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5.0 SHIELDING EVALUATION

The NAC-STC uses an optimized multiwall design to provide the most efficient shielding arrangement possible, and to comply with 10 CFR 71 limits. This chapter provides a description of the NAC-STC shield design, design basis contents for the shielding evaluation, and the conservative shielding analyses used to determine the transport dose rates.

The NAC-STC is designed to safely transport spent fuel assemblies in two configurations: directly loaded and canistered. In the directly loaded configuration, standard PWR fuel assemblies are placed directly into a fuel basket installed in the cask cavity. In the canistered configuration, a sealed transportable storage canister loaded with fuel assemblies is placed in an empty cask cavity with top and bottom spacers. In the directly loaded configuration, the NAC-STC can transport up to 26 standard PWR fuel assemblies. In the canistered configuration, the NAC-STC can transport up to 36 Yankee Class fuel assemblies in the Yankee-MPC configuration or up to 26 Connecticut Yankee fuel assemblies in the CY-MPC configuration.

For directly loaded fuel, the shielding evaluation considers reference fuel assemblies in 14×14, 15×15, 16×16 and 17×17 array sizes. The reference fuel assemblies have parameters selected from all of the fuel assemblies of the same array size to maximize the shielding source terms. The design basis fuel for the canistered configuration is the Yankee Class, Combustion Engineering, Type A, 16×16 PWR fuel assembly.

The NAC-STC can also safely transport Greater Than Class C (GTCC) waste in a canistered configuration. The Yankee Class GTCC waste consists primarily of activated steel sections or components, but may also include Zircaloy items. Core baffle sections and dross material are placed in a fuel assembly-sized container, as shown in Figure 5.1-4. Some stainless steel and Zircaloy items may be loaded directly into an interior GTCC loading position. The Connecticut Yankee GTCC waste, also consisting of activated steel, is also placed in a fuel assembly-sized can. The Yankee-MPC and CY-MPC GTCC canisters have 24 loading positions for GTCC waste.

The NAC-STC is assigned a nominal Transport Index of 21 (TI = 21) based on the requirement of 10 CFR 71.4 and the analysis results presented in Section 5.1.4. The maximum dose rate at 1 meter from the NAC-STC in normal conditions of transport is 20.3 mrem per hour, based on the directly loaded reference fuel. The actual measured dose rate is expected to be less.

The shielding evaluation for directly loaded fuel, canistered fuel and GTCC waste demonstrates compliance with 10 CFR 71 limits. The dose rates for both the canistered Yankee Class fuel and GTCC waste, and Connecticut Yankee Class fuel and GTCC waste, are shown to be significantly less than those for the directly loaded fuel configuration for both normal and accident conditions.

The shielding evaluation of the directly loaded configuration is performed using the SAS2H sequence (Hermann, 1995) of the SCALE-4.3 package for the PC (ORNL, 1995). This sequence uses the computer code ORIGEN-S (Hermann, 1989) to calculate the source terms. The MCBEND (AEA Technology, 2000) computer code is used to calculate the cask dose rates for normal transport and hypothetical accident conditions. The shielding analyses show that the dose rates are below regulatory limits.

The shielding evaluation of the Yankee Class canistered fuel and GTCC waste is performed using SCALE 4.3 for the PC (ORNL, 1995). This code uses SAS2H (Herman, 1995) to calculate source terms. One-dimensional shielding evaluations were performed using SAS1 (Knight, 1995). The shielding analyses show that the dose rates are well below the regulatory limits stated in 10 CFR 71 and are well below the dose rates reported for the design basis directly loaded fuel.

The shielding evaluation of the Connecticut Yankee canistered fuel and GTCC waste is performed using the MCBEND Monte Carlo transport code. Fuel source terms are developed using the SCALE isotopics sequence SAS2H (Herman, 1995).

Directly Loaded Fuel

The directly loaded basket construction is based on a tube and disk design. PWR fuel is loaded into 26 fuel tubes fabricated from Type 304 stainless steel sheets. BORAL or TalBor neutron absorber is encased in stainless steel on the outside face of the fuel tube. Twenty 5/8-inch thick aluminum disks are spaced between thirty-three 1/2-inch thick Type 17-4 PH stainless steel support disks to provide heat transfer. Radial shielding of PWR fuel in the directly loaded basket is provided by the multi-wall design of the NAC-STC cask body. Axial shielding is provided by the cask body closure lids and end forgings and the impact limiters.

Yankee Class Canistered Fuel and GTCC Waste

The canister containing Yankee Class fuel or GTCC waste is placed in the NAC-STC cavity with top and bottom spacers. The placement of the canister between the top and bottom spacers effectively precludes the source regions from streaming through areas above and below the neutron shield and tapered regions of the lead. In addition to the radial and axial shielding provided by the cask body and lids, radial and axial shielding is provided by the canister 5/8-inch shell, the 8 inches of stainless steel from the canister lids and 1 inch of steel from the canister bottom.

The Yankee-MPC fuel basket is of the same design as the steel/aluminum directly loaded basket previously described. It has a shorter overall length to accommodate the dimensions of the design basis Yankee Class fuel, and a smaller diameter to accommodate the inside dimension of the canister. Consistent with these smaller dimensions, the Yankee-MPC basket also has fewer support plates and heat transfer disks than the directly loaded basket.

The Yankee-MPC GTCC basket is a simplified tube-and-disk design. The steel tubes holding the GTCC waste containers are surrounded by a 2.5-inch steel basket support wall and are held in place by steel support disks. Heat transfer disks are not used.

Connecticut Yankee Canistered Fuel and GTCC Waste

The canister containing CY fuel or GTCC waste is placed in the NAC-STC cavity with a bottom spacer. In addition to the radial and axial shielding provided by the cask body and lids, radial and axial shielding is provided by the canister 5/8-inch shell, the 8 inches of stainless steel from the canister lids and 1.75 inches of steel from the canister bottom.

The CY-MPC canistered fuel basket is of the same design as the steel/aluminum directly loaded basket. The basket height is 141.25 inches and has a diameter sized to fit inside the canister, which has an outer diameter of 70.64 inches. The CY-MPC canister has 27 aluminum heat transfer disks and 28 stainless steel support disks.

The CY-MPC GTCC basket is a simplified supported tube design. The steel tubes holding the GTCC waste containers are surrounded by a 1.75-inch thick cylindrical steel basket support wall, which is held in place by steel support ribs.

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5.1 Discussion and Results

The radiation protection provided by the NAC-STC is in the form of solid multi-walled shielding materials, which totally surround the fuel. These shielding materials include steel and lead for gamma shielding and a borated polymer (NS-4-FR) for neutron shielding. The multi-walled arrangement of steel and lead in the NAC-STC provides optimal weight for gamma attenuation. The NS-4-FR neutron shielding material has a hydrogen density close to that of water and serves to moderate fast neutrons which are then captured in the boron. Boron capture in the neutron shield minimizes the contribution of secondary capture gammas to surface dose rates.

The NAC-STC uses a multi-walled arrangement for both radial and axial shields. The arrangement of the radial gamma shielding in the cask body is a 1.5-inch thick stainless steel inner shell and a 2.65-inch thick stainless steel outer shell with a 3.70-inch thick lead filled annulus between them. The radial neutron shield is arranged around the outer steel shell with a 5.5-inch thick NS-4-FR layer which is covered by a 0.25-inch (6 mm) thick neutron shield shell. The bottom of the cask contains a steel/NS-4-FR/steel shield arrangement with the two stainless steel components providing 11.65 inches of gamma shielding and 2 inches of NS-4-FR neutron shielding. The top of the cask has shields in the form of two closure lids. The inner lid also has a steel/NS-4-FR/steel arrangement with 6.0 inches of steel below 2 inches of NS-4-FR and 1.0 inch of steel above it. The outer lid is a 5.25-inch thick steel disk.

5.1.1 Design Criteria

The shielding design criteria for the NAC-STC meets the requirements of 10 CFR 71. For normal conditions, the dose rate limits specified in 10 CFR 71.47 for consignments under exclusive use are: 1,000 mrem/hour on the surface of the enclosed package, 200 mrem/hour on the outer surfaces of transport vehicle and 10 mrem/hour at 2 meters from the vertical planes represented by the outer lateral surfaces of the transport vehicle. The cask surface dose rate is less than 200 mrem/hr, except at the gap between the neutron shield and the upper impact limiter and at the rotation trunnions, where the maximum does rate is 366 mrem/hr. The maximum dose rate at the personnel barrier, which is the accessible surface of the package, adjacent to the gap between the neutron shield and upper impact limiter, is significantly less than 200 mrem/hr. Note that the cask tie-down structure that is present at this location is conservatively not considered. The 10 mrem/hour criterion has also been met at all locations 2 meters from the railcar. Under hypothetical accident conditions, 10 CFR 71.51 specifies a dose rate limit of

1,000 mrem/hour at 1 meter from the surface of the cask. This criterion has also been met at all locations.

The accessible surface of the package is defined as a personnel barrier that will be on the same plane as the outer radial surface of the top half of the impact limiters. The personnel barrier will attach to the edge of the railcar between the impact limiters. The personnel barrier location is shown in NAC Drawing 423-901.

5.1.2 Design Basis Fuel

The NAC-STC has two configurations for transport of design basis fuel: directly loaded and canistered. The design basis fuel for the directly loaded configuration is described in Section 5.1.2.1. There are two canister configurations. The Yankee-MPC for Yankee Class fuel and GTCC waste and the CY-MPC for Connecticut Yankee Class fuel and GTCC waste. The design basis fuels for shielding for these configurations are described in Sections 5.1.2.2 and 5.1.2.3, respectively.

5.1.2.1 Design Basis Directly Loaded Fuel

The NAC-STC can transport up to 26 directly loaded, intact PWR fuel assemblies over a range of burnups, initial ^{235}U enrichments, and minimum allowable cool times. The general fuel characteristics for directly loaded fuel are given in Table 5.1-1. Detailed material and geometry descriptions for the fuel types evaluated are provided in Section 5.2. Reference fuel assemblies have been developed and analyzed to envelop PWR fuel for 14×14, 15×15, 16×16, and 17×17 array sizes. These assemblies are constructed by surveying assembly data for assemblies less than 165 inches in length (the length of the STC cavity) and using bounding fuel parameters to maximize fuel mass (MTU) and hardware source terms. Decay heats and dose rates have been calculated for a finite range of burnups, initial ^{235}U enrichments, and cool times to generate an allowable loading table, or minimum cool time table. Adherence to the cool timetable ensures that heat load and dose rate limits will not be exceeded.

Three-dimensional dose rates are calculated using a response function methodology. Each of the four fuel assembly array sizes is analyzed over a range of source regions and source types with unit source in each relevant energy group. Source types considered are fuel neutron, fuel gamma fuel secondary gamma (n-gamma), in-core fuel hardware (grid spacers, steel guide tubes, etc.), plenum, and end fitting hardware. These sources are analyzed in a finite number of energy groups with a unit source in each group. The scalar product of source term and response function allows for the creation of large arrays of dose rate results, whether they are for a single detector, or the maximum or average over a detector surface. In this analysis, detector maximum responses have been used exclusively to generate minimum cool time tables.

5.1.2.2 Design Basis Yankee Class Canistered Fuel and GTCC Waste

The design basis fuel for the Yankee Class canistered configuration for shielding purposes is the Combustion Engineering (CE), Type A, 16 x 16 PWR assembly with an initial enrichment of 3.7 wt % ^{235}U, a uranium mass of 239.4 kilograms, a burnup of 36,000 MWD/MTU and 8.0-year cooling time. To meet maximum cask decay heat limits, an 8.1-year cool time is required. The 8.0-year cooled source terms are conservatively used as the shielding design basis. The dose rates resulting from this assembly are higher than those of the other Yankee Class fuels: CE Type B, Westinghouse, Exxon, and United Nuclear Type A and B fuel assemblies. The design basis Yankee Class fuel characteristics are given in Table 5.1-1. The design basis Yankee Class fuel physical parameters are presented in Table 5.1-2. The design basis canister fuel assembly source terms are presented in Table 5.1-3, and a sketch of the fuel assembly is shown in Figure 5.1-3.

Source terms and dose rate evaluations concluded that the Westinghouse, United Nuclear, and CE Yankee Class fuel assemblies at 32,000 MWD/MTU require minimum cooling times of 22, 11 and 7 years, respectively. The minimum nominal enrichments for these assemblies are 4.94, 4.0 and 3.5 wt % ^{235}U, respectively. Exxon fuel, with a burnup of 36,000 MWD/MTU and a minimum initial enrichment of 3.5 wt % ^{235}U, requires a minimum cooling time of 16 years for assemblies containing steel hardware in the active fuel region, and 10 years for assemblies with Zircaloy hardware. The 10-year cool time for Exxon fuel assemblies with Zircaloy fuel region hardware includes the activation of four hollow Zircaloy replacement rods with stainless steel slugs.

The Yankee-MPC may also hold Reconfigured Fuel Assemblies, Damaged Fuel Cans, or Recaged Fuel Assemblies.

The transportable storage canister may contain one or more Reconfigured Fuel Assemblies. The Reconfigured Fuel Assembly is designed to confine Yankee Class spent fuel rods, or portions thereof, which have been classified as failed. Each assembly can accommodate up to a total of 64 fuel rods. Due to the low number of rods, the reconfigured assembly fuel mass is significantly less than the fuel mass contained in the design basis assemblies described in this section and in Section 5.1.2.1. Because the source term (neutron and gamma) is directly proportional to the fuel mass, for a given burnup, the reconfigured assembly source term is bounded by that of the design basis Yankee Class fuel assemblies. The lower source term of the 64-rod reconfigured assembly more than offsets any reduced self-shielding associated with its lower mass. In addition, each Reconfigured Fuel Assembly fuel rod is placed within a steel enveloping rod. Consequently, a rigorous shielding analysis is not required for the Reconfigured Fuel Assembly.

The Yankee-MPC canister may also contain Damaged Fuel Cans in the four corner basket locations. To accommodate the Damaged Fuel Cans, oversized openings are present in the top and bottom basket weldments, and four 9.3-inch square, 1.4-inch deep recesses are made in the shield lid to accommodate the top fitting. Damaged fuel dose rates are estimated by determining the void area in the intact fuel description and conservatively scaling the source and dose rates to that of a full-density UO_2 region. This approach is conservative since no credit is taken for the increased self-shielding associated with the higher density source region. Only radial damaged fuel dose rates are considered due to the negligible top and bottom axial dose rates calculated for intact fuel. Top and bottom spacers in the cask cavity assure that the Yankee-MPC canister remains centered in the cask cavity.

Minimum cool time for recaged fuel assemblies, assemblies in which United Nuclear fuel rods are moved to a CE skeleton, are conservatively set to the United Nuclear assembly minimum cool time of 13 years. The CE fuel assembly skeleton contains a significantly lower amount of hardware and, therefore, contains a lower potential source term than the United Nuclear fuel assembly skeleton.

The NAC-STC can also safely transport Yankee GTCC waste. The GTCC waste consists primarily of activated steel from the baffle core structure, but includes miscellaneous hardware consisting of sectioned source vanes and fuel assembly cage guide tubes, grid straps and end fittings. Core baffle and dross from cutting operations is placed in a container (see Figure 5.1-4) that is the same size as a Yankee Class fuel assembly. Up to 24 GTCC containers can be loaded into the GTCC canister basket. The miscellaneous hardware material is loaded directly into one of the interior loading positions of the GTCC basket. The GTCC canister is loaded in the NAC-STC for transport.

The design basis gamma source for the Yankee GTCC waste is determined from dose rate measurements and chemical assay of the GTCC waste. This gamma source is primarily due to the activation of the core baffle from 30 years of neutron flux exposure and to a lesser extent from surface contamination. This source term is used for all of the loading positions of the GTCC basket and bounds the source term for the miscellaneous hardware items. The design basis source term for the GTCC waste canister is 9.493×10^{15} photon/s, which is equivalent to 125,000 curies of ^{60}Co. The design basis thermal output is 1.93 kW.

5.1.2.3 Design Basis Connecticut Yankee Canistered Fuel and GTCC Waste

The design basis Connecticut Yankee (CY) fuels for the shielding evaluation are stainless steel and Zircaloy clad 15 x 15 assemblies. The stainless steel clad assemblies have a maximum burnup of 38,000 MWD/MTU and a minimum of 10-year cool time. The Zircaloy clad assemblies have a maximum burnup of 43,000 MWD/MTU and a minimum of 10-year cool time. The characteristics of the Connecticut Yankee fuel assemblies are presented in Table 5.1-1 and the stainless steel and Zircaloy fuel physical parameters are presented in Table 5.1-2. The fuel assembly source terms are presented in Table 5.1-3. The source regions of the fuel assemblies are shown in Figure 5.1-5.

The NAC-STC can also safely transport Connecticut Yankee GTCC waste. The GTCC waste, consisting of activated steel, is placed in a fuel assembly sized can. Up to 24 GTCC containers can be loaded into the CY-MPC GTCC basket. The CY-MPC GTCC canister is loaded in the NAC-STC cask for transport.

The design basis gamma source for CY GTCC waste is due to the activation of the core baffle during the lifetime of core operation. The source term for the CY-MPC canister is based on 2.77×10^{5} curies of ^{60}Co in 14,300 lbs of core baffle material, four years after reactor shutdown.

The CY-MPC may contain up to four reconfigured fuel assemblies positioned in the oversized corner locations in the basket. The CY-MPC reconfigured fuel assembly is designed to confine individual spent fuel rods or portions thereof, within individual stainless steel tubes. Each CY-MPC reconfigured fuel assembly can accommodate up to 100 rods in a 10 x 10 lattice, which is significantly less than the number of fuel rods in an intact assembly. Because the source term (neutron and gamma) is directly proportional to fuel mass, for a given burnup and enrichment, the source term produced by the fuel rods within the CY-MPC reconfigured assembly is bounded by that of a design basis fuel assembly. Consequently, a rigorous shielding analysis is not required for the CY-MPC reconfigured fuel assemblies.

The CY-MPC may also contain up to four damaged fuel cans positioned in the oversized corner locations of the basket. The CY-MPC damaged fuel can may hold a complete fuel assembly, a lattice or a failed rod storage canister. As such, the shielding analysis conservatively assumes that no damaged fuel cans are present in the canister, as the additional shielding provided by the wall of the can would serve to reduce external dose rates. The effect of damaged fuel migrating into the void space in the upper and lower assembly hardware regions is evaluated explicitly.

The CY-MPC may also contain up to two assemblies with a maximum of two irradiated stainless steel filler rods per assembly. Assemblies with irradiated stainless steel rods may only be loaded in basket positions 13 and 14 as shown in Figure 6.3-3. A dose rate comparison for both normal and accident conditions yields filler rod dose rates are less than 1% of the total dose rate at any surface of the NAC-STC.

5.1.3 Shielding Materials

The shielding materials are selected and arranged to minimize cask weight while maintaining overall shield effectiveness. Lead and steel are chosen as effective gamma radiation shields, and NS-4-FR is provided to efficiently moderate and absorb the neutron radiation, while minimizing the generation of secondary gamma radiation.

