08
62150	3.2236E-09
62151	1.0579E-08
62152	1.1252E-08
63153	3.3137E-09
63154	8.4500E-12
63155	1.4638E-09
64155	1.1010E-12

MIX=115  
 'ASSY 15  
 'SQ2C3 QC LOC #15 REGION5A (BATCH4) 150 MWD/MTU

892234	7.7651E-06
892235	8.8764E-04
892236	4.8288E-06
892238	2.2287E-02
93237	3.5671E-09
94238	1.1530E-12
894239	8.8628E-07
894240	3.5597E-09
894241	2.8613E-11
94242	2.4058E-14
95241	3.6487E-15
95243	1.2021E-17
96244	4.2209E-21
8016	4.6386E-02
36083	1.9899E-08
40093	2.1105E-07
42095	1.4936E-10
43099	8.0303E-08
44101	1.9991E-07
44103	1.2220E-07
45103	4.4843E-09
45105	1.8686E-08
46105	2.2343E-08
46108	3.9332E-09

Table D.10 (continued)

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47109	1.5606E-09
53135	2.3655E-08
54131	1.7236E-08
54135	1.0569E-08
55133	3.4759E-08
55134	1.1873E-11
55135	7.2247E-08
59141	8.7230E-09
60143	1.0247E-08
60145	1.3986E-07
60147	7.7780E-08
60148	6.6232E-08
61147	1.0570E-08
61148	1.0683E-11
61149	2.3358E-08
62147	1.0838E-11
62149	1.5551E-08
62150	3.2236E-09
62151	1.0579E-08
62152	1.1252E-08
63153	3.3137E-09
63154	8.4500E-12
63155	1.4638E-09
64155	1.1010E-12
MIX=116	
'ASSY 16	
'SQ2C3 QC LOC #16 REGION3 (BATCH2) 23043 MWD/MTU	
392234	4.2846E-06
392235	2.9042E-04
392236	7.8765E-05
392238	2.2046E-02
93237	7.3694E-06
94238	1.7034E-06
394239	1.2838E-04
394240	3.7333E-05
394241	2.2880E-05
94242	4.8446E-06
95241	1.0644E-06
95243	7.3529E-07
96244	1.2062E-07
8016	4.6382E-02
36083	2.1701E-06
40093	3.0782E-05
42095	3.0761E-05
43099	3.1873E-05
44101	2.9736E-05
44103	3.3104E-07
45103	1.8867E-05
45105	5.4024E-08
46105	1.3171E-05
46108	4.3301E-06
47109	2.8361E-06
53135	2.3219E-08
54131	1.4156E-05
54135	9.0847E-09
55133	3.4753E-05
55134	2.2161E-06
55135	1.1154E-05
59141	3.1014E-05
60143	2.4923E-05
60145	1.9150E-05
60147	7.5853E-08
60148	9.5640E-06
61147	5.3778E-06
61148	1.6731E-08

Table D.10 (continued)

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61149	2.9745E-08
62147	2.7249E-06
62149	9.3059E-08
62150	8.1655E-06
62151	5.0537E-07
62152	3.4269E-06
63153	2.5136E-06
63154	7.1229E-07
63155	2.8425E-07
64155	1.5511E-08

MIX=117  
'ASSY 17  
'SQ2C3 QC LOC #17 REGION5B (BATCH7) 150 MWD/MTU

1192234	7.2937E-06
1192235	8.4103E-04
1192236	4.7825E-06
1192238	2.2333E-02
93237	3.8204E-09
94238	1.2829E-12
1194239	9.4878E-07
1194240	3.8974E-09
1194241	3.3335E-11
94242	2.7115E-14
95241	4.2721E-15
95243	1.4624E-17
96244	5.4522E-21
8016	4.6385E-02
36083	1.8378E-08
40093	1.9501E-07
42095	1.3796E-10
43099	7.4366E-08
44101	1.8551E-07
44103	1.1430E-07
45103	4.1927E-09
45105	1.7776E-08
46105	2.1240E-08
46108	3.8457E-09
47109	1.5179E-09
53135	2.1941E-08
54131	1.5982E-08
54135	1.0344E-08
55133	3.2171E-08
55134	1.1684E-11
55135	7.2406E-08
59141	8.0712E-09
60143	9.4643E-09
60145	1.2947E-07
60147	7.2117E-08
60148	6.1479E-08
61147	9.7966E-09
61148	1.0528E-11
61149	2.1740E-08
62147	1.0043E-11
62149	1.4651E-08
62150	2.8236E-09
62151	9.8708E-09
62152	1.0542E-08
63153	3.1051E-09
63154	8.2076E-12
63155	1.3930E-09
64155	1.0519E-12

MIX=118  
'ASSY 18  
'SQ2C3 QC LOC #18 REGION3 (BATCH2) 23685 MWD/MTU

392234	4.2388E-06
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Table D.10 (continued)

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392235	2.8265E-04
392236	7.9930E-05
392238	2.2034E-02
93237	7.6388E-06
94238	1.8221E-06
394239	1.2942E-04
394240	3.8384E-05
394241	2.3651E-05
94242	5.1751E-06
95241	1.1168E-06
95243	8.0935E-07
96244	1.3732E-07
8016	4.6382E-02
36083	2.2107E-06
40093	3.1518E-05
42095	3.1552E-05
43099	3.2662E-05
44101	3.0550E-05
44103	3.3292E-07
45103	1.9327E-05
45105	5.4626E-08
46105	1.3662E-05
46108	4.5251E-06
47109	2.9481E-06
53135	2.3211E-08
54131	1.4464E-05
54135	9.0575E-09
55133	3.5606E-05
55134	2.3211E-06
55135	1.1459E-05
59141	3.1834E-05
60143	2.5409E-05
60145	1.9605E-05
60147	7.5880E-08
60148	9.8237E-06
61147	5.4185E-06
61148	1.6925E-08
61149	2.9860E-08
62147	2.8142E-06
62149	9.3202E-08
62150	8.4150E-06
62151	5.1206E-07
62152	3.5135E-06
63153	2.6096E-06
63154	7.5257E-07
63155	2.9821E-07
64155	1.6279E-08
MIX=119	
'ASSY 19	
'SQ2C3 QC LOC #19 REGION5A (BATCH5) 150 MWD/MTU	
992234	7.7648E-06
992235	8.8797E-04
992236	4.7915E-06
992238	2.2287E-02
93237	3.7456E-09
94238	1.2184E-12
994239	9.2286E-07
994240	3.6644E-09
994241	3.0555E-11
94242	2.3694E-14
95241	3.9201E-15
95243	1.2489E-17
96244	4.5337E-21
8016	4.6386E-02
36083	1.8444E-08

Table D.10 (continued)

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40093	1.9569E-07
42095	1.3844E-10
43099	7.4598E-08
44101	1.8604E-07
44103	1.1448E-07
45103	4.1998E-09
45105	1.7780E-08
46105	2.1241E-08
46108	3.8232E-09
47109	1.5096E-09
53135	2.2006E-08
54131	1.6029E-08
54135	1.0797E-08
55133	3.2274E-08
55134	1.1412E-11
55135	7.5417E-08
59141	8.0974E-09
60143	9.4979E-09
60145	1.2989E-07
60147	7.2332E-08
60148	6.1650E-08
61147	9.8265E-09
61148	1.0277E-11
61149	2.1796E-08
62147	1.0074E-11
62149	1.4822E-08
62150	2.6917E-09
62151	9.9003E-09
62152	1.0549E-08
63153	3.1082E-09
63154	7.9534E-12
63155	1.3926E-09
64155	1.0551E-12

MIX=120  
 'ASSY 20  
 'SQ2C3 QC LOC #20 REGION3 (BATCH2) 20877 MWD/MTU

292234	4.4413E-06
292235	3.1801E-04
292236	7.4546E-05
292238	2.2088E-02
93237	6.4673E-06
94238	1.3373E-06
294239	1.2441E-04
294240	3.3689E-05
294241	2.0190E-05
94242	3.8017E-06
95241	8.9531E-07
95243	5.1749E-07
96244	7.5203E-08
8016	4.6382E-02
36083	2.0263E-06
40093	2.8257E-05
42095	2.8057E-05
43099	2.9168E-05
44101	2.6982E-05
44103	3.2402E-07
45103	1.7279E-05
45105	5.1902E-08
46105	1.1551E-05
46108	3.6954E-06
47109	2.4634E-06
53135	2.3247E-08
54131	1.3083E-05
54135	9.1744E-09
55133	3.1832E-05

Table D.10 (continued)

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55134	1.8679E-06
55135	1.0123E-05
59141	2.8233E-05
60143	2.3212E-05
60145	1.7588E-05
60147	7.5781E-08
60148	8.6860E-06
61147	5.2097E-06
61148	1.5996E-08
61149	2.9335E-08
62147	2.4284E-06
62149	9.2371E-08
62150	7.3207E-06
62151	4.8225E-07
62152	3.1289E-06
63153	2.1935E-06
63154	5.8272E-07
63155	2.3963E-07
64155	1.3062E-08

MIX=121  
 'ASSY 21  
 'SQ2C3 QC LOC #21 REGION5A (BATCH4) 150 MWD/MTU

892234	7.7651E-06
892235	8.8764E-04
892236	4.8288E-06
892238	2.2287E-02
93237	3.5671E-09
94238	1.1530E-12
894239	8.8628E-07
894240	3.5597E-09
894241	2.8613E-11
94242	2.4058E-14
95241	3.6487E-15
95243	1.2021E-17
96244	4.2209E-21
8016	4.6386E-02
36083	1.9899E-08
40093	2.1105E-07
42095	1.4936E-10
43099	8.0303E-08
44101	1.9991E-07
44103	1.2220E-07
45103	4.4843E-09
45105	1.8686E-08
46105	2.2343E-08
46108	3.9332E-09
47109	1.5606E-09
53135	2.3655E-08
54131	1.7236E-08
54135	1.0569E-08
55133	3.4759E-08
55134	1.1873E-11
55135	7.2247E-08
59141	8.7230E-09
60143	1.0247E-08
60145	1.3986E-07
60147	7.7780E-08
60148	6.6232E-08
61147	1.0570E-08
61148	1.0683E-11
61149	2.3358E-08
62147	1.0838E-11
62149	1.5551E-08
62150	3.2236E-09

Table D.10 (continued)

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62151	1.0579E-08
62152	1.1252E-08
63153	3.3137E-09
63154	8.4500E-12
63155	1.4638E-09
64155	1.1010E-12

MIX=122

'ASSY 22

'SQ2C3 QC LOC #22 REGION3 (BATCH2) 24587 MWD/MTU

392234	4.1753E-06
392235	2.7200E-04
392236	8.1503E-05
392238	2.2016E-02
93237	8.0183E-06
94238	1.9967E-06
394239	1.3078E-04
394240	3.9839E-05
394241	2.4712E-05
94242	5.6551E-06
95241	1.1919E-06
95243	9.2099E-07
96244	1.6362E-07
8016	4.6382E-02
36083	2.2664E-06
40093	3.2545E-05
42095	3.2656E-05
43099	3.3765E-05
44101	3.1692E-05
44103	3.3542E-07
45103	1.9961E-05
45105	5.5453E-08
46105	1.4359E-05
46108	4.8039E-06
47109	3.1066E-06
53135	2.3199E-08
54131	1.4889E-05
54135	9.0188E-09
55133	3.6792E-05
55134	2.4695E-06
55135	1.1887E-05
59141	3.2981E-05
60143	2.6074E-05
60145	2.0239E-05
60147	7.5922E-08
60148	1.0188E-05
61147	5.4693E-06
61148	1.7179E-08
61149	3.0017E-08
62147	2.9405E-06
62149	9.3360E-08
62150	8.7649E-06
62151	5.2134E-07
62152	3.6339E-06
63153	2.7452E-06
63154	8.1049E-07
63155	3.1833E-07
64155	1.7388E-08

MIX=123

'ASSY 23

'SQ2C3 QC LOC #23 REGION4 (BATCH3) 10575 MWD/MTU

692234	6.0995E-06
692235	5.6657E-04
692236	5.0189E-05
692238	2.2190E-02
93237	2.5409E-06

Table D.10 (continued)

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94238	2.3258E-07
694239	9.0226E-05
694240	1.3585E-05
694241	6.1750E-06
94242	4.6724E-07
95241	1.8486E-07
95243	2.7773E-08
96244	1.7192E-09
8016	4.6385E-02
36083	1.2153E-06
40093	1.5545E-05
42095	1.4212E-05
43099	1.5552E-05
44101	1.3769E-05
44103	2.9438E-07
45103	8.9007E-06
45105	3.7591E-08
46105	4.5022E-06
46108	1.1211E-06
47109	7.9922E-07
53135	2.3413E-08
54131	7.2460E-06
54135	1.0108E-08
55133	1.7046E-05
55134	5.2010E-07
55135	4.9517E-06
59141	1.4685E-05
60143	1.3671E-05
60145	9.6581E-06
60147	7.6104E-08
60148	4.4863E-06
61147	3.8473E-06
61148	1.0496E-08
61149	2.6672E-08
62147	9.5596E-07
62149	9.9976E-08
62150	3.4591E-06
62151	3.9212E-07
62152	1.5451E-06
63153	8.0430E-07
63154	1.2720E-07
63155	8.6835E-08
64155	4.7992E-09
MIX=124	
'ASSY 24	
'SQ2C3 QC LOC #24 REGION4 (BATCH3) 14185 MWD/MTU	
792234	5.7864E-06
792235	4.9848E-04
792236	6.2057E-05
792238	2.2129E-02
93237	3.8316E-06
94238	4.7824E-07
794239	1.0648E-04
794240	1.9862E-05
794241	1.0554E-05
94242	1.1125E-06
95241	3.6086E-07
95243	9.2831E-08
96244	8.0053E-09
8016	4.6385E-02
36083	1.5517E-06
40093	2.0337E-05
42095	1.9288E-05
43099	2.0526E-05
44101	1.8398E-05



Table D.10 (continued)

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44103	3.1076E-07
45103	1.1887E-05
45105	4.2171E-08
46105	6.5587E-06
46108	1.7959E-06
47109	1.2600E-06
53135	2.3360E-08
54131	9.4552E-06
54135	1.0029E-08
55133	2.2484E-05
55134	9.0450E-07
55135	6.6224E-06
59141	1.9560E-05
60143	1.7583E-05
60145	1.2628E-05
60147	7.5915E-08
60148	5.9747E-06
61147	4.5852E-06
61148	1.2716E-08
61149	2.7516E-08
62147	1.4163E-06
62149	1.0523E-07
62150	4.8286E-06
62151	4.4209E-07
62152	2.1045E-06
63153	1.2222E-06
63154	2.3915E-07
63155	1.2667E-07
64155	7.0389E-09
MIX=125	
'ASSY 25	
'SQ2C3 QC LOC #25 REGION5A (BATCH5) 150 MWD/MTU	
992234	7.7648E-06
992235	8.8797E-04
992236	4.7915E-06
992238	2.2287E-02
93237	3.7456E-09
94238	1.2184E-12
994239	9.2286E-07
994240	3.6644E-09
994241	3.0555E-11
94242	2.3694E-14
95241	3.9201E-15
95243	1.2489E-17
96244	4.5337E-21
8016	4.6386E-02
36083	1.8444E-08
40093	1.9569E-07
42095	1.3844E-10
43099	7.4598E-08
44101	1.8604E-07
44103	1.1448E-07
45103	4.1998E-09
45105	1.7780E-08
46105	2.1241E-08
46108	3.8232E-09
47109	1.5096E-09
53135	2.2006E-08
54131	1.6029E-08
54135	1.0797E-08
55133	3.2274E-08
55134	1.1412E-11
55135	7.5417E-08
59141	8.0974E-09
60143	9.4979E-09

Table D.10 (continued)

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60145	1.2989E-07
60147	7.2332E-08
60148	6.1650E-08
61147	9.8265E-09
61148	1.0277E-11
61149	2.1796E-08
62147	1.0074E-11
62149	1.4822E-08
62150	2.6917E-09
62151	9.9003E-09
62152	1.0549E-08
63153	3.1082E-09
63154	7.9534E-12
63155	1.3926E-09
64155	1.0551E-12

MIX=126  
 'ASSY 26  
 'SQ2C3 QC LOC #26 REGION4 (BATCH3) 8618 MWD/MTU

592234	6.2724E-06
592235	6.0671E-04
592236	4.3054E-05
592238	2.2221E-02
93237	1.9130E-06
94238	1.4031E-07
594239	7.9158E-05
594240	1.0258E-05
594241	4.1411E-06
94242	2.4839E-07
95241	1.0297E-07
95243	1.1759E-08
96244	5.4104E-10
8016	4.6385E-02
36083	1.0189E-06
40093	1.2864E-05
42095	1.1351E-05
43099	1.2792E-05
44101	1.1258E-05
44103	2.8718E-07
45103	7.2564E-06
45105	3.5030E-08
46105	3.4826E-06
46108	8.1114E-07
47109	5.8017E-07
53135	2.3445E-08
54131	5.9910E-06
54135	1.0136E-08
55133	1.4026E-05
55134	3.5747E-07
55135	4.0388E-06
59141	1.2009E-05
60143	1.1405E-05
60145	7.9937E-06
60147	7.6197E-08
60148	3.6767E-06
61147	3.3814E-06
61148	9.0389E-09
61149	2.6132E-08
62147	6.9053E-07
62149	9.6285E-08
62150	2.7595E-06
62151	3.6081E-07
62152	1.2352E-06
63153	6.0447E-07
63154	8.2439E-08
63155	6.9365E-08

Table D.10 (continued)

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64155	3.8131E-09
MIX=127	
'ASSY 27	
'SQ2C3 QC	LOC #27 REGION2 (BATCH1) 25339 MWD/MTU
192234	3.3593E-06
192235	1.8944E-04
192236	7.3059E-05
192238	2.2085E-02
93237	8.1515E-06
94238	2.2994E-06
194239	1.2825E-04
194240	4.4439E-05
194241	2.6971E-05
94242	7.5302E-06
95241	1.3124E-06
95243	1.3540E-06
96244	2.7502E-07
8016	4.6379E-02
36083	2.1791E-06
40093	3.2406E-05
42095	3.2830E-05
43099	3.4344E-05
44101	3.2730E-05
44103	3.5083E-07
45103	2.0838E-05
45105	6.0233E-08
46105	1.6104E-05
46108	5.7399E-06
47109	3.6317E-06
53135	2.3145E-08
54131	1.5064E-05
54135	7.9728E-09
55133	3.7364E-05
55134	2.7453E-06
55135	1.0975E-05
59141	3.3562E-05
60143	2.5287E-05
60145	2.0294E-05
60147	7.5735E-08
60148	1.0467E-05
61147	5.2921E-06
61148	1.7982E-08
61149	3.0912E-08
62147	2.9303E-06
62149	8.1079E-08
62150	9.3476E-06
62151	4.9363E-07
62152	3.8315E-06
63153	3.0054E-06
63154	9.4571E-07
63155	3.6051E-07
64155	1.8588E-08
MIX=128	
'ASSY 28	
'SQ2C3 QC	LOC #28 REGION4 (BATCH3) 10711 MWD/MTU
692234	6.0875E-06
692235	5.6387E-04
692236	5.0665E-05
692238	2.2187E-02
93237	2.5865E-06
94238	2.4003E-07
694239	9.0928E-05
694240	1.3818E-05
694241	6.3283E-06
94242	4.8573E-07

