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

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MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
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Computational Physics and Engineering Division

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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_{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_{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.[1] 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_{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[2] (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_{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[3] developed at ORNL has been the primary computational tool used by DOE to investigate technical issues related to burnup credit.[4] 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[5] and criticality safety analyses via the CSAS/KENO V.a analysis sequence.[6] 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[7] 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[8] 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_{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_{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 (±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

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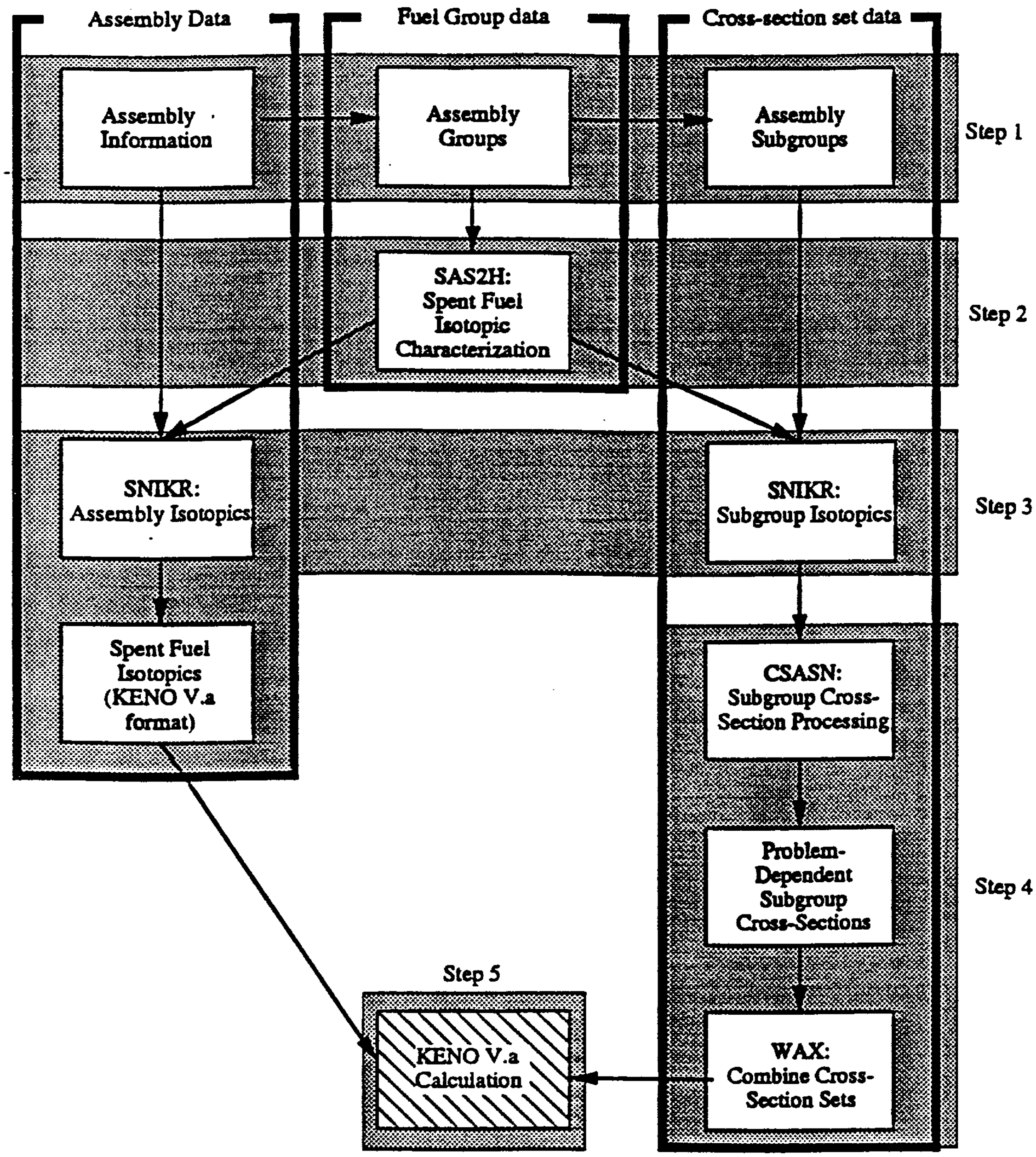

Fig. 1. Overview of the reactor critical calculation procedure.

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_{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[5] sequence of the SCALE-4 code system and the 27-group burnup library. The SAS2H sequence invokes the ORIGEN-S[9] 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[10,11] 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 $1.2*B_{max}$ 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 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}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.[10,13]

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[9] 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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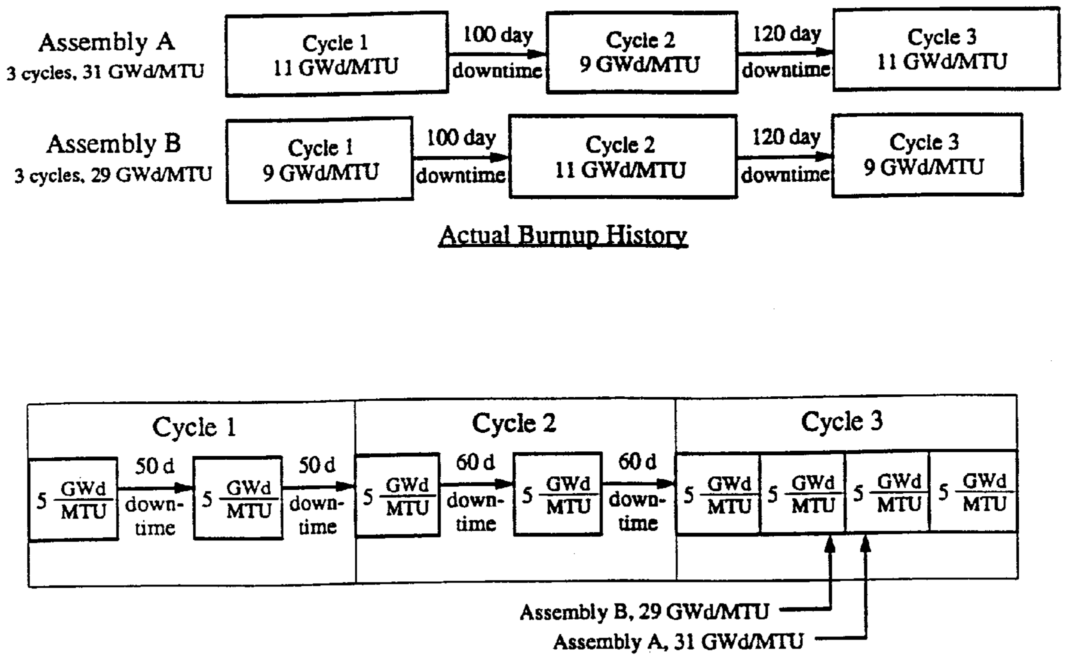

Fig. 2. SAS2H burnup model of assemblies within a fuel group.

Table 1. Nuclides updated by SAS2H

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

[a]Automatically updated by SAS2H.
[b]Not an actinide or fission product, but present in UO_2 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_∞ (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_∞ 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}Ru, ^{135}I, ^{148}Nd, and ^{149}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[1] 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[6] 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[14] to perform resonance shielding calculations using Bondarenko factors, followed by NITAWL-II[15] 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}U, ^{235}U, ^{236}U, ^{238}U, ^{239}Pu, ^{240}Pu, and ^{241}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_{eff}; however, the effect is extremely small (<0.1% $\Delta k/k$).