5.1.4 Results

For both the directly loaded and the canistered transport configurations, this section demonstrates that the NAC-STC satisfies the regulatory criteria of 10 CFR 71.47 under normal transport condition, and 10 CFR 71.51(a) for hypothetical accident conditions. Specifically, for an exclusive use shipment in an enclosed transport vehicle, the dose rates remain less than 1,000 mrem/hour on the surface of the package, less than 200 mrem/hour at all locations on the surface of the personnel barrier and less than 10 mrem/hour at all locations 2 meters from the edge of the railcar (any point 2 meters from the vertical planes projected from the outer edges of the conveyance). Also, under hypothetical accident conditions, the dose rate is less than 1,000 mrem/hr at 1 meter from the surface of the package. Therefore, the NAC-STC satisfies the shielding criteria of 10 CFR 71.

5.1.4.1 Results of the Shielding Evaluation for Directly Loaded Fuel

The maximum dose rates calculated for the normal transport conditions are shown in Table 5.1-4, with locations of the maximum dose rates shown in Figure 5.1-2. Cask surface dose rates do not exceed the regulatory limit for a closed transport vehicle of 1,000 mrem/hour at the surface of the package. The dose rates at 2 meters from the railcar comply with the 10 mrem/hour regulatory limit.

The maximum normal conditions surface dose rate at the cask radial midplane is 41 mrem/hour. The highest dose rate, occurring on the surface of the cask at the gap between the radial neutron shield and the upper impact limiter, is 366.4 mrem/hour. All cask surface dose rates are much less than 1,000 mrem/hour. Ducting of neutrons through the copper/stainless steel fins is considered in Section 5.4.1.1. The results of the ducting evaluation show that this phenomenon has a very small effect on the total cask dose rate. Azimuthal variations in the calculated dose rate are considered in the explicit heat fin and neutron shield model. The neutron dose rate increase resulting from the ducting is offset by the reduction of the gamma dose rate resulting from the additional shielding provided by the fins.

Table 5.1-5 provides accident dose rates that could occur in the event of the loss of all gaseous elements in the neutron shield combined with radial and axial lead slumps due to cask side and end drops. Although the neutron shield material exceeds its safe operating temperature limits in the fire accident, a complete loss of neutron shielding is not credible for the NAC-STC. Some of the neutron shielding capability may be lost, however, as a result of the fire accident. Therefore, the accident shielding calculations conservatively assume a complete loss of gaseous elements in the neutron shielding. In the event of a cask end drop, it is possible for the lead gamma shielding to slump and fill the annular gap (if one exists) created by the cooling of the lead after fabrication. For worst case conditions, this accident could create a 2.35-inch gap at the top or bottom of the lead annulus. If the cask is subject to a side drop, the lead gamma shielding could slump and create a void on the upper side of the cask. An evaluation of this accident shows the lead thickness may be reduced by a maximum of 0.928-inch. The dose rates shown in Table 5.1-5 show that neither the loss of the neutron shielding nor the slumping of the lead will result in a dose rate that exceeds the hypothetical accident dose rate limit of 1,000 mrem/hour at 1 meter from the cask surface.

Therefore, the NAC-STC fulfills the design criteria of Chapter 1 in that under normal transport conditions, the maximum dose rates are less than 1,000 mrem/hour on the surface of the package, less than 200 mrem/hour at all locations at the surface of the personnel barrier, and less than 10 mrem/hour at all locations 2 meters from the personnel barrier. The cask also satisfies the hypothetical accident criteria of 1,000 mrem/hour at 1 meter from the cask surface.

5.1.4.2 Shielding Evaluation for Yankee Class Canistered Fuel and GTCC Waste

A 1-D radial and axial shielding analysis was performed for both the canistered Yankee Class fuel and GTCC waste under normal and hypothetical accident conditions. The dose rates for canistered fuel (Combustion Engineering, 36,000 MWD/MTU, 8-year cooled) are provided in Tables 5.1-6 and 5.1-7. These dose rates are provided in Tables 5.1-8 and 5.1-9 for the GTCC waste. Under normal conditions, the canister is positioned in the cavity with top and bottom spacers, and the impact limiters are in place on the cask. Under accident conditions (i.e., 30-foot drop and fire accident), the radial midplane results assume loss of neutron shielding. A complete loss of neutron shielding is not credible for the NAC-STC. However, because of the elevated fire accident temperatures, the neutron shields exceed their safe operating limits and some neutron shielding capability may be lost. Also, in the axial models, it is assumed that the cavity spacers are crushed, the impact limiters are lost, and the canister is positioned at either the top or the bottom of the cavity.

The maximum calculated dose at the surface of the cask centerline when loaded with canistered Yankee Class fuel under normal conditions is 10.25 mrem/hour. This is much less than the 41 mrem/hour for the same location with the directly loaded reference fuel in the cask. In the accident condition involving loss of neutron shielding and lead slump, a maximum dose rate of 262.76 mrem/hour is calculated at 1 meter from the radial midplane of the NAC-STC. Based on the 4.6 dose multiplier assigned to the damaged fuel region in Section 5.3.2.3, the maximum damaged fuel dose rate is 7.91 mrem/hr at 2 meters and 47 mrem/hr on the cask surface. The multiplier conservatively does not account for self-shielding of the increased source mass or the presence of only four damaged fuel cans in the 36-assembly basket. For the accident case, the 1 meter dose rate for damaged fuel is 18.9 mrem/hr. Consequently, the Transport Index of 21 remains controlled by the directly loaded contents condition. This is also less than the directly loaded reference fuel accident dose rates shown in Table 5.1-5 and is well below 10 CFR 71 regulatory limits.

The maximum calculated dose at the surface of the cask centerline when loaded with GTCC waste under normal conditions of transport is 7.03 mrem/hour. This is much less than the 41 mrem/hour for the same location with the directly loaded reference fuel in the cask. In the accident condition, a maximum dose rate of 55.77 mrem/hour is calculated at 1 meter from the radial surface of the NAC-STC. This is also much less than the directly loaded reference fuel accident dose rates shown in Table 5.1-5 and is well below 10 CFR 71 regulatory limits.

5.1.4.3 Shielding Evaluation for Connecticut Yankee Class Fuel and GTCC Waste

A three-dimensional radial and axial shielding analysis was performed for both the Connecticut Yankee fuel and GTCC waste under normal and hypothetical accident conditions. The dose rates for canistered fuel (stainless steel clad, 38,000 MWD/MTU, 10-year cooled and Zircaloy clad, 43,000 MWD/MTU, 10-year cooled) are provided in Tables 5.1-10 through 5.1-13. The dose rates for the GTCC waste are provided in Tables 5.1-14 and 5.1-15.

Under normal conditions, the canister is positioned in the canister cavity with a bottom spacer and the impact limiters are in place on the cask. Under accident conditions (i.e., 30-foot drop and fire accident), the NAC-STC is modeled without a radial neutron shield and without the impact limiters. A combined slump of the lead shielding is assumed to be present radially and at both the top and bottom axial locations. Spacer deformation does not occur and is not modeled.

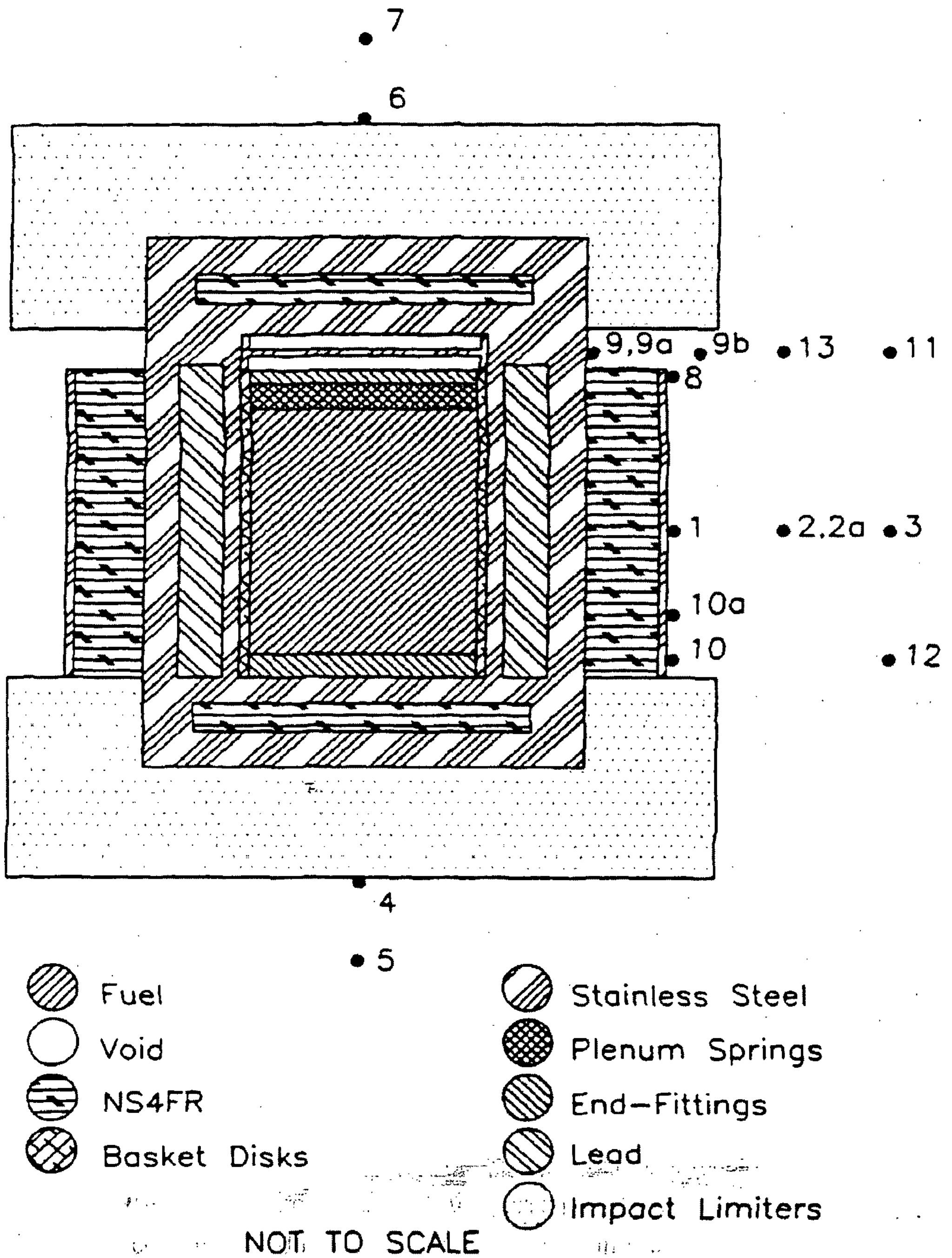
The maximum calculated dose at the radial surface of the cask with CY-MPC fuel under normal conditions is 49.1 mrem/hr. In the accident condition involving loss of neutron shielding, a maximum dose rate of 369 mrem/hr is calculated at 1 meter from the radial midplane of the NAC-STC. This is much less than the directly loaded reference fuel accident dose rates shown in Table 5.1-5 and is well below 10 CFR 71 regulatory limits.

The maximum calculated dose at the radial surface of the cask when loaded with CY-MPC GTCC waste under normal conditions of transport is 6.1 mrem/hr. This is much less than the 41 mrem/hr at the cask centerline with the directly loaded reference fuel in the cask. In the accident condition, a maximum dose rate of 25.0 mrem/hr is calculated at 1 meter from the radial surface of the NAC-STC. This is also much less than the directly loaded reference fuel fire accident dose rates shown in Table 5.1-5 and is well below 10 CFR 71 regulatory limits.

Locations of the maximum dose rates for CY-MPC fuel and GTCC waste are shown in Figures 5.1-6 and 5.1-7 for normal conditions of transport and the accident condition, respectively.

The dose rate increase due to the inclusion of up to two assemblies with a maximum of two irradiated stainless steel filler rods per assembly is less than 1% of the total dose rate at any surface of the NAC-STC.

Figure 5.1-1 Detector Locations for Yankee Class Canistered Fuel and GTCC Waste



Detector locations are described in Tables 5.1-6 through 5.1-9

Figure 5.1-2 Maximum Dose Rate Locations for the Three-Dimensional Directly Loaded Fuel Analysis in Normal Conditions

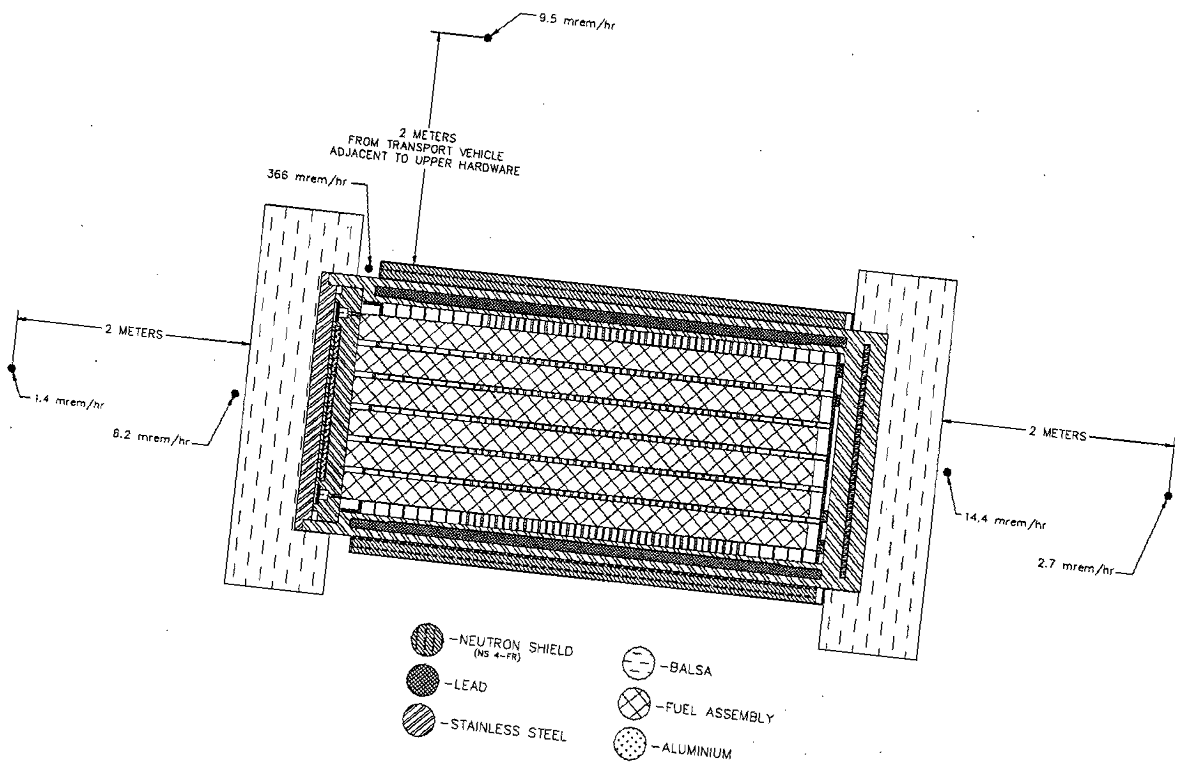


Figure 5.1-3 Design Basis Yankee Class Combustion Engineering Fuel Assembly

Figure Withheld Under 10 CFR 2.390

Figure 5.1-4 Yankee GTCC Waste Container

Figure Withheld Under 10 CFR 2.390

Figure 5.1-5 Connecticut Yankee Design Basis Fuel Assembly Source Regions and Elevations

Figure Withheld Under 10 CFR 2.390

(Dimensions in cm)

Figure 5.1-6 Location of Maximum Dose Rates for CY-MPC Fuel and GTCC Waste in Normal Conditions of Transport

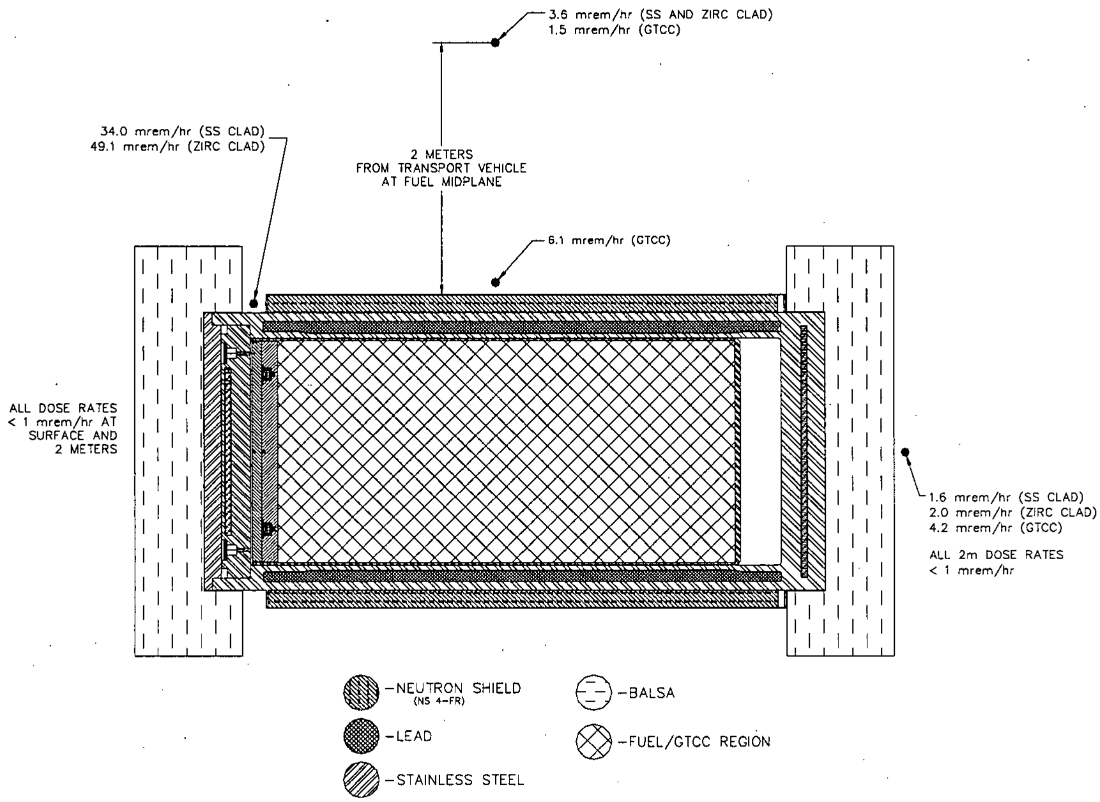


Figure 5.1-7 Location of Maximum Dose Rates for CY-MPC Fuel and GTCC Waste in Accident Conditions