Table D.10 (continued)

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95241	1.9109E-07
95243	2.9295E-08
96244	1.8409E-09
8016	4.6385E-02
36083	1.2285E-06
40093	1.5728E-05
42095	1.4409E-05
43099	1.5742E-05
44101	1.3943E-05
44103	2.9489E-07
45103	9.0142E-06
45105	3.7773E-08
46105	4.5757E-06
46108	1.1441E-06
47109	8.1532E-07
53135	2.3411E-08
54131	7.3317E-06
54135	1.0105E-08
55133	1.7254E-05
55134	5.3254E-07
55135	5.0151E-06
59141	1.4870E-05
60143	1.3826E-05
60145	9.7723E-06
60147	7.6094E-08
60148	4.5423E-06
61147	3.8774E-06
61148	1.0584E-08
61149	2.6705E-08
62147	9.7454E-07
62149	1.0020E-07
62150	3.5086E-06
62151	3.9414E-07
62152	1.5665E-06
63153	8.1895E-07
63154	1.3071E-07
63155	8.8141E-08
64155	4.8731E-09
MIX=129	
'ASSY 29	
'SQ2C3 QC LOC #29 REGION4 (BATCH3) 8550 MWD/MTU	
592234	6.2785E-06
592235	6.0814E-04
592236	4.2797E-05
592238	2.2223E-02
93237	1.8923E-06
94238	1.3760E-07
594239	7.8742E-05
594240	1.0146E-05
594241	4.0743E-06
94242	2.4228E-07
95241	1.0046E-07
95243	1.1376E-08
96244	5.1545E-10
8016	4.6385E-02
36083	1.0119E-06
40093	1.2769E-05
42095	1.1251E-05
43099	1.2695E-05
44101	1.1170E-05
44103	2.8689E-07
45103	7.1989E-06
45105	3.4930E-08
46105	3.4485E-06
46108	8.0110E-07

Table D.10 (continued)

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47109	5.7299E-07
53135	2.3446E-08
54131	5.9466E-06
54135	1.0137E-08
55133	1.3920E-05
55134	3.5235E-07
55135	4.0071E-06
59141	1.1915E-05
60143	1.1324E-05
60145	7.9351E-06
60147	7.6204E-08
60148	3.6485E-06
61147	3.3638E-06
61148	8.9900E-09
61149	2.6115E-08
62147	6.8166E-07
62149	9.6152E-08
62150	2.7355E-06
62151	3.5963E-07
62152	1.2243E-06
63153	5.9790E-07
63154	8.1080E-08
63155	6.8796E-08
64155	3.7808E-09
MIX=130	
'ASSY 30	
'SQ2C3 QC LOC #30 REGION5B (BATCH6) 150 MWD/MTU	
1092234	7.2940E-06
1092235	8.4069E-04
1092236	4.8211E-06
1092238	2.2334E-02
93237	3.6241E-09
94238	1.2084E-12
1094239	9.0914E-07
1094240	3.7795E-09
1094241	3.1061E-11
94242	2.7474E-14
95241	3.9554E-15
95243	1.3989E-17
96244	5.0317E-21
8016	4.6385E-02
36083	1.9885E-08
40093	2.1093E-07
42095	1.4927E-10
43099	8.0272E-08
44101	1.9987E-07
44103	1.2227E-07
45103	4.4864E-09
45105	1.8702E-08
46105	2.2367E-08
46108	3.9555E-09
47109	1.5693E-09
53135	2.3648E-08
54131	1.7231E-08
54135	1.0103E-08
55133	3.4745E-08
55134	1.2160E-11
55135	6.9205E-08
59141	8.7191E-09
60143	1.0241E-08
60145	1.3980E-07
60147	7.7756E-08
60148	6.6220E-08
61147	1.0566E-08
61148	1.0947E-11

Table D.10 (continued)

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61149	2.3354E-08
62147	1.0834E-11
62149	1.5380E-08
62150	3.4011E-09
62151	1.0569E-08
62152	1.1270E-08
63153	3.3169E-09
63154	8.7351E-12
63155	1.4658E-09
64155	1.0980E-12

MIX=131  
 'ASSY 31  
 'SQ2C3 QC LOC #31 REGION3 (BATCH2) 24497 MWD/MTU

392234	4.1817E-06
392235	2.7305E-04
392236	8.1349E-05
392238	2.2018E-02
93237	7.9804E-06
94238	1.9788E-06
394239	1.3064E-04
394240	3.9694E-05
394241	2.4607E-05
94242	5.6064E-06
95241	1.1843E-06
95243	9.0944E-07
96244	1.6084E-07
8016	4.6382E-02
36083	2.2609E-06
40093	3.2443E-05
42095	3.2546E-05
43099	3.3655E-05
44101	3.1578E-05
44103	3.3518E-07
45103	1.9899E-05
45105	5.5370E-08
46105	1.4289E-05
46108	4.7758E-06
47109	3.0907E-06
53135	2.3200E-08
54131	1.4847E-05
54135	9.0226E-09
55133	3.6674E-05
55134	2.4547E-06
55135	1.1844E-05
59141	3.2867E-05
60143	2.6008E-05
60145	2.0176E-05
60147	7.5917E-08
60148	1.0152E-05
61147	5.4646E-06
61148	1.7155E-08
61149	3.0002E-08
62147	2.9279E-06
62149	9.3346E-08
62150	8.7300E-06
62151	5.2042E-07
62152	3.6221E-06
63153	2.7317E-06
63154	8.0463E-07
63155	3.1630E-07
64155	1.7275E-08

MIX=1  
 40302 4.25156E-02  
 MIX=2  
 24304 1.74286E-02

Table D.10 (continued)

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25055	1.73633E-03
26304	5.93579E-02
28304	7.72073E-03
MIX=3	
1001	4.78066E-02
308016	2.39033E-02
5010	9.04977E-06
5011	3.67394E-05
MIX=4	
424304	8.71428E-03
425055	8.68166E-04
426304	2.96789E-02
428304	3.86037E-03
401001	2.39033E-02
408016	1.19517E-02
405010	4.52490E-06
405011	1.83697E-05
MIX=5	
524304	1.74286E-02
525055	1.73633E-03
526304	5.93579E-02
528304	7.72073E-03
MIX=6	
601001	4.91708E-02
608016	2.45854E-02
605010	9.30801E-06
605011	3.77878E-05
MIX=7	
724304	1.74286E-02
725055	1.73633E-03
726304	5.93579E-02
728304	7.72073E-03
MIX=8	
801001	5.04213E-02
808016	2.52107E-02
805010	9.54473E-06
805011	3.87488E-05
MIX=9	
924304	1.74286E-02
925055	1.73633E-03
926304	5.93579E-02
928304	7.72073E-03
MIX=11	
'SQ2C3 BP FOR QC LOC #2 REGION5B (BATCH7)	
1108016	4.49700E-02
1105010	9.3990E-04
1105011	3.86300E-03
11023	1.65000E-03
13027	5.80000E-04
MIX=12	
'SQ2C3 BP FOR QC LOC #4 REGION5B (BATCH7)	
1108016	4.49700E-02
1105010	9.3990E-04
1105011	3.86300E-03
11023	1.65000E-03
13027	5.80000E-04
MIX=13	
'SQ2C3 BP FOR QC LOC #6 REGION5B (BATCH7)	
1108016	4.49700E-02
1105010	9.3990E-04
1105011	3.86300E-03
11023	1.65000E-03
13027	5.80000E-04
MIX=14	
'SQ2C3 BP FOR QC LOC #14 REGION5A (BATCH5)	

Table D.10 (continued)

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1108016 4.49700E-02
1105010 9.4056E-04
1105011 3.86300E-03
11023 1.65000E-03
13027 5.80000E-04
MIX=15
'SQ2C3 BP FOR QC LOC #17 REGION5B (BATCH7)
1108016 4.49700E-02
1105010 9.3990E-04
1105011 3.86300E-03
11023 1.65000E-03
13027 5.80000E-04
MIX=16
'SQ2C3 BP FOR QC LOC #19 REGION5A (BATCH5)
1108016 4.49700E-02
1105010 9.4056E-04
1105011 3.86300E-03
11023 1.65000E-03
13027 5.80000E-04
MIX=17
'SQ2C3 BP FOR QC LOC #25 REGION5A (BATCH5)
1108016 4.49700E-02
1105010 9.4056E-04
1105011 3.86300E-03
11023 1.65000E-03
13027 5.80000E-04
END MIXT

READ GEOM

'--- FUEL PINS
UNIT 101
CYLINDER 0101 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 102
CYLINDER 0102 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 103
CYLINDER 0103 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 104
CYLINDER 0104 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 105
CYLINDER 0105 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 106
CYLINDER 0106 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 107
CYLINDER 0107 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0

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Table D.10 (continued)

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CUBOID	3	1	2P.62992	2P.62992	365.76	0.0
UNIT 108						
CYLINDER	0108	1	.40958	365.76	0.0	
CYLINDER	0	1	.41783	365.76	0.0	
CYLINDER	1	1	.47498	365.76	0.0	
CUBOID	3	1	2P.62992	2P.62992	365.76	0.0
UNIT 109						
CYLINDER	0109	1	.40958	365.76	0.0	
CYLINDER	0	1	.41783	365.76	0.0	
CYLINDER	1	1	.47498	365.76	0.0	
CUBOID	3	1	2P.62992	2P.62992	365.76	0.0
UNIT 110						
CYLINDER	0110	1	.40958	365.76	0.0	
CYLINDER	0	1	.41783	365.76	0.0	
CYLINDER	1	1	.47498	365.76	0.0	
CUBOID	3	1	2P.62992	2P.62992	365.76	0.0
UNIT 111						
CYLINDER	0111	1	.40958	365.76	0.0	
CYLINDER	0	1	.41783	365.76	0.0	
CYLINDER	1	1	.47498	365.76	0.0	
CUBOID	3	1	2P.62992	2P.62992	365.76	0.0
UNIT 112						
CYLINDER	0112	1	.40958	365.76	0.0	
CYLINDER	0	1	.41783	365.76	0.0	
CYLINDER	1	1	.47498	365.76	0.0	
CUBOID	3	1	2P.62992	2P.62992	365.76	0.0
UNIT 113						
CYLINDER	0113	1	.40958	365.76	0.0	
CYLINDER	0	1	.41783	365.76	0.0	
CYLINDER	1	1	.47498	365.76	0.0	
CUBOID	3	1	2P.62992	2P.62992	365.76	0.0
UNIT 114						
CYLINDER	0114	1	.40958	365.76	0.0	
CYLINDER	0	1	.41783	365.76	0.0	
CYLINDER	1	1	.47498	365.76	0.0	
CUBOID	3	1	2P.62992	2P.62992	365.76	0.0
UNIT 115						
CYLINDER	0115	1	.40958	365.76	0.0	
CYLINDER	0	1	.41783	365.76	0.0	
CYLINDER	1	1	.47498	365.76	0.0	
CUBOID	3	1	2P.62992	2P.62992	365.76	0.0
UNIT 116						
CYLINDER	0116	1	.40958	365.76	0.0	
CYLINDER	0	1	.41783	365.76	0.0	
CYLINDER	1	1	.47498	365.76	0.0	
CUBOID	3	1	2P.62992	2P.62992	365.76	0.0
UNIT 117						
CYLINDER	0117	1	.40958	365.76	0.0	
CYLINDER	0	1	.41783	365.76	0.0	
CYLINDER	1	1	.47498	365.76	0.0	
CUBOID	3	1	2P.62992	2P.62992	365.76	0.0
UNIT 118						
CYLINDER	0118	1	.40958	365.76	0.0	
CYLINDER	0	1	.41783	365.76	0.0	
CYLINDER	1	1	.47498	365.76	0.0	
CUBOID	3	1	2P.62992	2P.62992	365.76	0.0
UNIT 119						
CYLINDER	0119	1	.40958	365.76	0.0	
CYLINDER	0	1	.41783	365.76	0.0	
CYLINDER	1	1	.47498	365.76	0.0	
CUBOID	3	1	2P.62992	2P.62992	365.76	0.0
UNIT 120						
CYLINDER	0120	1	.40958	365.76	0.0	
CYLINDER	0	1	.41783	365.76	0.0	
CYLINDER	1	1	.47498	365.76	0.0	

Table D.10 (continued)

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CUBOID      3  1  2P.62992  2P.62992  365.76  0.0
UNIT 121
CYLINDER 0121 1  .40958  365.76  0.0
CYLINDER      0 1  .41783  365.76  0.0
CYLINDER      1 1  .47498  365.76  0.0
CUBOID      3  1  2P.62992  2P.62992  365.76  0.0
UNIT 122
CYLINDER 0122 1  .40958  365.76  0.0
CYLINDER      0 1  .41783  365.76  0.0
CYLINDER      1 1  .47498  365.76  0.0
CUBOID      3  1  2P.62992  2P.62992  365.76  0.0
UNIT 123
CYLINDER 0123 1  .40958  365.76  0.0
CYLINDER      0 1  .41783  365.76  0.0
CYLINDER      1 1  .47498  365.76  0.0
CUBOID      3  1  2P.62992  2P.62992  365.76  0.0
UNIT 124
CYLINDER 0124 1  .40958  365.76  0.0
CYLINDER      0 1  .41783  365.76  0.0
CYLINDER      1 1  .47498  365.76  0.0
CUBOID      3  1  2P.62992  2P.62992  365.76  0.0
UNIT 125
CYLINDER 0125 1  .40958  365.76  0.0
CYLINDER      0 1  .41783  365.76  0.0
CYLINDER      1 1  .47498  365.76  0.0
CUBOID      3  1  2P.62992  2P.62992  365.76  0.0
UNIT 126
CYLINDER 0126 1  .40958  365.76  0.0
CYLINDER      0 1  .41783  365.76  0.0
CYLINDER      1 1  .47498  365.76  0.0
CUBOID      3  1  2P.62992  2P.62992  365.76  0.0
UNIT 127
CYLINDER 0127 1  .40958  365.76  0.0
CYLINDER      0 1  .41783  365.76  0.0
CYLINDER      1 1  .47498  365.76  0.0
CUBOID      3  1  2P.62992  2P.62992  365.76  0.0
UNIT 128
CYLINDER 0128 1  .40958  365.76  0.0
CYLINDER      0 1  .41783  365.76  0.0
CYLINDER      1 1  .47498  365.76  0.0
CUBOID      3  1  2P.62992  2P.62992  365.76  0.0
UNIT 129
CYLINDER 0129 1  .40958  365.76  0.0
CYLINDER      0 1  .41783  365.76  0.0
CYLINDER      1 1  .47498  365.76  0.0
CUBOID      3  1  2P.62992  2P.62992  365.76  0.0
UNIT 130
CYLINDER 0130 1  .40958  365.76  0.0
CYLINDER      0 1  .41783  365.76  0.0
CYLINDER      1 1  .47498  365.76  0.0
CUBOID      3  1  2P.62992  2P.62992  365.76  0.0
UNIT 131
CYLINDER 0131 1  .40958  365.76  0.0
CYLINDER      0 1  .41783  365.76  0.0
CYLINDER      1 1  .47498  365.76  0.0
CUBOID      3  1  2P.62992  2P.62992  365.76  0.0

'--- GUIDE TUBE
UNIT 161
CYLINDER      3  1  .57150  365.76  0.0
CYLINDER      1 1  .61214  365.76  0.0
CUBOID      3  1  2P.62992  2P.62992  365.76  0.0

'--- BP RODS
UNIT 162

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Table D.10 (continued)

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CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0
CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	11	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0
CYLINDER	2	1	0.48387	365.76	0.0
CYLINDER	3	1	0.57150	365.76	0.0
CYLINDER	1	1	0.61214	365.76	0.0
CUBOID	3	1	2P0.62992	2P0.62992	365.76 0.0
UNIT 163					
CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0
CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	12	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0
CYLINDER	2	1	0.48387	365.76	0.0
CYLINDER	3	1	0.57150	365.76	0.0
CYLINDER	1	1	0.61214	365.76	0.0
CUBOID	3	1	2P0.62992	2P0.62992	365.76 0.0
UNIT 164					
CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0
CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	13	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0
CYLINDER	2	1	0.48387	365.76	0.0
CYLINDER	3	1	0.57150	365.76	0.0
CYLINDER	1	1	0.61214	365.76	0.0
CUBOID	3	1	2P0.62992	2P0.62992	365.76 0.0
UNIT 165					
CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0
CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	14	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0
CYLINDER	2	1	0.48387	365.76	0.0
CYLINDER	3	1	0.57150	365.76	0.0
CYLINDER	1	1	0.61214	365.76	0.0
CUBOID	3	1	2P0.62992	2P0.62992	365.76 0.0
UNIT 166					
CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0
CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	15	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0
CYLINDER	2	1	0.48387	365.76	0.0
CYLINDER	3	1	0.57150	365.76	0.0
CYLINDER	1	1	0.61214	365.76	0.0
CUBOID	3	1	2P0.62992	2P0.62992	365.76 0.0
UNIT 167					
CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0
CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	16	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0
CYLINDER	2	1	0.48387	365.76	0.0
CYLINDER	3	1	0.57150	365.76	0.0
CYLINDER	1	1	0.61214	365.76	0.0
CUBOID	3	1	2P0.62992	2P0.62992	365.76 0.0
UNIT 168					
CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0
CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	17	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0

Table D.10 (continued)

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CYLINDER      2  1  0.48387 365.76 0.0
CYLINDER      3  1  0.57150 365.76 0.0
CYLINDER      1  1  0.61214 365.76 0.0
CUBOID         3  1  2P0.62992 2P0.62992 365.76 0.0