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

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

[a]The 25 nuclides to be used in burnup credit analysis (ref. 4).
[b]Additional burnup credit nuclides from ref. 1.
[c]Additional reactor physics nuclides from Virginia Power's PDQ calculations (ref. 10).
[d]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[16] 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 × 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.

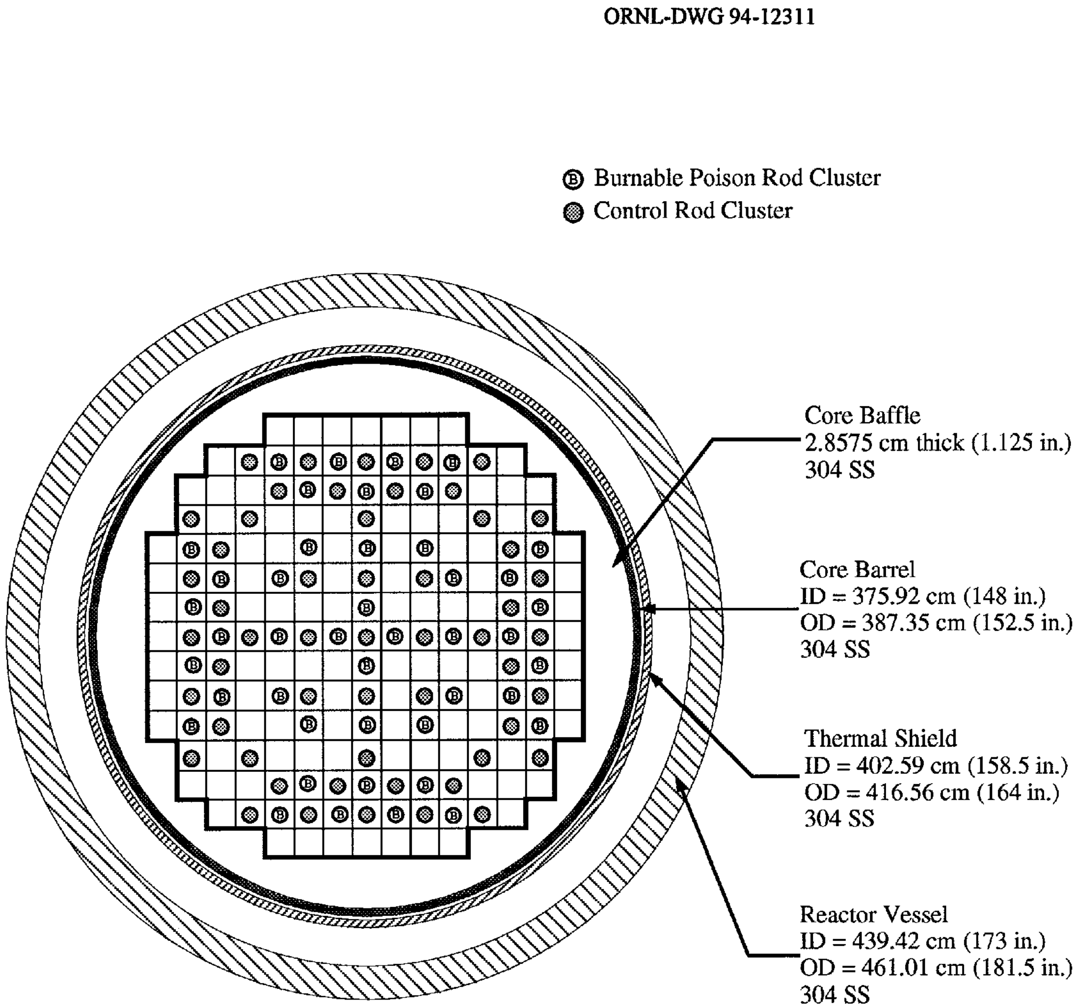

Fig. 3. Sequoyah Unit 2 Cycle 3 core configuration.

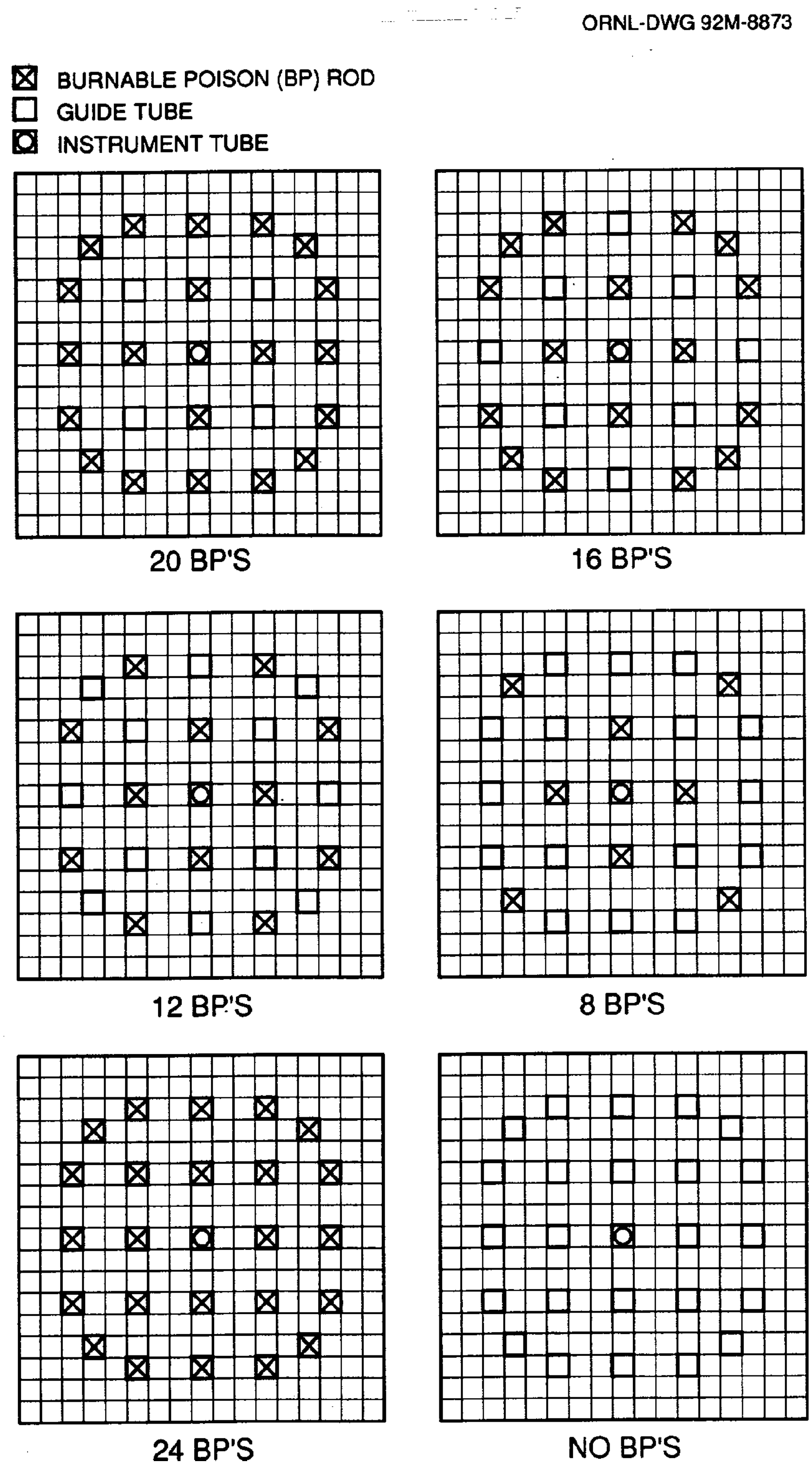

Fig. 4. Fuel assembly lattice arrangements in Sequoyah Unit 2 Cycle 3.