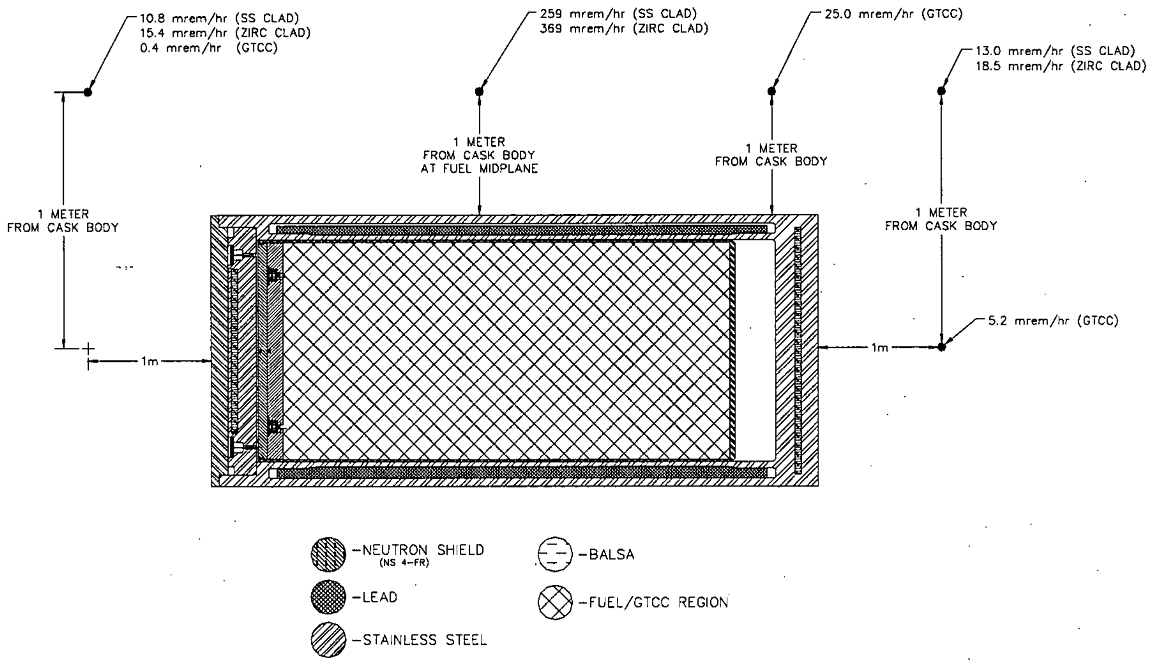


Table 5.1-1 Type, Form, Quantity and Potential Sources of the Fuel Used for Design Basis Directly Loaded and Canistered Fuel

	Design Basis Directly Loaded Fuel	**Design Basis Yankee Class Canistered Fuel**
Fuel Type and Parameters	• PWR, 14 x 14, 15 x 15, 16 x 16 and 17 x 17 • Array-dependent maximum uranium mass • Variable minimum initial ^{235}U enrichment • 45,000 MWD/MTU maximum burnup • 0.85 kW per assembly maximum decay heat, 22.1 kW per cask for 26 assemblies • Variable minimum cool time	• Yankee Class PWR Combustion Engineering, 16 x 16 Type A • 239.4 kg maximum uranium mass • 3.7 wt % maximum initial ^{235}U enrichment[1] • 36,000 MWD/MTU maximum burnup[2] • 0.347 kW per assembly maximum decay heat, 12.5 kW per cask for 36 assemblies • 8.1 years (or more) decay time after reactor discharge[2]
Fuel form	Intact assemblies	Yankee Class Fuel
Quantity	26 design basis fuel assemblies	36 design basis fuel assemblies
Heat Load	22.1 kilowatts, thermal per cask	12.5 kilowatts, thermal per cask
Sources of Fuel	Commercial PWR nuclear power reactors	Commercial Yankee Class nuclear power reactors

1. 3.7 wt % ^{235}U is used for the 36,000 MWD/MTU fuel assembly shielding source terms. It yields higher source terms than the 3.9 wt % ^{235}U used in the criticality analysis.
2. Yankee Class Westinghouse, United Nuclear and Combustion Engineering (3.5 wt % ^{235}U) fuel assemblies with burnups up to 32,000 MWD/MTU require minimum cool times of 22, 11 and 7 years, respectively. Exxon assemblies with burnups up to 36,000 MWD/MTU require a minimum cool time of 16 years for assemblies containing steel hardware in the active fuel region and 10 years for assemblies with Zircaloy hardware.

Table 5.1-1 Type, Form, Quantity and Potential Sources of the Fuel Used for Design Basis Directly Loaded and Canistered Fuel (Continued)

	Design Basis Stainless Steel Clad Connecticut Yankee Canistered Fuel	**Design Basis Zircaloy Clad Connecticut Yankee Canistered Fuel**
Fuel Type and Parameters	• Connecticut Yankee 15 x 15 Stainless Steel Clad • 431.7 kg maximum uranium mass • 3.65 wt % maximum initial ^{235}U enrichment • 38,000 MWD/MTU maximum burnup • 10 years decay time after reactor discharge	• Connecticut Yankee 15 x 15 Zircaloy Clad • 395.2 kg maximum uranium mass • 3.59 wt % maximum initial ^{235}U enrichment • 43,000 MWD/MTU maximum burnup • 10 years decay time after reactor discharge
Fuel form	Intact or damaged assemblies	Intact or damaged assemblies
Quantity	26 design basis fuel assemblies	26 design basis fuel assemblies
Heat Load	15.6 kilowatts, thermal per cask	16.3 kilowatts, thermal per cask
Sources of Fuel	Connecticut Yankee Haddam Neck nuclear reactor	Connecticut Yankee Haddam Neck nuclear reactor

Table 5.1-2 Design Basis Canistered Fuel - Physical Parameters

PARAMETER	Canistered Fuel		
	Yankee Class	CY Stainless Steel Clad	CY Zircaloy Clad
Assembly Rod Array	16 x 16	15 x 15	15 x 15
Assembly Length, in	111.79	137.1	137.1
Active Fuel Length, in	91	121.8	121.1
No. of Fuel Rods	231	204	204
Rod Pitch, in	0.472	0.563	0.563
Cladding Material	Zircaloy-4	Stainless Steel	Zircaloy-4
Rod Diameter, in	0.365	0.422	0.424
Cladding Thickness, in	0.024	0.0165	0.025
Pellet Diameter, in	0.3105	0.3835	0.3680
Pellet Material	UO_2 (sintered)	UO_2 (sintered)	UO_2 (sintered)
Maximum Fuel Rod Pressure, psig	315	475	475
Theoretical Density, percent	95	95	95
Maximum Initial Enrichment, wt % U^{235}	3.9[2]	4.03[4]	4.61[4]
Design Basis Burnup, MWD/MTU	36,000	38,000	43,000
Weight of U, kg (typical)	239.4[1]	421.2	386.7
Weight of UO_2, kg (typical)	271.6	477.8	438.7
Upper End-Fitting, kg/assembly	5.5	11.24	11.84
Lower End-Fitting, kg/assembly	5.18	8.85	5.44
Upper Plenum Springs, kg/assembly	0.762	-[3]	-[3]
Upper Plenum Grid, kg/assembly	0.590	3.879[3]	5.137[3]
Lower Plenum Grid, kg/assembly	NA	NA	NA

1 A bounding value of 469 kg is used for the total mass of Uranium.
2 An initial enrichment of 3.7 wt % ^{235}U is used in source term generation to maximize the neutron source.
3 Upper plenum spring and grid hardware mass is combined.
4 Initial enrichments of 3.65 wt % ^{235}U and 3.59 wt % ^{235}U for stainless steel and Zircaloy clad fuels, respectively, to maximize the neutron sources.

Table 5.1-3 Nuclear Parameters of the Canistered Fuels and GTCC Waste

Configuration	Yankee Class Fuel	Yankee GTCC Waste[1]	CY Stainless Steel Clad Fuel	CY Zircaloy Clad Fuel	CY GTCC Waste
No. of Fuel Assemblies or Containers	36	24	26	26	24
Burnup, MWD/MTU	36,000	N/A	38,000	43,000	N/A
Cooling Time, years	8	N/A	10	10	10
Gamma Source, MeV/s photons/sec	2.856×10^{16} 6.423×10^{16}	1.16×10^{16} 9.493×10^{15}	7.712×10^{16}	8.002×10^{16}	1.81×10^{16}
Neutron Source, neutrons/sec	2.415×10^{9}	N/A	3.689×10^{9}	5.348×10^{9}	N/A
Core Grids, photons/sec[2]	0.0	N/A	3.879×10^{15}	1.974×10^{15}	N/A
Upper end-fitting ^{60}Co Source, photons/s[3]	8.330×10^{13}	N/A	1.018×10^{14}	1.204×10^{14}	N/A
Lower end-fitting ^{60}Co Source, photons/sec[3]	7.876×10^{13}	N/A	9.926×10^{13}	5.532×10^{13}	N/A
Upper Plenum Hardware ^{60}Co Source, photons/sec[3]	2.309×10^{13}	N/A	8.937×10^{13}	1.045×10^{14}	N/A
Lower Plenum ^{60}Co Source, photons/sec	5.242×10^{13}	N/A	N/A	N/A	N/A

1 Includes depleted Sb-Be source vanes, fuel assembly cage components and core baffle steel.
2 CY hardware sources include steel guide tubes for Zircaloy clad fuel and steel guide tubes and steel clad for stainless steel clad fuel.
3 CY upper end-fitting, lower end-fitting, and upper plenum source strengths are total sources, not ^{60}Co sources.

Table 5.1-4 Directly Loaded Fuel Maximum Dose Rates for Normal Conditions of Transport

Detector	Source	Surface		2 meter[1]	
		mrem/hr	RSD	mrem/hr[2]	RSD
Top Axial	Neutron	0.5	0.2%	0.2	0.2%
	Gamma	5.7	0.4%	1.2	0.4%
	Total	6.2	0.3%	1.4	0.3%
Radial	Neutron	152.2	0.3%	2.9	0.3%
	Gamma	214.2	0.3%	6.6	0.4%
	Total	366.4	0.2%	9.5	0.3%
Bottom Axial	Neutron	4.0	0.3%	0.8	0.2%
	Gamma	10.4	0.6%	1.9	0.9%
	Total	14.4	0.4%	2.7	0.7%

1. Dose rates are rounded to the indicated precision.
2. Dose rates at 2 meter locations radially are 2 meters from the railcar. Dose rates at 2 meter locations axially are measured from the ends of the impact limiters.

Table 5.1-5 Directly Loaded Fuel Maximum Dose Rates for Hypothetical Accident Conditions

Detector	Source	Surface[1]		1 meter[1]	
		mrem/hr[2]	RSD	mrem/hr[2]	RSD
Top Axial	Neutron	31.3	0.5%	23.4	0.9%
	Gamma	20.5	0.8%	10.9	2.7%
	Total	51.8	0.5%	34.3	1.1%
Radial[3]	Neutron	1586	0.2%	578	0.2%
	Gamma	52	6.6%	27	5.1%
	Total	1638	0.3%	605	0.3%
Bottom Axial	Neutron	119.3	0.3%	51.2	6.3%
	Gamma	67.2	0.8%	17.9	0.9%
	Total	186.5	0.3%	69.1	4.7%

1. The hypothetical accident conditions include a loss of all oxygen, hydrogen, and nitrogen in the radial neutron shield material and radial and axial lead slumps.
2. Dose rates are rounded to the indicated precision.
3. The azimuthal maximum radial dose rates are 1729 (1.9%) and 665 (4.4%) mrem/hr at the surface and at 1 meter from the surface, respectively.

Table 5.1-6 Combined Top, Radial Midplane, and Bottom Canistered Yankee Class Fuel Dose Rates for Normal Conditions of Transport

Location	Detector I.D.	Radiation	Dose Rate (mrem/hr)
Radial Surface, fuel midplane	1	Fuel Gamma Fuel Neutron (n,γ) TOTAL	3.89 3.46 2.90 10.25
Radial, 1m from cask surface, fuel midplane	2	Fuel Gamma Fuel Neutron (n,γ) TOTAL	1.73 1.29 1.09 4.11
Radial, 2m from transport vehicle, fuel midplane**	3	Fuel Gamma Fuel Neutron (n,γ) TOTAL	0.79 0.52 0.41 1.72
Bottom impact limiter surface, axial centerline	4	Fuel Gamma Upper Plenum Gamma Top Endfitting Gamma Fuel Neutron (n,γ) TOTAL	0.09 0.13 0.37 0.01 0.04 0.64
Bottom, 2m from surface of impact limiter, axial centerline	5	Fuel Gamma Upper Plenum Gamma Top Endfitting Gamma Fuel Neutron (n,γ) TOTAL	0.05 0.07 0.00* 0.00* 0.02 0.14
Top impact limiter surface, axial centerline	6	Fuel Gamma Upper Plenum Gamma Top Endfitting Gamma Fuel Neutron (n,γ) TOTAL	0.00* 0.00* 0.00* 0.00* 0.00* 0.00
Top, 2m from surface of impact limiter, axial centerline	7	Fuel Gamma Upper Plenum Gamma Top Endfitting Gamma Fuel Neutron (n,γ) TOTAL	0.00* 0.00* 0.00* 0.00* 0.00* 0.00

* Values are less than 0.005.

** A neutron peaking factor of $(1.2)^{4.2} = 2.15$ is applied to the detector locations at or near the radial midplane of the fuel region.

Table 5.1-7 Combined Top, Radial Midplane, and Bottom Canistered Yankee Class Fuel Dose Rates for Hypothetical Accident Conditions

Location	Detector I.D.	Radiation	Dose Rate (mrem/hr)
Radial, 1m from cask surface, fuel midplane without neutron shield[1]	2a	Fuel Gamma Fuel Neutron (n,γ) TOTAL	32.11[4] 230.14 0.50 262.76
Bottom, 1m from cask surface, axial centerline, without neutron shield (assumes loss of impact limiter)[1,2]	4	Fuel Gamma Upper Plenum Gamma Top Endfitting Gamma Fuel Neutron (n,γ) TOTAL	0.81 1.35 4.04 5.35 0.10 11.65
Top, 1m from cask surface, axial centerline, without neutron shield (assumes loss of impact limiter)[2]	6	Fuel Gamma Upper Plenum Gamma Top Endfitting Gamma Fuel Neutron (n,γ) TOTAL	0.00[3] 0.00[3] 0.00[3] 18.20 0.01 18.25

1 Assumes complete loss of neutron shielding material.

2 Assumes loss of impact limiters and positioning of the canister either top or bottom of cavity.

3 Values are less than 0.005.

4 Assumes 0.88 inch reduction in lead shielding due to side drop lead slump.

Table 5.1-8 Canistered Yankee GTCC Waste Dose Rates for Normal Conditions of Transport

Location	Detector I.D.	Radiation	Dose Rate(mrem/hr)
Radial Surface, fuel midplane	1	Neutron Gamma Total	0.00 7.03 7.03
Radial, 1m from cask surface, fuel midplane	2	Neutron Gamma Total	0.00 3.17 3.17
Radial, 2m from transport vehicle, midplane	3	Neutron Gamma Total	0.00 1.49 1.49
Top impact limiter surface, axial centerline	6	Neutron Gamma Total	0.00 0.00 0.0
Top 2m from impact limiter surface, axial centerline	7	Neutron Gamma Total	0.00 0.00 0.0
Bottom impact limiter surface, axial centerline	4	Neutron Gamma Total	0.0 2.54 2.54
Bottom, 2m from cask surface, axial centerline	5	Neutron Gamma Total	0.00 0.46 0.46

Table 5.1-9 Canistered Yankee GTCC Waste Dose Rates for Hypothetical Accident Conditions

Location	Detector I.D.	Dose Rate (mrem/hr)
Radial, 1m from cask surface, fuel midplane, without neutron shielding[1]	2a	55.77
Top surface 1m from cask surface, axial centerline[2]	6	0.01
Bottom, 1m from cask surface, axial centerline, without neutron shield[2,3]	4	22.88

1 Assumes complete loss of neutron shielding material and lead slump. Loss of neutron shielding alone results in a dose of 12.15 mrem/hr. This dose is increased by a factor of 4.59 to account for a 0.88 inch reduction in lead thickness due to lead slump.

2 Assumes loss of impact limiters and positioning of the canister in either the top or bottom of the cavity.

3 Assumes complete loss of neutron shielding material.

Table 5.1-10 Connecticut Yankee Stainless Steel Clad Fuel Maximum Dose Rates for Normal Conditions of Transport

Detector	Source	Surface		2 meter	
		mrem/hr	**RSD**	**mrem/hr**	**RSD**
Top Axial	Neutron	0.1	0.5%	0.1	2.8%
	Gamma	0.1	4.9%	0.1	3.0%
	Total	0.3	2.4%	0.1	2.1%
Radial	Neutron	30.2	0.5%	0.9	0.6%
	Gamma	3.8	2.2%	2.7	1.4%
	Total	34.0	0.5%	3.6	1.0%
Bottom Axial	Neutron	0.5	0.4%	0.1	1.2%
	Gamma	1.2	0.6%	0.2	0.5%
	Total	1.6	0.4%	0.3	0.5%

Note: Dose rates at 2 meter location radially are 2 meters from the railcar. Dose rates at 2 meter locations axially are measured from the ends of the impact limiters.

Table 5.1-11 Connecticut Yankee Zircaloy Clad Fuel Maximum Dose Rates for Normal Conditions of Transport

Detector	Source	Surface		2 meter	
		mrem/hr	**RSD**	**mrem/hr**	**RSD**
Top Axial	Neutron	0.2	0.7%	0.1	3.7%
	Gamma	0.2	2.0%	0.1	2.1%
	Total	0.4	1.0%	0.2	2.2%
Radial	Neutron	43.6	0.4%	1.3	0.5%
	Gamma	5.5	5.5%	2.3	1.2%
	Total	49.1	0.7%	3.6	0.8%
Bottom Axial	Neutron	0.8	0.4%	0.1	0.9%
	Gamma	1.2	2.9%	0.2	1.9%
	Total	2.0	1.8%	0.3	1.1%

Note: Dose rates at 2 meter location radially are 2 meters from the railcar. Dose rates at 2 meter locations axially are measured from the ends of the impact limiters.