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'--- FUEL ASSY'S
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UNIT 1
ARRAY         0101 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 2
ARRAY         0102 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 3
ARRAY         0103 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 4
ARRAY         0104 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 5
ARRAY         0105 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 6
ARRAY         0106 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 7
ARRAY         0107 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 8
ARRAY         0108 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 9
ARRAY         0109 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 10
ARRAY         0110 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 11
ARRAY         0111 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 12
ARRAY         0112 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 13
ARRAY         0113 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 14
ARRAY         0114 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 15
ARRAY         0115 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 16
ARRAY         0116 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 17
ARRAY         0117 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 18
ARRAY         0118 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 19
ARRAY         0119 2R-10.70864 0.0
REFLECTOR     3  1  4R0.04318 2R0.0 1
UNIT 20
ARRAY         0120 2R-10.70864 0.0

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Table D.10 (continued)

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REFLECTOR    3   1  4R0.04318  2R0.0  1
UNIT 21
ARRAY        0121  2R-10.70864  0.0
REFLECTOR    3   1  4R0.04318  2R0.0  1
UNIT 22
ARRAY        0122  2R-10.70864  0.0
REFLECTOR    3   1  4R0.04318  2R0.0  1
UNIT 23
ARRAY        0123  2R-10.70864  0.0
REFLECTOR    3   1  4R0.04318  2R0.0  1
UNIT 24
ARRAY        0124  2R-10.70864  0.0
REFLECTOR    3   1  4R0.04318  2R0.0  1
UNIT 25
ARRAY        0125  2R-10.70864  0.0
REFLECTOR    3   1  4R0.04318  2R0.0  1
UNIT 26
ARRAY        0126  2R-10.70864  0.0
REFLECTOR    3   1  4R0.04318  2R0.0  1
UNIT 27
ARRAY        0127  2R-10.70864  0.0
REFLECTOR    3   1  4R0.04318  2R0.0  1
UNIT 28
ARRAY        0128  2R-10.70864  0.0
REFLECTOR    3   1  4R0.04318  2R0.0  1
UNIT 29
ARRAY        0129  2R-10.70864  0.0
REFLECTOR    3   1  4R0.04318  2R0.0  1
UNIT 30
ARRAY        0130  2R-10.70864  0.0
REFLECTOR    3   1  4R0.04318  2R0.0  1
UNIT 31
ARRAY        0131  2R-10.70864  0.0
REFLECTOR    3   1  4R0.04318  2R0.0  1

'--- BAFFLE REGION
UNIT 41
CUBOID      2   1      0.0      -2.8575      0.0      -2.8575      365.76  0.0
UNIT 42
CUBOID      2   1      2P10.75182      2P1.42875      365.76  0.0
UNIT 43
CUBOID      2   1      2.8575      0.0      21.50364      0.0      365.76  0.0
UNIT 44
CUBOID      2   1      2P21.50364      2P1.42875      365.76  0.0

'---ROWS OF ASSY'S W/ BAFFLE REGIONS ON EACH END
UNIT 51
COM=! ROW 1 !
ARRAY      1 -78.12024 -13.60932  0.0
UNIT 52
COM=! ROW 2 !
ARRAY      2 -121.12752 -10.75182  0.0
UNIT 53
COM=! ROWS 3 & 4 !
ARRAY      3 -142.63116 -21.50364  0.0
UNIT 55
COM=! ROWS 5 - 11 !
ARRAY      5 -164.1348 -75.26274  0.0
UNIT 62
COM=! ROWS 12 & 13 !
ARRAY     12 -142.63116 -21.50364  0.0
UNIT 64
COM=! ROW 14 !
ARRAY     14 -121.12752 -10.75182  0.0
UNIT 65

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Table D.10 (continued)

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COM=! ROW 15 !
ARRAY 15 -78.12024 -10.75182 0.0

GLOBAL UNIT 70
CYLINDER 3 1 187.96 365.76 0.0
HOLE 55 0.0 0.0 0.0
HOLE 53 0.0 -96.76638 0.0
HOLE 62 0.0 96.76638 0.0
HOLE 52 0.0 -129.02184 0.0
HOLE 64 0.0 129.02184 0.0
HOLE 51 0.0 -150.52548 0.0
HOLE 65 0.0 150.52548 0.0
HOLE 44 -99.62388 141.20241 0
HOLE 44 -99.62388 -141.20241 0
HOLE 44 99.62388 141.20241 0
HOLE 44 99.62388 -141.20241 0
HOLE 42 -131.87936 119.69877 0
HOLE 42 -131.87936 -119.69877 0
HOLE 42 131.87934 119.69877 0
HOLE 42 131.87934 -119.69877 0
HOLE 42 -153.38300 76.69149 0
HOLE 42 -153.38300 -76.69149 0
HOLE 42 153.38298 76.69149 0
HOLE 42 153.38298 -76.69149 0
CYLINDER 4 1 187.96 390.76 -25.0
REFLECTOR 5 1 5.715 0.0 0.0 1
REFLECTOR 6 1 7.620 0.0 0.0 1
REFLECTOR 7 1 6.985 0.0 0.0 1
REFLECTOR 8 1 11.43 0.0 0.0 1
REFLECTOR 9 1 21.59 0.0 0.0 1
CUBOID 0 1 2P245.0 2P245.0 390.76 -25.0
END GEOM

READ ARRAY

'--- FUEL ASSY'S
ARA=101 NUX=17 NUY=17 NUZ=1 FILL F101
  A40 161 A43 161 A46 161 A55 161 A65 161
  A88 161 A91 161 A94 161 A97 161 A100 161
  A139 161 A142 161 A145 161 A148 161 A151 161
  A190 161 A193 161 A196 161 A199 161 A202 161
  A225 161 A235 161 A244 161 A247 161 A250 161 END FILL
'-- ASSY 2 16 BP
ARA=102 NUX=17 NUY=17 NUZ=1 FILL F102
  A40 162 A43 161 A46 162 A55 162 A65 162
  A88 162 A91 161 A94 162 A97 161 A100 162
  A139 161 A142 162 A145 161 A148 162 A151 161
  A190 162 A193 161 A196 162 A199 161 A202 162
  A225 162 A235 162 A244 162 A247 161 A250 162 END FILL
ARA=103 NUX=17 NUY=17 NUZ=1 FILL F103
  A40 161 A43 161 A46 161 A55 161 A65 161
  A88 161 A91 161 A94 161 A97 161 A100 161
  A139 161 A142 161 A145 161 A148 161 A151 161
  A190 161 A193 161 A196 161 A199 161 A202 161
  A225 161 A235 161 A244 161 A247 161 A250 161 END FILL
'-- ASSY 4 24 BP
ARA=104 NUX=17 NUY=17 NUZ=1 FILL F104
  A40 163 A43 163 A46 163 A55 163 A65 163
  A88 163 A91 163 A94 163 A97 163 A100 163
  A139 163 A142 163 A145 161 A148 163 A151 163
  A190 163 A193 163 A196 163 A199 163 A202 163
  A225 163 A235 163 A244 163 A247 163 A250 163 END FILL
ARA=105 NUX=17 NUY=17 NUZ=1 FILL F105
  A40 161 A43 161 A46 161 A55 161 A65 161
  A88 161 A91 161 A94 161 A97 161 A100 161

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Table D.10 (continued)

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A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
'-- ASSY 6 12 BP										
ARA=106		NUX=17	NUY=17	NUZ=1		FILL		F106		
A40	164	A43	161	A46	164	A55	161	A65	161	
A88	164	A91	161	A94	164	A97	161	A100	164	
A139	161	A142	164	A145	161	A148	164	A151	161	
A190	164	A193	161	A196	164	A199	161	A202	164	
A225	161	A235	161	A244	164	A247	161	A250	164	END FILL
ARA=107		NUX=17	NUY=17	NUZ=1		FILL		F107		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=108		NUX=17	NUY=17	NUZ=1		FILL		F108		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=109		NUX=17	NUY=17	NUZ=1		FILL		F109		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=110		NUX=17	NUY=17	NUZ=1		FILL		F110		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=111		NUX=17	NUY=17	NUZ=1		FILL		F111		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=112		NUX=17	NUY=17	NUZ=1		FILL		F112		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=113		NUX=17	NUY=17	NUZ=1		FILL		F113		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
'-- ASSY 14 16 BP										
ARA=114		NUX=17	NUY=17	NUZ=1		FILL		F114		
A40	165	A43	161	A46	165	A55	165	A65	165	
A88	165	A91	161	A94	165	A97	161	A100	165	
A139	161	A142	165	A145	161	A148	165	A151	161	
A190	165	A193	161	A196	165	A199	161	A202	165	
A225	165	A235	165	A244	165	A247	161	A250	165	END FILL
ARA=115		NUX=17	NUY=17	NUZ=1		FILL		F115		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	

Table D.10 (continued)

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A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=116	NUX=17	NUY=17	NUZ=1	FILL F116	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
'-- ASSY 17 12 BP					
ARA=117	NUX=17	NUY=17	NUZ=1	FILL F117	
A40 166	A43 161	A46 166	A55 161	A65 161	
A88 166	A91 161	A94 166	A97 161	A100 166	
A139 161	A142 166	A145 161	A148 166	A151 161	
A190 166	A193 161	A196 166	A199 161	A202 166	
A225 161	A235 161	A244 166	A247 161	A250 166	END FILL
ARA=118	NUX=17	NUY=17	NUZ=1	FILL F118	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
'-- ASSY 19 20 BP					
ARA=119	NUX=17	NUY=17	NUZ=1	FILL F119	
A40 167	A43 167	A46 167	A55 167	A65 167	
A88 167	A91 161	A94 167	A97 161	A100 167	
A139 167	A142 167	A145 161	A148 167	A151 167	
A190 167	A193 161	A196 167	A199 161	A202 167	
A225 167	A235 167	A244 167	A247 167	A250 167	END FILL
ARA=120	NUX=17	NUY=17	NUZ=1	FILL F120	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=121	NUX=17	NUY=17	NUZ=1	FILL F121	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=122	NUX=17	NUY=17	NUZ=1	FILL F122	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=123	NUX=17	NUY=17	NUZ=1	FILL F123	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=124	NUX=17	NUY=17	NUZ=1	FILL F124	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
'-- ASSY 25 8 BP					
ARA=125	NUX=17	NUY=17	NUZ=1	FILL F125	
A40 161	A43 161	A46 161	A55 168	A65 168	
A88 161	A91 161	A94 168	A97 161	A100 161	
A139 161	A142 168	A145 161	A148 168	A151 161	
A190 161	A193 161	A196 168	A199 161	A202 161	
A225 168	A235 168	A244 161	A247 161	A250 161	END FILL
ARA=126	NUX=17	NUY=17	NUZ=1	FILL F126	



Table D.10 (continued)

---

```

A40 161 A43 161 A46 161 A55 161 A65 161
A88 161 A91 161 A94 161 A97 161 A100 161
A139 161 A142 161 A145 161 A148 161 A151 161
A190 161 A193 161 A196 161 A199 161 A202 161
A225 161 A235 161 A244 161 A247 161 A250 161 END FILL
ARA=127 NUX=17 NUY=17 NUZ=1 FILL F127
A40 161 A43 161 A46 161 A55 161 A65 161
A88 161 A91 161 A94 161 A97 161 A100 161
A139 161 A142 161 A145 161 A148 161 A151 161
A190 161 A193 161 A196 161 A199 161 A202 161
A225 161 A235 161 A244 161 A247 161 A250 161 END FILL
ARA=128 NUX=17 NUY=17 NUZ=1 FILL F128
A40 161 A43 161 A46 161 A55 161 A65 161
A88 161 A91 161 A94 161 A97 161 A100 161
A139 161 A142 161 A145 161 A148 161 A151 161
A190 161 A193 161 A196 161 A199 161 A202 161
A225 161 A235 161 A244 161 A247 161 A250 161 END FILL
ARA=129 NUX=17 NUY=17 NUZ=1 FILL F129
A40 161 A43 161 A46 161 A55 161 A65 161
A88 161 A91 161 A94 161 A97 161 A100 161
A139 161 A142 161 A145 161 A148 161 A151 161
A190 161 A193 161 A196 161 A199 161 A202 161
A225 161 A235 161 A244 161 A247 161 A250 161 END FILL
ARA=130 NUX=17 NUY=17 NUZ=1 FILL F130
A40 161 A43 161 A46 161 A55 161 A65 161
A88 161 A91 161 A94 161 A97 161 A100 161
A139 161 A142 161 A145 161 A148 161 A151 161
A190 161 A193 161 A196 161 A199 161 A202 161
A225 161 A235 161 A244 161 A247 161 A250 161 END FILL
ARA=131 NUX=17 NUY=17 NUZ=1 FILL F131
A40 161 A43 161 A46 161 A55 161 A65 161
A88 161 A91 161 A94 161 A97 161 A100 161
A139 161 A142 161 A145 161 A148 161 A151 161
A190 161 A193 161 A196 161 A199 161 A202 161
A225 161 A235 161 A244 161 A247 161 A250 161 END FILL

'--- ROWS OF FUEL ASSY'S
ARA=1 NUX=9 NUY=2 NUZ=1 FILL
      41 42 42 42 42 1B4
      43      26 21 15 8 1B4
END FILL
ARA=2 NUX=13 NUY=1 NUZ=1 FILL
      43      31 29 25 20 14 7 1B6
END FILL
ARA=3 NUX=15 NUY=2 NUZ=1 FILL
      43      31 30 28 24 19 13 6 1B7
      43      29 28 27 23 18 12 5 1B7
END FILL
ARA=5 NUX=17 NUY=7 NUZ=1 FILL
      43      26 25 24 23 22 17 11 4 1B8
      43      21 20 19 18 17 16 10 3 1B8
      43      15 14 13 12 11 10 9 2 1B8
      43      8 7 6 5 4 3 2 1 1B59
END FILL
ARA=12 NUX=15 NUY=2 NUZ=1 FILL
      43      29 28 27 23 18 12 5 1B7
      43      31 30 28 24 19 13 6 1B7
END FILL
ARA=14 NUX=13 NUY=1 NUZ=1 FILL
      43      31 29 25 20 14 7 1B6
END FILL
ARA=15 NUX=9 NUY=2 NUZ=1 FILL
      43      26 21 15 8 1B4
      41 42 42 42 42 1B4
END FILL

```

Table D.10 (continued)

---

```

END ARRAY
READ PLOT
TTL=! SEQUOYAH UNIT 2 CYCLE 3 FULL CORE BY GEOM UNIT !
PIC=UNIT
XUL=-200 YUL=200 XLR=200 YLR=-200 UAX=1 VDN=-1 NAX=130 END
TTL=! ASSEMBLY LOC 2 !
PIC=MAT NCH=! 12 45555556789999ABCDEFGHIJKLMNPOQRSTUVWXYZ#>$-+)@&!
XUL=-11 YUL=32.5 XLR=11 YLR=10.5 UAX=1 VDN=-1 NAX=130 END
TTL=! SEQUOYAH UNIT 2 CYCLE 3 FULL CORE BY COMPOSITION!
PIC=MAT NCH=! 1/ 4/ / /5555555ABCDEFGHIJKLMNPOQRSTUVWXYZ#>$-+)@&!
XUL=-200 YUL=200 XLR=200 YLR=-200 UAX=1 VDN=-1 NAX=520 END
END PLOT
END DATA
END

```

---

## **APPENDIX E**

### **KENO V.a MOC MODEL SETUP INPUT EXAMPLES**

This appendix gives examples of the input for the different calculational steps for setting up the KENO V.a model for MOC (HFP).

Table E.1. SNIKR/ORIGEN-S input for fuel assembly isotopics

```

//ST5ASY1 JOB (35899),'S M BOWMAN 6011',TIME=1,
// NOTIFY=ST5,MSGCLASS=T
//*MAIN CLASS=SHORT
//PROCLIB DD DISP=SHR,DSN=TZA.PROCLIB.CNTL
//A EXEC FORTVCLG,REGION=2048K
//FORT.SYSPRINT DD DUMMY
//FORT.SYSIN DD DSN=ST5.SNIKR1.FORT,DISP=SHR
//*
//*****
//* #####NEED JCL FOR UNITS N72,NOUT,NORS,NOUT3,NICE
//*****
//GO.FT05F001 DD *
SNIKR1
SQ2C3 QC LOC #1 REGION3 (BATCH2) 29434 MWD/MTU
READ BURNUP
N72=72
NOUT=70
BURN=29434.0
NCYC= 9
END BURNUP
READ DECAY
NORS=74
N71=71
COOLTME=2.730
LIGHTEL=0
END DECAY
//GO.FT70F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
// DSN=&&NOUT1,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,PASS)
//GO.FT72F001 DD UNIT=,SPACE=,LABEL=(,,IN),
// DISP=SHR,DSN=OWH.BATCH2.PWR17F72,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=6400)
//GO.FT73F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
// DSN=X.ST535899.SQ2C3A1.NOUT3,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,CATLG)
//GO.FT74F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
// DSN=&&NORS,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,PASS)
//GO.FT75F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
// DSN=&&NICE,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,PASS)
//*
//*C#####
//*C###EXECUTE ORS AT THIS POINT
//*C#####
//B EXEC SCALE4,REGION=1640K
//GO.FT05F001 DD SPACE=(480,(500,20))
//GO.FT13F001 DD SYSOUT=*,DCB=(RECFM=FA,BLKSIZE=133,BUFL=150)
//GO.FT40F001 DD DUMMY
//GO.FT71F001 DD UNIT=DISK,SPACE=(TRK,(5,10)),DISP=(NEW,CATLG),
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136),
// DSN=X.ST535899.SQ2C3A1.FT71
//GO.SYSIN DD DISP=(OLD,PASS),DSN=&&NORS
//**B2 EXEC SCALE4
//GO.FT13F001 DD SYSOUT=*
//GO.FT31F001 DD DSN=OWH.BATCH2.PWR17F38,DISP=SHR,
// LABEL=(,,IN)
//GO.FT71F001 DD DSN=X.ST535899.SQ2C3A1.FT71,
// DISP=SHR
//GO.SYSIN DD *
#ORIGENS
0$$ A11 71 E T
OWH LIBRARY FOR SQ2C3
3$$ 31 1 1 0 A33 0 E T
35$$ 0 T

```

Table E.1 (continued)