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	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)	Power	Control Bank D[a] position (cm inserted)	Critical boron (ppm)	Average temp. (°F)
BOC	0	HZP	0.0	1685	547
BOC	150	HFP	0.0	1150	582
MOC	8250	HFP	1.6	475	582

[a]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 % ^{235}U, respectively. Both batches were loaded initially in Cycle 1. Batch 4, with an enrichment of 3.5 wt % ^{235}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 % ^{235}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_{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 × 17
Coolant pressure, psia	2250
Water temperature, K (°F)	579 (582)[a]
Water density, g/cm^3	0.7149[a,b]
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_2
Pellet stack density, % TD	94.85[c]
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)[a]
Clad temperature, K (°F)	629 (670)[a]
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

[a]Average HFP value.

[b]Interpolated from the water density vs pressure and temperature table in the SAS2H input guide (ref. 5).

[c]Based on a fuel loading of 90,000 kgU.

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	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}U enrichment of the associated fuel batch. The following empirical relationship was used to determine relative isotopic content:[17]

$$w_{234} = 0.007731(w_{235})^{1.0837},$$
$$w_{236} = 0.0046w_{235},$$
$$w_{238} = 100 - w_{234} - w_{235} - w_{236},$$

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,γ) 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 %			
	^{234}U	^{235}U	^{236}U	^{238}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.[18] These data and atomic weights of the elements and isotopic abundance values[19] were applied in deriving the atomic densities of the borosilicate glass in Table 9. The glass density, 2.23 g/cm^3, 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

V_T = total cell volume = (pitch)^2 × (length),
V_{GT} = guide tube volume (same as outer tube in BPR cell),
V_{BP} = BP rod total volume.

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):

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

where

A = the material's inner radius in an actual BP rod,
B = the same material zone's outer radius.

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

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

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_2	0.805
B_2O_3	0.125
Na_2O	0.038
K_2O	0.004
Al_2O_3	0.022

Table 9. Borosilicate glass input atom densities[a]

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	
	^{10}B		9.595E-4[b]
	^{11}B		3.863E-3
Total		0.99402	

[a]Applying weight fractions of compounds in Table 8 and 2.23 g/cm^3 glass density.

[b]Read as 9.595×10^{-4}.

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

			Number/assembly		Total number		
Fuel group	Fuel batch	Number of assemblies	BP rods	Guide tubes	BP rods	Guide tubes	Nonfuel[a] 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

[a]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^3	SAS2H mixture number	Radius in cell, cm	
				Fuel group 5	Fuel group 7
1	Air	1.22E-3[a]	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

[a]Read as 1.22×10^{-3}.

Table 12. Fuel assembly data for eighth-core geometry

			Cross-section set		Average burnup (MWd/MTU)	
Eighth-core location	Sequoyah fuel batch	SAS2H fuel group	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 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 1×10^{-20} (^{135}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		4
					7,366 – 8,060	
					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[a]	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[a]	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[a]	41.468	205	0	4@5	120.58	0	30
4	3[a]	37.765	205	0	4@5	79.439	0	20
5	3[a]	46.278	205	0	4@5	64.826	0	20
6	3[a]	37.625	205	0	4@5	79.734	0	20
7	3[a]	48.666	205	0	5@5	61.645	0	25

[a]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 × 17 fuel was calculated as 5.51884E-6. The core average power level assumed for Sequoyah Unit 2 was 37.90 MW/MTU, or 2.0916E-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}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[16] 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[20] eigenvalue calculation in stand-alone mode and via the CSAS1X[6] 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 (HZP 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_∞ comparison for validation of cross-section methodology

			k_∞		
Burnup	Power	Assembly ID	XSDRNPM stand-alone	CSAS1X sequence	% Difference
MOC	HFP	N38	0.896084	0.895497	0.065
MOC	HFP	P17	1.00332	1.00247	0.085
BOC	HZP	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_{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,[21] 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_2O 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.

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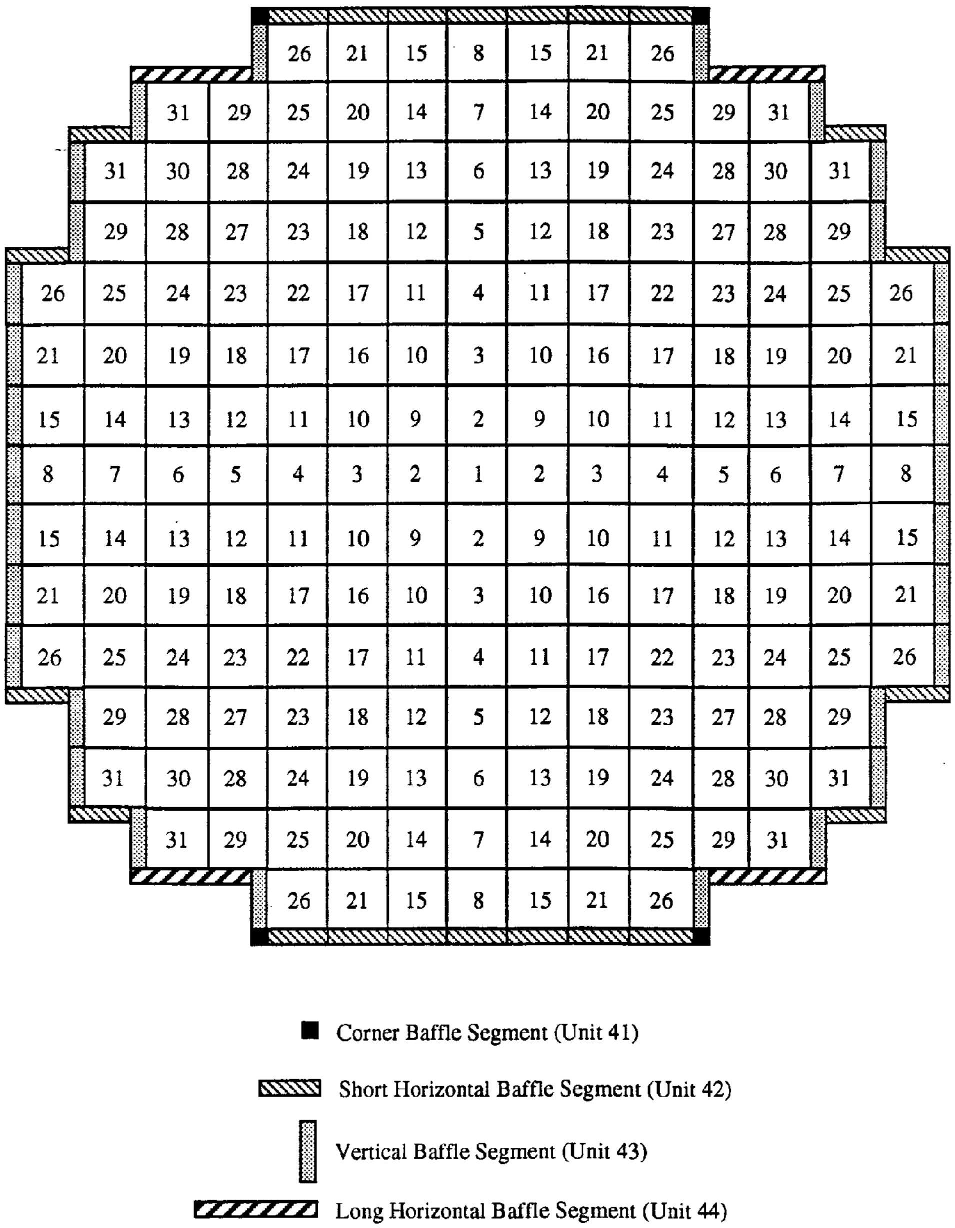

Fig. 7. Full-core assembly positions and core baffle configuration.