Table 5.1-12 Connecticut Yankee Stainless Steel Clad Fuel Maximum Dose Rates for Hypothetical Accident Conditions

Detector	Source	Surface		1 meter	
		mrem/hr	RSD	mrem/hr	RSD
Top Axial	Neutron	2.1	0.6%	9.5	1.7%
	Gamma	0.2	11.8%	1.2	2.5%
	Total	2.4	1.3%	10.8	1.5%
Radial	Neutron	746	0.6%	234	0.4%
	Gamma	60	8.7%	25	1.3%
	Total	806	0.9%	259	0.4%
Bottom Axial	Neutron	4.7	0.5%	12.3	3.2%
	Gamma	3.8	0.7%	0.8	9.9%
	Total	8.5	0.4%	13.0	3.1%

Table 5.1-13 Connecticut Yankee Zircaloy Clad Fuel Maximum Dose Rates for Hypothetical Accident Conditions

Detector	Source	Surface		1 meter	
		mrem/hr	RSD	mrem/hr	RSD
Top Axial	Neutron	3.1	0.6%	14.1	1.7%
	Gamma	0.3	5.4%	1.3	1.3%
	Total	3.4	0.8%	15.4	1.6%
Radial	Neutron	1,123	0.6%	348	0.4%
	Gamma	47	3.9%	21	1.8%
	Total	1,170	0.6%	369	0.4%
Bottom Axial	Neutron	7.6	0.5%	17.6	3.4%
	Gamma	3.7	1.8%	0.9	14.2%
	Total	11.3	1.3%	18.5	3.3%

Table 5.1-14 Connecticut Yankee GTCC Waste Maximum Dose Rates for Normal Conditions of Transport

Detector	Surface		2 meter	
	mrem/hr	RSD	mrem/hr	RSD
Top Axial	< 0.1	1.2%	< 0.1	1.4%
Radial	6.1	0.6%	1.5	0.3%
Bottom Axial	4.2	0.2%	0.7	0.3%

Note: Dose rates at 2 meter location radially are 2 meters from the railcar. Dose rates at 2 meter locations axially are measured from the ends of the impact limiters.

Table 5.1-15 Connecticut Yankee GTCC Waste Maximum Dose Rates for Hypothetical Accident Conditions

Detector	Surface		1 meter	
	mrem/hr	RSD	mrem/hr	RSD
Top Axial	< 0.1	8.5%	0.4	11.4%
Radial	141.4	10.8%	25.0	5.7%
Bottom Axial	16.7	0.2%	5.2	0.2%

5.2 Source Specification

This section presents the source specifications for the directly loaded fuel and for the Yankee-MPC and CY-MPC fuel and GTCC waste configurations.

5.2.1 Directly Loaded Fuel Source Specification

The directly loaded NAC-STC is designed to safely transport a range of 14×14, 15×15, 16×16, and 17×17 fuel assemblies. The analyzed fuel assemblies are reference fuel assemblies, with assembly geometry and activated hardware masses chosen to maximum uranium loading (MTU) and activated hardware source term.

In order to generate a minimum cool time table for directly loaded fuel, each fuel assembly is analyzed over a range of burnups, initial ^{235}U enrichments and cool times. Fuel assembly burnup is evaluated from 30,000 MWD/MTU to 45,000 MWD/MTU in 5,000 MWD/MTU increments. Initial ^{235}U enrichments are evaluated from 1.7 to 4.5 wt % ^{235}U in 0.2 wt % increments. Cool times range from 5 to 40 years with varying increments. This matrix creates a total of 1,080 source terms for each assembly (4 burnups × 15 enrichments × 18 cool times).

Neutron and gamma source terms for the directly loaded design basis fuel are calculated with the ORIGEN-S computer code (Hermann, 1989) as part of the SAS2H sequence (Hermann, 1995) in the SCALE 4.3 code package for the PC (ORNL, 1995). ORIGEN-S also calculates the gamma spectrum, the neutron spectrum, and the concentration of radiologically important isotopes such as ^{3}H, ^{131}Xe, ^{129}I, ^{85}Kr, ^{134}Cs, ^{137}Cs and ^{60}Co. Reactor operating conditions assumed for the analysis are shown in Table 5.2-2. The SAS2H-generated source spectra are rebinned onto the standard 28 group neutron and 22 group gamma scheme used in MCBEND as shown in Tables 5.2-21 and 5.2-22, respectively. Source terms are generated for the fuel and fuel assembly hardware. The hardware activation is calculated by light element transmutation using the in-core neutron flux spectrum produced by the SAS2H neutronics model.

The fuel-dependent input data for the shielding and source term evaluations of directly loaded design basis PWR assemblies are given in Table 5.2-1. Fuel assembly parameters have been selected to maximize fuel mass and, therefore, fuel source terms. Fuel assembly hardware masses have likewise been selected to maximize hardware source term.

Fuel assembly parameters used in the SAS2H source term analysis and the MCBEND shielding analysis are identical. Parameters necessary to generate SAS2H input are shown in Table 5.2-3.

Fuel neutron, fuel gamma, and hardware gamma radiation contribute at varying levels to cask dose rates due to significant changes in the material composition of the cask shields at different radial and axial locations. As such, no single source term produces a bounding set of dose rates at all locations. For example, the radial maximum surface dose rate (normal conditions) of 366 mrem/hr is produced by a 40,000 MWD/MTU, 2.3 wt % ^{235}U, 10-year cooled source term, shown in Table 5.2-6. Top axial maximum dose rates (normal conditions) are produced by a 30,000 MWD/MTU, 2.3 wt % ^{235}U, 6-year cooled source term. By employing the response function method to calculate maximum dose rates, the limiting source term becomes a result of the analysis, rather than an input, and the limiting source term and dose rate are captured for radial and axial detectors and normal and accident conditions.

The end-fitting, plenum spring and grid spacer activations are calculated by ORIGEN-S using the same burnup cycle as the fuel. The fuel hardware masses activated are provided in Table 5.2-4 for the directly loaded fuel. The grid spacers and other fuel hardware in the core region are conservatively assumed to be exposed to 100 percent of the flux in the core. For the plenum springs, the grid spacers in the plenum region, and the bottom end-fittings, 20 percent of the flux in the core is used for irradiation purposes. For the top end-fittings, 10 percent of the flux in the core is used for irradiation purposes. These irradiation values are taken from Luksic. The amount of ^{59}Co present in the grid spacers and end-fittings was taken as 1.2 gram per kilogram of material, irrespective of being Inconel or Type 304 stainless steel. However, the value is conservative for both stainless steel and Inconel, as most nuclear-grade material specifications require less than 1 gram of ^{59}Co per kilogram of metal. It is conservatively assumed that all of the cobalt is ^{59}Co. When ^{59}Co absorbs a neutron, it becomes ^{60}Co.

5.2.1.1 Directly Loaded Fuel Neutron Source

As described in Section 5.2.1, a total of 1,080 neutron source terms have been calculated for each directly loaded fuel assembly. Neutron source terms have been rebinned onto the MCBEND 28 group structure, shown in Table 5.2-21. The neutron source results from actinide spontaneous fission and from (α,n) reactions with oxygen in UO_2. The isotopes ^{242}Cm and ^{244}Cm characteristically produce all but a few percent of the spontaneous fission neutrons and (α,n) source in light water reactor fuel. The next largest contribution is from (α,n) reactions of ^{238}Pu with oxygen. The neutron spectrum from spontaneous fission is based on fission spectrum measurements of ^{235}U and ^{252}Cf. Neutron spectra from (α,n) reactions are based on Po-α-O source measurements. These spectra are included in the ORIGEN-S nuclear data libraries of the SCALE 4.3 code package. The spectra are automatically collapsed from the energy group structure of the data library into that of the standard MCBEND 28 group structure using ORIGEN-S as part of the source term decay evaluation.

The effect of subcritical neutron multiplication is not directly computed in the MCBEND analysis conducted for directly loaded fuel, due to difficulties in adequately biasing the calculation. Instead, neutron source rates are scaled by a subcritical multiplication factor based on the system multiplication factor, k_{eff}:

$$\text{Scale Factor} = \frac{1}{1 - k_{eff}}$$

For the dry cask conditions of transport, the system k_{eff} is taken as 0.4, with a resulting scale factor of 1.67. This scale factor is input as a scaling factor on the source strength input in MCBEND.

5.2.1.2 Directly Loaded Fuel Gamma Sources

As described in Section 5.2.1, 1,080 gamma source terms have been calculated for each directly loaded fuel assembly. Gamma source terms have been rebinned onto the MCBEND 22 group structure, shown in Table 5.2-22, using ORIGEN-S as part of the source term decay evaluation. The hardware gamma spectrum for directly loaded fuel contains contributions primarily from ^{60}Co due to the activation of Type 304 stainless steel with 1.2 g/kg ^{59}Co impurity and with some minor contributions from ^{59}Ni and ^{58}Fe. The magnitude of these spectra is based on the irradiation of 1 kg of stainless steel in the in-core flux spectrum produced by the SAS2H neutronics calculation.

The activated fuel assembly hardware source terms are found by multiplying the source strength from 1 kilogram by the kilograms of steel or inconel material in the plenum, upper end fitting or lower end fitting regions, and by multiplying by a regional flux ratio. The regional flux ratio accounts for the effects of both magnitude and spectrum variation on hardware activation. These ratios are based on empirical data (Luksic). A flux ratio of 0.2 is applied to hardware regions directly adjacent to the active core region (i.e., upper and lower plenum) and a flux ratio of 0.1 is applied to hardware regions once removed from the active core region (i.e., upper and lower end fitting region). Activated mass in each region and the corresponding flux factor are summarized in Table 5.2-4 for each array size. In the case of CE 16×16 fuel, which has a longer plenum, the upper end fitting (upper nozzle) flux factor is reduced to 0.05 (Luksic).

5.2.1.3 Directly Loaded Fuel Source Axial Profiles

The design basis axial burnup profile used in the directly loaded fuel shielding evaluations is shown in Figure 5.2-1. This profile is converted to a set of line segments suitable for input into the MCBEND shielding code. The converted profile assures that the burnup peak of the more detailed profile shown in Figure 5.2-1 is bounded while conserving the average burnup (i.e., the area under the curve is maintained as to not add source). Neutron and gamma source profiles are computed based on the relation between burnup, B, and source strength, S, in the form:

$$S = aB^b$$

where parameters a and b are determined based on fits to SAS2H computed source rates at various fuel burnups. The parameter a is simply a scaling factor and is not relevant to the analysis. For neutron sources, parameter b is 4.22. For gamma sources, the relation between burnup and source rate is linear and b is 1.0. The resulting gamma source profile is therefore identical to the burnup profile. Table 5.2–5 gives the resulting neutron and gamma source rate profiles for directly loaded fuel. The relative source strength in each axial interval is shown, and these values are used directly in the MCBEND source strength description by defining an axial source mesh within the fuel region at the indicated elevations for each fuel type. A plot of the axial source profiles is shown in Figure 5.2–2.

5.2.2 Yankee Class Fuel and GTCC Waste Source Specification

The canistered fuel design basis source terms are based on the CE 16 x 16 Yankee Class fuel assembly with a burnup of 36,000 MWD/MTU and 8.1-year cooling time. An enrichment of 3.7 wt % ^{235}U is selected to maximize the neutron source for this type of fuel. Dose rates associated with the Yankee Class Westinghouse, United Nuclear, and CE (3.5 wt % ^{235}U) fuel types at 32,000 MWD/MTU are bounded by the canister fuel design basis for cooling times of 22, 11 and 7 years, respectively. Exxon fuel at 36,000 MWD/MTU with steel or Zircaloy fuel hardware is bounded by the canister fuel design basis for cooling times of 16 and 10 years, respectively. The 10-year cool time for Exxon fuel assemblies with Zircaloy fuel region hardware includes the activation of four hollow Zircaloy replacement rods with stainless steel slugs. Multiple inert/dummy rod configurations were employed in CE and Exxon fuel assemblies, while only the stainless steel slugs are considered in the shielding evaluation based on their contribution to the activated hardware source term. Also of note, the cool time of 22 years for Westinghouse fuel assemblies is based on the activation of 120 kg of fuel region hardware.

Neutron and gamma source terms for the canistered design basis fuel are calculated with the SAS2H code sequence of the SCALE 4.3 code package for the PC. SAS2H includes an XSDRNPM neutronics model of the fuel assembly and ORIGEN-S fuel depletion/source term calculations. The canister fuel assembly input data for SAS2H is summarized in Table 5.2-7. Source terms are generated for both UO_2 fuel and fuel assembly hardware. The hardware activation is calculated by light element transmutation using the in-core neutron flux spectrum produced by the SAS2H neutronics model. The hardware is assumed to be Type 304 stainless steel with 1.2 g/kg of ^{59}Co impurity. The effects of axial flux spectrum and magnitude variation on hardware activation are estimated by flux ratios based on empirical data (Luksic).

5.2.2.1 Yankee Class Fuel Neutron Source

The design basis fuel neutron spectrum for canistered fuel is shown in Table 5.2-8. The neutron source results from actinide spontaneous fission and from (α,n) reactions with oxygen in UO_2. The isotopes ^{242}Cm and ^{244}Cm characteristically produce all but a few percent of the spontaneous fission neutrons and (α,n) source in light water reactor fuel. The next largest contribution is from (α,n) reactions of ^{238}Pu with oxygen. The neutron spectra from spontaneous fission is based on fission spectrum measurements of ^{235}U and ^{252}Cf. Neutron spectra from (α,n) reactions are based on Po-α-O source measurements. These spectra are included in the ORIGEN-S nuclear data libraries of the SCALE 4.3 code package. The spectra are automatically collapsed from the energy group structure of the data library into that of the SCALE 27 group neutron cross section library.

5.2.2.2 Yankee Class Fuel and Yankee GTCC Waste Gamma Sources

The design basis Yankee Class fuel gamma spectrum for canistered fuel is shown in Table 5.2-9. Fuel gamma radiation sources consist primarily of decay gammas from fission products. Actinides also emit a significant amount of gamma radiation. The gamma source strength depends on the irradiation period and the cooling time after discharge from the reactor core.

An additional source of gamma radiation is from ^{59}Co activation in the fuel hardware materials. The design basis fuel hardware gamma spectrum for canistered fuel is shown in Table 5.2-10.

The gamma spectrum for the decay of ^{60}Co in the activated hardware was calculated using ORIGEN-S. The total source in each hardware region depends on the flux used to irradiate the region and the mass of material in that region. The default gamma energy group spectrum of the hardware gamma sources were rebinned to the SCALE-4.0 18-group structure using ORIGEN-S. This method regroups the source based on the actual energy spectrum of each specific nuclide, yielding more accurate results than those achieved by simply multiplying the individual energy group source strength by the ratio of the old to new mean energies of each respective group.

The hardware gamma spectra contains contributions primarily from ^{60}Co due to the activation of Type 304 stainless steel with 1.2 g/kg ^{59}Co impurity and with some minor contributions from ^{59}Ni and ^{58}Fe. The magnitude of these spectra is based on the irradiation of 1 kg of stainless steel in the incore flux spectrum produced by the SAS2H neutronics calculation. This activated hardware spectra is used for the GTCC waste spectra, but the magnitude is scaled up from 103 curies of ^{60}Co in the 1 kg of activated hardware to 1.25×10^5 curies ^{60}Co in the GTCC waste. This assumed source term bounds the source term for the fuel assembly cage and depleted source vane material placed in an interior loading position of the GTCC basket.

The activated fuel assembly hardware source terms are found by multiplying the source strength from 1 kilogram by the kilograms of steel or inconel material in the plenum, upper end fitting or lower end fitting regions, and by multiplying by a regional flux ratio. The regional flux ratio accounts for the effects of both magnitude and spectrum variation on hardware activation. These ratios are based on empirical data (Luksic). A flux ratio of 0.2 is applied to hardware regions directly adjacent to the active core region (i.e., upper and lower plenum) and a flux ratio of 0.1 is applied to hardware regions once removed from the active core region (i.e., upper and lower end fitting region).

5.2.2.3 Yankee Class Fuel Source Axial Profiles

The design basis Yankee Class fuel axial burnup profile used in the canister fuel shielding evaluation is shown in Figure 5.2-3. This is based on core calculations of Yankee Class fuel in the range of 30,000 to 36,000 MWD/MTU of burnup. This burnup profile has a peaking factor of 1.15. Thus, a peaking factor of 1.15 is applied to the radial midplane gamma dose rates and a peaking factor of $(1.15)^{4.2} = 1.80$ is applied to the radial midplane neutron dose rates reported in Tables 5.1-6 and 5.1-7.

The design basis gamma source profile for Yankee GTCC waste (primarily activated stainless steel core baffle) is shown in Figure 5.2-4. A GTCC gamma source peaking factor of 1.23 for GTCC waste is determined from actual dose rate measurements of the GTCC waste containers holding core baffle material. This peaking factor is due to the activation of the core baffle from 30 years of neutron flux exposure. This neutron flux exposure produces an activation profile similar to the chopped cosine axial shape of the neutron flux during reactor operation. The GTCC source term includes an estimated contribution from crud (as surface contamination).

5.2.3 Connecticut Yankee Fuel and GTCC Waste Source Specification

The NAC-STC loaded with the CY-MPC system is designed to safely transport Connecticut Yankee (CY) fuel assemblies, non-fuel hardware, and GTCC waste. The spent fuel inventory consists of both stainless steel and Zircaloy clad fuel assemblies. Due to the activation of cobalt impurities present in the stainless steel cladding, these two fuel types are considered separately in the analysis. Based on the fuel inventory, the limiting combination of burnup and cool time for the two fuel types is:

Fuel Type	Maximum Burnup [MWD/MTU]	Minimum Cool Time [years]
Stainless steel clad	38,000	10
Zircaloy clad	43,000	10

In some cases, additional activated non-fuel hardware, such as Reactor Control Cluster Assemblies and Flow Mixers, will be inserted in CY fuel assemblies. The fuel assemblies with inserted components are subject to certain additional constraints on either maximum burnup or minimum cool time. However, no credit for the reduced source terms of these fuel assemblies is taken here. The non-fuel hardware activation analysis is performed using conservative values for cumulative lifetime exposure. Each Reactor Control Cluster Assembly is assumed to have been positioned in the reactor during operation so as to achieve the maximum possible activation of material throughout its lifetime. Additionally, each flow mixer is assumed to have been in place in the top nozzle of a fuel assembly for every CY plant cycle.

The CY-MPC may also contain up to two assemblies with a maximum of two irradiated stainless steel filler rods per assembly. The mass of irradiated steel is calculated based on the maximum CY fuel rod diameter of 1.076 cm, a rod length of 321.87 cm, and the stainless steel density; the calculated mass is 2.323 kg. Conservatively, the entire mass is applied over the active fuel height.

The design basis CY GTCC waste inventory is analyzed by assuming a fixed mass loading in the CY-MPC GTCC basket and applying the highest activity of any of the GTCC sources to the mass loading. The design basis GTCC source is the core baffle, which has a modeled total activity of 3.71 x 10^5 curies at 10 years from core shutdown (^{60}Co activity of 1.96 x 10^5 curies). The GTCC source is loaded into the four center tubes with a weight of 1300 lbs and the 20 peripheral waste tubes with a weight of 800 lbs for a total assumed weight of 21,200 pounds.

An evaluation of the Connecticut Yankee spent fuel inventory establishes the Westinghouse 15 x 15 fuel assembly as the limiting fuel type based on initial mass loading of uranium. The bounding stainless steel clad fuel in the Connecticut Yankee inventory has a maximum burnup of 38,000 MWD/MTU, minimum initial enrichment of 3.65 wt. % ^{235}U, and a minimum cooling time of 10 years. Some stainless steel clad fuel assemblies in the Connecticut Yankee inventory have initial enrichments as low at 3.00 wt % ^{235}U; however, stainless steel clad assemblies with initial enrichments lower than 3.65 wt % ^{235}U also have lower maximum burnups as shown below.