---

```

56$$ 6 6 A6 1 A10 0 A13 -7 A14 3 A15 3 A18 1 E
57** 0 A3 1.E-5 1 E T
SEQUOYAH 2 CYCLE 3* STARTUP TO EQ XE
ATOMS / BN-CM
58** 2.0916E-4 2.0916E-4 2.0916E-4 2.0916E-4 2.0916E-4 2.0916E-4
60** 1 5 25 50 75 10066$$ A1 1 A5 1 A9 1 E T
56$$ 0 0 A10 6 E T
56$$ F0 T
END
/*
//C EXEC FORTVCLG,REGION=2048K
//FORT.SYSPRINT DD DUMMY
//FORT.SYSIN DD DSN=ST5.SNIKR3.FORT,DISP=SHR
/*
/*#####
/* * #####NEED JCL FOR UNITS N71,NOUT,NICE
/* * #####
//GO.FT05F001 DD *
SNIKR1
SQ2C3 QC LOC #1 REGION3 (BATCH2) 29434 MWD/MTU
READ BURNUP
N72=72
NOUT=70
BURN=29434.0
NCYC= 9
END BURNUP
READ DECAY
NORS=74
N71=71
COOLTME=20
LIGHTEL=0
END DECAY
SNIKR3
SQ2C3 QC LOC #1 REGION3 (BATCH2) 29434 MWD/MTU
READ MXFUEL
N71=71
NICE=75
NOUT=73
NCOOL= 7
FISPROD= -2
MIXF= 1
IDMOD= 2
END MXFUEL
//GO.FT71F001 DD UNIT=,SPACE=,LABEL=(,,IN),
// DISP=SHR,DSN=X.ST535899.SQ2C3A1.FT71,
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136)
//GO.FT73F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
// DSN=X.ST535899.SQ2C3A1.NOUT3,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=SHR
//GO.FT75F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
// DSN=&&NICE,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(OLD,DELETE)

```

---

Table E.2. SNIKR/ORIGEN-S input for BP isotopics

```

//ST5BP2 JOB (35899),'S M BOWMAN 6011',TIME=1,
// NOTIFY=ST5,MSGCLASS=T
//*MAIN CLASS=SHORT
//PROCLIB DD DISP=SHR,DSN=TZA.PROCLIB.CNTL
//A EXEC FORTVCLG,REGION=2048K
//FORT.SYSPRINT DD DUMMY
//FORT.SYSIN DD DSN=ST5.SNIKR1.FORT,DISP=SHR
//*
/*#####
/* *#####NEED JCL FOR UNITS N72,NOUT,NORS,NOUT3,NICE
/*#####
//GO.FT05F001 DD *
SNIKR1
SQ2C3 BP FOR QC LOC #2 REGION5B (BATCH7) 10102 MWD/MTU
READ BURNUP
N72=72
NOUT=70
BURN=10102.0
NCYC= 5
END BURNUP
READ DECAY
NORS=74
N71=71
COOLTME=2.730
LIGHTEL= 5
END DECAY
      8016 0.04497 1
      11023 0.0 3
      13027 0.0 3
      5010 0.0 3
      5011 0.0 3
//GO.FT70F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
//      DSN=&&NOUT1,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,PASS)
//GO.FT72F001 DD UNIT=,SPACE=,LABEL=(,,IN),
//      DISP=SHR,DSN=OWH.BATCH7.PWR17F72,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=6400)
//GO.FT73F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
//      DSN=X.ST535899.SQ2C3B2.NOUT3,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,CATLG)
//GO.FT74F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
//      DSN=&&NORS,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,PASS)
//GO.FT75F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
//      DSN=&&NICE,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,PASS)
/*
/*C#####
/*C###EXECUTE ORS AT THIS POINT
/*C#####
//B EXEC SCALE4,REGION=1640K
//GO.FT05F001 DD SPACE=(480,(500,20))
//GO.FT13F001 DD SYSOUT=*,DCB=(RECFM=FA,BLKSIZE=133,BUFL=150)
//GO.FT40F001 DD DUMMY
//GO.FT71F001 DD UNIT=DISK,SPACE=(TRK,(5,10)),DISP=(NEW,CATLG),
//      DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136),
//      DSN=X.ST535899.SQ2C3B2.FT71
//GO.SYSIN DD DISP=(OLD,PASS),DSN=&&NORS
/*
//B2 EXEC SCALE4
//GO.FT13F001 DD SYSOUT=*
//GO.FT31F001 DD DSN=OWH.BATCH7.PWR17F36,DISP=SHR,
//      LABEL=(,,IN)
//GO.FT71F001 DD DSN=X.ST535899.SQ2C3B2.FT71,
//      DISP=SHR

```

Table E.2 (continued)

---

```

//GO.SYSIN DD *
#ORIGENS
0$$ A11 71 E T
OWH LIBRARY FOR SQ2C3
3$$ 31 1 1 0 A33 0 E T
35$$ 0 T
56$$ 6 6 A6 1 A10 0 A13 -7 A14 3 A15 3 A18 1 E57** 0 A3 1.E-5 1 E T
SEQUOYAH 2 CYCLE 3* STARTUP TO EQ XE
ATOMS / BN-CM
58** 2.0916E-4 2.0916E-4 2.0916E-4 2.0916E-4 2.0916E-4 2.0916E-4
60** 1 5 25 50 75 100
66$$ A1 1 A5 1 A9 1 E T
56$$ 0 0 A10 6 E T
56$$ F0 T
END
/*
//C EXEC FORTVCLG,REGION=2048K
//FORT.SYSPRINT DD DUMMY
//FORT.SYSIN DD DSN=ST5.SNIKR3.FORT,DISP=SHR
//*
/*#####
/* * #####NEED JCL FOR UNITS N71,NOUT,NICE
/*#####
//GO.FT05F001 DD *
SNIKR1
SQ2C3 BP FOR QC LOC #2 REGION5B (BATCH7) 10102 MWD/MTU
READ BURNUP
N72=72
NOUT=70
BURN=10102.0
NCYC= 5
END BURNUP
READ DECAY
NORS=74
N71=71
COOLTME=20
LIGHTEL= 5
END DECAY
      8016 0.04497 1
      11023 0.0 3
      13027 0.0 3
      5010 0.0 3
      5011 0.0 3
SNIKR3
SQ2C3 BP FOR QC LOC #2 REGION5B (BATCH7) 10102 MWD/MTU
READ MXFUEL
N71=71
NICE=75
NOUT=73
NCOOL= 7
FISPROD= 5
MIXF= 1
IDMOD=11
END MXFUEL
      8016 11023 13027 5010 5011
//GO.FT71F001 DD UNIT=,SPACE=,LABEL=(,,IN),
//      DISP=SHR,DSN=X.ST535899.SQ2C3B2.FT71,
//      DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136)
//GO.FT73F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
//      DSN=X.ST535899.SQ2C3B2.NOUT3,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=SHR
//GO.FT75F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
//      DSN=&&NICE,
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(OLD,DELETE)

```

---

Table E.3. SNIKR/ORIGEN-S input for average  
cross-section set isotopics

```
//ST5R3X3 JOB (35899),'S M BOWMAN 6011',TIME=1,
// NOTIFY=ST5,MSGCLASS=T
//*MAIN CLASS=SHORT
//PROCLIB DD DISP=SHR,DSN=TZA.PROCLIB.CNTL
//A EXEC FORTVCLG,REGION=2048K
//FORT.SYSPRINT DD DUMMY
//FORT.SYSIN DD DSN=ST5.SNIKR1.FORT,DISP=SHR
//*
/*#####
/* #####NEED JCL FOR UNITS N72,NOUT,NORS,NOUT3,NICE
/*#####
//GO.FT05F001 DD *
SNIKR1
SQ2 REGION3 3.1 WT% 31213 MWD/MTU XSEC SET 3
READ BURNUP
N72=72
NOUT=70
BURN=31213.0
NCYC= 9
END BURNUP
READ DECAY
NORS=74
N71=71
COOLTME=2.730
LIGHTEL=0
END DECAY
//GO.FT70F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
// DSN=&&NOUT1,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,PASS)
//GO.FT72F001 DD UNIT=,SPACE=,LABEL=(,,IN),
// DISP=SHR,DSN=OWH.BATCH2.PWR17F72,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=6400)
//GO.FT73F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
// DSN=X.ST535899.SQ2R3X3.NOUT3,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,CATLG)
//GO.FT74F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
// DSN=&&NORS,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,PASS)
//GO.FT75F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
// DSN=&&NICE,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(NEW,PASS)
/*
/*C#####
/*C###EXECUTE ORS AT THIS POINT
/*C#####
//B EXEC SCALE4,REGION=1640K
//GO.FT05F001 DD SPACE=(480,(500,20))
//GO.FT13F001 DD SYSOUT=*,DCB=(RECFM=FA,BLKSIZE=133,BUFL=150)
//GO.FT40F001 DD DUMMY
//GO.FT71F001 DD UNIT=DISK,SPACE=(TRK,(5,10)),DISP=(NEW,CATLG),
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136),
// DSN=X.ST535899.SQ2R3X3.FT71
//GO.SYSIN DD DISP=(OLD,PASS),DSN=&&NORS
/*
```



Table E.3 (continued)

---

```

//C EXEC FORTVCLG,REGION=2048K
//FORT.SYSPRINT DD DUMMY
//FORT.SYSIN DD DSN=ST5.SNIKR3.FORT,DISP=SHR
//*
/*#####
/* #####NEED JCL FOR UNITS N71,NOUT,NICE
/*#####
//GO.FT05F001 DD *
SNIKR1
SQ2 REGION3 3.1 WT% 31213 MWD/MTU XSEC SET 3
READ BURNUP
N72=72
NOUT=70
BURN=31213.0
BURNUP
READ DECAYNORS=74
N71=71
COOLTME=20.0
LIGHTEL=0
END DECAY
SNIKR3
SQ2 REGION3 3.1 WT% 31213 MWD/MTU XSEC SET 3
READ MXFUEL
N71=71
NICE=75
NOUT=73
NCOOL= 6
FISPROD= -2
MIXF= 1
IDMOD= 0
END MXFUEL
//GO.FT71F001 DD UNIT=,SPACE=,LABEL=(,,IN),
// DISP=SHR,DSN=X.ST535899.SQ2R3X3.FT71,
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136)
//GO.FT73F001 DD UNIT=DISK,SPACE=(TRK,(4,2),RLSE),
// DSN=X.ST535899.SQ2R3X3.NOUT3,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=SHR
//GO.FT75F001 DD UNIT=SYSDA,SPACE=(TRK,(4,2),RLSE),
// DSN=&&NICE,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=4000),DISP=(OLD,DELETE)

```

---

Table E.4. CSASN input for cross-section sets with important actinides only

---

```
//ST5XS3 JOB (35899),'S BOWMAN 6011',MSGCLASS=T,TIME=10,
//  NOTIFY=ST5
//*MAIN CLASS=WHENEVER
//PROCLIB DD DSN=TZA.PROCLIB.CNTL,DISP=SHR
// EXEC SCALE4,GOSIZE=2048K
//GO.FT04F001 DD DSN=X.ST535899.SQ2R3X3.XSEC,UNIT=DISK,DISP=(,CATLG)
//GO.SYSIN DD *
=CSASN
SEQUOYAH 2 REGION 3 XSEC SET 3
27BURNUP LATTICECELL
  U-234    1 0 3.8052E-06 901 END
  U-235    1 0 2.0504E-04 901 END
  U-236    1 0 9.0738E-05 901 END
  U-238    1 0 2.1887E-02 901 END
  PU-239    1 0 1.3950E-04 901 END
  PU-240    1 0 4.9554E-05 901 END
  PU-241    1 0 2.8217E-05 901 END
    0       1 0 4.6382E-02 901 END
  ZIRCALLOY 2 1 628 END
  H2O       3 DEN=.7149 1 579 END
  BORON     3 DEN=.7149 475.E-6 579 END
END COMP
SQUAREPITCH 1.25984 .81915 1 3 .94966 2 .83566 0 END
END
```

---

Table E.5. CSASN input for cross-section set 4

---

```

//ST5XS4 JOB (35899),'S BOWMAN 6011',MSGCLASS=T,TIME=10,
//  NOTIFY=ST5
//*MAIN CLASS=STANDBY
//PROCLIB DD DSN=TZA.PROCLIB.CNTL,DISP=SHR
// EXEC SCALE4,GOSIZE=2048K
//GO.FT04F001 DD DSN=X.ST535899.SQ2R3X4.XSEC,UNIT=DISK,DISP=(,CATLG)
//GO.SYSIN DD *
=CSASN
SEQUOYAH 2 REGION 3 XSEC SET 4 (+ BP XSECS + STRUCTURAL MATERIAL XSECS)
27BURNUP LATTICECELL
  U-234 10 0 3.5981E-06 901 END
  U-235 10 0 1.7497E-04 901 END
  U-236 10 0 9.4368E-05 901 END
  U-238 10 0 2.1814E-02 901 END
NP-237 10 0 1.2187E-05 901 END
PU-238 10 0 4.5358E-06 901 END
PU-239 10 0 1.4019E-04 901 END
PU-240 10 0 5.4151E-05 901 END
PU-241 10 0 3.1199E-05 901 END
PU-242 10 0 1.1979E-05 901 END
AM-241 10 0 5.2942E-06 901 END
AM-243 10 0 2.7617E-06 901 END
CM-244 10 0 6.9491E-07 901 END
  O 10 0 4.6382E-02 901 END
KR-83 10 0 2.7754E-06 901 END
ZR-93 10 0 4.3286E-05 901 END
MO-95 10 0 4.5475E-05 901 END
TC-99 10 0 4.5275E-05 901 END
RU-101 10 0 4.4196E-05 901 END
RU-103 10 0 2.0682E-07 901 END
RH-103 10 0 2.6530E-05 901 END
RH-105 10 0 6.2615E-08 901 END
PD-105 10 0 2.2594E-05 901 END
PD-108 10 0 8.2379E-06 901 END
AG-109 10 0 4.9024E-06 901 END
  I-135 10 0 2.3030E-08 901 END
XE-131 10 0 1.8985E-05 901 END
XE-135 10 0 8.4286E-09 901 END
CS-133 10 0 4.9107E-05 901 END
CS-134 10 0 2.0833E-06 901 END
CS-135 10 0 1.6567E-05 901 END
PR-141 10 0 4.5461E-05 901 END
ND-143 10 0 3.2233E-05 901 END
ND-145 10 0 2.6815E-05 901 END
ND-147 10 0 7.6742E-08 901 END
ND-148 10 0 1.4193E-05 901 END
PM-147 10 0 3.2474E-06 901 END
PM-148 10 0 1.0968E-08 901 END
PM-149 10 0 2.8949E-08 901 END
SM-147 10 0 6.7140E-06 901 END
SM-149 10 0 9.2162E-08 901 END
SM-150 10 0 1.2718E-05 901 END
SM-151 10 0 6.0882E-07 901 END
SM-152 10 0 4.8822E-06 901 END
EU-153 10 0 4.2567E-06 901 END
EU-154 10 0 1.2900E-06 901 END
EU-155 10 0 4.2762E-07 901 END

```

Table E.5 (continued)

---

```

GD-155    10  0  1.5152E-07  901  END
ZIRCALLOY 1  1.    628.0 END
SS304     2  1.    578.6 END
H2O       3  DEN=.7149  1      578.6  END
BORON     3  DEN=.7149  475.E-6 578.6  END
SS304     4  0.5    578.6 END
H2O       4  DEN=.7149  0.5     578.6  END
BORON     4  DEN=.7149  237.5E-6 578.6  END
SS304     5  1.    573.7 END
H2O       6  DEN=.7353  1.0     568.9  END
BORON     6  DEN=.7353  475.E-6 568.9  END
SS304     7  1.    564.0 END
H2O       8  DEN=.7540  1.0     559.1  END
BORON     8  DEN=.7540  475.E-6 559.1  END
SS304     9  1.    559.1 END O      11  0  4.4970E-03  579  END
NA        11  0  1.6496E-03  579  END
AL        11  0  5.7993E-04  579  END
  B-10    11  0  1.8633E-04  579  END
  B-11    11  0  3.8630E-03  579  END
END COMP
SQUAREPITCH 1.25984 .81915 10 3 .94966 1 .83566 0  END
END

```

---

Table E.6. WAX input for cross-section library generation

---

```

//ST5WAX JOB (35899),'S.M.BOWMAN 6011',MSGCLASS=T,
// NOTIFY=ST5,TIME=5
//*MAIN CLASS=SHORT
//PROCLIB DD DSN=TZA.PROCLIB.CNTL,DISP=SHR
// EXEC SCALE4,GOSIZE=2048K
//GO.FT04F001 DD DSN=X.ST535899.SQ2C3.XSECLIB,UNIT=DISK,DISP=(,CATLG)
//GO.FT33F001 DD DSN=X.ST535899.SQ2R2X1.XSEC,DISP=SHR
//GO.FT34F001 DD DSN=X.ST535899.SQ2R3X2.XSEC,DISP=SHR
//GO.FT35F001 DD DSN=X.ST535899.SQ2R3X3.XSEC,DISP=SHR
//GO.FT36F001 DD DSN=X.ST535899.SQ2R3X4.XSEC,DISP=SHR
//GO.FT37F001 DD DSN=X.ST535899.SQ2R4X5.XSEC,DISP=SHR
//GO.FT38F001 DD DSN=X.ST535899.SQ2R4X6.XSEC,DISP=SHR
//GO.FT39F001 DD DSN=X.ST535899.SQ2R4X7.XSEC,DISP=SHR
//GO.FT40F001 DD DSN=X.ST535899.SQ2R5AX8.XSEC,DISP=SHR
//GO.FT41F001 DD DSN=X.ST535899.SQ2R5AX9.XSEC,DISP=SHR
//GO.FT42F001 DD DSN=X.ST535899.SQ25BX10.XSEC,DISP=SHR
//GO.FT43F001 DD DSN=X.ST535899.SQ25BX11.XSEC,DISP=SHR
//GO.SYSIN DD *
=WAX
'WRITE FINAL LIBRARY TO UNIT 4 / BIGGEST INPUT LIB IS ON UNIT 36
0$$ 4 36
'INPUT XSEC'S FROM 11 LIBS
1$$ 11 T
'INPUT XSEC'S FOR FUEL XSEC SET 1
2$$ 33 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 192234 192235 192236 192238 194239 194240 194241 T
'INPUT XSEC'S FOR FUEL XSEC SET 2
2$$ 34 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 292234 292235 292236 292238 294239 294240 294241 T
'INPUT XSEC'S FOR FUEL XSEC SET 3
2$$ 35 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 392234 392235 392236 392238 394239 394240 394241 T
'INPUT XSEC'S FOR FUEL XSEC SET 4 + BP + STRUCT. MAT'LS
2$$ 36 0 T
'INPUT XSEC'S FOR FUEL XSEC SET 5
2$$ 37 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 592234 592235 592236 592238 594239 594240 594241 T
'INPUT XSEC'S FOR FUEL XSEC SET 6
2$$ 38 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 692234 692235 692236 692238 694239 694240 694241 T
'INPUT XSEC'S FOR FUEL XSEC SET 7
2$$ 39 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 792234 792235 792236 792238 794239 794240 794241 T
'INPUT XSEC'S FOR FUEL XSEC SET 8
2$$ 40 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 892234 892235 892236 892238 894239 894240 894241 T
'INPUT XSEC'S FOR FUEL XSEC SET 9
2$$ 41 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 992234 992235 992236 992238 994239 994240 994241 T
'INPUT XSEC'S FOR FUEL XSEC SET 10
2$$ 42 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 1092234 1092235 1092236 1092238 1094239 1094240 1094241 T
'INPUT XSEC'S FOR FUEL XSEC SET 11
2$$ 43 7 T
3$$ 92234 92235 92236 92238 94239 94240 94241
4$$ 1192234 1192235 1192236 1192238 1194239 1194240 1194241 T
END