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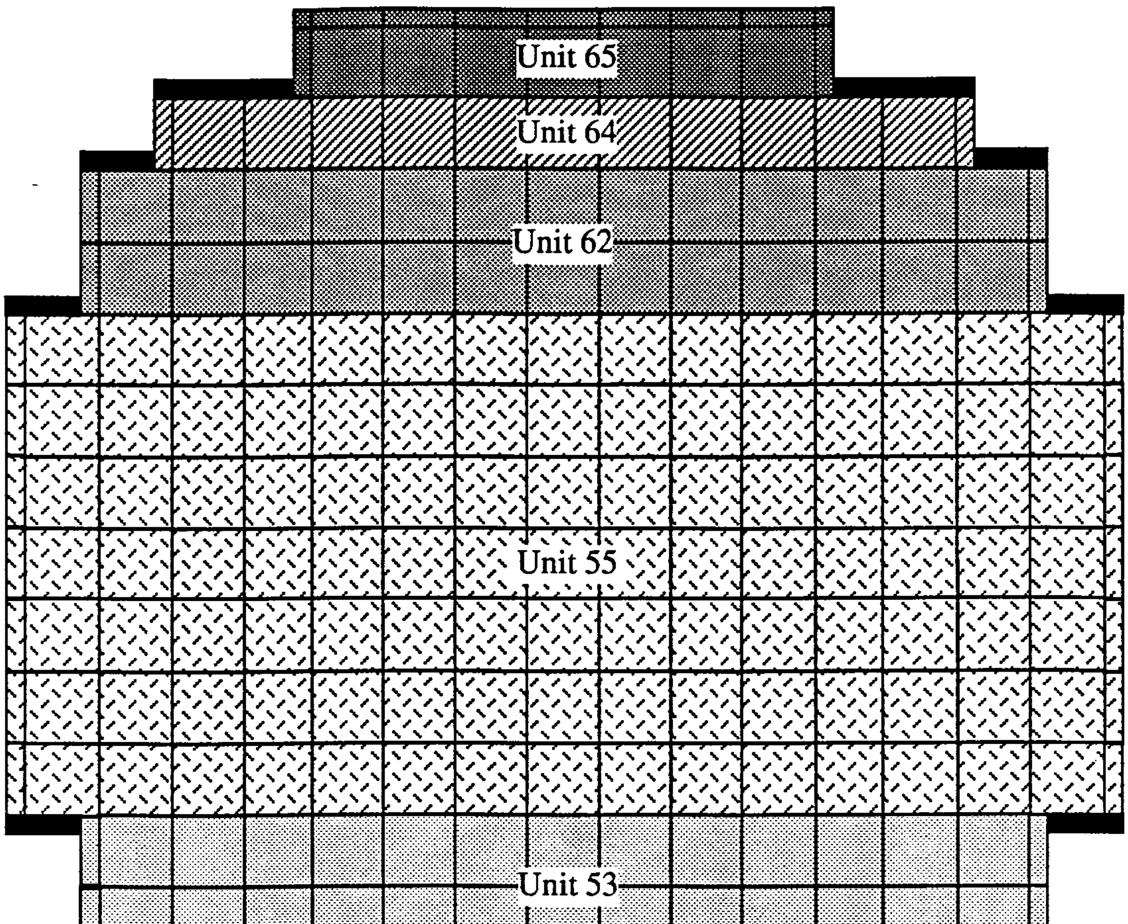

Fig. 8. KENO V.a unit definitions based on component arrays.

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 × 2.8575 cm (corner) segment of core baffle
42	21.50364 × 2.8575 cm (horizontal) segment of core baffle
43	2.8575 × 21.50364 cm (vertical) segment of core baffle
44	43.00728 × 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_{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 1×10^6 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_{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_{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.[22] 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_{eff}	Average energy group where fission occurs[a]	Neutron histories
BOC	HZP	1685	1.0039 ± 0.0005	20.4868 ± 0.0037	1,000,000
BOC	HFP	1150	1.0067 ± 0.0005	20.3822 ± 0.0035	1,000,000
MOC	HFP	475	1.0046 ± 0.0005	20.4437 ± 0.0037	1,000,000

[a]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 (% Δk/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

ORNL-DWG 92M-8306R

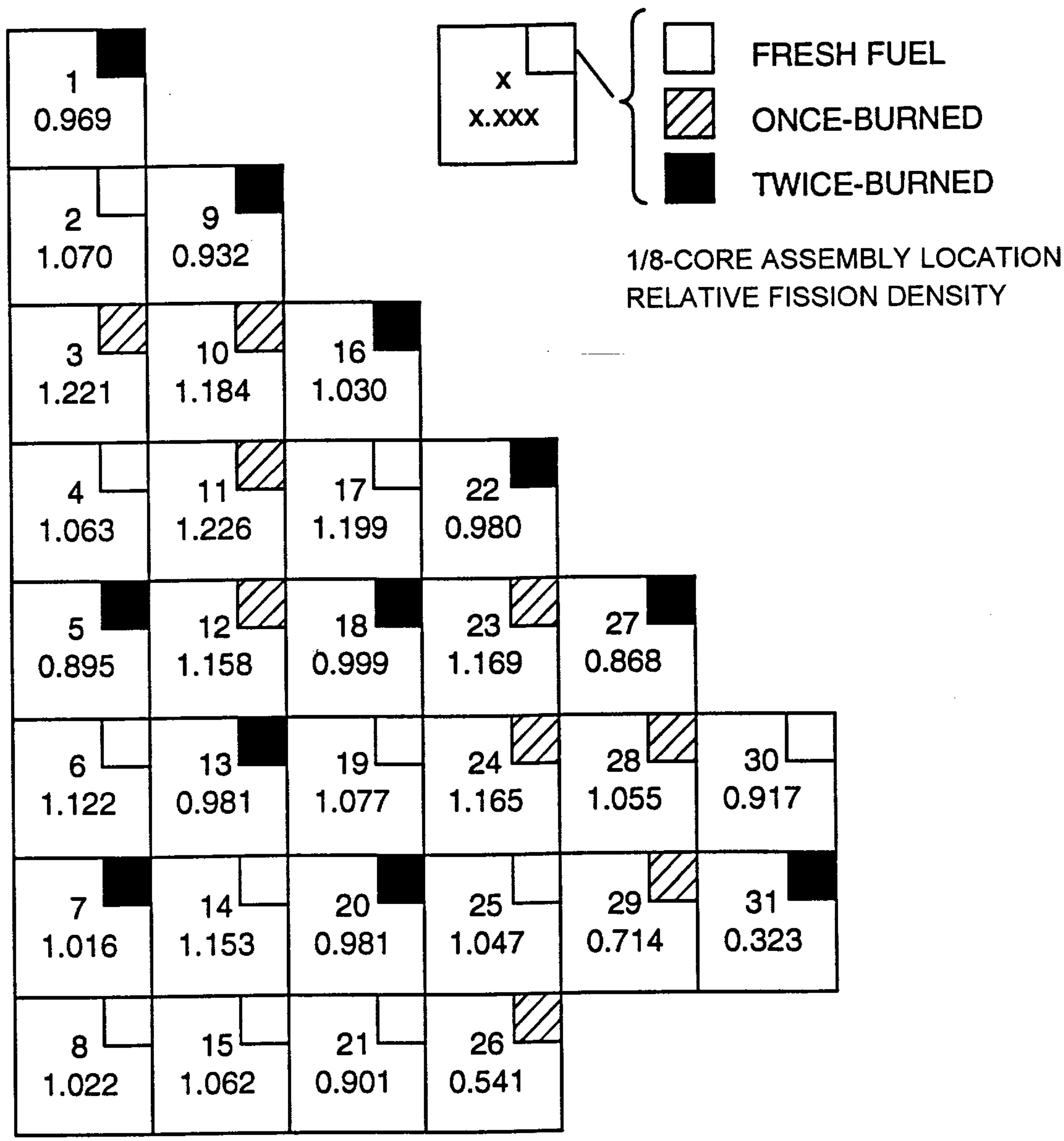

Fig. 9. BOC, HZP eighth-core relative fission density distribution.