For Zircaloy clad fuels, the limiting fuel description is based on a maximum burnup of 43,000 MWD/MTU, minimum initial enrichment of 3.59 wt % ^{235}U, and a minimum cooling time of 10 years. Some Zircaloy clad fuel in the Connecticut Yankee inventory have lower initial enrichments (as low as 2.95 wt % ^{235}U); however, source terms produced by the combination of burnup and initial enrichment for the limiting Zircaloy clad fuel assemblies bound those of Zircaloy clad fuel assemblies at lower initial enrichments.

The following provides the acceptable combinations of maximum burnup and minimum initial enrichment that are bounded by the design basis stainless steel and Zircaloy clad fuel assemblies utilized in the dose rate analyses:

Stainless Steel Clad Fuel			Zircaloy Clad Fuel		
Enrichment	**Maximum Burnup**	**Minimum Cool Time**	**Enrichment**	**Maximum Burnup**	**Minimum Cool Time**
[wt % ^{235}U]	**[MWD/MTU]**	**[years]**	**[wt % ^{235}U]**	**[MWD/MTU]**	**[years]**
$e \geq 3.65$	38,000	10	$e \geq 3.59$	43,000	10
$3.23 \leq e < 3.96$	34,000	10	$3.40 \leq e < 3.59$	40,000	10
$3.00 \leq e < 3.23$	30,000	10	$2.95 \leq e < 3.40$	30,000	10

The SAS2H code sequence (Herman) is used to generate source terms. This code sequence is part of the SCALE 4.3 code package for the PC (ORNL). SAS2H includes an XSDRNPM (Greene) neutronics model of the fuel assembly and ORIGEN-S (Herman) fuel depletion/source term calculations. Reactor operating conditions assumed for the analysis are shown in Table 5.2-11. The SAS2H-generated source spectra are rebinned onto the standard 28 group neutron and 22 group gamma scheme used in MCBEND as shown in Table 5.2-21 and Table 5.2-22, respectively. Source terms are generated for the fuel and fuel assembly hardware. The hardware activation is calculated by light element transmutation using the in-core neutron flux spectrum produced by the SAS2H neutronics model.

The Connecticut Yankee design basis fuel source terms are presented in Tables 5.2-12 and 5.2-13. The activated hardware source term is provided on a per unit mass basis. Source strengths are defined for five source regions: active fuel, upper end fitting, upper plenum, lower end fitting and lower plenum. The fuel assembly length, active fuel region length and fuel assembly hardware lengths are shown for the design basis fuel assemblies in Figure 5.1-5.

5.2.3.1 Connecticut Yankee Fuel Gamma Source

The design basis fuel and hardware gamma source spectra are shown in Tables 5.2-11 and 5.2-13. The fuel gamma source contains contributions from both fission products and actinides. The spectra are presented in the standard 22 group structure used by MCBEND. The hardware gamma spectra contains contributions primarily from ^{60}Co, due to the activation of Type 304 stainless steel with either 0.5 g/kg for stainless steel clad fuel (Table 5.2-12) or 1.2 g/kg for Zircaloy clad fuel (Table 5.2-13) ^{59}Co impurity and with some minor contributions from ^{59}Ni and ^{58}Fe. The magnitude of this spectra is based on the irradiation of 1 kg of stainless steel in the in-core flux spectrum produced by the SAS2H neutronics calculation.

The activated fuel assembly hardware source strength for a given source region is determined as the product of 1) the hardware source strength per unit mass (from Table 5.2-12 and Table 5.2-13); 2) the mass of hardware present (from Table 5.2-14); 3) a mass scale factor discussed below (Table 5.2-14); and 4) a regional flux activation ratio (Table 5.2-14). The mass scale factor simply accounts for the difference in assumed cobalt concentration in the fuel cladding for stainless steel clad fuels. For stainless steel clad fuel, the SAS2H analysis is conducted based on a cobalt concentration of 0.5 g/kg. The hardware source terms in Table 5.2-12 reflect this assumed cobalt loading. However, this cobalt concentration is used only for the fuel cladding and end plugs; the remaining hardware source regions are modeled at the standard 1.2 g/kg cobalt concentration. Hence, a mass scale factor of 1.2/0.5 = 2.4 is applied to these source regions for the stainless steel clad fuels only. The Zircaloy clad fuel source terms are generated based on an assumed cobalt concentration of 1.2 g/kg for all fuel hardware, except the Zircaloy cladding material, so no adjustment is required and the mass factor for Zircaloy clad fuels is unity. The regional flux activation ratio accounts for the effects of both magnitude and spectrum variation on hardware activation. These ratios are based on empirical data (Luksic). A flux ratio of 0.2 is applied to hardware regions directly adjacent to the active core region, i.e., upper and lower plenum. A flux ratio of 0.1 is applied to hardware regions once removed from the active core region, i.e., upper and lower end fitting region.

5.2.3.2 Connecticut Yankee Fuel Neutron Source

The neutron source results from actinide spontaneous fission and from (α,n) reactions with the oxygen in UO_2. The isotopes ^{242}Cm and ^{244}Cm characteristically produce all but a few percent of the spontaneous fission neutrons and (α,n) source in light water reactor fuel. The next largest contribution is from (α,n) reactions from ^{238}Pu. The neutron spectra from spontaneous fission is based on fission spectrum measurements of ^{235}U and ^{252}Cf. Neutron spectra from (α,n) reactions is based on Po-α-O source measurements. These spectra are included in the ORIGEN-S nuclear data libraries of the SCALE 4.3 code package. The spectra is automatically collapsed from the energy group structure of the data library into that of the MCBEND 28 group neutron cross section structure.

The effect of subcritical neutron multiplication is not directly computed in the MCBEND analysis conducted here, due to difficulties in adequately biasing the calculation. Instead, neutron source rates are scaled by a subcritical multiplication factor based on the system multiplication factor, k_{eff}:

$$\text{Scale Factor} = \frac{1}{1 - k_{eff}}$$

For the dry cask conditions of transport, the system k_{eff} is taken as 0.4, with a resulting scale factor of 1.67.

5.2.3.3 Connecticut Yankee Non-Fuel Hardware Source

Activated non-fuel hardware suitable for in situ storage in the CY–MPC includes Reactor Control Cluster Assemblies and Flow Mixer hardware. There are no source term constraints on the selection of the assembly holding these components. In the case of Flow Mixer hardware, a constraint on the permissible number and location of containing assemblies within the basket is imposed. No more than eight assemblies containing Flow Mixers can be loaded into a single canister, and the assemblies must be loaded into fuel assemblies in the center-most basket positions 7, 8, 12, 13, 14, 15, 19 and 20 as shown in Figure 6.3-3.

SAS2H models are developed which reproduce the irradiation history of the Reactor Control Cluster Assemblies (RCCA) and Flow Mixers in the Connecticut Yankee spent fuel pool inventory. The cycle burnup history for the Connecticut Yankee reactor is shown in Table 5.2-15. The Flow Mixers are conservatively assumed to be present in every cycle of operation. The Reactor Control Cluster Assemblies are classified into two groups and analyzed separately. The first set of RCCAs was irradiated during operating cycles 1 through 14. The second, and more limiting group of RCCAs, was irradiated during operating cycles 15 through 19 and are assumed to have been partially inserted into the active core during operation. That is, the bottom-most 9 inches of the RCCA are exposed to 60% of the full power flux for the entire irradiation history. The source term analysis for the RCCAs considers activation of both Inconel and Ag-In-Cd material. The resulting source spectra are presented in Table 5.2–16 on a per unit mass basis. The modeled mass in each source region is shown in Table 5.2–17 for both Reactor Control Cluster Assemblies and Flow Mixers.

In general, the dose rates resulting from activation of the non-fuel hardware material are relatively small as compared to those from fuel sources. Results are presented in Section 5.4.

5.2.3.4 Connecticut Yankee Fuel Source Axial Profile

An enveloping axial burnup shape for three-dimensional shielding and thermal evaluations is created based on measured burnup profile data for PWR fuel. Neutron and gamma source profiles are computed based on an assumed relation between burnup, B, and source strength, S, in the form:

$$S = aB^b$$

where parameters a and b are determined based on fits to SAS2H computed source rates at various fuel burnups. The parameter a is simply a scaling factor and is not relevant to the analysis. For neutron sources parameter b is 4.22. For gamma sources, the relation between burnup and source rate is linear and b is 1.0. Table 5.2–18 gives the resulting source rate profiles for stainless steel clad and Zircaloy clad fuel types. The relative source strength in each axial interval is shown, and these values are used directly in the MCBEND source strength description by defining an axial source mesh within the fuel region at the indicated elevations for each fuel type. A plot of the axial source profiles is shown in Figure 5.2–5. The maximum peaking factors produced by these profiles is lower than the peaking factors reported for the Yankee Class fuel assemblies in Section 5.2.2.3 due to the higher burnup of the CY design basis fuel.

5.2.3.5 Connecticut Yankee GTCC Waste Source

The CY GTCC waste consists of stainless steel sections of the Connecticut Yankee reactor core baffle, core barrel, core support plate and miscellaneous related stainless steel hardware associated with the core components. As described in this section, the CY GTCC source term is based on a characterization of the CY GTCC material performed in September 2000.

The design basis CY GTCC source spectrum and isotopic content are shown in Tables 5.2-19 and 5.2-20, respectively. The CY GTCC waste spectrum is dominated by ^{60}Co. No axial profile is applied.

The CY GTCC source term was generated in four steps. First, the waste characterization was assessed to determine the maximum source component in curies/gram. The core baffle, with a mass of 14,300 lbs, provided the maximum curie content using this measure. Second, ORIGEN-S was used to decay the core baffle radionuclide inventory to a cool time consistent with the 10 year cool time applied to Connecticut Yankee fuel. Since the waste characterization was performed in September 2000, a decay of 6 years was specified in ORIGEN-S based on the end of Cycle 19 (Table 5.2-15). This decayed curie inventory is the characterized inventory shown in Table 5.2-20. Third, the curie content of each radionuclide was scaled up by 5% and a source spectrum was calculated in ORIGEN-S using the scaled curie content. This is the "Modeled Source" inventory shown in Table 5.2-20, which is the basis for the spectrum shown in Table 5.2-18.

The fourth step is the MCBEND source term and volume fraction calculation, summarized in the table below. MCBEND requires source strength input on a volumetric basis, which necessitates the calculation of the equivalent source volume (24 GTCC openings with width of 8.75 inches and can height of 133.50 inches). The volume fraction of steel in the openings (0.2741) is calculated based on loading 800 lbs in each of 24 openings with the calculated source volume (4.020E+06 cm^3). Next, the modeled source strength is calculated based on the ORIGEN-S total source and the mass ratio of the canister contents to the ORIGEN-S input mass (19,200/14,300=1.34). Finally, the volumetric source (3.4245E+09 $\gamma/sec/cm^3$) is calculated using the modeled source strength and the source volume. Source strength is input into MCBEND by using the spectrum from Table 5.2-19 and a volumetric component (3.3401E-07/cm^3) of the ratio of the volumetric source strength to the ORIGEN-S source. A source representative of 1300 lbs of CY GTCC waste is modeled in the four center tubes by introducing radial scale factors in MCBEND. No credit is taken for the additional modeled material in the four center tubes in the shielding analysis. Thus, the total effective source considered is 21,200 lbs.

Parameter	**Value**	**Units**
Maximum Source Weight	19,200	lbs
Core Baffle Source Weight	14,300	lbs
Total Source Strength (based on 14,300 lbs)	1.03E+16	g/sec
Modeled Source Strength (based on 19,200 lbs)	1.38E+16	g/sec
Total Decay Heat - 14,300 lbs	2.04E+03	watts
Equivalent Source Area	11854.82	cm^2
Equivalent Source Length	339.090	cm
Equivalent Source Volume	4.020E+06	cm^3
SS304 Density	0.017424	lbs/cm^3
Weight at Full Density	7.004E+04	lbs
Maximum Weight (19,200 lbs) Volume Fraction	0.2741	
Maximum Volumetric Source	3.4245E+09	g/sec/cm^3
MCBEND Source Component	3.3401E-07	/cm^3

Figure 5.2-1 Directly Loaded Fuel Design Basis Burnup Profile

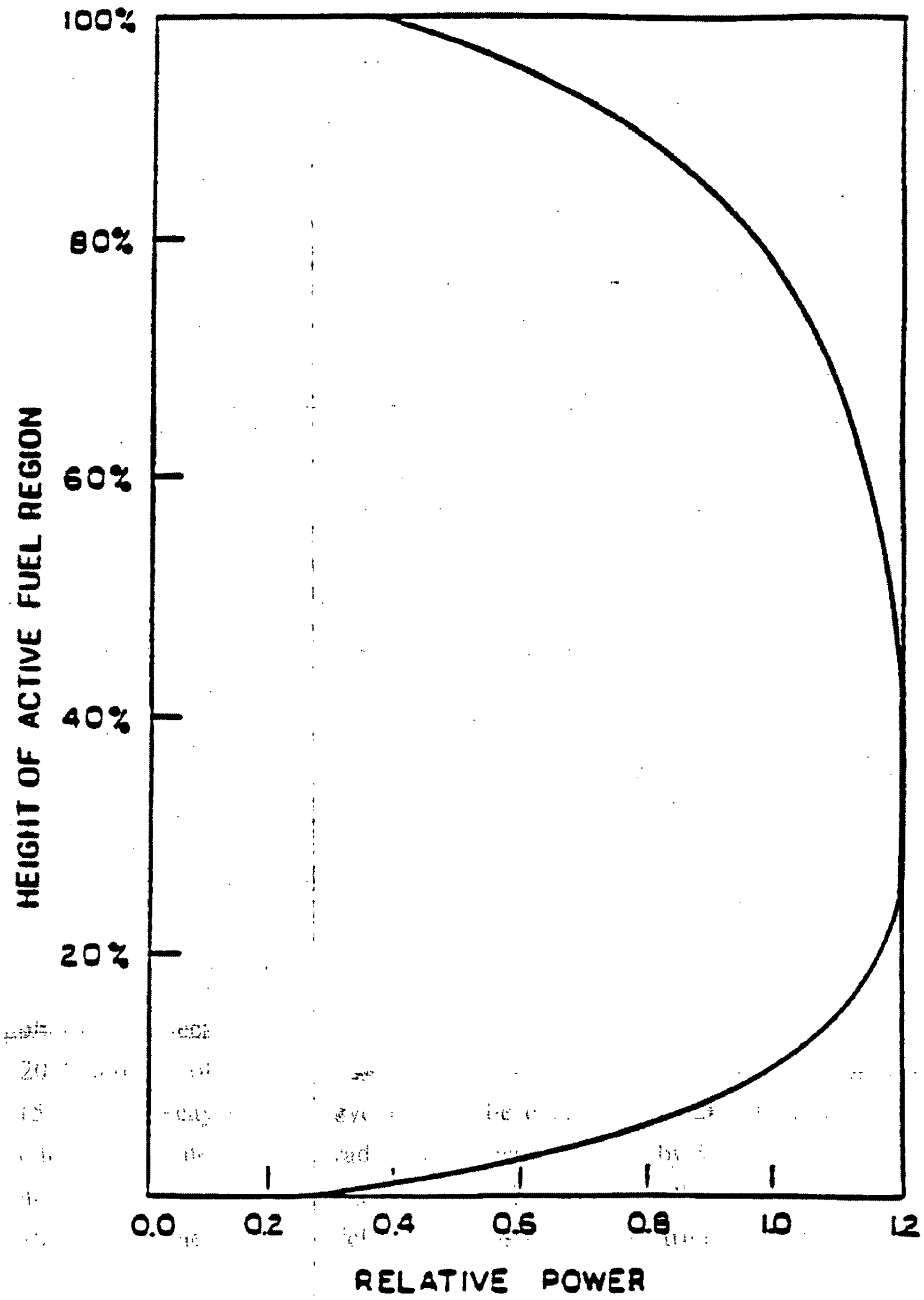


Figure 5.2-2 Directly Loaded Fuel Neutron and Gamma Source Profiles

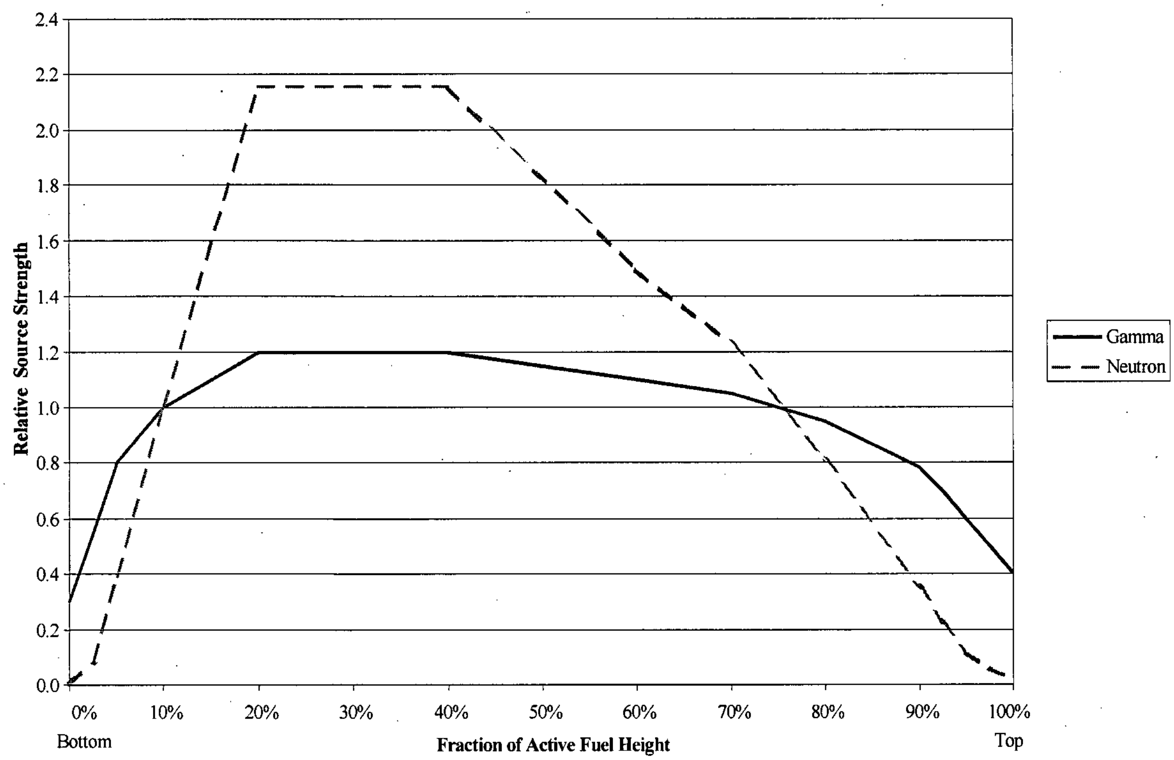


Figure 5.2-3 Design Basis Yankee Class Fuel Burnup Profile

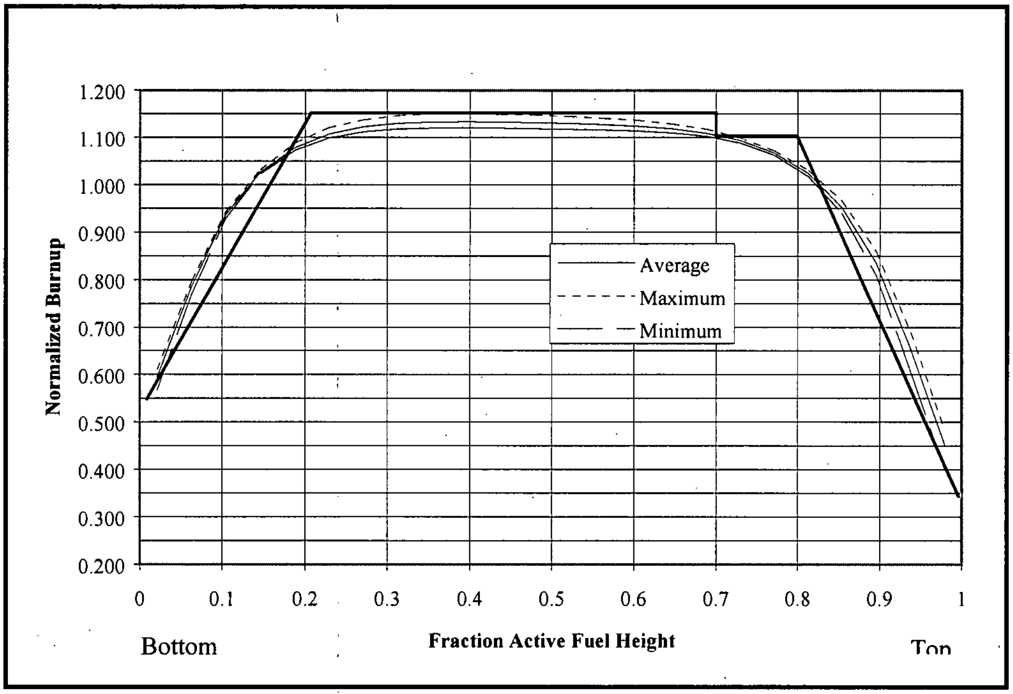


Figure 5.2-4 Yankee GTCC Waste Container Gamma Source Profile Based on Dose Rate Measurements