```

---

Table E.7. XSDRNPM input for assembly P17

---

```

//ST5XSP17 JOB (35899),'SM BOWMAN 6011',TIME=1,MSGCLASS=T,
// NOTIFY=ST5
//*MAIN CLASS=SHORT
//PROCLIB DD DSN=TZA.PROCLIB.CNTL,DISP=SHR
// EXEC SCALE4
//GO.FT04F001 DD DSN=X.ST535899.SQ2C3.XSECLIB,DISP=SHR,UNIT=
//GO.SYSIN DD *
=XSDRN
SQ2C3 ASSY P17 K-INF CALC FOR COMPARISON TO CSAS1X
1$$$ 2 4 22 1 3 3 53 8 3 1 20 25 E
2$$$ -2 -1 0 A7 -1 E 5** A4 0. 0. E T
13$$$ 48R1 2 4R3
14$$$
692234 692235 692236 692238 93237 94238
694239 694240 694241 94242 95241 95243
96244 8016 36083 40093 42095 43099
44101 44103 45103 45105 46105 46108
47109 53135 54131 54135 55133 55134
55135 59141 60143 60145 60147 60148
61147 61148 61149 62147 62149 62150
62151 62152 63153 63154 63155 64155
40302 1001 308016 5010 5011
15**
5.2024E-06 3.8143E-04 8.1526E-05 2.2001E-02 6.8013E-06 1.3292E-06
1.2798E-04 3.2434E-05 1.7977E-05 3.4246E-06 2.7523E-06 4.5751E-07
5.9459E-08 4.6385E-02 2.1370E-06 2.9457E-05 3.0651E-05 3.0091E-05
2.7692E-05 1.8200E-07 1.7834E-05 4.9358E-08 1.1290E-05 3.5132E-06
2.3476E-06 2.3253E-08 1.3482E-05 9.6616E-09 3.2923E-05 9.4185E-07
9.9190E-06 2.9260E-05 2.4474E-05 1.8254E-05 7.5984E-08 8.9610E-06
3.1488E-06 9.2002E-09 2.7074E-08 4.7621E-06 1.1111E-07 7.8764E-06
5.2528E-07 3.1691E-06 2.2051E-06 4.8479E-07 1.7929E-07 6.6666E-08
4.25156E-02 4.78066E-02 2.39033E-02 3.73795E-06 1.51750E-05 T
33## F1 T
35** 0 3.1722E-2 8.14931E-2 2.04787E-1 .328082 .377853
.409575 .410647 .413702 .416758 .417830 .425230 .44633 .46743
.47483 .487890 .505462 .532417 .592809 .6532 .680156 .697728 .710788
36$$$ 6R1 4R2 4R3 8R4
39$$$ 1 0 2 3 40$$$ F3 T
END

```

---

Table E.8. CSAS1X input for assembly P17

---

```

//ST5CXP17 JOB (35899),'S BOWMAN 6011',MSGCLASS=T,TIME=10,
//  NOTIFY=ST5
//*MAIN CLASS=STANDBY
//PROCLIB DD DSN=TZA.PROCLIB.CNTL,DISP=SHR
//  EXEC SCALE4,GOSIZE=2048K
//GO.SYSIN DD *
=CSAS1X
SQ2C3 QC LOC #12 REGION4 (BATCH3) ASSY P17 21463 MWD/MTU
27BURNUP LATTICECELL
  U-234      1 0 5.2024E-06 901 END
  U-235      1 0 3.8143E-04 901 END
  U-236      1 0 8.1526E-05 901 END
  U-238      1 0 2.2001E-02 901 END
NP-237      1 0 6.8013E-06 901 END
PU-238      1 0 1.3292E-06 901 END
PU-239      1 0 1.2798E-04 901 END
PU-240      1 0 3.2434E-05 901 END
PU-241      1 0 1.7977E-05 901 END
PU-242      1 0 3.4246E-06 901 END
AM-241      1 0 2.7523E-06 901 END
AM-243      1 0 4.5751E-07 901 END
CM-244      1 0 5.9459E-08 901 END
  O          1 0 4.6385E-02 901 END
KR-83       1 0 2.1370E-06 901 END
ZR-93       1 0 2.9457E-05 901 END
MO-95       1 0 3.0651E-05 901 END
TC-99       1 0 3.0091E-05 901 END
RU-101      1 0 2.7692E-05 901 END
RU-103      1 0 1.8200E-07 901 END
RH-103      1 0 1.7834E-05 901 END
RH-105      1 0 4.9358E-08 901 END
PD-105      1 0 1.1290E-05 901 END
PD-108      1 0 3.5132E-06 901 END
AG-109      1 0 2.3476E-06 901 END
  I-135      1 0 2.3253E-08 901 END
XE-131      1 0 1.3482E-05 901 END
XE-135      1 0 9.6616E-09 901 END
CS-133      1 0 3.2923E-05 901 END
CS-134      1 0 9.4185E-07 901 END
CS-135      1 0 9.9190E-06 901 END
PR-141      1 0 2.9260E-05 901 END
ND-143      1 0 2.4474E-05 901 END
ND-145      1 0 1.8254E-05 901 END
ND-147      1 0 7.5984E-08 901 END
ND-148      1 0 8.9610E-06 901 END
PM-147      1 0 3.1488E-06 901 END
PM-148      1 0 9.2002E-09 901 END
PM-149      1 0 2.7074E-08 901 END
SM-147      1 0 4.7621E-06 901 END
SM-149      1 0 1.1111E-07 901 END
SM-150      1 0 7.8764E-06 901 END
SM-151      1 0 5.2528E-07 901 END
SM-152      1 0 3.1691E-06 901 END
EU-153      1 0 2.2051E-06 901 END
EU-154      1 0 4.8479E-07 901 END
EU-155      1 0 1.7929E-07 901 END
GD-155      1 0 6.6666E-08 901 END
ZIRCALLOY  2 1 628 END
H2O         3 DEN=.7149 1 579 END
BORON       3 DEN=.7149 475.E-6 579 END
END COMP
SQUAREPITCH 1.25984 .81915 1 3 .94966 2 .83566 0 END
END

```

---

```
//ST5SQ2C3 JOB (35899), 'S.M.BOWMAN 6011',MSGCLASS=T,  
// NOTIFY=ST5,TIME=60  
//*MAIN CLASS=STANDBY  
//PROCLIB DD DSN=TZA.PROCLIB.CNTL,DISP=SHR  
//KENO EXEC SCALE41,REGION.GO=3500K  
//GO.FT04F001 DD DISP=SHR,LABEL=(,,,IN),  
// DSN=X.ST535899.SQ2C3.XSECLIB,UNIT=  
//GO.FT05F001 DD VOL=SER=,UNIT=SYSDA,DISP=(NEW,PASS),  
// SPACE=(4800,(0040,20)),DCB=BLKSIZE=4800  
//GO.FT08F001 DD UNIT=SYSDA,SPACE=(CYL,(200,5)),  
// DCB=(DSORG=DA,RECFM=F)  
//GO.FT09F001 DD UNIT=SYSDA,SPACE=(CYL,(200,5)),  
// DCB=(DSORG=DA,RECFM=F)  
//GO.FT34F001 DD DSN=T.ST535899.SQ2C3.KENOVRS,  
// DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136,BUFL=6136),  
// UNIT=DISK,SPACE=(TRK,(05,05)),DISP=(,CATLG)  
//GO.SYSIN DD *  
#KENOV  
SEQUOYAH 2 CYCLE 3* (1/8 CORE SYM) HFP, ARO EQXE  
  
| **** * |  
| **** * |  
| **** * FULL CORE KENO5A REACTOR CONFIGURATION |  
| **** * FOR SEQUOYAH UNIT-2 BOC-3* HFP, ARO EQXE |  
| **** * 1 PLANE MODEL |  
| **** * |  
| **** * BY |  
| **** * STEVE BOWMAN |  
| **** * OAK RIDGE NATIONAL LABORATORY |  
| **** * |  
| **** * 1991 |  
| **** * |  
| **** * |  
| **** * |  
  
READ PARM  
RUN=YES PLT=NO NUB=YES FDN=YES TME=50.0 GEN=303 NPG=1000  
WRS=34 RES=50  
LIB=4 NB8=2400 NL8=880 END PARM  
  
READ MIXT  
MIX=101  
'ASSY 1'  
292234 3.9026E-06  
292235 2.2036E-04  
292236 8.8749E-05  
292238 2.1920E-02  
93237 1.0072E-05  
94238 3.1680E-06  
294239 1.3641E-04  
294240 4.7246E-05  
294241 2.6906E-05  
94242 8.5129E-06  
95241 4.5867E-06  
95243 1.6764E-06  
96244 3.4248E-07  
8016 4.6382E-02  
36083 2.5370E-06  
  
40093 3.7901E-05  
42095 3.9723E-05  
43099 3.9511E-05  
44101 3.7800E-05  
44103 2.0008E-07  
45103 2.3347E-05  
45105 5.8975E-08  
46105 1.8249E-05  
46108 6.3965E-06
```



Table E.9 (continued)

---

47109	3.9726E-06
53135	2.3099E-08
54131	1.7014E-05
54135	8.6892E-09
55133	4.2956E-05
55134	1.5612E-06
55135	1.4171E-05
59141	3.9146E-05
60143	2.9331E-05
60145	2.3533E-05
60147	7.6215E-08
60148	1.2140E-05
61147	3.0855E-06
61148	1.0095E-08
61149	2.8289E-08
62147	6.1807E-06
62149	9.1742E-08
62150	1.0646E-05
62151	5.5945E-07
62152	4.2578E-06
63153	3.4810E-06
63154	9.5774E-07
63155	3.1996E-07
64155	1.1439E-07
MIX=102	
'ASSY 2	
'SQ2C3 QC LOC #2 REGION5B (BATCH7) 10102 MWD/MTU	
1192234	6.3021E-06
1192235	6.0323E-04
1192236	4.9504E-05
1192238	2.2160E-02
93237	2.6475E-06
94238	2.2997E-07
1194239	9.7474E-05
1194240	1.3141E-05
1194241	5.5242E-06
94242	4.1129E-07
95241	7.6701E-07
95243	2.5156E-08
96244	1.4320E-09
8016	4.6385E-02
36083	1.1575E-06
40093	1.4734E-05
42095	1.5127E-05
43099	1.4996E-05
44101	1.3082E-05
44103	1.5649E-07
45103	8.7290E-06
45105	3.7107E-08
46105	4.2931E-06
46108	1.0733E-06
47109	7.6252E-07
53135	2.2895E-08
54131	6.9039E-06
54135	1.0931E-08
55133	1.6273E-05
55134	2.4696E-07
55135	4.5632E-06
59141	1.4006E-05
60143	1.3176E-05
60145	9.1615E-06
60147	7.3200E-08
60148	4.2832E-06
61147	2.0598E-06
61148	5.6822E-09

Table E.9 (continued)

---

61149	2.4835E-08
62147	2.4616E-06
62149	1.2373E-07
62150	3.0436E-06
62151	4.0563E-07
62152	1.4265E-06
63153	7.5366E-07
63154	9.8030E-08
63155	6.4523E-08
64155	2.4707E-08
MIX=103	
'ASSY 3	
792234	5.0783E-06
792235	3.5897E-04
792236	8.5073E-05
792238	2.1972E-02
93237	7.4930E-06
94238	1.5820E-06
794239	1.3121E-04
794240	3.5057E-05
794241	1.9802E-05
94242	4.1087E-06
95241	3.0490E-06
95243	5.9423E-07
96244	8.4331E-08
8016	4.6385E-02
36083	2.2500E-06
40093	3.1371E-05
42095	3.2689E-05
43099	3.2107E-05
44101	2.9722E-05
44103	1.8476E-07
45103	1.9036E-05
45105	5.0851E-08
46105	1.2419E-05
46108	3.9478E-06
47109	2.6065E-06
53135	2.3230E-08
54131	1.4288E-05
54135	9.5904E-09
55133	3.5112E-05
55134	1.0742E-06
55135	1.0637E-05
59141	3.1335E-05
60143	2.5817E-05
60145	1.9428E-05
60147	7.6025E-08
60148	9.6134E-06
61147	3.2519E-06
61148	9.6048E-09
61149	2.7299E-08
62147	4.9971E-06
62149	1.1199E-07
62150	8.5721E-06
62151	5.4439E-07
62152	3.3924E-06
63153	2.4379E-06
63154	5.6271E-07
63155	2.0326E-07
64155	7.5485E-08
MIX=104	
'ASSY 4	
'SQ2C3 QC LOC #4 REGION5B (BATCH7) 9787 MWD/MTU	
1192234	6.3310E-06
1192235	6.0951E-04

Table E.9 (continued)

---

1192236	4.8361E-05
1192238	2.2165E-02
93237	2.5370E-06
94238	2.1320E-07
1194239	9.5615E-05
1194240	1.2590E-05
1194241	5.1929E-06
94242	3.7331E-07
95241	7.1914E-07
95243	2.2053E-08
96244	1.2128E-09
8016	4.6385E-02
36083	1.1263E-06
40093	1.4308E-05
42095	1.4678E-05
43099	1.4549E-05
44101	1.2679E-05
44103	1.5553E-07
45103	8.4558E-06
45105	3.6650E-08
46105	4.1254E-06
46108	1.0208E-06
47109	7.2573E-07
53135	2.2873E-08
54131	6.7037E-06
54135	1.0927E-08
55133	1.5788E-05
55134	2.3261E-07
55135	4.4229E-06
59141	1.3580E-05
60143	1.2810E-05
60145	8.8974E-06
60147	7.3172E-08
60148	4.1526E-06
61147	2.0142E-06
61148	5.5465E-09
61149	2.4756E-08
62147	2.3968E-06
62149	1.2301E-07
62150	2.9344E-06
62151	4.0032E-07
62152	1.3778E-06
63153	7.2107E-07
63154	9.1646E-08
63155	6.2208E-08
64155	2.3814E-08
MIX=105	
'ASSY 5	
192234	3.1051E-06
192235	1.4460E-04
192236	7.8656E-05
192238	2.1966E-02
93237	1.0286E-05
94238	3.7166E-06
194239	1.3314E-04
194240	5.2417E-05
194241	2.9061E-05
94242	1.1354E-05
95241	4.9462E-06
95243	2.4877E-06
96244	5.9333E-07
8016	4.6379E-02
36083	2.4379E-06
40093	3.8115E-05
42095	4.0281E-05

Table E.9 (continued)

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43099	4.0633E-05
44101	3.9624E-05
44103	2.0971E-07
45103	2.4548E-05
45105	6.3954E-08
46105	2.0846E-05
46108	7.7667E-06
47109	4.6769E-06
53135	2.3026E-08
54131	1.7306E-05
54135	7.7009E-09
55133	4.4081E-05
55134	1.7760E-06
55135	1.3360E-05
59141	4.0369E-05
60143	2.8461E-05
60145	2.3836E-05
60147	7.6159E-08
60148	1.2662E-05
61147	2.9876E-06
61148	1.0557E-08
61149	2.8986E-08
62147	6.0834E-06
62149	7.9908E-08
62150	1.1523E-05
62151	5.3921E-07
62152	4.5321E-06
63153	3.8552E-06
63154	1.1326E-06
63155	3.7084E-07
64155	1.2617E-07
MIX=106	
'ASSY 6	
'SQ2C3 QC LOC #6 REGION5B (BATCH7) 9755 MWD/MTU	
1192234	6.3340E-06
1192235	6.1016E-04
1192236	4.8245E-05
1192238	2.2166E-02
93237	2.5258E-06
94238	2.1153E-07
1194239	9.5423E-05
1194240	1.2535E-05
1194241	5.1596E-06
94242	3.6958E-07
95241	7.1435E-07
95243	2.1754E-08
96244	1.1921E-09
8016	4.6385E-02
36083	1.1231E-06
40093	1.4265E-05
42095	1.4632E-05
43099	1.4503E-05
44101	1.2638E-05
44103	1.5543E-07
45103	8.4280E-06
45105	3.6603E-08
46105	4.1085E-06
46108	1.0155E-06
47109	7.2202E-07
53135	2.2871E-08
54131	6.6834E-06
54135	1.0926E-08
55133	1.5738E-05
55134	2.3117E-07
55135	4.4086E-06

Table E.9 (continued)

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59141	1.3536E-05
60143	1.2773E-05
60145	8.8704E-06
60147	7.3169E-08
60148	4.1393E-06
61147	2.0095E-06
61148	5.5325E-09
61149	2.4748E-08
62147	2.3901E-06
62149	1.2294E-07
62150	2.9233E-06
62151	3.9978E-07
62152	1.3729E-06
63153	7.1779E-07
63154	9.1012E-08
63155	6.1976E-08
64155	2.3725E-08
MIX=107	
'ASSY 7	
392234	3.8679E-06
392235	2.1489E-04
392236	8.9469E-05
392238	2.1909E-02
93237	1.0309E-05
94238	3.3113E-06
394239	1.3694E-04
394240	4.8094E-05
394241	2.7369E-05
94242	8.8767E-06
95241	4.6810E-06
95243	1.7811E-06
96244	3.7300E-07
8016	4.6382E-02
36083	2.5657E-06
40093	3.8509E-05
42095	4.0372E-05
43099	4.0164E-05
44101	3.8510E-05
44103	2.0080E-07
45103	2.3711E-05
45105	5.9354E-08
46105	1.8718E-05
46108	6.5924E-06
47109	4.0750E-06
53135	2.3098E-08
54131	1.7245E-05
54135	8.6324E-09
55133	4.3653E-05
55134	1.6122E-06
55135	1.4437E-05
59141	3.9850E-05
60143	2.9678E-05
60145	2.3906E-05
60147	7.6319E-08
60148	1.2367E-05
61147	3.0990E-06
61148	1.0168E-08
61149	2.8366E-08
62147	6.2540E-06
62149	9.1619E-08
62150	1.0869E-05
62151	5.6464E-07
62152	4.3290E-06
63153	3.5669E-06
63154	9.9284E-07