ORNL-DWG 92M-8307R

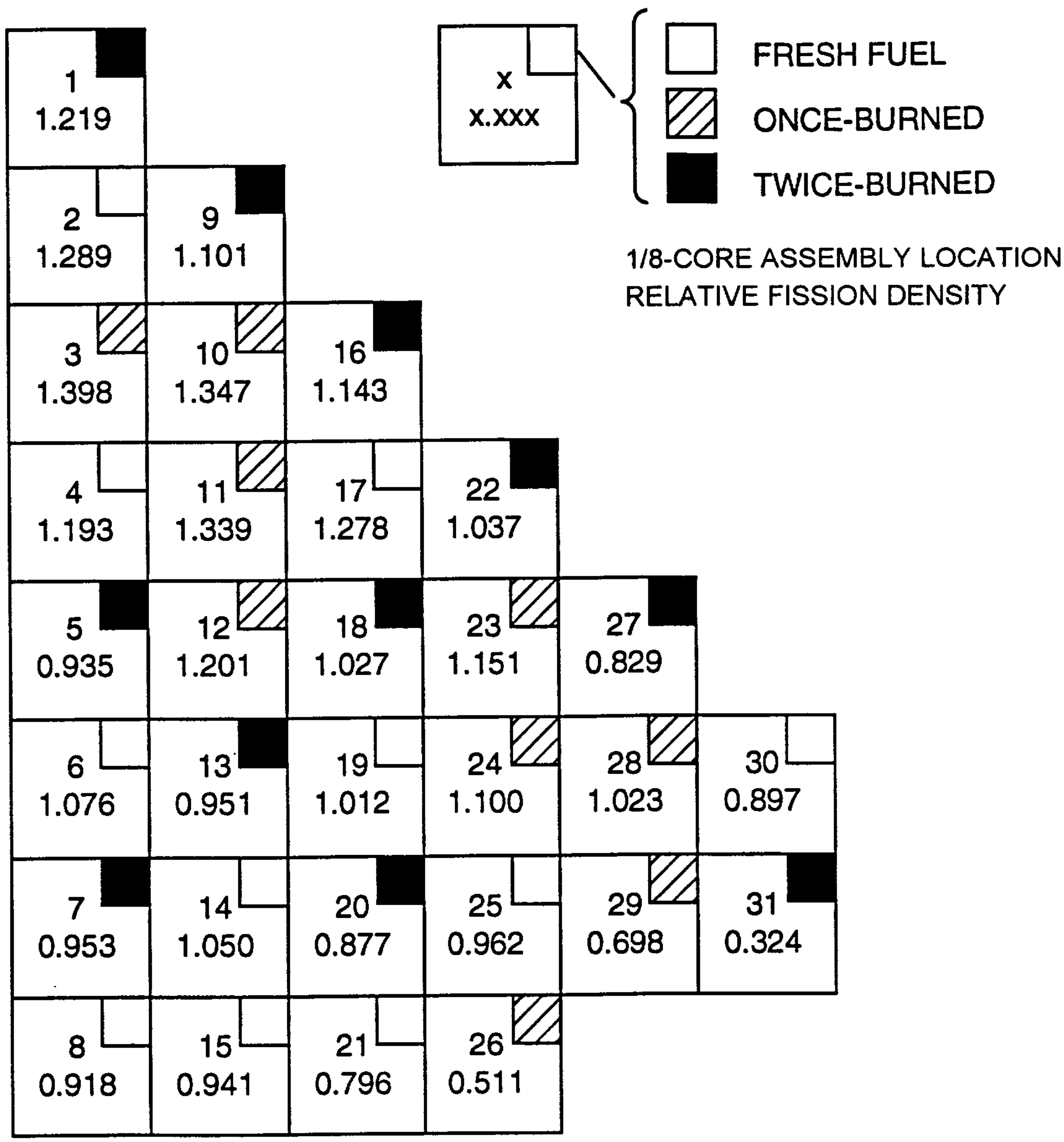

Fig. 10. BOC, HFP eighth-core relative fission density distribution.

ORNL-DWG 92M-8872R

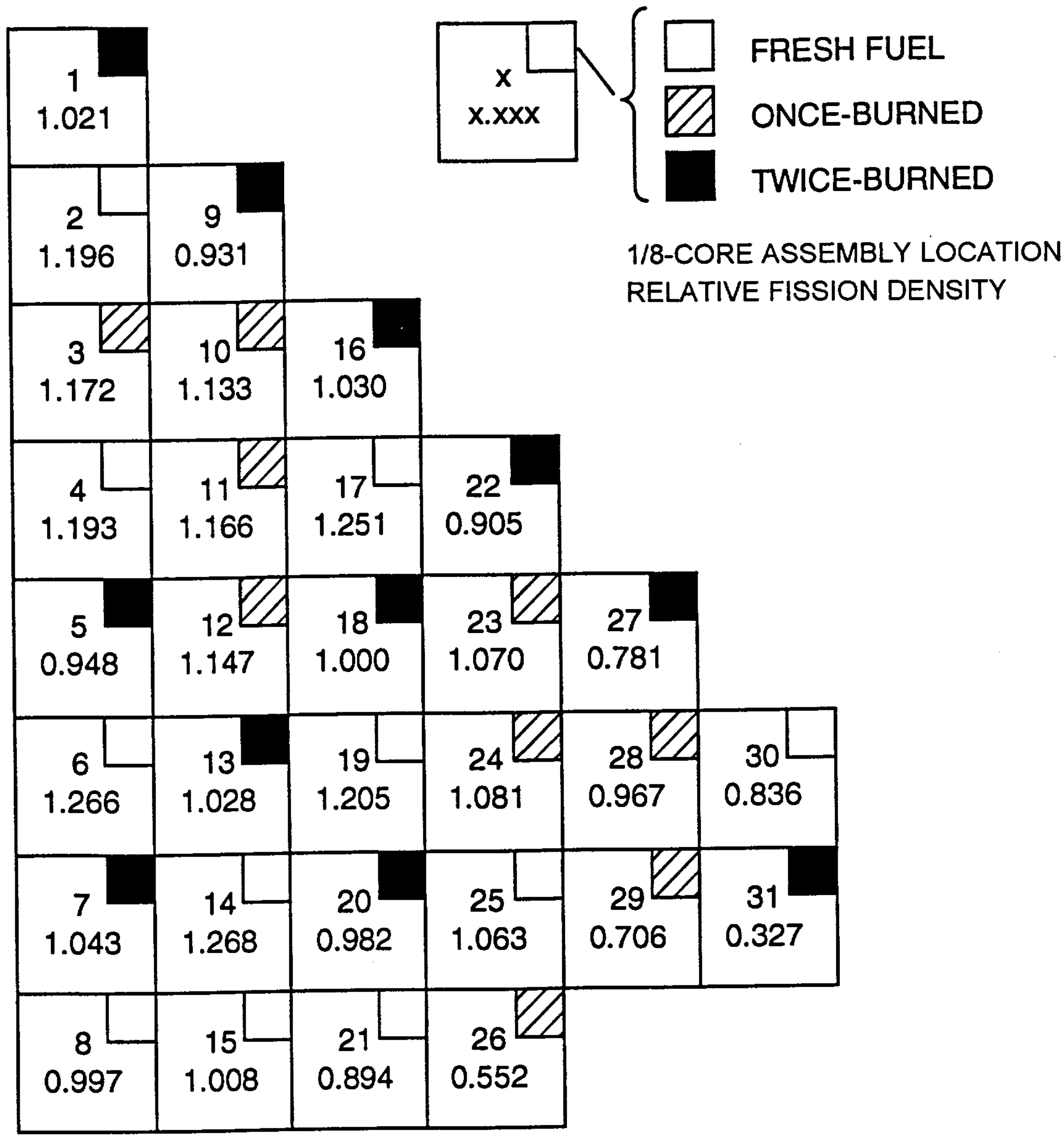

Fig. 11. MOC, HFP eighth-core relative fission density distribution.