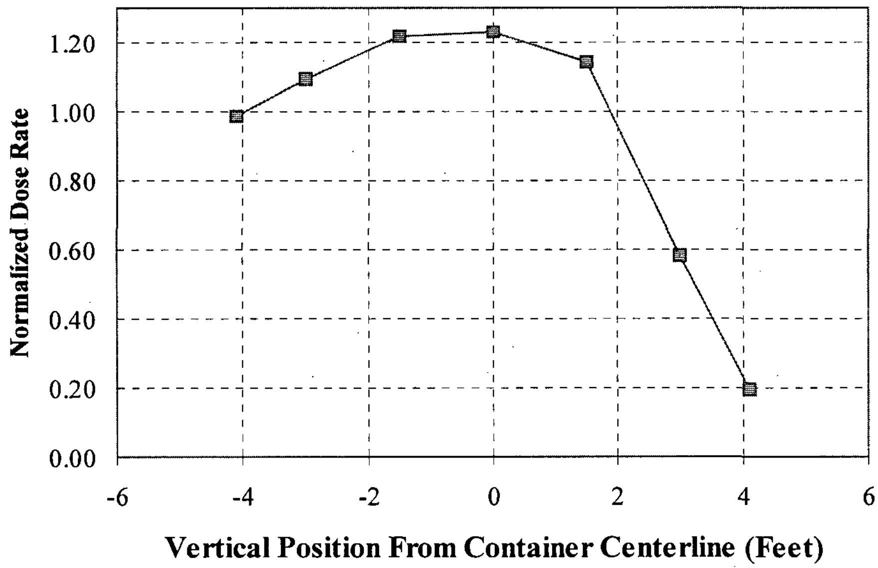


Figure 5.2-5 Connecticut Yankee Design Basis Fuel Neutron and Gamma Burnup Profiles

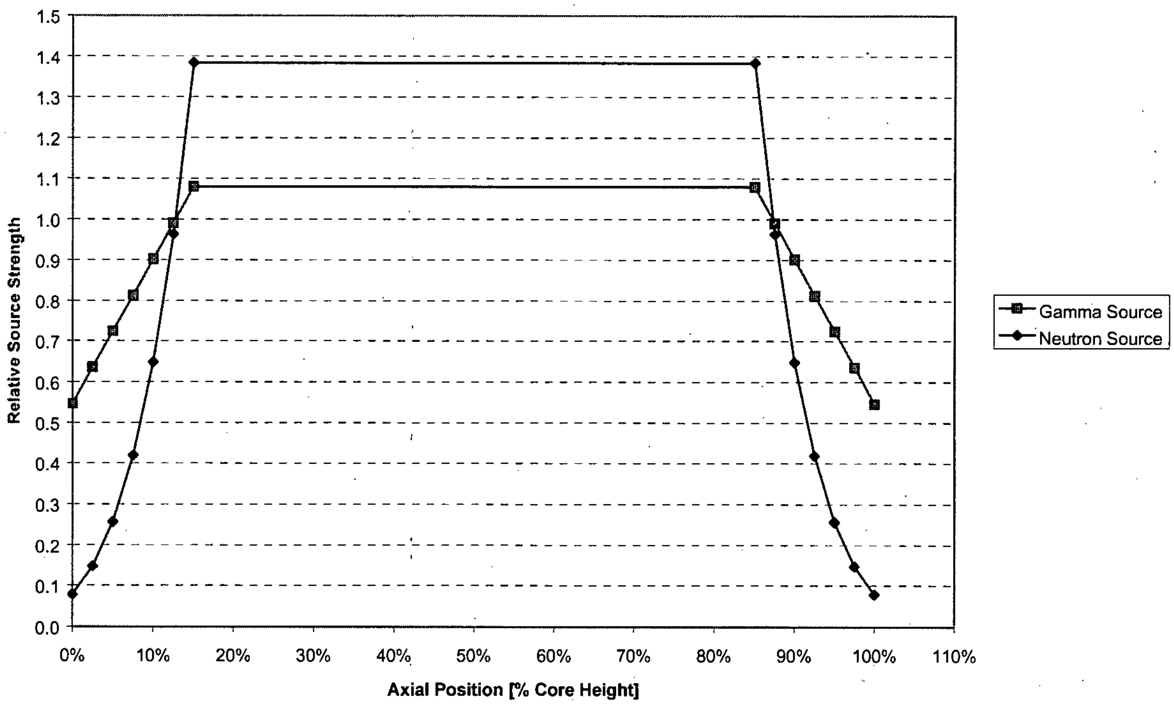


Table 5.2-1 Directly Loaded Three-Dimensional PWR Reference Fuel Assembly Descriptions

Parameter Description	Reference Fuel Assembly			
	14×14	**15×15**	**16×16**	**17×17**
Fuel Rod Height [inch]	152.360	152.756	146.499	152.300
Top End-Cap Height [inch]	0.685	0.685	0.750	0.685
Bottom End-Cap Height [inch]	0.685	0.685	0.891	0.895
Active Fuel Region Height [inch]	145.2	144.0	136.7	144.0
Fuel Rod Diameter [inch]	0.422	0.422	0.382	0.374
Fuel Clad Thickness [inch]	0.023	0.024	0.025	0.022
Fuel Pellet Diameter [inch]	0.367	0.367	0.325	0.323
Array	14	15	16	17
Fuel Rod Pitch [inch]	0.556	0.563	0.506	0.496
Number of Guide Tubes	16	20	4	24
Guide Tube OD [inch]	0.481	0.484	1.115	0.474
Guide Tube Thickness [inch]	0.034	0.015	0.026	0.015
Number of Instrument Tubes	1	1	1	1
Instrument Tube OD [inch]	0.481	0.484	1.115	0.474
Instrument Tube Thickness [inch]	0.034	0.015	0.026	0.015
Fuel Assembly Height [inch]	161.100	160.100	158.129	161.693
Fuel Assembly Width [inch]	7.763	8.449	8.100	8.430
Lower Nozzle Height [inch]	2.738	2.738	3.821	2.421
Upper Nozzle Height [inch]	3.500	3.480	6.821	3.480
Gap Fuel Rod to Bottom Nozzle [inch]	0.000	0.813	0.000	0.791
Gap Fuel Rod to Top Nozzle [inch]	2.502	0.313	0.988	2.701
Upper Plenum Region Height [inch]	5.790	7.386	8.158	6.720
Number of Fuel Rods	179	204	236	264
Calculated MTU [MTU]	0.4144	0.4671	0.4025	0.4636
Lower Nozzle Hardware Mass [kg]	7.893	5.680	5.400	6.307
In-core Hardware Mass [kg][1]	14.880	17.450	1.360	5.440
Upper Plenum Hardware Mass [kg]	8.050	4.120	10.700	5.410
Upper Nozzle Hardware Mass [kg]	9.890	11.840	9.500	7.850

1. Reference literature indicates the use of stainless steel guide/instrument tubes and/or steel grids in early generations of 14×14 and 15×15 assemblies, with later generations switching to Zircaloy components. To provide a bounding fuel description, the higher steel mass present in the early generations of these fuels was employed in the source term and shielding models.

Table 5.2-2 PWR Fuel Reactor Operating Conditions for Directly Loaded Fuel

Reference Assembly Parameter	14×14	**15×15**	**16×16**	**17×17**
Assembly Power, MW	13.72	16.33	16.62	18.55
Fuel Temperature, K	900	900	900	900
Clad Temperature, K	620	620	620	620
Moderator Temperature, K	580	580	580	580
Moderator Density, g/cc	0.725	0.725	0.725	0.725
Boron, ppm	550	550	550	550
Down Time, days	60	60	60	60

Table 5.2-3 PWR Cycle Length Calculation for Directly Loaded Fuel Source Terms

Reference Fuel Type	Burnup [MWD/MTU]	% TD	Pellet OD [cm]	Active Length [cm]	Number of Rods	Volume [cm^3]	MTU [MTU]	Assy Power [MW]	Number of Cycles	Cycle Length [days]
14×14	30000	0.95	0.9332	368.808	179	4.52E+04	0.4144	13.72	2	453.14
	35000	0.95	0.9332	368.808	179	4.52E+04	0.4144	13.72	3	352.45
	40000	0.95	0.9332	368.808	179	4.52E+04	0.4144	13.72	3	402.80
	45000	0.95	0.9332	368.808	179	4.52E+04	0.4144	13.72	3	453.14
	50000	0.95	0.9332	368.808	179	4.52E+04	0.4144	13.72	3	503.49
	55000	0.95	0.9332	368.808	179	4.52E+04	0.4144	13.72	3	553.84
	60000	0.95	0.9332	368.808	179	4.52E+04	0.4144	13.72	3	604.19
15×15	30000	0.95	0.9319	365.76	204	5.09E+04	0.4671	16.33	2	429.15
	35000	0.95	0.9319	365.76	204	5.09E+04	0.4671	16.33	3	333.78
	40000	0.95	0.9319	365.76	204	5.09E+04	0.4671	16.33	3	381.46
	45000	0.95	0.9319	365.76	204	5.09E+04	0.4671	16.33	3	429.15
	50000	0.95	0.9319	365.76	204	5.09E+04	0.4671	16.33	3	476.83
	55000	0.95	0.9319	365.76	204	5.09E+04	0.4671	16.33	3	524.51
	60000	0.95	0.9319	365.76	204	5.09E+04	0.4671	16.33	3	572.20
16×16	30000	0.95	0.8255	347.218	236	4.39E+04	0.4025	16.62	2	363.26
	35000	0.95	0.8255	347.218	236	4.39E+04	0.4025	16.62	3	282.53
	40000	0.95	0.8255	347.218	236	4.39E+04	0.4025	16.62	3	322.90
	45000	0.95	0.8255	347.218	236	4.39E+04	0.4025	16.62	3	363.26
	50000	0.95	0.8255	347.218	236	4.39E+04	0.4025	16.62	3	403.62
	55000	0.95	0.8255	347.218	236	4.39E+04	0.4025	16.62	3	443.98
	60000	0.95	0.8255	347.218	236	4.39E+04	0.4025	16.62	3	484.34
17×17	30000	0.943	0.8192	365.76	264	5.09E+04	0.4636	18.55	2	374.82
	35000	0.943	0.8192	365.76	264	5.09E+04	0.4636	18.55	3	291.53
	40000	0.943	0.8192	365.76	264	5.09E+04	0.4636	18.55	3	333.18
	45000	0.943	0.8192	365.76	264	5.09E+04	0.4636	18.55	3	374.82
	50000	0.943	0.8192	365.76	264	5.09E+04	0.4636	18.55	3	416.47
	55000	0.943	0.8192	365.76	264	5.09E+04	0.4636	18.55	3	458.12
	60000	0.943	0.8192	365.76	264	5.09E+04	0.4636	18.55	3	499.76

Table 5.2-4 Directly Loaded PWR Fuel Assembly Hardware Mass and Activation Scale Factors by Source Region

Reference Fuel Type	Region	Activated Mass [kg/assy]	Flux Factor
14×14	Lower Nozzle	7.89	0.20
	Fuel	14.88	1.00
	Upper Plenum	8.05	0.20
	Upper Nozzle	9.89	0.10
15×15	Lower Nozzle	5.68	0.20
	Fuel	17.45	1.00
	Upper Plenum	4.12	0.20
	Upper Nozzle	11.84	0.10
16×16	Lower Nozzle	5.40	0.20
	Fuel	1.36	1.00
	Upper Plenum	10.70	0.20
	Upper Nozzle	9.50	0.05
17×17	Lower Nozzle	6.31	0.20
	Fuel	5.44	1.00
	Upper Plenum	5.41	0.20
	Upper Nozzle	7.85	0.10

Table 5.2-5 Directly Loaded Fuel Axial Gamma and Neutron Source Profiles

% Core Height	Burnup Profile	Gamma Interval	Neutron Interval
0.0	0.30	--	--
2.5	0.55	4.250E-01	4.322E-02
5.0	0.80	6.750E-01	2.351E-01
10.0	1.00	9.000E-01	6.950E-01
20.0	1.20	1.100E+00	1.579E+00
40.0	1.20	1.200E+00	2.158E+00
60.0	1.10	1.150E+00	1.827E+00
70.0	1.05	1.075E+00	1.362E+00
80.0	0.95	1.000E+00	1.017E+00
90.0	0.78	8.650E-01	5.779E-01
92.5	0.70	7.400E-01	2.862E-01
95.0	0.60	6.500E-01	1.689E-01
97.5	0.50	5.500E-01	8.474E-02
100.0	0.40	4.500E-01	3.729E-02

Table 5.2-6 Directly Loaded 14×14 Fuel Assembly Spectra at 40,000 MWD/MTU, 2.3 wt % ^{235}U, 10 Years Cool Time in MCBEND Group Format

Group	Fuel Neutron [neutrons/sec/assy]	Fuel Gamma [photons/sec/assy]	Fuel Hardware [photons/sec/kg]
1	0.000E+00	0.0000E+00	0.0000E+00
2	2.224E+04	9.8892E+03	0.0000E+00
3	9.268E+04	1.9127E+05	0.0000E+00
4	3.079E+05	9.0084E+05	0.0000E+00
5	9.658E+05	4.5923E+06	0.0000E+00
6	2.593E+06	1.1443E+07	0.0000E+00
7	4.476E+06	3.8389E+08	2.6368E-15
8	1.498E+07	3.1958E+09	3.6815E+04
9	2.543E+07	4.1373E+10	2.3742E+07
10	3.434E+07	9.7271E+10	6.7752E-06
11	8.165E+07	2.9870E+12	6.3110E+00
12	1.275E+08	4.4115E+13	2.2492E+12
13	3.319E+07	2.0530E+13	2.3708E+12
14	1.151E+07	8.5789E+13	9.9650E+08
15	2.977E+02	1.4229E+15	4.1857E+06
16	0.000E+00	1.3765E+14	1.2053E+07
17	0.000E+00	2.5948E+13	1.9070E+08
18	0.000E+00	4.3836E+13	1.4535E+08
19	0.000E+00	1.6029E+14	2.9272E+09
20	0.000E+00	1.9875E+14	1.2134E+10
21	0.000E+00	4.8210E+14	3.4773E+10
22	0.000E+00	3.2604E+14	4.1497E+10
23	0.000E+00	--	--
24	0.000E+00	--	--
25	0.000E+00	--	--
26	0.000E+00	--	--
27	0.000E+00	--	--
28	0.000E+00	--	--
Total	3.370E+08	2.9511E+15	4.7127E+12

Table 5.2-7 Design Basis Yankee Class Fuel Input Parameters for SAS2H

Parameter	Value
Basket Configuration	Canistered
Fuel assembly type	CE 16×16 Yankee Class
Weight of U, kg/assembly	239.4
In core grids, kg/assembly	2.36 (4 Zircaloy)
Plenum spring, kg/assembly	0.762
Grids in plenum springs, kg/assembly	0.590 (Zircaloy)
Upper end fittings, kg/assembly	5.5
Lower end fittings, kg/assembly	5.2
Lower Plenum Hardware, kg/assembly	1.73
Fuel enrichment, wt.% ^{235}U	3.7[1]
Fuel burnup, MWD/MTU	36,000
Cooling time	8
Burnup cycle, power cycles, down cycles	2 cycles of 496 days 1 of 60 days
Burnup, MWD/assembly	8,618
Irradiation power, MW	8.486
^{59}Co concentration in steel hardware, g/kg	1.2
Irradiation flux, grid spacers in core region	100%
grid spacers in plenum region	20%
upper plenum springs	20%
upper end-fittings	10%
lower end-fittings	10%
lower plenum hardware	20%
Fuel temperature, K	787
Clad temperature, K	600
Coolant temperature, K	551
Boron content in coolant, ppm (by weight)	800

1 The analyzed minimum enrichment for CE fuel is 3.66 wt % ^{235}U for fuel with a maximum burnup of 36,000 MWD/MTU. This reduction in minimum enrichment does not significantly affect calculated dose rates. (See Section 5.4.1.2.)