Table E.9 (continued)

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63155	3.3101E-07
64155	1.1807E-07
MIX=108	
'ASSY 8	
'SQ2C3 QC LOC #8 REGION5B (BATCH6) 8060 MWD/MTU	
1092234	6.5417E-06
1092235	6.4141E-04
1092236	4.1506E-05
1092238	2.2207E-02
93237	1.7662E-06
94238	1.1804E-07
1094239	7.6671E-05
1094240	9.0337E-06
1094241	3.0790E-06
94242	1.8352E-07
95241	4.2094E-07
95243	7.9060E-09
96244	3.0926E-10
8016	4.6385E-02
36083	9.6122E-07
40093	1.2071E-05
42095	1.2285E-05
43099	1.2112E-05
44101	1.0499E-05
44103	1.5266E-07
45103	6.8670E-06
45105	3.3901E-08
46105	3.1743E-06
46108	7.0685E-07
47109	5.0375E-07
53135	2.3454E-08
54131	5.6021E-06
54135	1.0438E-08
55133	1.3148E-05
55134	1.5144E-07
55135	4.1274E-06
59141	1.1299E-05
60143	1.0772E-05
60145	7.4972E-06
60147	7.6261E-08
60148	3.4326E-06
61147	1.7483E-06
61148	4.6384E-09
61149	2.4951E-08
62147	2.0961E-06
62149	9.9753E-08
62150	2.3357E-06
62151	3.4954E-07
62152	1.1243E-06
63153	5.4539E-07
63154	5.9029E-08
63155	4.7459E-08
64155	1.7841E-08
MIX=109	
'ASSY 9	
92234	3.5981E-06
92235	1.7497E-04
92236	9.4368E-05
92238	2.1814E-02
93237	1.2187E-05
94238	4.5358E-06
94239	1.4019E-04
94240	5.4151E-05
94241	3.1199E-05
94242	1.1979E-05

Table E.9 (continued)

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95241	5.2942E-06
95243	2.7617E-06
96244	6.9491E-07
8016	4.6382E-02
36083	2.7754E-06
40093	4.3286E-05
42095	4.5475E-05
43099	4.5275E-05
44101	4.4196E-05
44103	2.0682E-07
45103	2.6530E-05
45105	6.2615E-08
46105	2.2594E-05
46108	8.2379E-06
47109	4.9024E-06
53135	2.3030E-08
54131	1.8985E-05
54135	8.4286E-09
55133	4.9107E-05
55134	2.0833E-06
55135	1.6567E-05
59141	4.5461E-05
60143	3.2233E-05
60145	2.6815E-05
60147	7.6742E-08
60148	1.4193E-05
61147	3.2474E-06
61148	1.0968E-08
61149	2.8949E-08
62147	6.7140E-06
62149	9.2162E-08
62150	1.2718E-05
62151	6.0882E-07
62152	4.8822E-06
63153	4.2567E-06
63154	1.2900E-06
63155	4.2762E-07
64155	1.5152E-07
MIX=110	
'ASSY 10	
792234	5.0976E-06
792235	3.6245E-04
792236	8.4530E-05
792238	2.1976E-02
93237	7.3833E-06
94238	1.5404E-06
794239	1.3073E-04
794240	3.4648E-05
794241	1.9518E-05
94242	3.9969E-06
95241	3.0025E-06
95243	5.7112E-07
96244	7.9966E-08
8016	4.6385E-02
36083	2.2326E-06
40093	3.1071E-05
42095	3.2370E-05
43099	3.1792E-05
44101	2.9402E-05
44103	1.8433E-07
45103	1.8849E-05
45105	5.0620E-08
46105	1.2240E-05
46108	3.8781E-06
47109	2.5654E-06

Table E.9 (continued)

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53135	2.3234E-08	
54131	1.4162E-05	
54135	9.6018E-09	
55133	3.4770E-05	
55134	1.0530E-06	
55135	1.0524E-05	
59141	3.1009E-05	
60143	2.5609E-05	
60145	1.9244E-05	
60147	7.6018E-08	
60148	9.5107E-06	
61147	3.2369E-06	
61148	9.5440E-09	
61149	2.7265E-08	
62147	4.9606E-06	
62149	1.1187E-07	
62150	8.4622E-06	
62151	5.4141E-07	
62152	3.3574E-06	
63153	2.4010E-06	
63154	5.5010E-07	
63155	1.9938E-07	
64155	7.4058E-08	
MIX=111		
'ASSY 11		792234
5.0231E-06		792235
3.4919E-04		792236
8.6594E-05		792238
2.1958E-02		93237
7.8081E-06		94238
1.7043E-06		794239
1.3254E-04		794240
3.6222E-05		794241
2.0610E-05		94242
4.4366E-06		95241
3.1824E-06		95243
6.6374E-07		96244
9.7837E-08		8016
4.6385E-02		36083
2.2991E-06		40093
3.2224E-05		42095
3.3599E-05		43099
3.3008E-05		44101
3.0637E-05		44103
1.8596E-07		45103
1.9569E-05		45105
5.1504E-08		46105
1.2940E-05		46108
4.1502E-06		47109
2.7252E-06		53135
2.3220E-08		54131
1.4643E-05		54135
9.5575E-09		55133
3.6089E-05		55134
1.1359E-06		55135
1.0961E-05		59141
3.2268E-05		60143
2.6403E-05		60145
1.9951E-05		60147
7.6048E-08		60148
9.9074E-06		61147
3.2926E-06		61148
9.7730E-09		61149
2.7398E-08		62147
5.1009E-06		



Table E.9 (continued)

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62149	1.1232E-07
62150	8.8872E-06
62151	5.5286E-07
62152	3.4922E-06
63153	2.5444E-06
63154	5.9949E-07
63155	2.1464E-07
64155	7.9660E-08
MIX=112	
'ASSY 12	
692234	5.2369E-06
692235	3.8781E-04
692236	8.0506E-05
692238	2.2009E-02
93237	6.6127E-06
94238	1.2640E-06
694239	1.2701E-04
694240	3.1703E-05
694241	1.7467E-05
94242	3.2469E-06
95241	2.6704E-06
95243	4.2391E-07
96244	5.3716E-08
8016	4.6385E-02
36083	2.1050E-06
40093	2.8925E-05
42095	3.0084E-05
43099	2.9530E-05
44101	2.7132E-05
44103	1.8122E-07
45103	1.7498E-05
45105	4.8936E-08
46105	1.0984E-05
46108	3.3970E-06
47109	2.2773E-06
53135	2.3259E-08
54131	1.3255E-05
54135	9.6809E-09
55133	3.2313E-05
55134	9.0648E-07
55135	9.7213E-06
59141	2.8688E-05
60143	2.4093E-05
60145	1.7927E-05
60147	7.5975E-08
60148	8.7812E-06
61147	3.1173E-06
61148	9.0813E-09
61149	2.7011E-08
62147	4.6960E-06
62149	1.1082E-07
62150	7.6856E-06
62151	5.1995E-07
62152	3.1071E-06
63153	2.1418E-06
63154	4.6424E-07
63155	1.7300E-07
64155	6.4347E-08
MIX=113	
'ASSY 13	
292234	3.8982E-06
292235	2.1965E-04
292236	8.8841E-05

Table E.9 (continued)

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292238	2.1919E-02
93237	1.0102E-05
94238	3.1861E-06
294239	1.3648E-04
294240	4.7349E-05
294241	2.6970E-05
94242	8.5588E-06
95241	4.5988E-06
95243	1.6896E-06
96244	3.4626E-07
8016	4.6382E-02
36083	2.5407E-06
40093	3.7977E-05
42095	3.9806E-05
43099	3.9595E-05
44101	3.7890E-05
44103	2.0018E-07
45103	2.3393E-05
45105	5.9031E-08
46105	1.8309E-05
46108	6.4213E-06
47109	3.9856E-06
53135	2.3098E-08
54131	1.7042E-05
54135	8.6859E-09
55133	4.3044E-05
55134	1.5677E-06
55135	1.4205E-05
59141	3.9236E-05
60143	2.9375E-05
60145	2.3580E-05
60147	7.6221E-08
60148	1.2169E-05
61147	3.0872E-06
61148	1.0105E-08
61149	2.8297E-08
62147	6.1902E-06
62149	9.1744E-08
62150	1.0674E-05
62151	5.6013E-07
62152	4.2667E-06
63153	3.4919E-06
63154	9.6219E-07
63155	3.2136E-07
64155	1.1488E-07
MIX=114	
'ASSY 14	
992234	6.7557E-06
992235	6.4997E-04
992236	4.9843E-05
992238	2.2120E-02
93237	2.5603E-06
94238	2.1323E-07
994239	9.5485E-05
994240	1.2268E-05
994241	5.0466E-06
94242	3.4973E-07
95241	7.0141E-07
95243	2.0552E-08
96244	1.1403E-09
8016	4.6386E-02
36083	1.1502E-06
40093	1.4582E-05
42095	1.4942E-05
43099	1.4774E-05

Table E.9 (continued)

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44101	1.2864E-05
44103	1.5399E-07
45103	8.5141E-06
45105	3.5886E-08
46105	4.1320E-06
46108	9.9836E-07
47109	7.0800E-07
53135	2.2891E-08
54131	6.7976E-06
54135	1.1328E-08
55133	1.6032E-05
55134	2.3384E-07
55135	4.8417E-06
59141	1.3810E-05
60143	1.3054E-05
60145	9.0573E-06
60147	7.3318E-08
60148	4.2137E-06
61147	2.0402E-06
61148	5.4890E-09
61149	2.4690E-08
62147	2.4493E-06
62149	1.2712E-07
62150	2.9657E-06
62151	4.1468E-07
62152	1.3831E-06
63153	7.2347E-07
63154	9.1129E-08
63155	6.2542E-08
64155	2.4252E-08
MIX=115	
'ASSY 15	
'SQ2C3 QC LOC #15 REGION5A (BATCH4) 8177 MWD/MTU	
892234	6.9756E-06
892235	6.8340E-04
892236	4.2669E-05
892238	2.2162E-02
93237	1.7861E-06
94238	1.1761E-07
894239	7.6744E-05
894240	8.7869E-06
894241	2.9908E-06
94242	1.7162E-07
95241	4.0934E-07
95243	7.3501E-09
96244	2.8642E-10
8016	4.6386E-02
36083	9.8000E-07
40093	1.2284E-05
42095	1.2494E-05
43099	1.2299E-05
44101	1.0646E-05
44103	1.5132E-07
45103	6.9302E-06
45105	3.3256E-08
46105	3.1752E-06
46108	6.9189E-07
47109	4.9139E-07
53135	2.3466E-08
54131	5.6810E-06
54135	1.0867E-08
55133	1.3350E-05
55134	1.5226E-07
55135	4.3535E-06
59141	1.1480E-05

Table E.9 (continued)

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60143	1.0976E-05
60145	7.6228E-06
60147	7.6366E-08
60148	3.4833E-06
61147	1.7765E-06
61148	4.6065E-09
61149	2.4896E-08
62147	2.1331E-06
62149	1.0566E-07
62150	2.3613E-06
62151	3.6377E-07
62152	1.1264E-06
63153	5.4762E-07
63154	5.8634E-08
63155	4.7917E-08
64155	1.8268E-08
MIX=116	
'ASSY 16	
'SQ2C3 QC LOC #16 REGION3 (BATCH2) 31051 MWD/MTU	
392234	3.8042E-06
392235	2.0506E-04
392236	9.0736E-05
392238	2.1888E-02
93237	1.0747E-05
94238	3.5833E-06
394239	1.3782E-04
394240	4.9559E-05
394241	2.8296E-05
94242	9.5649E-06
95241	4.8450E-06
95243	1.9870E-06
96244	4.3494E-07
8016	4.6382E-02
36083	2.6173E-06
40093	3.9629E-05
42095	4.1567E-05
43099	4.1365E-05
44101	3.9826E-05
44103	1.8122E-07
45103	2.4377E-05
45105	6.0143E-08
46105	1.9597E-05
46108	6.9614E-06
47109	4.2655E-06
53135	2.3082E-08
54131	1.7665E-05
54135	8.5840E-09
55133	4.4937E-05
55134	1.7118E-06
55135	1.4929E-05
59141	4.1154E-05
60143	3.0304E-05
60145	2.4591E-05
60147	7.6406E-08
60148	1.2789E-05
61147	3.1268E-06
61148	1.0330E-08
61149	2.8495E-08
62147	6.3807E-06
62149	9.1676E-08
62150	1.1287E-05
62151	5.7475E-07
62152	4.4589E-06
63153	3.7268E-06
63154	1.0591E-06

Table E.9 (continued)

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63155	3.5219E-07
64155	1.2545E-07
MIX=117	
'ASSY 17	
'SQ2C3 QC LOC #17 REGION5B (BATCH7) 10118 MWD/MTU	
1192234	6.3006E-06
1192235	6.0291E-04
1192236	4.9562E-05
1192238	2.2160E-02
93237	2.6532E-06
94238	2.3083E-07
1194239	9.7567E-05
1194240	1.3169E-05
1194241	5.5413E-06
94242	4.1328E-07
95241	7.6948E-07
95243	2.5322E-08
96244	1.4439E-09
8016	4.6385E-02
36083	1.1590E-06
40093	1.4755E-05
42095	1.5150E-05
43099	1.5019E-05
44101	1.3102E-05
44103	1.5654E-07
45103	8.7428E-06
45105	3.7130E-08
46105	4.3016E-06
46108	1.0760E-06
47109	7.6440E-07
53135	2.2897E-08
54131	6.9141E-06
54135	1.0931E-08
55133	1.6298E-05
55134	2.4770E-07
55135	4.5703E-06
59141	1.4028E-05
60143	1.3195E-05
60145	9.1749E-06
60147	7.3201E-08
60148	4.2899E-06
61147	2.0621E-06
61148	5.6890E-09
61149	2.4839E-08
62147	2.4649E-06
62149	1.2377E-07
62150	3.0491E-06
62151	4.0589E-07
62152	1.4290E-06
63153	7.5532E-07
63154	9.8359E-08
63155	6.4643E-08
64155	2.4753E-08
MIX=118	
'ASSY 18	
'SQ2C3 QC LOC #18 REGION3 (BATCH2) 31312 MWD/MTU	
392234	3.7885E-06
392235	2.0268E-04
392236	9.1037E-05
392238	2.1882E-02
93237	1.0856E-05
94238	3.6520E-06
394239	1.3802E-04
394240	4.9916E-05
394241	2.8523E-05

Table E.9 (continued)

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94242	9.7385E-06
95241	4.8837E-06
95243	2.0400E-06
96244	4.5140E-07
8016	4.6382E-02
36083	2.6298E-06
40093	3.9905E-05
42095	4.1863E-05
43099	4.1661E-05
44101	4.0152E-05
44103	2.0262E-07
45103	2.4541E-05
45105	6.0337E-08
46105	1.9817E-05
46108	7.0542E-06
47109	4.3128E-06
53135	2.3078E-08
54131	1.7768E-05
54135	8.5721E-09
55133	4.5253E-05
55134	1.7374E-06
55135	1.5051E-05
59141	4.1476E-05
60143	3.0457E-05
60145	2.4760E-05
60147	7.6429E-08
60148	1.2894E-05
61147	3.1344E-06
61148	1.0373E-08
61149	2.8528E-08
62147	6.4102E-06
62149	9.1699E-08
62150	1.1392E-05
62151	5.7727E-07
62152	4.4909E-06
63153	3.7665E-06
63154	1.0758E-06
63155	3.5756E-07
64155	1.2732E-07
MIX=119	
'ASSY 19	
'SQ2C3 QC LOC #19 REGION5A (BATCH5) 9506 MWD/MTU	
992234	6.7967E-06
992235	6.5880E-04
992236	4.8223E-05
992238	2.2127E-02
93237	2.4116E-06
94238	1.9185E-07
994239	9.2879E-05
994240	1.1545E-05
994241	4.6202E-06
94242	3.0519E-07
95241	6.3979E-07
95243	1.7056E-08
96244	8.9619E-10
8016	4.6386E-02
36083	1.1068E-06
40093	1.3996E-05
42095	1.4325E-05
43099	1.4163E-05
44101	1.2315E-05
44103	1.5270E-07
45103	8.1453E-06
45105	3.5279E-08
46105	3.9101E-06

Table E.9 (continued)

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46108	9.3099E-07
47109	6.6061E-07
53135	2.2861E-08
54131	6.5237E-06
54135	1.1322E-08
55133	1.5368E-05
55134	2.1513E-07
55135	4.6358E-06
59141	1.3226E-05
60143	1.2547E-05
60145	8.6945E-06
60147	7.3278E-08
60148	4.0358E-06
61147	1.9769E-06
61148	5.3053E-09
61149	2.4586E-08
62147	2.3587E-06
62149	1.2614E-07
62150	2.8189E-06
62151	4.0725E-07
62152	1.3169E-06
63153	6.8051E-07
63154	8.2990E-08
63155	5.9510E-08
64155	2.3066E-08
MIX=120	
'ASSY 20	
'SQ2C3 QC LOC #20 REGION3 (BATCH2) 28554 MWD/MTU	
292234	3.9572E-06
292235	2.2906E-04
292236	8.7582E-05
292238	2.1938E-02
93237	9.7017E-06
94238	2.9498E-06
294239	1.3557E-04
294240	4.5972E-05
294241	2.6095E-05
94242	7.9598E-06
95241	4.4337E-06
95243	1.5194E-06
96244	2.9865E-07
8016	4.6382E-02
36083	2.4913E-06
40093	3.6947E-05
42095	3.8708E-05
43099	3.8489E-05
44101	3.6694E-05
44103	1.9881E-07
45103	2.2778E-05
45105	5.8287E-08
46105	1.7525E-05
46108	6.0957E-06
47109	3.8138E-06
53135	2.3113E-08
54131	1.6647E-05
54135	8.7304E-09
55133	4.1862E-05
55134	1.4841E-06
55135	1.3757E-05
59141	3.8048E-05
60143	2.8778E-05
60145	2.2950E-05
60147	7.6151E-08
60148	1.1786E-05
61147	3.0661E-06