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

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

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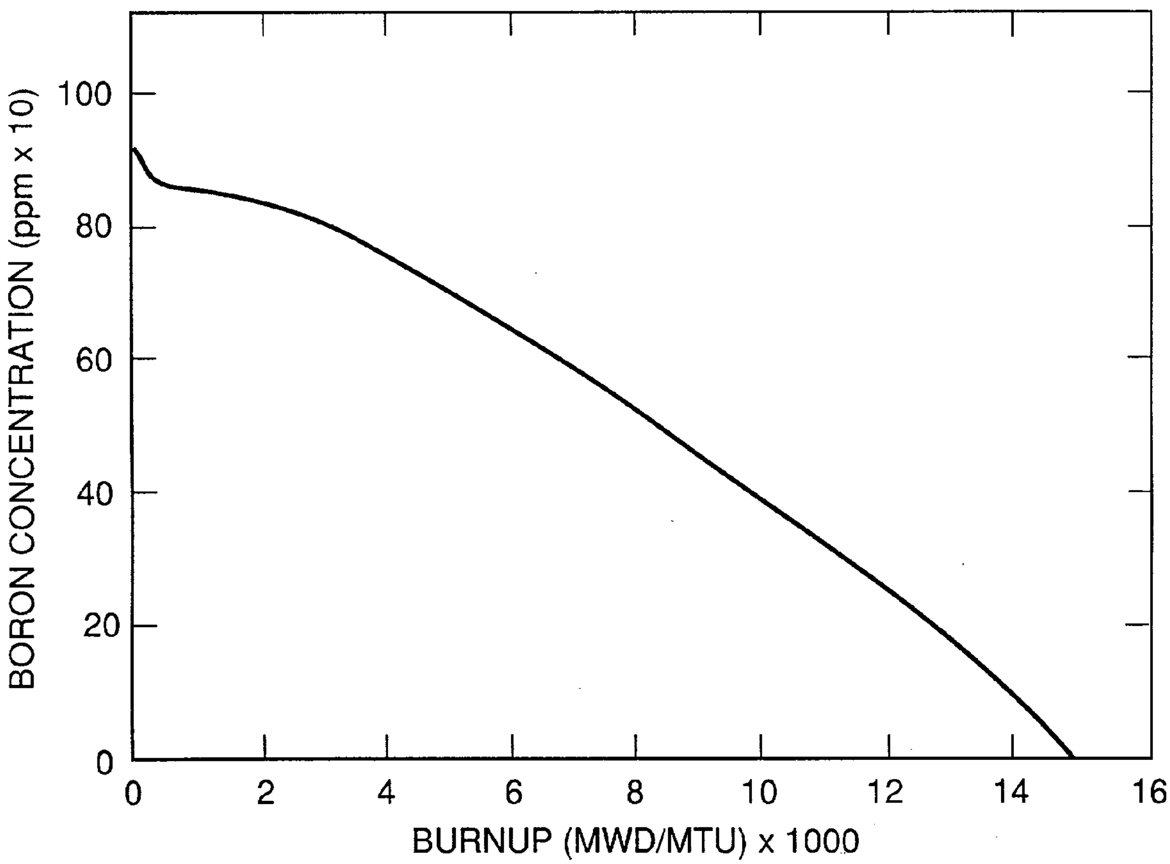

Fig. A.1. Sequoyah Unit 2, Cycle 1, boron letdown curve.

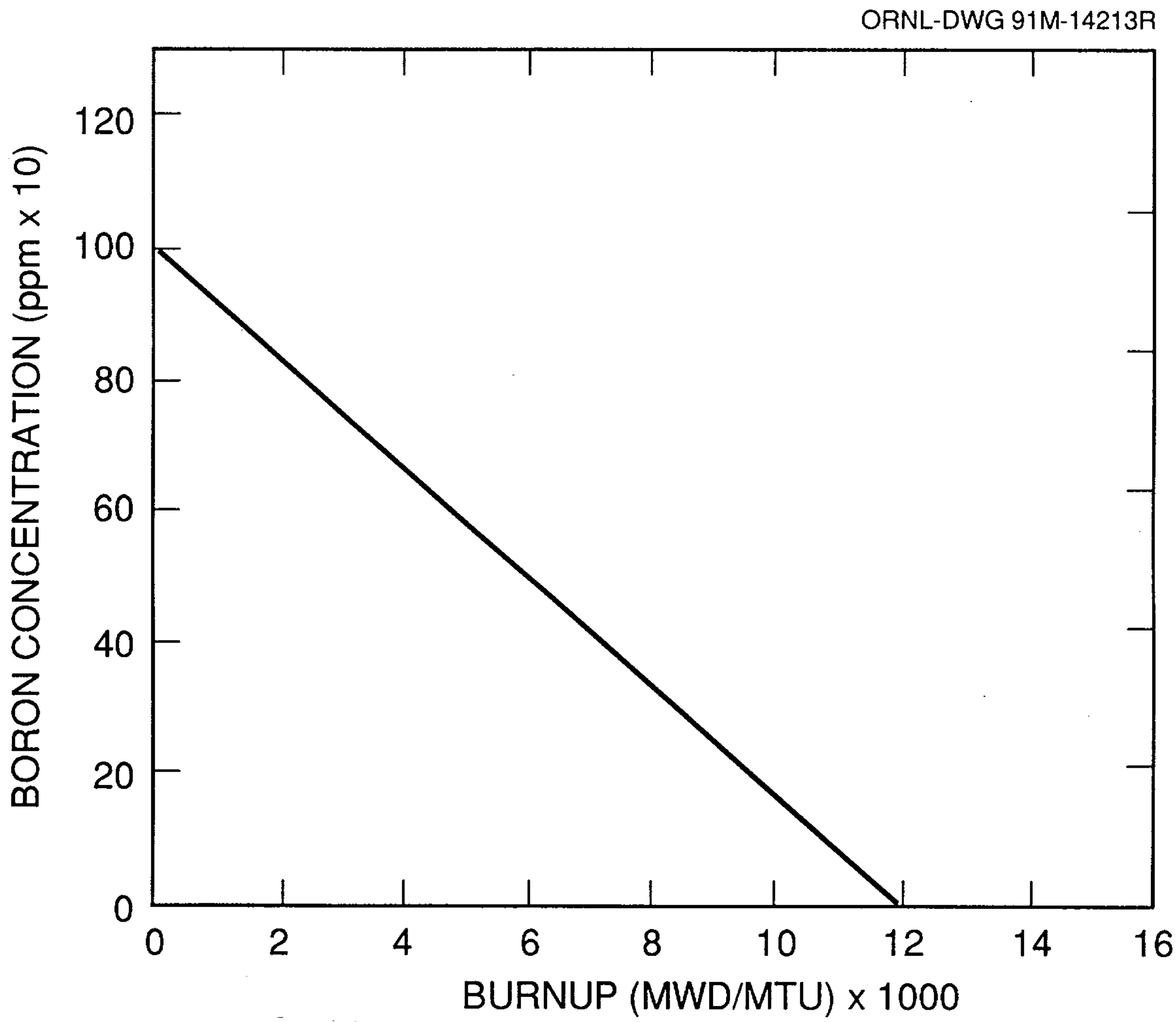

Fig. A.2. Sequoyah Unit 2, Cycle 2, normalized boron letdown curve.