Table 5.2-8 Design Basis Yankee Class Fuel Neutron Source Spectra at 36,000 MWD/MTU and 8 Years Cooling

GROUP	E_{HI} (MeV)	E_{LOW} (MeV)	Neutrons/Sec-Assembly
1	2.00E+01	6.43E+00	1.2290E+06
2	6.43E+00	3.00E+00	1.4080E+07
3	3.00E+00	1.85E+00	1.5760E+07
4	1.85E+00	1.40E+00	8.7930E+06
5	1.40E+00	9.00E-01	1.1840E+07
6	9.00E-01	4.00E-01	1.2870E+07
7	4.00E-01	1.00E-01	2.5190E+06
8	1.00E-01	1.70E-02	0.0000E+00
9	1.70E-02	3.00E-03	0.0000E+00
10	3.00E-03	5.50E-04	0.0000E+00
11	5.50E-04	1.00E-04	0.0000E+00
12	1.00E-04	3.00E-05	0.0000E+00
13	3.00E-05	1.00E-05	0.0000E+00
14	1.00E-05	3.05E-06	0.0000E+00
15	3.05E-06	1.77E-06	0.0000E+00
16	1.77E-06	1.30E-06	0.0000E+00
17	1.30E-06	1.13E-06	0.0000E+00
18	1.13E-06	1.00E-06	0.0000E+00
19	1.00E-06	8.00E-07	0.0000E+00
20	8.00E-07	4.00E-07	0.0000E+00
21	4.00E-07	3.25E-07	0.0000E+00
22	3.25E-07	2.25E-07	0.0000E+00
23	2.25E-07	1.00E-07	0.0000E+00
24	1.00E-07	5.00E-08	0.0000E+00
25	5.00E-08	3.00E-08	0.0000E+00
26	3.00E-08	1.00E-08	0.0000E+00
27	1.00E-08	1.00E-11	0.0000E+00
TOTAL			6.7090E+07

Table 5.2-9 Design Basis Yankee Class Fuel Gamma Source Spectra at 36,000 MWD/MTU and 8 Years Cooling

GROUP	E_{HI} (MeV)	E_{LOW} (MeV)	Photons/Sec-Assembly
1	1.00E+01	8.00E+00	3.7701E+04
2	8.00E+00	6.50E+00	1.7759E+05
3	6.50E+00	5.00E+00	9.0547E+05
4	5.00E+00	4.00E+00	2.2566E+06
5	4.00E+00	3.00E+00	6.2676E+08
6	3.00E+00	2.50E+00	5.1211E+09
7	2.50E+00	2.00E+00	1.0789E+11
8	2.00E+00	1.66E+00	9.9933E+10
9	1.66E+00	1.33E+00	4.8070E+12
10	1.33E+00	1.00E+00	3.4718E+13
11	1.00E+00	8.00E-01	6.3503E+13
12	8.00E-01	6.00E-01	8.2333E+14
13	6.00E-01	4.00E-01	1.1897E+14
14	4.00E-01	3.00E-01	1.7831E+13
15	3.00E-01	2.00E-01	2.8386E+13
16	2.00E-01	1.00E-01	1.0201E+14
17	1.00E-01	5.00E-02	1.3136E+14
18	5.00E-02	1.00E-02	4.5899E+14
Total			1.7842E+15

Table 5.2-10 Design Basis Yankee Class Fuel Hardware and GTCC Waste Gamma Spectra

GROUP	E_{HI} (MeV)	E_{LOW} (MeV)	Photons/Sec-kg
1	1.00E+01	8.00E+00	0.0000E+00
2	8.00E+00	6.50E+00	0.0000E+00
3	6.50E+00	5.00E+00	0.0000E+00
4	5.00E+00	4.00E+00	0.0000E+00
5	4.00E+00	3.00E+00	1.0141E-15
6	3.00E+00	2.50E+00	3.3511E+04
7	2.50E+00	2.00E+00	2.1611E+07
8	2.00E+00	1.66E+00	9.5163E-03
9	1.66E+00	1.33E+00	9.1066E+11
10	1.33E+00	1.00E+00	3.2247E+12
11	1.00E+00	8.00E-01	4.3841E+09
12	8.00E-01	6.00E-01	3.8100E+06
13	6.00E-01	4.00E-01	1.0971E+07
14	4.00E-01	3.00E-01	1.7359E+08
15	3.00E-01	2.00E-01	1.3230E+08
16	2.00E-01	1.00E-01	2.6645E+09
17	1.00E-01	5.00E-02	1.1044E+10
18	5.00E-02	1.00E-02	5.5673E+10
TOTAL			4.2095E+12

Table 5.2-11 Connecticut Yankee Design Basis Fuel Reactor Operating Conditions

Parameter	**Stainless Steel Clad**	**Zircaloy Clad**
Assembly Power, MW	12.787	12.787
Fuel Temperature, K	900	900
Clad Temperature, K	620	620
Moderator Temperature, K	580	580
Moderator Density, g/cc	0.725	0.725
Boron, ppm	550	550
Fuel Burnup, MWD/MTU	38,000	43,000
Number of Cycles	3	3
Burnup Cycle, days	427.61	442.99
Down Time, days	60	60

Table 5.2-12 Connecticut Yankee Design Basis Stainless Steel Clad Fuel Source Term

Group	Fuel Neutron [n/sec/assy]	Fuel Gamma [g/sec/assy]	Fuel Hardware [g/sec/kg]
1	0.0000E+00	0.0000E+00	0.0000E+00
2	9.2580E+03	4.1234E+03	0.0000E+00
3	3.8570E+04	7.9755E+04	0.0000E+00
4	1.2810E+05	3.7568E+05	0.0000E+00
5	4.0200E+05	1.9154E+06	0.0000E+00
6	1.0790E+06	4.7736E+06	0.0000E+00
7	1.8630E+06	2.7498E+08	1.0419E-15
8	6.2330E+06	2.4916E+09	1.1328E+04
9	1.0640E+07	3.6651E+10	7.3057E+06
10	1.4640E+07	9.8663E+10	6.9845E-06
11	3.4830E+07	2.5367E+12	1.9419E+00
12	5.3360E+07	3.6912E+13	6.9208E+11
13	1.3830E+07	1.7642E+13	7.2951E+11
14	4.7980E+06	7.3398E+13	7.7774E+08
15	2.2220E+02	1.3845E+15	1.2880E+06
16	0.0000E+00	1.2185E+14	3.7087E+06
17	0.0000E+00	2.9407E+13	5.8681E+07
18	0.0000E+00	4.7288E+13	4.4724E+07
19	0.0000E+00	1.6792E+14	9.0073E+08
20	0.0000E+00	2.1999E+14	3.7338E+09
21	0.0000E+00	5.0942E+14	1.0749E+10
22	0.0000E+00	3.5520E+14	1.2974E+10
23	0.0000E+00		
24	0.0000E+00		
25	0.0000E+00		
26	0.0000E+00		
27	0.0000E+00		
28	0.0000E+00		
Total	1.4190E+08	2.9661E+15	1.4508E+12

Note: Source Term at 38,000 MWD/MTU at 10 years cool time.

Table 5.2-13 Connecticut Yankee Design Basis Zircaloy Clad Fuel Source Term

Group	Fuel Neutron [n/sec/assy]	Fuel Gamma [g/sec/assy]	Fuel Hardware [g/sec/kg]
1	0.0000E+00	0.0000E+00	0.0000E+00
2	1.3500E+04	6.0098E+03	0.0000E+00
3	5.6270E+04	1.1624E+05	0.0000E+00
4	1.8690E+05	5.4750E+05	0.0000E+00
5	5.3360E+07	2.7912E+06	0.0000E+00
6	1.3830E+07	6.9554E+06	0.0000E+00
7	2.7180E+06	3.0126E+08	1.6009E-15
8	9.0930E+06	2.6661E+09	3.0554E+04
9	1.5480E+07	3.7772E+10	1.9704E+07
10	2.1080E+07	1.0156E+11	6.8283E-06
11	5.0140E+07	2.7561E+12	5.2376E+00
12	7.7590E+07	4.0362E+13	1.8666E+12
13	2.0160E+07	1.9175E+13	1.9676E+12
14	6.9950E+06	8.0632E+13	8.8123E+08
15	2.4660E+02	1.4427E+15	3.4738E+06
16	0.0000E+00	1.3283E+14	1.0003E+07
17	0.0000E+00	2.9843E+13	1.5827E+08
18	0.0000E+00	4.8521E+13	1.2063E+08
19	0.0000E+00	1.7307E+14	2.4294E+09
20	0.0000E+00	2.2227E+14	1.0070E+10
21	0.0000E+00	5.2257E+14	2.8855E+10
22	0.0000E+00	3.6263E+14	3.4424E+10
23	0.0000E+00		
24	0.0000E+00		
25	0.0000E+00		
26	0.0000E+00		
27	0.0000E+00		
28	0.0000E+00		
Total	2.0570E+08	3.0776E+15	3.9112E+12

Note: Source Term at 43,000 MWD/MTU at 10 years cool time.

Table 5.2-14 Connecticut Yankee Design Basis Fuel Assembly Hardware Mass and Mass Scale Factors by Source Region

Stainless Steel Clad			
Region	**Mass [kg/assembly]**	**Mass Factor**	**Activation Ratio**
Lower Nozzle	8.850	2.4	0.1
Lower End Plug	2.537	1.0	0.2
Fuel	102.832	1.0	1.0
Upper Plenum	3.879	2.4	0.2
Upper End Plug	2.537	1.0	0.2
Upper Nozzle	11.240	2.4	0.1
Zircaloy Clad			
Region	**Mass [kg/assembly]**	**Mass Factor**	**Activation Ratio**
Lower Nozzle	5.440	1.0	0.1
Lower End Plug	0.000	1.0	0.2
Fuel	19.415	1.0	1.0
Upper Plenum	5.137	1.0	0.2
Upper End Plug	0.000	1.0	0.2
Upper Nozzle	11.840	1.0	0.1

Table 5.2-15 Connecticut Yankee Reactor Operational Cycle History

Cycle	Cycle End Date	Cycle Length (days)	Core Loading (MTU)	Avg Cycle Burnup (MWD/MTU)
1	04/17/70	838	65.9	16,965
2	04/16/71	295	65.3	7,602
3	06/10/72	382	64.7	10,201
4	07/08/73	359	64.4	9,157
5	05/17/75	519	64.6	13,152
6	05/18/76	323	64.6	8,738
7	10/15/77	454	64.6	12,283
8	01/27/79	423	64.6	11,105
9	05/03/80	418	64.7	11,044
10	09/26/81	427	64.7	11,342
11	01/22/83	437	64.7	11,081
12	08/01/84	479	64.6	12,987
13	01/04/86	422	64.5	10,987
14	07/18/87	435	64.5	10,039
15	09/02/89	526	64.5	12,982
16	10/17/91	428	64.8	10,095
17	05/15/93	426	62.5	12,035
18	01/28/95	558	59.9	13,588
19	07/22/96	461	58.5	13,844

Table 5.2-16 Connecticut Yankee Design Basis Non-Fuel Assembly Hardware Source Spectra

Group	RCCA [γ/kg/sec]	Flow Mixer Upper Plenum [γ/kg/sec]	Flow Mixer End Fitting [γ/kg/sec]
1	0.0000E+00	0.0000E+00	0.0000E+00
2	0.0000E+00	0.0000E+00	0.0000E+00
3	0.0000E+00	0.0000E+00	0.0000E+00
4	0.0000E+00	0.0000E+00	0.0000E+00
5	0.0000E+00	0.0000E+00	0.0000E+00
6	0.0000E+00	0.0000E+00	0.0000E+00
7	1.3895E-09	6.3717E-17	3.1859E-17
8	1.6188E+03	1.0762E+04	5.3810E+03
9	9.9426E+05	6.9405E+06	3.4702E+06
10	3.2170E+06	1.1419E-06	5.7094E-07
11	1.8234E+09	1.8449E+00	9.2243E-01
12	9.0559E+10	6.5749E+11	3.2874E+11
13	9.2794E+10	6.9304E+11	3.4652E+11
14	1.1895E+10	1.5598E+08	7.7991E+07
15	4.1816E+12	1.2236E+06	6.1180E+05
16	1.8817E+12	3.5233E+06	1.7617E+06
17	2.4186E+09	5.5747E+07	2.7874E+07
18	3.6601E+09	4.2489E+07	2.1244E+07
19	1.2166E+10	8.5571E+08	4.2785E+08
20	1.9099E+11	3.5472E+09	1.7736E+09
21	1.0140E+12	1.0238E+10	5.1192E+09
22	3.3857E+10	1.2439E+10	6.2194E+09
Total	7.5175E+12	1.3779E+12	6.8894E+11

Table 5.2-17 Connecticut Yankee Design Basis Non-Fuel Hardware Masses

Reactor Control Cluster Assemblies			
Source	**Mass [kg]**	**Activation Region**	**Modeled Source Region**
Inconel 625	1.50	Active Core (60% Flux)	Fuel (bottom 18 in)
Ag-In-Cd	5.00	Active Core (60% Flux)	Fuel (bottom 18 in)
Total	13.00	--	--

Flow Mixers		
Source	**Mass [kg]**	**Activation and Modeled Source Region**
St. Steel	1.80	Upper Fitting
Inconel	0.42	Upper Fitting
Total Fitting	2.22	--
St. Steel	2.70	Upper Plenum
Total Plenum	2.70	--

Table 5.2-18 CY-MPC Axial Gamma and Neutron Source Profiles – Design Basis Stainless Steel and Zircaloy Clad Fuels

% Core Height	SS Clad Elevation [cm]	Zirc Clad Elevation [cm]	Burnup Profile	Gamma Interval	Neutron Interval
0.0	14.2824	14.2824	0.5470	--	--
2.5	22.0167	21.9723	0.6358	5.914E-01	1.132E-01
5.0	29.7510	29.6621	0.7247	6.803E-01	2.024E-01
7.5	37.4853	37.3520	0.8135	7.691E-01	3.377E-01
10.0	45.2196	45.0418	0.9023	8.579E-01	5.333E-01
12.5	52.9539	52.7317	0.9912	9.468E-01	8.057E-01
15.0	60.6882	60.4215	1.0800	1.036E+00	1.173E+00
85.0	277.2486	275.7373	1.0800	1.080E+00	1.384E+00
87.5	284.9829	283.4272	0.9912	1.036E+00	1.173E+00
90.0	292.7172	291.1170	0.9023	9.468E-01	8.057E-01
92.5	300.4515	298.8069	0.8135	8.579E-01	5.333E-01
95.0	308.1858	306.4967	0.7247	7.691E-01	3.377E-01
97.5	315.9201	314.1866	0.6358	6.803E-01	2.024E-01
100.0	323.6544	321.8764	0.5470	5.914E-01	1.132E-01

Table 5.2-19 Connecticut Yankee GTCC Waste Source Term at 10 Years' Cool Time

Group	Gamma/Sec
1 - 7	0.0000E+00
8	8.0085E+07
9	5.1648E+10
10	0.0000E+00
11	1.3728E+04
12	4.8928E+15
13	5.1573E+15
14	1.5175E+12
15	4.8847E+10
16	2.6219E+10
17	4.1485E+11
18	3.1620E+11
19	6.3680E+12
20	2.6399E+13
21	7.5986E+13
22	9.1670E+13
Total[1]	1.0253E+16

1. Based on 14,300 lbs.

Table 5.2-20 Isotopic Constituents of the Connecticut Yankee GTCC Waste at 10 Years' Cool Time

Isotope	Characterized Inventory 14,300 lbs.	Modeled Source Inventory 14,300 lbs.
C 14	7.23E+01 Ci	7.59E+01 Ci
MN 54	3.15E+01 Ci	3.31E+01 Ci
FE 55	6.60E+04 Ci	6.93E+04 Ci
CO 60	1.26E+05 Ci	1.32E+05 Ci
NI 59	2.71E+02 Ci	2.85E+02 Ci
NI 63	4.61E+04 Ci	4.84E+04 Ci
NB 94	1.02E+00 Ci	1.07E+00 Ci
TC 99	1.83E-01 Ci	1.92E-01 Ci
TOTAL	2.38E+05 Ci	2.50E+05 Ci

Table 5.2-21 MCBEND Standard 28 Group Neutron Boundaries

Group	E Lower [MeV]	E Upper [MeV]	E Average [MeV]
1	1.360E+01	1.460E+01	1.410E+01
2	1.250E+01	1.360E+01	1.305E+01
3	1.125E+01	1.250E+01	1.188E+01
4	1.000E+01	1.125E+01	1.063E+01
5	8.250E+00	1.000E+01	9.125E+00
6	7.000E+00	8.250E+00	7.625E+00
7	6.070E+00	7.000E+00	6.535E+00
8	4.720E+00	6.070E+00	5.395E+00
9	3.680E+00	4.720E+00	4.200E+00
10	2.870E+00	3.680E+00	3.275E+00
11	1.740E+00	2.870E+00	2.305E+00
12	6.400E-01	1.740E+00	1.190E+00
13	3.900E-01	6.400E-01	5.150E-01
14	1.100E-01	3.900E-01	2.500E-01
15	6.740E-02	1.100E-01	8.870E-02
16	2.480E-02	6.740E-02	4.610E-02
17	9.120E-03	2.480E-02	1.696E-02
18	2.950E-03	9.120E-03	6.035E-03
19	9.610E-04	2.950E-03	1.956E-03
20	3.540E-04	9.610E-04	6.575E-04
21	1.660E-04	3.540E-04	2.600E-04
22	4.810E-05	1.660E-04	1.071E-04
23	1.600E-05	4.810E-05	3.205E-05
24	4.000E-06	1.600E-05	1.000E-05
25	1.500E-06	4.000E-06	2.750E-06
26	5.500E-07	1.500E-06	1.025E-06
27	7.090E-08	5.500E-07	3.105E-07
28	1.000E-11	7.090E-08	3.546E-08

Table 5.2-22 MCBEND Standard 22 Group Gamma Boundaries

Group	E Lower [MeV]	E Upper [MeV]	E Average [MeV]
1	1.200E+01	1.400E+01	1.300E+01
2	1.000E+01	1.200E+01	1.100E+01
3	8.000E+00	1.000E+01	9.000E+00
4	6.500E+00	8.000E+00	7.250E+00
5	5.000E+00	6.500E+00	5.750E+00
6	4.000E+00	5.000E+00	4.500E+00
7	3.000E+00	4.000E+00	3.500E+00
8	2.500E+00	3.000E+00	2.750E+00
9	2.000E+00	2.500E+00	2.250E+00
10	1.660E+00	2.000E+00	1.830E+00
11	1.440E+00	1.660E+00	1.550E+00
12	1.220E+00	1.440E+00	1.330E+00
13	1.000E+00	1.220E+00	1.110E+00
14	8.000E-01	1.000E+00	9.000E-01
15	6.000E-01	8.000E-01	7.000E-01
16	4.000E-01	6.000E-01	5.000E-01
17	3.000E-01	4.000E-01	3.500E-01
18	2.000E-01	3.000E-01	2.500E-01
19	1.000E-01	2.000E-01	1.500E-01
20	5.000E-02	1.000E-01	7.500E-02
21	2.000E-02	5.000E-02	3.500E-02
22	1.000E-02	2.000E-02	1.500E-02

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5.3 Model Specification

The radiation protection provided by the NAC-STC is in the form of solid multi-walled shielding materials which totally surround the fuel. These shielding materials include steel and lead for gamma shielding and a borated polymer (NS-4-FR) for neutron shielding. The multi-walled arrangement of steel and lead in the NAC-STC provides optimal weight for gamma attenuation. The NS-4-FR neutron shielding material has a hydrogen density close to that of water and serves to moderate fast neutrons which are then captured in the boron. Boron capture in the neutron shield minimizes the contribution of secondary capture gammas to surface dose rates.