Table E.9 (continued)

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61148	9.9728E-09
61149	2.8183E-08
62147	6.0603E-06
62149	9.1728E-08
62150	1.0301E-05
62151	5.5099E-07
62152	4.1472E-06
63153	3.3469E-06
63154	9.0424E-07
63155	3.0310E-07
64155	1.0848E-07
MIX=121	
'ASSY 21	
'SQ2C3 QC LOC #21 REGION5A (BATCH4) 7306 MWD/MTU	
892234	7.0578E-06
892235	7.0281E-04
892236	3.9132E-05
892238	2.2176E-02
93237	1.5297E-06
94238	8.9609E-08
894239	7.0879E-05
894240	7.4499E-06
894241	2.3348E-06
94242	1.1869E-07
95241	3.1591E-07
95243	4.4297E-09
96244	1.4274E-10
8016	4.6386E-02
36083	8.8677E-07
40093	1.1054E-05
42095	1.1208E-05
43099	1.1033E-05
44101	9.5307E-06
44103	1.4889E-07
45103	6.1830E-06
45105	3.2014E-08
46105	2.7658E-06
46108	5.7970E-07
47109	4.1058E-07
53135	2.3482E-08
54131	5.1054E-06
54135	1.0870E-08
55133	1.1973E-05
55134	1.2285E-07
55135	3.8965E-06
59141	1.0278E-05
60143	9.9012E-06
60145	6.8613E-06
60147	7.6459E-08
60148	3.1215E-06
61147	1.6295E-06
61148	4.2142E-09
61149	2.4757E-08
62147	1.9265E-06
62149	1.0363E-07
62150	2.0793E-06
62151	3.4692E-07
62152	9.9031E-07
63153	4.7052E-07
63154	4.6283E-08
63155	4.2751E-08
64155	1.6252E-08
MIX=122	
'ASSY 22	
'SQ2C3 QC LOC #22 REGION3 (BATCH2) 32147 MWD/MTU	



Table E.9 (continued)

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392234	3.7387E-06
392235	1.9521E-04
392236	9.1968E-05
392238	2.1865E-02
93237	1.1202E-05
94238	3.8742E-06
394239	1.3864E-04
394240	5.1043E-05
394241	2.9236E-05
94242	1.0301E-05
95241	5.0012E-06
95243	2.2148E-06
96244	5.0709E-07
8016	4.6382E-02
36083	2.6690E-06
40093	4.0786E-05
42095	4.2803E-05
43099	4.2603E-05
44101	4.1196E-05
44103	2.0373E-07
45103	2.5061E-05
45105	6.0943E-08
46105	2.0524E-05
46108	7.3533E-06
47109	4.4644E-06
53135	2.3065E-08
54131	1.8092E-05
54135	8.5343E-09
55133	4.6260E-05
55134	1.8217E-06
55135	1.5442E-05
59141	4.2507E-05
60143	3.0933E-05
60145	2.5296E-05
60147	7.6504E-08
60148	1.3229E-05
61147	3.1603E-06
61148	1.0515E-08
61149	2.8634E-08
62147	6.4991E-06
62149	9.1782E-08
62150	1.1729E-05
62151	5.8535E-07
62152	4.5928E-06
63153	3.8932E-06
63154	1.1298E-06
63155	3.7505E-07
64155	1.3338E-07
MIX=123	
'ASSY 23	
'SQ2C3 QC LOC #23 REGION4 (BATCH3) 19376 MWD/MTU	
692234	5.3679E-06
692235	4.1245E-04
692236	7.6512E-05
692238	2.2038E-02
93237	5.9152E-06
94238	1.0365E-06
694239	1.2303E-04
694240	2.8887E-05
694241	1.5586E-05
94242	2.6238E-06
95241	2.3636E-06
95243	3.1281E-07
96244	3.5883E-08
8016	4.6385E-02

Table E.9 (continued)

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36083	1.9813E-06
40093	2.6912E-05
42095	2.7942E-05
43099	2.7412E-05
44101	2.5034E-05
44103	1.7844E-07
45103	1.6217E-05
45105	4.7453E-08
46105	9.8610E-06
46108	2.9757E-06
47109	2.0188E-06
53135	2.3277E-08
54131	1.2387E-05
54135	9.7888E-09
55133	3.0005E-05
55134	7.7856E-07
55135	8.9803E-06
59141	2.6532E-05
60143	2.2629E-05
60145	1.6688E-05
60147	7.5882E-08
60148	8.1072E-06
61147	2.9881E-06
61148	8.5971E-09
61149	2.6752E-08
62147	4.4414E-06
62149	1.0970E-07
62150	6.9759E-06
62151	4.9992E-07
62152	2.8720E-06
63153	1.9088E-06
63154	3.9082E-07
63155	1.5066E-07
64155	5.6190E-08
MIX=124	
'ASSY 24	
'SQ2C3 QC LOC #24 REGION4 (BATCH3) 22943 MWD/MTU	
792234	5.0874E-06
792235	3.6060E-04
792236	8.4817E-05
792238	2.1974E-02
93237	7.4412E-06
94238	1.5623E-06
794239	1.3099E-04
794240	3.4865E-05
794241	1.9668E-05
94242	4.0558E-06
95241	3.0270E-06
95243	5.8324E-07
96244	8.2248E-08
8016	4.6385E-02
36083	2.2417E-06
40093	3.1230E-05
42095	3.2539E-05
43099	3.1958E-05
44101	2.9571E-05
44103	1.8455E-07
45103	1.8948E-05
45105	5.0742E-08
46105	1.2335E-05
46108	3.9149E-06
47109	2.5871E-06
53135	2.3232E-08
54131	1.4229E-05
54135	9.5957E-09

Table E.9 (continued)

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55133	3.4951E-05
55134	1.0642E-06
55135	1.0584E-05
59141	3.1181E-05
60143	2.5719E-05
60145	1.9341E-05
60147	7.6022E-08
60148	9.5649E-06
61147	3.2449E-06
61148	9.5764E-09
61149	2.7283E-08
62147	4.9799E-06
62149	1.1194E-07
62150	8.5203E-06
62151	5.4298E-07
62152	3.3759E-06
63153	2.4205E-06
63154	5.5674E-07
63155	2.0143E-07
64155	7.4810E-08
MIX=125	
'ASSY 25	
'SQ2C3 QC LOC #25 REGION5A (BATCH5) 9019 MWD/MTU	
992234	6.8454E-06
992235	6.6936E-04
992236	4.6280E-05
992238	2.2136E-02
93237	2.2397E-06
94238	1.6833E-07
994239	8.9685E-05
994240	1.0699E-05
994241	4.1338E-06
94242	2.5744E-07
95241	5.6988E-07
95243	1.3503E-08
96244	6.5920E-10
8016	4.6386E-02
36083	1.0552E-06
40093	1.3301E-05
42095	1.3594E-05
43099	1.3440E-05
44101	1.1668E-05
44103	1.5114E-07
45103	7.7091E-06
45105	3.4548E-08
46105	3.6526E-06
46108	8.5390E-07
47109	6.0611E-07
53135	2.2822E-08
54131	6.1981E-06
54135	1.1314E-08
55133	1.4582E-05
55134	1.9395E-07
55135	4.3929E-06
59141	1.2536E-05
60143	1.1942E-05
60145	8.2641E-06
60147	7.3223E-08
60148	3.8256E-06

Table E.9 (continued)

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61147	1.9000E-06
61148	5.0833E-09
61149	2.4459E-08
62147	2.2503E-06
62149	1.2492E-07
62150	2.6470E-06
62151	3.9814E-07
62152	1.2386E-06
63153	6.3104E-07
63154	7.3920E-08
63155	5.6028E-08
64155	2.1703E-08
MIX=126	
'ASSY 26	
'SQ2C3 QC LOC #26 REGION4 (BATCH3) 13362 MWD/MTU	
592234	5.8646E-06
592235	5.1337E-04
592236	5.9496E-05
592238	2.2143E-02
93237	3.5270E-06
94238	4.1682E-07
594239	1.0317E-04
594240	1.8420E-05
594241	8.5647E-06
94242	9.3430E-07
95241	1.2636E-06
95243	7.2924E-08
96244	5.4060E-09
8016	4.6385E-02
36083	1.4779E-06
40093	1.9261E-05
42095	1.9837E-05
43099	1.9405E-05
44101	1.7343E-05
44103	1.6634E-07
45103	1.1351E-05
45105	4.1006E-08
46105	6.0710E-06
46108	1.6304E-06
47109	1.1492E-06
53135	2.3362E-08
54131	8.9637E-06
54135	1.0028E-08
55133	2.1259E-05
55134	3.8552E-07
55135	6.2429E-06
59141	1.8541E-05
60143	1.6721E-05
60145	1.1963E-05
60147	7.5912E-08
60148	5.6357E-06
61147	2.4083E-06
61148	6.6534E-09
61149	2.5826E-08
62147	3.3451E-06
62149	1.0321E-07
62150	4.5064E-06
62151	4.2387E-07
62152	1.9782E-06
63153	1.1219E-06
63154	1.7595E-07
63155	8.5566E-08
64155	3.1983E-08
MIX=127	
'ASSY 27	

Table E.9 (continued)

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'SQ2C3	QC	LOC #27	REGION2 (BATCH1)	31622	MWD/MTU
192234		3.0635E-06			
192235		1.3883E-04			
192236		7.9295E-05			
192238		2.1948E-02			
93237		1.0592E-05			
94238		3.9311E-06			
194239		1.3369E-04			
194240		5.3480E-05			
194241		2.9703E-05			
94242		1.1959E-05			
95241		5.0566E-06			
95243		2.6865E-06			
96244		6.6247E-07			
8016		4.6379E-02			
36083		2.4717E-06			
40093		3.8934E-05			
42095		4.1163E-05			
43099		4.1534E-05			
44101		4.0638E-05			
44103		2.1073E-07			
45103		2.5047E-05			
45105		6.4512E-08			
46105		2.1569E-05			
46108		8.0817E-06			
47109		4.8314E-06			
53135		2.3014E-08			
54131		1.7610E-05			
54135		7.6749E-09			
55133		4.5038E-05			
55134		1.8568E-06			
55135		1.3715E-05			
59141		4.1354E-05			
60143		2.8878E-05			
60145		2.4340E-05			
60147		7.6241E-08			
60148		1.2986E-05			
61147		3.0074E-06			
61148		1.0670E-08			
61149		2.9081E-08			
62147		6.1691E-06			
62149		8.0043E-08			
62150		1.1852E-05			
62151		5.4724E-07			
62152		4.6320E-06			
63153		3.9800E-06			
63154		1.1863E-06			
63155		3.8803E-07			
64155		1.3191E-07			
MIX=128					
'ASSY 28					
'SQ2C3	QC	LOC #28	REGION4 (BATCH3)	18755	MWD/MTU
692234		5.4178E-06			
692235		4.2206E-04			
692236		7.4936E-05			
692238		2.2049E-02			
93237		5.6560E-06			
94238		9.5742E-07			
694239		1.2139E-04			
694240		2.7829E-05			
694241		1.4849E-05			
94242		2.4062E-06			
95241		2.2481E-06			
95243		2.7658E-07			
96244		3.0499E-08			

Table E.9 (continued)

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8016	4.6385E-02
36083	1.9332E-06
40093	2.6144E-05
42095	2.7125E-05
43099	2.6605E-05
44101	2.4242E-05
44103	1.7726E-07
45103	1.5727E-05
45105	4.6820E-08
46105	9.4464E-06
46108	2.8224E-06
47109	1.9233E-06
53135	2.3286E-08
54131	1.2052E-05
54135	9.8135E-09
55133	2.9125E-05
55134	7.3229E-07
55135	8.7002E-06
59141	2.5716E-05
60143	2.2060E-05
60145	1.6215E-05
60147	7.5880E-08
60148	7.8526E-06
61147	2.9352E-06
61148	8.4120E-09
61149	2.6661E-08
62147	4.3417E-06
62149	1.0916E-07
62150	6.7108E-06
62151	4.9222E-07
62152	2.7824E-06
63153	1.8225E-06
63154	3.6470E-07
63155	1.4272E-07
64155	5.3244E-08
MIX=129	
'ASSY 29	
'SQ2C3 QC LOC #29 REGION4 (BATCH3) 14546 MWD/MTU	
592234	5.7647E-06
592235	4.9206E-04
592236	6.3164E-05
592238	2.2123E-02
93237	3.9723E-06
94238	5.1391E-07
594239	1.0786E-04
594240	2.0491E-05
594241	9.9224E-06
94242	1.1929E-06
95241	1.4744E-06
95243	1.0267E-07
96244	8.3810E-09
8016	4.6385E-02
36083	1.5836E-06
40093	2.0806E-05
42095	2.1467E-05
43099	2.1015E-05
44101	1.8860E-05
44103	1.6898E-07
45103	1.2326E-05
45105	4.2410E-08
46105	6.7757E-06
46108	1.8698E-06
47109	1.3094E-06
53135	2.3344E-08
54131	9.6684E-06

Table E.9 (continued)

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54135	9.9940E-09
55133	2.3019E-05
55134	4.5232E-07
55135	6.7871E-06
59141	2.0130E-05
60143	1.7955E-05
60145	1.2919E-05
60147	7.5864E-08
60148	6.1233E-06
61147	2.5324E-06
61148	7.0404E-09
61149	2.6002E-08
62147	3.5879E-06
62149	1.0471E-07
62150	4.9717E-06
62151	4.3924E-07
62152	2.1589E-06
63153	1.2671E-06
63154	2.1127E-07
63155	9.6328E-08
64155	3.6019E-08
MIX=130	
'ASSY 30	
'SQ2C3 QC LOC #30 REGION5B (BATCH6) 7366 MWD/MTU	
1092234	6.6049E-06
1092235	6.5658E-04
1092236	3.8761E-05
1092238	2.2219E-02
93237	1.5611E-06
94238	9.5014E-08
1094239	7.2017E-05
1094240	7.9253E-06
1094241	2.5312E-06
94242	1.3693E-07
95241	3.4290E-07
95243	5.2862E-09
96244	1.7776E-10
8016	4.6385E-02
36083	8.8775E-07
40093	1.1097E-05
42095	1.1265E-05
43099	1.1105E-05
44101	9.6095E-06
44103	1.5064E-07
45103	6.2673E-06
45105	3.2869E-08
46105	2.8408E-06
46108	6.1336E-07
47109	4.3637E-07
53135	2.3467E-08
54131	5.1437E-06
54135	1.0439E-08
55133	1.2052E-05
55134	1.2758E-07
55135	3.7767E-06
59141	1.0344E-05
60143	9.9239E-06
60145	6.8933E-06
60147	7.6339E-08
60148	3.1445E-06
61147	1.6322E-06
61148	4.3220E-09
61149	2.4835E-08
62147	1.9328E-06
62149	9.8184E-08

Table E.9 (continued)

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62150	2.1100E-06
62151	3.3675E-07
62152	1.0148E-06
63153	4.8278E-07
63154	4.8847E-08
63155	4.3287E-08
64155	1.6235E-08
MIX=131	
'ASSY 31	
'SQ2C3 QC LOC #31 REGION3 (BATCH2) 27263 MWD/MTU	
292234	4.0384E-06
292235	2.4237E-04
292236	8.5755E-05
292238	2.1963E-02
93237	9.1573E-06
94238	2.6414E-06
294239	1.3420E-04
294240	4.4054E-05
294241	2.4870E-05
94242	7.1738E-06
95241	4.1962E-06
95243	1.3049E-06
96244	2.4199E-07
8016	4.6382E-02
36083	2.4215E-06
40093	3.5534E-05
42095	3.7203E-05
43099	3.6972E-05
44101	3.5071E-05
44103	1.9689E-07
45103	2.1928E-05
45105	5.7244E-08
46105	1.6477E-05
46108	5.6636E-06
47109	3.5818E-06
53135	2.3132E-08
54131	1.6094E-05
54135	8.7910E-09
55133	4.0238E-05
55134	1.3761E-06
55135	1.3149E-05
59141	3.6431E-05
60143	2.7937E-05
60145	2.2081E-05
60147	7.6064E-08
60148	1.1267E-05
61147	3.0390E-06
61148	9.8005E-09
61149	2.8029E-08
62147	5.8713E-06
62149	9.1717E-08
62150	9.7999E-06
62151	5.3854E-07
62152	3.9829E-06
63153	3.1504E-06
63154	8.2780E-07
63155	2.7927E-07
64155	1.0009E-07
MIX=1	
40302	4.25156E-02
MIX=2	
24304	1.74286E-02
25055	1.73633E-03
26304	5.93579E-02



Table E.9 (continued)

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28304	7.72073E-03
MIX=3	
1001	4.78066E-02
308016	2.39033E-02
5010	3.73795E-06
5011	1.51750E-05
MIX=4	
424304	8.71428E-03
425055	8.68166E-04
426304	2.96789E-02
428304	3.86037E-03
401001	2.39033E-02
408016	1.19517E-02
405010	1.86898E-06
405011	7.58749E-06
MIX=5	
524304	1.74286E-02
525055	1.73633E-03
526304	5.93579E-02
528304	7.72073E-03
MIX=6	
601001	4.91708E-02
608016	2.45854E-02
605010	3.84461E-06
605011	1.56080E-05
MIX=7	
724304	1.74286E-02
725055	1.73633E-03
726304	5.93579E-02
728304	7.72073E-03
MIX=8	
801001	5.04213E-02
808016	2.52107E-02
805010	3.94239E-06
805011	1.60049E-05
MIX=9	
924304	1.74286E-02
925055	1.73633E-03
926304	5.93579E-02
928304	7.72073E-03
MIX=11	
'SQ2C3 BP FOR QC LOC #2 REGION5B (BATCH7) 10102 MWD/MTU	
1108016	4.4970E-03
11023	1.6496E-03
13027	5.7993E-04
1105010	1.8689E-04
1105011	3.8630E-03
MIX=12	
'SQ2C3 BP FOR QC LOC #4 REGION5B (BATCH7) 9787 MWD/MTU	
1108016	4.4970E-03
11023	1.6496E-03
13027	5.7993E-04
1105010	1.9828E-04
1105011	3.8630E-03
MIX=13	
'SQ2C3 BP FOR QC LOC #6 REGION5B (BATCH7) 9755 MWD/MTU	
1108016	4.4970E-03
11023	1.6496E-03
13027	5.7993E-04
1105010	1.9948E-04
1105011	3.8630E-03
MIX=14	
'SQ2C3 BP FOR QC LOC #14 REGION5A (BATCH5) 9935 MWD/MTU	
1108016	4.4970E-03
11023	1.6495E-03