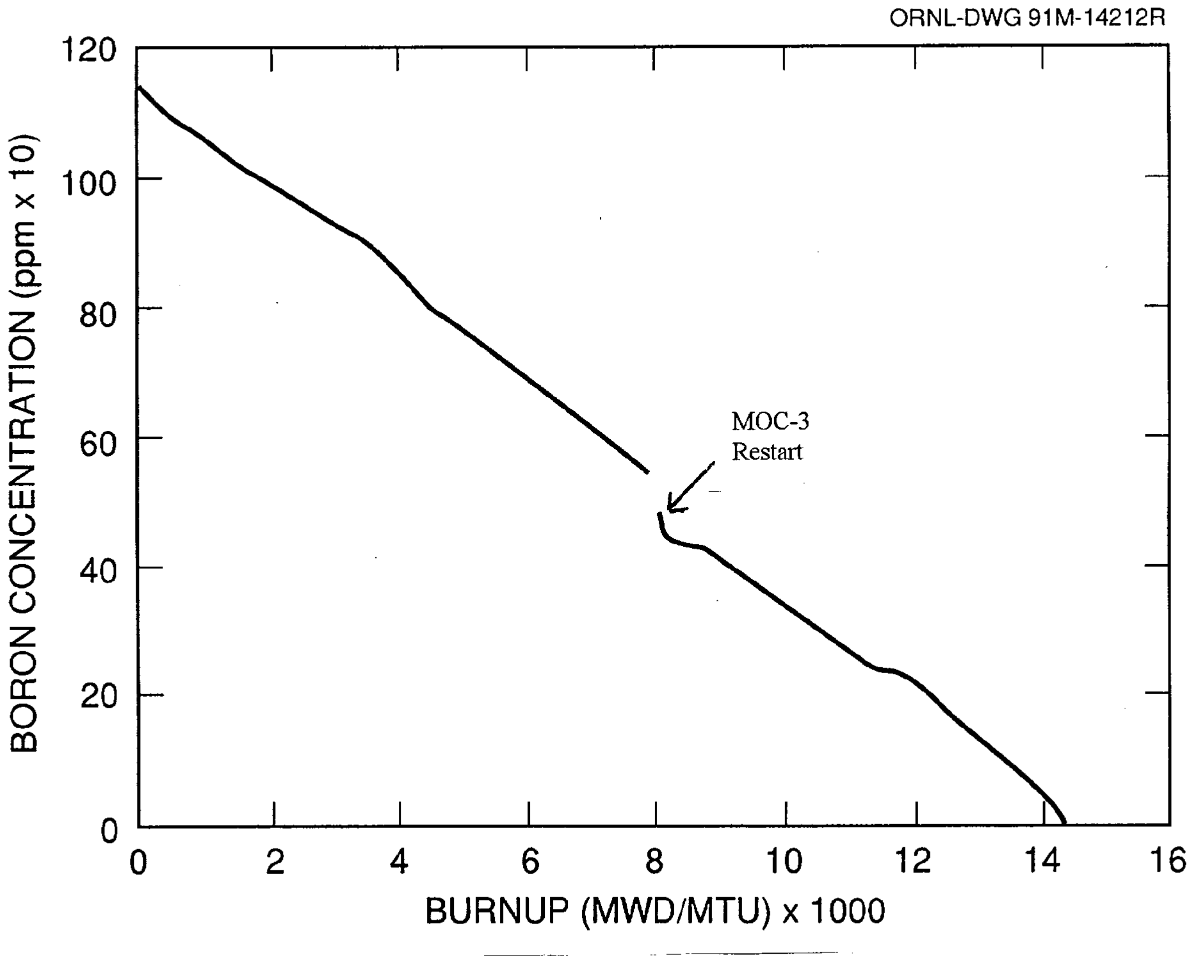

Fig. A.3. Sequoyah Unit 2, Cycle 3, boron letdown curve.

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	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		ASSEMBLY ID REGION ID			N48 3	N41 3	N17 3	N39 3	N21 3	N05 3	N03 3				

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.

ORNL-DWG 91M-14216

	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 7890 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 8589 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 2	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 3	N35 15235 2	N01 11630 3	M36 15507 2	N47 11627 3	M01 15484 2	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.

ORNL-DWG 91M-14217

	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 0	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.

ORNL-DWG 91M-14218

	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					N48 8566	N41 10059	N17 11409	N39 10870	N21 11551	N05 10184	N03 8489				

ASSEMBLY ID
BURNUP (MWD/MTU)

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.

ORNL-DWG 91M-14219

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					P06 8390	P29 10649	P33 10573	M62 23370	P50 10648	P52 10789	P03 8523				
2			P63 8805	P13 12073	P43 13123	M09 28928	P45 14153	L34 24287	P38 14238	M02 29129	P41 13171	P28 11611	P31 8646		
3		P01 8526	P49 13183	M17 25632	M31 29017	P26 14367	M43 28150	N02 22277	M04 28525	P15 14207	M10 28619	M55 25442	P57 13279	P55 8852	
4		P47 11656	M53 25660	N26 26976	N22 20879	M15 28414	M14 27228	M70 25679	M05 26950	M72 28022	N16 21008	N43 27144	M06 25854	P68 11862	
5	P46 8569	P42 13269	M18 28569	N32 21137	M63 28277	N03 21121	N18 24230	N39 22991	N15 24588	N48 21137	M33 28130	N31 20907	M58 28731	P54 13020	P14 8432
6	P59 10867	M50 28903	P12 14416	M25 28103	N44 21177	M66 26148	N21 23558	M03 26715	N17 23461	M12 26665	N46 21168	M42 28165	P30 14318	M16 28534	P53 10610
7	P36 10706	P56 14405	N23 28085	M54 27038	N35 24587	N34 23874	M45 26086	N41 22240	M40 26492	N29 23628	N19 24708	M27 27470	M57 28083	P58 14196	P67 10623
8	M39 23878	L48 24318	N23 22226	M26 25881	N14 23260	M67 26552	N10 22311	L40 24482	N20 22278	M30 26499	N09 22945	M41 25697	N13 22332	L31 24251	M56 23661
9	P07 10475	P66 14181	M71 28733	M69 26923	N08 24384	N28 23755	M32 26733	N07 22129	M20 26368	N06 23718	N38 24745	M47 27273	M68 28455	P08 14513	P21 10759
10	P11 10730	M65 28850	P22 14346	M61 27728	N37 21202	M35 26398	N01 23727	M36 26296	N47 23736	M01 26684	N42 20955	M59 28166	P35 13772	M38 29214	P34 11010
11	P16 8695	P51 13561	M52 28829	N45 20839	M22 28400	N12 20933	N25 24426	N27 22976	N36 24667	N33 21182	M24 28608	N40 20701	M28 28315	P60 13801	P39 8756
12		P37 11774	M48 25378	N11 26708	N04 20674	M13 27934	M21 27054	M19 25757	M51 27006	M11 28101	N30 20871	N24 26609	M34 25081	P17 12216	
13		P27 8544	P10 13158	M29 25171	M46 28487	P09 13902	M60 28147	N05 22068	M44 27986	P19 14149	M64 28826	M08 25480	P48 12927	P61 8478	
14			P20 8504	P04 11783	P02 13208	M49 28595	P25 14021	L29 24313	P65 14123	M07 29087	P62 13233	P64 11789	P24 8588		
15				ASSEMBLY ID BURNUP (MWD/MTU)	P23 8669	P44 10538	P40 10310	M37 23637	P32 10509	P18 10491	P05 8364				

REGION 1 - 24331 MWD/MTU
REGION 2 - 27232 MWD/MTU
REGION 3 - 22900 MWD/MTU
REGION 4 - 11598 MWD/MTU

BURNUP TILT

1.0011	1.0008
0.9978	1.0003

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 SPDASCR
//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	LIGHTEL=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 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,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  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,140)NORS
      WRITE(NOUT,180)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 ORIGEN-S STEP
      IF(BURN.EQ.0.0.OR.COOL.EQ.0.0)GO TO 1000
C  SET UP ORIGEN-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 ORIGEN-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 /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)
      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
C  READ LABEL AND CHECK TO BE SURE BURN DATA IS NEXT
      READ(N5,110)ICHK
      IF(ICHK.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)ICHK
      IF(ICHK.NE.'END BU')STOP 5103
C  READ AND CHECK THAT DECAY DATA BEGINS WITH NEXT CARD
      READ(N5,110)ICHK
      IF(ICHK.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 OUTPUT 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)ICHK
      IF(ICHK.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),LTYP(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)
```

```
  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
```

```
      IBN=NBN
      WRITE(NOUT,110)
      WRITE(NOUT,140)BURN,RDBURN(NBN)
      GO TO 1500
      END IF
       DO 20 I=1,NBN
      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  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,NBN
   26 A(J-1)=AD(I,J)
      DO 28 K=2,NBN
  28  B(K-1)=RDBURN(K)
      NBINT=NBN-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,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 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
```

```
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,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 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,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
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
```

```
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,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)
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
```

```
      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
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')
```

```
  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),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,
     &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 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 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)ICHK
      IF(ICHK.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
```

```
      END
C-----------------------------------------------------------------------
       SUBROUTINE CLECT(IFLAG)
       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 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 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(IDCRIT(I).EQ.99999)GO TO 70
       ADCRIT(I)=0.0
       DO 60 J=NLP1,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
```

```
        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),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 /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)
```

```
      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
  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---------------------------------------------------------------------
```

SNIKR3 FORTRAN Listing

```
C
      PROGRAM SNIKR3
       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),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,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),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
```

```
C  READ LABEL AND CHECK TO BE SURE BURN DATA IS NEXT
      READ(N5,110)ICHK
      IF(ICHK.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)ICHK
      IF(ICHK.NE.'END BU')STOP 5103
C  READ AND CHECK THAT DECAY DATA BEGINS WITH NEXT CARD
      READ(N5,110)ICHK
      IF(ICHK.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)ICHK
      IF(ICHK.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),LTYP(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)
  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,IACT,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)
      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 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 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)ICHK
      IF(ICHK.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
      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,IACT,IFP,ITOT,NCYC
       COMMON /UNTNOS/ N72,NOUT,N71,NORS,NICE
       COMMON /IDENT/ IDLITL(40),IDCRIT(210),IDDK(2000)
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       COMMON /ADENS/ ADLITL(40),LTYP(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,IACT,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,IACT,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+IACT
         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,IACT,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)
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
       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,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),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(IDCRIT(I).EQ.99999)GO TO 70
      ADCRIT(I)=0.0
      DO 60 J=NLP1,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
      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(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 /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)
      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
  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
```

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 (HZP 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
COOLTME=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
COOLTME=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
COOLTME=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.S2C3HZP.XSECLIB,DISP=SHR,UNIT=
//GO.SYSIN DD *
=XSDRN
SQ2C3 ASSY P17 K-INF CALC FOR COMPARISON TO CSAS1X (HZP)
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
BOROM     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.KENOVRST,
//  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
```

Table D.9. (continued)

```
    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)

```
    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)

```
    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)

```
 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
```

Table D.9 (continued)

```
   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)

```
    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)

```
    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)

```
   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)

```
'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
```

Table D.9 (continued)

```
'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
```

Table D.9 (continued)

```
   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)

```
    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)

```
    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)

```
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
```

Table D.9 (continued)

```
    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)

```
    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)

```
    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)

```
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
```

Table D.9 (continued)

```
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
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Table D.9 (continued)

```
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
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Table D.9 (continued)

```
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)

```
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
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Table D.9 (continued)

```
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)

```
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
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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
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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
```

Table D.9 (continued)

```
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 45555556789999ABCDEFGHIJKLMNOPQRSTUVWXYZ#>$-+)@&!
XUL=-11  YUL=32.5  XLR=11  YLR=10.5  UAX=1 VDN=-1  NAX=130  END
TTL=! SEQUOYAH UNIT 2 CYCLE 3 FULL CORE BY COMPOSITION!
PIC=MAT  NCH=! 1/ 4/ / /5555555ABCDEFGHIJKLMNOPQRSTUVWXYZ#>$-+)@&!
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.KENOVRST,
//  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
```

Table D.10 (continued)

```
    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)

```
    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)

```
  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)

```
    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)

```
    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)

```
    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)

```
     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)

```
    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)

```
    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)

```
    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)

```
    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)

```
    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)

```
    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
```

Table D.10 (continued)

```
   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)

```
    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)

```
    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)

```
    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)

```
    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)

```
    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)

```
    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)

```
    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)

```
    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)

```
    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)

```
    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)

```
 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)

```
  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
```

Table D.10 (continued)

```
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)

```
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)

```
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)

```
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
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)

```
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)

```
 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 45555556789999ABCDEFGHIJKLMNOPQRSTUVWXYZ#>$-+)@&!
XUL=-11  YUL=32.5  XLR=11  YLR=10.5  UAX=1 VDN=-1  NAX=130  END
TTL=! SEQUOYAH UNIT 2 CYCLE 3 FULL CORE BY COMPOSITION!
PIC=MAT  NCH=! 1/ 4/ / /5555555ABCDEFGHIJKLMNOPQRSTUVWXYZ#>$-+)@&!
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
   O      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
```

Table E.9. KENO V.a input file for MOC, HFP

```
//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.KENOVRST,
//  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)

```
 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)

```
  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)

```
 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)

```
 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)

```
 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)

```
 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)

```
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)

```
 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)

```
 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)

```
 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)

```
 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)

```
 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)

```
 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)

```
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)

```
 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)

```
 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)

```
 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)

```
'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)

```
  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)

```
 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)

```
  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)

```
 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)

```
  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
```

Table E.9 (continued)

```
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)

```
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)

```
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
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Table E.9 (continued)

```
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)

```
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
```

Table E.9 (continued)

```
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
```

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 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 E.9 (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 45555556789999ABCDEFGHIJKLMNOPQRSTUVWXYZ#>$-+)@&!
XUL=-11  YUL=32.5  XLR=11  YLR=10.5  UAX=1 VDN=-1  NAX=130  END
TTL=! SEQUOYAH UNIT 2 CYCLE 3 FULL CORE BY COMPOSITION!
PIC=MAT  NCH=! 1/ 4/ / /5555555ABCDEFGHIJKLMNOPQRSTUVWXYZ#>$-+)@&!
XUL=-200  YUL=200  XLR=200  YLR=-200  UAX=1 VDN=-1  NAX=520  END
END PLOT
END DATA
END
```

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