Table E.9 (continued)

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    13027 5.7993E-04
1105010 2.0496E-04
1105011 3.8630E-03
MIX=15
'SQ2C3 BP FOR QC LOC #17 REGION5B (BATCH7) 10118 MWD/MTU
1108016 4.4970E-03
    11023 1.6496E-03
    13027 5.7993E-04
1105010 1.8633E-04
1105011 3.8630E-03
MIX=16
'SQ2C3 BP FOR QC LOC #19 REGION5A (BATCH5) 9506 MWD/MTU
1108016 4.4970E-03
    11023 1.6496E-03
    13027 5.7994E-04
1105010 2.2135E-04
1105011 3.8630E-03
MIX=17
'SQ2C3 BP FOR QC LOC #25 REGION5A (BATCH5) 9019 MWD/MTU
1108016 4.4970E-03
    11023 1.6496E-03
    13027 5.7994E-04
1105010 2.4205E-04
1105011 3.8630E-03
END MIXT

READ GEOM

'--- FUEL PINS
UNIT 101
CYLINDER 0101 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 102
CYLINDER 0102 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 103
CYLINDER 0103 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 104
CYLINDER 0104 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 105
CYLINDER 0105 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 106
CYLINDER 0106 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 107
CYLINDER 0107 1 .40958 365.76 0.0
CYLINDER 0 1 .41783 365.76 0.0
CYLINDER 1 1 .47498 365.76 0.0
CUBOID 3 1 2P.62992 2P.62992 365.76 0.0
UNIT 108

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Table E.9 (continued)

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CYLINDER	0108	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 109					
CYLINDER	0109	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 110					
CYLINDER	0110	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 111					
CYLINDER	0111	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 112					
CYLINDER	0112	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 113					
CYLINDER	0113	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 114					
CYLINDER	0114	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 115					
CYLINDER	0115	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 116					
CYLINDER	0116	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 117					
CYLINDER	0117	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 118					
CYLINDER	0118	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 119					
CYLINDER	0119	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 120					
CYLINDER	0120	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 121					

Table E.9 (continued)

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CYLINDER	0121	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 122					
CYLINDER	0122	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 123					
CYLINDER	0123	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 124					
CYLINDER	0124	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 125					
CYLINDER	0125	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 126					
CYLINDER	0126	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 127					
CYLINDER	0127	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 128					
CYLINDER	0128	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 129					
CYLINDER	0129	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 130					
CYLINDER	0130	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
UNIT 131					
CYLINDER	0131	1	.40958	365.76	0.0
CYLINDER	0	1	.41783	365.76	0.0
CYLINDER	1	1	.47498	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
'--- GUIDE TUBE					
UNIT 161					
CYLINDER	3	1	.57150	365.76	0.0
CYLINDER	1	1	.61214	365.76	0.0
CUBOID	3	1	2P.62992	2P.62992	365.76 0.0
'--- BP RODS					
UNIT 162					
CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0

Table E.9 (continued)

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CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	11	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0
CYLINDER	2	1	0.48387	365.76	0.0
CYLINDER	3	1	0.57150	365.76	0.0
CYLINDER	1	1	0.61214	365.76	0.0
CUBOID	3	1	2P0.62992	2P0.62992	365.76 0.0
UNIT 163					
CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0
CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	12	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0
CYLINDER	2	1	0.48387	365.76	0.0
CYLINDER	3	1	0.57150	365.76	0.0
CYLINDER	1	1	0.61214	365.76	0.0
CUBOID	3	1	2P0.62992	2P0.62992	365.76 0.0
UNIT 164					
CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0
CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	13	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0
CYLINDER	2	1	0.48387	365.76	0.0
CYLINDER	3	1	0.57150	365.76	0.0
CYLINDER	1	1	0.61214	365.76	0.0
CUBOID	3	1	2P0.62992	2P0.62992	365.76 0.0
UNIT 165					
CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0
CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	14	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0
CYLINDER	2	1	0.48387	365.76	0.0
CYLINDER	3	1	0.57150	365.76	0.0
CYLINDER	1	1	0.61214	365.76	0.0
CUBOID	3	1	2P0.62992	2P0.62992	365.76 0.0
UNIT 166					
CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0
CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	15	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0
CYLINDER	2	1	0.48387	365.76	0.0
CYLINDER	3	1	0.57150	365.76	0.0
CYLINDER	1	1	0.61214	365.76	0.0
CUBOID	3	1	2P0.62992	2P0.62992	365.76 0.0
UNIT 167					
CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0
CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	16	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0
CYLINDER	2	1	0.48387	365.76	0.0
CYLINDER	3	1	0.57150	365.76	0.0
CYLINDER	1	1	0.61214	365.76	0.0
CUBOID	3	1	2P0.62992	2P0.62992	365.76 0.0
UNIT 168					
CYLINDER	0	1	0.21400	365.76	0.0
CYLINDER	2	1	0.23051	365.76	0.0
CYLINDER	0	1	0.24130	365.76	0.0
CYLINDER	17	1	0.42672	365.76	0.0
CYLINDER	0	1	0.43688	365.76	0.0
CYLINDER	2	1	0.48387	365.76	0.0
CYLINDER	3	1	0.57150	365.76	0.0

Table E.9 (continued)

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CYLINDER	1	1	0.61214	365.76	0.0
CUBOID	3	1	2P0.62992	2P0.62992	365.76 0.0

'--- FUEL ASSY'S

UNIT 1					
ARRAY	0101	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 2					
ARRAY	0102	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 3					
ARRAY	0103	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 4					
ARRAY	0104	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 5					
ARRAY	0105	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 6					
ARRAY	0106	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 7					
ARRAY	0107	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 8					
ARRAY	0108	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 9					
ARRAY	0109	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 10					
ARRAY	0110	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 11					
ARRAY	0111	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 12					
ARRAY	0112	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 13					
ARRAY	0113	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 14					
ARRAY	0114	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 15					
ARRAY	0115	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 16					
ARRAY	0116	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 17					
ARRAY	0117	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 18					
ARRAY	0118	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 19					
ARRAY	0119	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1
UNIT 20					
ARRAY	0120	2R-10.70864	0.0		
REFLECTOR	3	1	4R0.04318	2R0.0	1

Table E.9 (continued)

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UNIT 21
ARRAY      0121 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 22
ARRAY      0122 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 23
ARRAY      0123 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 24
ARRAY      0124 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 25
ARRAY      0125 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 26
ARRAY      0126 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 27
ARRAY      0127 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 28
ARRAY      0128 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 29
ARRAY      0129 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 30
ARRAY      0130 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1
UNIT 31
ARRAY      0131 2R-10.70864 0.0
REFLECTOR  3  1 4R0.04318 2R0.0 1

'--- BAFFLE REGION
UNIT 41
CUBOID    2  1    0.0      -2.8575      0.0      -2.8575      365.76 0.0
UNIT 42
CUBOID    2  1    2P10.75182    2P1.42875                      365.76 0.0
UNIT 43
CUBOID    2  1    2.8575      0.0      21.50364    0.0      365.76 0.0
UNIT 44
CUBOID    2  1    2P21.50364    2P1.42875                      365.76 0.0

'---ROWS OF ASSY'S W/ BAFFLE REGIONS ON EACH END
UNIT 51
COM=! ROW 1 !
ARRAY    1 -78.12024  -13.60932 0.0
UNIT 52
COM=! ROW 2 !
ARRAY    2 -121.12752 -10.75182 0.0
UNIT 53
COM=! ROWS 3 & 4 !
ARRAY    3 -142.63116 -21.50364 0.0
UNIT 55
COM=! ROWS 5 - 11 !
ARRAY    5 -164.1348  -75.26274 0.0
UNIT 62
COM=! ROWS 12 & 13 !
ARRAY   12 -142.63116 -21.50364 0.0
UNIT 64
COM=! ROW 14 !
ARRAY   14 -121.12752 -10.75182 0.0

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Table E.9 (continued)

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UNIT 65
COM=! ROW 15 !
ARRAY 15 -78.12024 -10.75182 0.0

GLOBAL UNIT 70
CYLINDER 3 1 187.96 365.76 0.0
HOLE 55 0.0 0.0 0.0
HOLE 53 0.0 -96.76638 0.0
HOLE 62 0.0 96.76638 0.0
HOLE 52 0.0 -129.02184 0.0
HOLE 64 0.0 129.02184 0.0
HOLE 51 0.0 -150.52548 0.0
HOLE 65 0.0 150.52548 0.0
HOLE 44 -99.62388 141.20241 0
HOLE 44 -99.62388 -141.20241 0
HOLE 44 99.62388 141.20241 0
HOLE 44 99.62388 -141.20241 0
HOLE 42 -131.87936 119.69877 0
HOLE 42 -131.87936 -119.69877 0
HOLE 42 131.87934 119.69877 0
HOLE 42 131.87934 -119.69877 0
HOLE 42 -153.38300 76.69149 0
HOLE 42 -153.38300 -76.69149 0
HOLE 42 153.38298 76.69149 0
HOLE 42 153.38298 -76.69149 0
CYLINDER 4 1 187.96 390.76 -25.0
REFLECTOR 5 1 5.715 0.0 0.0 1
REFLECTOR 6 1 7.620 0.0 0.0 1
REFLECTOR 7 1 6.985 0.0 0.0 1
REFLECTOR 8 1 11.43 0.0 0.0 1
REFLECTOR 9 1 21.59 0.0 0.0 1
CUBOID 0 1 2P245.0 2P245.0 390.76 -25.0
END GEOM

READ ARRAY

'--- FUEL ASSY'S
ARA=101 NUX=17 NUY=17 NUZ=1 FILL F101
  A40 161 A43 161 A46 161 A55 161 A65 161
  A88 161 A91 161 A94 161 A97 161 A100 161
  A139 161 A142 161 A145 161 A148 161 A151 161
  A190 161 A193 161 A196 161 A199 161 A202 161
  A225 161 A235 161 A244 161 A247 161 A250 161 END FILL
'-- ASSY 2 16 BP
ARA=102 NUX=17 NUY=17 NUZ=1 FILL F102
  A40 162 A43 161 A46 162 A55 162 A65 162
  A88 162 A91 161 A94 162 A97 161 A100 162
  A139 161 A142 162 A145 161 A148 162 A151 161
  A190 162 A193 161 A196 162 A199 161 A202 162
  A225 162 A235 162 A244 162 A247 161 A250 162 END FILL
ARA=103 NUX=17 NUY=17 NUZ=1 FILL F103
  A40 161 A43 161 A46 161 A55 161 A65 161
  A88 161 A91 161 A94 161 A97 161 A100 161
  A139 161 A142 161 A145 161 A148 161 A151 161
  A190 161 A193 161 A196 161 A199 161 A202 161
  A225 161 A235 161 A244 161 A247 161 A250 161 END FILL
'-- ASSY 4 24 BP
ARA=104 NUX=17 NUY=17 NUZ=1 FILL F104
  A40 163 A43 163 A46 163 A55 163 A65 163
  A88 163 A91 163 A94 163 A97 163 A100 163
  A139 163 A142 163 A145 161 A148 163 A151 163
  A190 163 A193 163 A196 163 A199 163 A202 163
  A225 163 A235 163 A244 163 A247 163 A250 163 END FILL
ARA=105 NUX=17 NUY=17 NUZ=1 FILL F105
  A40 161 A43 161 A46 161 A55 161 A65 161

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Table E.9 (continued)

A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
'-- ASSY 6 12 BP										
ARA=106		NUX=17	NUY=17	NUZ=1		FILL		F106		
A40	164	A43	161	A46	164	A55	161	A65	161	
A88	164	A91	161	A94	164	A97	161	A100	164	
A139	161	A142	164	A145	161	A148	164	A151	161	
A190	164	A193	161	A196	164	A199	161	A202	164	
A225	161	A235	161	A244	164	A247	161	A250	164	END FILL
ARA=107		NUX=17	NUY=17	NUZ=1		FILL		F107		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=108		NUX=17	NUY=17	NUZ=1		FILL		F108		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=109		NUX=17	NUY=17	NUZ=1		FILL		F109		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=110		NUX=17	NUY=17	NUZ=1		FILL		F110		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=111		NUX=17	NUY=17	NUZ=1		FILL		F111		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=112		NUX=17	NUY=17	NUZ=1		FILL		F112		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
ARA=113		NUX=17	NUY=17	NUZ=1		FILL		F113		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	
A225	161	A235	161	A244	161	A247	161	A250	161	END FILL
'-- ASSY 14 16 BP										
ARA=114		NUX=17	NUY=17	NUZ=1		FILL		F114		
A40	165	A43	161	A46	165	A55	165	A65	165	
A88	165	A91	161	A94	165	A97	161	A100	165	
A139	161	A142	165	A145	161	A148	165	A151	161	
A190	165	A193	161	A196	165	A199	161	A202	165	
A225	165	A235	165	A244	165	A247	161	A250	165	END FILL
ARA=115		NUX=17	NUY=17	NUZ=1		FILL		F115		
A40	161	A43	161	A46	161	A55	161	A65	161	
A88	161	A91	161	A94	161	A97	161	A100	161	
A139	161	A142	161	A145	161	A148	161	A151	161	
A190	161	A193	161	A196	161	A199	161	A202	161	

Table E.9 (continued)

A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=116	NUX=17	NUY=17	NUZ=1	FILL F116	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
'-- ASSY 17 12 BP					
ARA=117	NUX=17	NUY=17	NUZ=1	FILL F117	
A40 166	A43 161	A46 166	A55 161	A65 161	
A88 166	A91 161	A94 166	A97 161	A100 166	
A139 161	A142 166	A145 161	A148 166	A151 161	
A190 166	A193 161	A196 166	A199 161	A202 166	
A225 161	A235 161	A244 166	A247 161	A250 166	END FILL
ARA=118	NUX=17	NUY=17	NUZ=1	FILL F118	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
'-- ASSY 19 20 BP					
ARA=119	NUX=17	NUY=17	NUZ=1	FILL F119	
A40 167	A43 167	A46 167	A55 167	A65 167	
A88 167	A91 161	A94 167	A97 161	A100 167	
A139 167	A142 167	A145 161	A148 167	A151 167	
A190 167	A193 161	A196 167	A199 161	A202 167	
A225 167	A235 167	A244 167	A247 167	A250 167	END FILL
ARA=120	NUX=17	NUY=17	NUZ=1	FILL F120	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=121	NUX=17	NUY=17	NUZ=1	FILL F121	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=122	NUX=17	NUY=17	NUZ=1	FILL F122	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=123	NUX=17	NUY=17	NUZ=1	FILL F123	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=124	NUX=17	NUY=17	NUZ=1	FILL F124	
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
'-- ASSY 25 8 BP					
ARA=125	NUX=17	NUY=17	NUZ=1	FILL F125	
A40 161	A43 161	A46 161	A55 168	A65 168	
A88 161	A91 161	A94 168	A97 161	A100 161	
A139 161	A142 168	A145 161	A148 168	A151 161	
A190 161	A193 161	A196 168	A199 161	A202 161	
A225 168	A235 168	A244 161	A247 161	A250 161	END FILL
ARA=126	NUX=17	NUY=17	NUZ=1	FILL F126	

Table E.9 (continued)

A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=127	NUX=17	NUY=17	NUZ=1	FILL	F127
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=128	NUX=17	NUY=17	NUZ=1	FILL	F128
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=129	NUX=17	NUY=17	NUZ=1	FILL	F129
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=130	NUX=17	NUY=17	NUZ=1	FILL	F130
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
ARA=131	NUX=17	NUY=17	NUZ=1	FILL	F131
A40 161	A43 161	A46 161	A55 161	A65 161	
A88 161	A91 161	A94 161	A97 161	A100 161	
A139 161	A142 161	A145 161	A148 161	A151 161	
A190 161	A193 161	A196 161	A199 161	A202 161	
A225 161	A235 161	A244 161	A247 161	A250 161	END FILL
'--- ROWS OF FUEL ASSY'S					
ARA=1	NUX=9	NUY=2	NUZ=1	FILL	
		41	42	42	42 1B4
	43		26	21	15 8 1B4
END FILL					
ARA=2	NUX=13	NUY=1	NUZ=1	FILL	
	43	31	29	25	20 14 7 1B6
END FILL					
ARA=3	NUX=15	NUY=2	NUZ=1	FILL	
	43	31	30	28	24 19 13 6 1B7
	43	29	28	27	23 18 12 5 1B7
END FILL					
ARA=5	NUX=17	NUY=7	NUZ=1	FILL	
	43	26	25	24	23 22 17 11 4 1B8
	43	21	20	19	18 17 16 10 3 1B8
	43	15	14	13	12 11 10 9 2 1B8
	43	8	7	6	5 4 3 2 1 1B59
END FILL					
ARA=12	NUX=15	NUY=2	NUZ=1	FILL	
	43	29	28	27	23 18 12 5 1B7
	43	31	30	28	24 19 13 6 1B7
END FILL					
ARA=14	NUX=13	NUY=1	NUZ=1	FILL	
	43	31	29	25	20 14 7 1B6
END FILL					
ARA=15	NUX=9	NUY=2	NUZ=1	FILL	
	43		26	21	15 8 1B4
		41	42	42	42 1B4
END FILL					

Table E.9 (continued)

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END ARRAY
READ PLOT
TTL=! SEQUOYAH UNIT 2 CYCLE 3 FULL CORE BY GEOM UNIT !
PIC=UNIT
XUL=-200 YUL=200 XLR=200 YLR=-200 UAX=1 VDN=-1 NAX=130 END
TTL=! ASSEMBLY LOC 2 !
PIC=MAT NCH=! 12 455555567899999ABCDEFGHIJKLMNPOQRSTUVWXYZ#>$-+ )@&!
XUL=-11 YUL=32.5 XLR=11 YLR=10.5 UAX=1 VDN=-1 NAX=130 END
TTL=! SEQUOYAH UNIT 2 CYCLE 3 FULL CORE BY COMPOSITION!
PIC=MAT NCH=! 1/ 4/ / /5555555ABCDEFGHIJKLMNPOQRSTUVWXYZ#>$-+ )@&!
XUL=-200 YUL=200 XLR=200 YLR=-200 UAX=1 VDN=-1 NAX=520 END
END PLOT
END DATA
END

```

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