The NAC-STC uses a multi-walled arrangement for both radial and axial shields. The arrangement of the radial gamma shielding in the cask body is a 1.5-inch thick stainless steel inner shell and a 2.65-inch thick stainless steel outer shell with a 3.70-inch lead annulus between them. The radial neutron shield is arranged around the outer steel shell with a 5.5-inch minimum, 5.925-inch maximum thickness of NS-4-FR that is covered by a 0.236-inch (6 mm) thick neutron shield shell. Variations in the neutron shield thickness result from filling the cavity formed by the multifaceted neutron shield shell and the cylindrical cask outer shell with NS-4-FR. The minimum shield thickness is obtained at the heat transfer fin location and increases towards the cask corners. As indicated in Section 5.3.2.1, an equivalent cylindrical shield has a 5.52-inch thickness (conservatively assuming that the expansion foam in the cavity retains its maximum thickness). The bottom of the cask contains a steel/NS-4-FR/steel shield arrangement with the two stainless steel components providing 11.65 inches of gamma shielding and 2 inches of NS-4-FR neutron shielding. The top of the cask has shields in the form of two closure lids. The inner lid also has a steel/NS-4-FR/steel arrangement with 6.0 inches of steel below 2 inches of NS-4-FR and 1.0 inch of steel above it. The outer lid is a 5.25-inch thick steel disk.

5.3.1 Directly Loaded Fuel Model

MCBEND three-dimensional shielding analysis allows detailed modeling of fuel assemblies, basket, and cask shield configuration, including streaming paths. For fuel assembly sources, some fuel assembly detail is homogenized in the model to simplify model input and improve computational efficiency. Thus, the three-dimensional models represent the various fuel assembly source regions as homogenized zones within the fuel tubes in the basket, but explicitly model the axial extent of the source regions. The fuel and hardware source regions of each assembly are therefore homogenized within the volumes defined by the periphery of the fuel assembly and the source region axial extents. The basket details, including support disks, heat transfer disks, and top and bottom weldments are explicitly modeled. Cask body details include the axial extent of the cask shield as described by the License Drawings.

The geometric description of a MCBEND model is based on the combinatorial geometry system embedded in the code. In this system, bodies such as cylinders and rectangular parallelpipeds, and their logical intersections and unions, are used to describe the extent of material zones.

MCBEND employs an automated biasing technique for the Monte Carlo calculation based on a three-dimensional adjoint diffusion calculation. Mesh cells for the adjoint solution are selected based on half value thicknesses for each material.

MCBEND Monte Carlo calculations are performed for each source type present in each source region. This approach entails seven separate analyses, encompassing fuel neutron, fuel gamma, fuel n-gamma (secondary gammas arising from neutron interaction in the shield), fuel region hardware, upper plenum, and upper and lower end-fitting gamma sources. Typically, a total of 5 to 20 million histories are tracked to yield dose rate profiles for each model. These cases are analyzed for both radial and axial detector locations and for normal and hypothetical accident conditions.

5.3.1.1 Directly Loaded Assembly Model

Based on the fuel parameters provided in Table 5.2-1, homogenized treatments of fuel assembly source regions are developed. The homogenized fuel assembly is represented in the model as a stack of boxes with width equal to the fuel assembly width. The height of each box corresponds to the modeled height of the corresponding assembly region.

The active fuel region homogenizations for the four design basis assemblies are shown in Table 5.3-1 based on the detailed three-dimensional data in Table 5.2-1. Components of the fuel assembly homogenization are subdivided to account for the various area fractions present in the homogenized fuel assembly description. "Interstitial" refers to the space within the fuel assembly array defined by the lattice pitch but outside the fuel rod or guide/instrument tubes. "Inside tubes" refers to the space inside the instrument and guide tubes and "void" refers to the pellet to clad gap. All three regions are assigned a void material as part of the shielding evaluation since the cask cavity is dry during all transport conditions. Combined with the fuel rod clad, fuel material, and guide/instrument tube materials the void accounts for the total fuel region volume. The clad region is Zircaloy (density 6.55 g/cm^3) for all four design basis assemblies. The resulting regional compositions on an atom/barn-cm basis are shown in Table 5.3-2.

Fuel assembly non-fuel regions are homogenized as shown in Tables 5.3-3 and 5.3-4 for stainless steel and Zircaloy materials, respectively. Using the detailed dimensions in Table 5.2-1, the axial source regions are modeled as follows: the gap between the lower nozzle and the fuel rod (if present) and the fuel rod bottom end-cap are assigned to the lower nozzle region, the fuel rod top end-cap and gap to the top nozzle are assigned to the top plenum region, with the top nozzle region height not being modified. The only material included in the homogenized region is stainless steel for the upper end fitting and combinations of Zircaloy and stainless steel in the upper plenum and lower end fitting regions. Zircaloy in these regions is due to end caps and the portion of the fuel rod cladding in the upper plenum. Volume fractions of material are based on the modeled regional volume and the volume of stainless steel or Zircaloy present as computed from the modeled mass and density (7.92 g/cm^3 for stainless steel and 6.55 g/cm^3 for Zircaloy).

5.3.1.2 Directly Loaded Basket Model

For a given fuel type, the MCBEND description of the basket elements forms a common sub-model employed in the transport cask analysis. The key features of the model are the detailed representation of fuel tubes, basket support and heat transfer disks, and weldment structures.

5.3.1.3 Description of MCBEND NAC-STC Model

The three-dimensional model of the NAC-STC cask containing design basis fuel assemblies is based on the following features:

Normal conditions:

- Radial neutron shield and shield shell (includes heat fins in the neutron shield)
- All balsa upper and lower impact limiters (100% balsa chosen for conservatism)

Accident conditions:

- Top axial lead slump
- Bottom axial lead slump
- Radial lead slump
- Radial neutron shield and shield shell with removal of oxygen, hydrogen, and nitrogen from NS-4-FR material definition

- Loss of upper and lower impact limiters

Features common to both the normal and accident conditions models are the inner lid vent and drain ports, the inner lid neutron shield, the bottom forging neutron shield, the annular expansion foam region below the neutron shield (modeled conservatively as void), radial neutron shield heat fins, and the lower rotating trunnions.

Detailed model parameters used in creating the three-dimensional model are taken directly from the License Drawings. Elevations associated with the transport cask three-dimensional features are established with respect to the center bottom of the NAC-STC cavity for the MCBEND combinatorial model. The three-dimensional NAC-STC models are shown in Figures 5.3-1 through 5.3-3.

5.3.1.4 Directly Loaded Configuration Shield Regional Densities

Based on the homogenization described in Section 5.3.1.1, the resulting active fuel regional densities are shown in Table 5.3-2 for the design basis directly loaded fuel assemblies. Material compositions for remaining structural and shield materials are shown in Table 5.3-5. Compositions for fuel assembly non-fuel regions are equivalent to the stainless steel and Zircaloy compositions in Table 5.3-5 scaled by the material volume fractions shown in Tables 5.3-3 and 5.3-4.

5.3.2 Yankee-MPC Fuel and GTCC Waste Model Specifications

This section provides the radial and axial shielding models used for the Yankee-MPC canistered fuel and GTCC waste.

5.3.2.1 Yankee-MPC Fuel and GTCC Waste Radial Shielding Models

One-dimensional cylindrical SAS1 models are used to evaluate radial midplane dose rates for the NAC-STC containing Yankee-MPC design basis canistered fuel and GTCC waste. In both cases, the source region is transformed into an equivalent cylindrical volume. In the case of the canister fuel region, this volume is based on the periphery of the fuel basket tubes and has an equivalent radius of 30.63 inches (77.80 cm). The fuel assembly source regions are homogenized into the volumes defined by the fuel/basket equivalent radius and the fuel regional elevations defined in Figure 5.1-3. Since the canister basket contains an explicit heat transfer region with aluminum heat transfer disks, an additional middle fuel region is defined with this material for the radial midplane evaluation. The remaining cask body regions are modeled using the exact dimensions of the cask, except for the radial neutron shield. Its thickness varies as a result of its polygon shape. An equivalent thickness of 5.52 inches (14.02 cm) is modeled to conserve the actual neutron shield volume (see Figure 5.3-4). To account for axial leakage, an axial buckling equivalent to the active fuel height is applied. In the accident situation, the neutron shield material, NS-4-FR, is voided. An axial peaking factor of 1.15 and 1.80 is applied to the radial midplane gamma and neutron results, respectively, to account for the axial burnup profile as described in Section 5.2.2. Radial models are also constructed for the Westinghouse, United Nuclear and Exxon fuel types to determine minimum cool time based on shielding constraints. By performing shielding analysis rather than source term magnitude comparisons, spectrum differences are taken into account. Shielding analysis of the Exxon assembly at 10 years' cooling is not required, since its neutron and gamma source is lower in each energy group and its mass (and therefore its self-shielding) is identical to the design basis assembly.

In the case of the GTCC waste, the volume is based on the interior periphery of the GTCC basket support wall and has an equivalent radius of 23.47 inches (59.61 cm). The GTCC source region is homogenized into the volume defined by the GTCC basket interior periphery and the container height of 98.25 inches (249.56 cm [See Figure 5.1-4]). This gives a GTCC source volume of 170,023 inches^3 (2.786 x 10^6 cm^3). The GTCC basket support wall is also cylindrical with a 2.5-inch (6.35-cm) thickness. The remaining cask body regions are modeled using the exact dimensions of the cask, except for the radial neutron shield that is again modeled with an equivalent thickness of 5.52 inches (14.02 cm [See Figure 5.3-7]). To account for axial leakage, an axial buckling equivalent to the container height of 98.35 inches is applied. In the accident situation, the neutron shield material, NS-4-FR, is voided. An axial peaking factor of 1.23 is applied to the radial midplane results to account for gamma source peaking as described in Section 5.2.2.3.

5.3.2.2 Yankee-MPC Fuel and GTCC Waste Axial Shielding Models

One-dimensional slab SAS1 models are used to evaluate top and bottom dose rates for the NAC-STC containing design basis Yankee-MPC fuel and GTCC waste. The top axial model begins at either the active fuel or homogenized GTCC waste canister source midplane and proceeds along the cask centerline to the surface of the top impact limiter. Similarly, the NAC-STC bottom axial model begins at either the canistered fuel or homogenized GTCC waste canister center and ends at the bottom impact limiter. See Figures 5.3-5 and 5.3-6 for the canister fuel axial shielding models and Figures 5.3-8 and 5.3-9 for the canister GTCC waste axial shielding models. To account for transverse radial leakage, radial bucklings equal to the equivalent diameter of the source regions are applied. In the accident situation, the impact limiters are lost, the canister is positioned on either the top or bottom cavity surface, and the NS-4-FR neutron shield material, including that in the bottom forging, is considered to be lost.

5.3.2.3 Cask Regional Material Compositions - Yankee Class Fuel and GTCC Waste

The densities of the materials used in the shielding evaluations for canister fuel and GTCC waste are calculated using the effective fuel radius and source regional elevation. See Figure 5.1-3 for the design basis canistered fuel source zones and elevations. In the case of the canistered Yankee Class fuel, the homogenized source regions include a top fuel, middle fuel (heat transfer zone), bottom fuel, top plenum, bottom plenum, and the top and bottom end-fittings. The structural and heat transfer disks exterior to the fuel/basket region are also homogenized in the one-dimensional radial models. Similarly, the GTCC waste density is based on homogenizing the mass of GTCC waste into the volume defined by the equivalent radius and the height of the container. The homogenized densities and nuclide concentrations are shown in Table 5.3-6.

For the damaged fuel evaluation, dose rates are estimated using the amount of UO_2 that could disperse into the active fuel void space. Based on the homogenized density of UO_2 fuel of 2.2769 g/cm^3 (Table 5.3-6), additional source could be concentrated into the fuel region equivalent to the density ratio of 10.412/2.2769, or 4.6.

5.3.3 CY-MPC Fuel and GTCC Waste Model Specifications

MCBEND three-dimensional shielding analysis allows detailed modeling of radiation source (either fuel assemblies or GTCC waste), basket, and cask shield configuration, including streaming paths. For fuel assembly sources, some fuel assembly detail is homogenized in the model to simplify model input and improve computational efficiency. Thus, the three-dimensional models represent the various fuel assembly source regions as homogenized zones within the fuel tubes in the basket, but explicitly model the axial extent of the source regions. For the GTCC waste source, the waste is homogenized using the mass of waste to be loaded in conjunction with the available volume in the GTCC waste tubes. The basket details, including support disks, heat transfer disks, and top and bottom weldments are explicitly modeled.

The fuel and hardware source regions of each assembly are homogenized within the volumes defined by the periphery of the fuel assembly and the source region axial extents. Cask body details include the true axial extent of the cask shield as described by the drawings in Section 1.3.2.

The geometric description of a MCBEND model is based on the Fractal Geometry combinatorial geometry system embedded in the code. In this system, bodies such as cylinders and rectangular parallelpipeds, and their logical intersections and unions, are used to describe the extent of material zones.

MCBEND employs an automated biasing technique for the Monte Carlo calculation based on a three-dimensional adjoint diffusion calculation. Mesh cells for the adjoint solution are selected based on half value thicknesses for each material.

MCBEND Monte Carlo calculations are performed for each source type present in each source region. This approach entails seven separate analyses, encompassing fuel neutron, fuel gamma, fuel n-gamma (secondary gammas arising from neutron interaction in the shield), fuel hardware, upper plenum, and upper and lower end-fitting gamma sources. Typically, a total of some 5 to 20 million histories are tracked to yield dose rate profiles for each model. These cases are analyzed for both radial and axial detector locations and for normal and hypothetical accident conditions. Similar analyses are also conducted for GTCC waste.

5.3.3.1 Connecticut Yankee Fuel Assembly Model

Based on the fuel parameters provided in Table 5.1-2, homogenized treatments of the stainless steel and Zircaloy clad fuel assembly source regions are developed. The homogenized fuel assembly is represented in the model as a stack of boxes with width equal to the fuel assembly width. The height of each box corresponds to the modeled height of the corresponding assembly region, shown in Figure 5.1-5.

The active fuel region homogenizations for stainless steel and Zircaloy clad fuel are shown in Tables 5.3-7 and 5.3-8, respectively. The interstitial material is void under the dry canister conditions of transport. The clad region is either stainless steel (density 7.92 g/cm^3) or Zircaloy (density 6.55 g/cm^3) depending on the fuel type. The resulting regional compositions on an atom/barn-cm basis are shown in Table 5.3-9.

Fuel assembly non-fuel regions are homogenized as shown in Tables 5.3-10 and 5.3-11 for stainless steel and Zircaloy clad fuel types, respectively. The only material included in the homogenized region is stainless steel. Volume fractions of material are based on the modeled regional volume and the volume of stainless steel present as computed from the modeled mass and density (7.92 g/cm^3). Although the geometry of the fuel end plug regions is modeled explicitly, the radiation source from activated fuel pin end plug material is assigned to adjacent source regions. For upper end plugs, the activation source term is assigned to the upper plenum source region, and for lower end plugs, the source term is assigned to the lower nozzle source region. This simplifying assumption reduces the number of source cases required and has little impact on computed dose rates.

5.3.3.2 CY-MPC Canister and Basket Model

For a given fuel type, the MCBEND description of the canister and basket elements forms a common sub-model employed in the transport cask analysis. The key features of the model are the detailed representation of fuel tubes, basket support and heat transfer disks, and weldment structures; the inclusion of the vent and drain ports in the canister shield lid; and explicit modeling of the shielding installed beneath the lid ports.

The vent and drain ports in the canister shield lid are modeled as a series of three stacked cylinders. The port cover is also modeled, and is in place for all transport analyses. The port cover is modeled as a solid piece of stainless steel. The CY-MPC canister is shown in Figure 5.3-10.

5.3.3.3 Description of CY GTCC Waste, Basket, and Canister Model

A homogenized treatment of CY GTCC waste is developed based on loading 800 lbs. of GTCC waste into each GTCC tube and calculating a volume fraction of stainless steel over the length of the GTCC fuel assembly size can (GTCC can) that holds the waste. The loading of 1300 lbs. in the center four tubes is accomplished by scaling the source strength in those locations internally in MCBEND. The calculated volume fraction based on a tube width of 8.75 in. and a GTCC can height of 133.50 in., is 0.2741.

The 24 stainless steel CY GTCC waste tubes are surrounded by a stainless steel cylindrical shell weldment that retains the GTCC waste and provides additional shielding. The CY GTCC basket support ribs are not modeled. The CY GTCC canister is modeled as identical to the fuel canister.

A schematic of the CY GTCC basket is shown in Figure 5.3-12.

5.3.3.4 Description of MCBEND NAC-STC Model

The three-dimensional model of the NAC-STC cask containing Connecticut Yankee design basis fuel assemblies or GTCC waste is based on the following features:

Normal conditions:

- Lower rotating trunnions
- Annular void below the neutron shield
- Radial neutron shield and shield shell
- Radial neutron shield heat fins
- All balsa upper and lower impact limiters (simplified to a length of 33.50 in.)

Accident conditions:

- Top axial lead slump
- Bottom axial lead slump
- Radial lead slump
- Loss of radial neutron shield and shield shell
- Loss of upper and lower impact limiters

Features common to both the normal and accident condition models are the inner lid vent and drain ports, the inner lid neutron shield, the bottom forging neutron shield, and the canister spacer below the CY-MPC canister.

Detailed model parameters used in creating the three-dimensional model are taken directly from the drawings in Section 1.3.2. Elevations associated with the transport cask three-dimensional features are established with respect to the center bottom of the canister for the MCBEND combinatorial model. The three-dimensional NAC-STC model is shown in Figure 5.3-11.

5.3.3.5 CY-MPC Shield Regional Densities

Based on the homogenization described in Section 5.3.3.1, the resulting active fuel regional densities are shown in Table 5.3-9 for stainless steel and Zircaloy clad fuel types. Material compositions for remaining structural and shield materials and GTCC waste are shown in Table 5.3-12. Compositions for fuel assembly non-fuel regions are equivalent to the stainless steel composition in Table 5.3-12 scaled by the material volume fractions shown in Tables 5.3-10 and 5.3-11.

Figure 5.3-1 Three-Dimensional MCBEND Model for Directly Loaded Fuel – Normal Conditions – Axial Detail

Figure Withheld Under 10 CFR 2.390

Figure 5.3-2 Three-Dimensional MCBEND Model for Directly Loaded Fuel – Accident Conditions – Axial Detail

Figure Withheld Under 10 CFR 2.390

Figure 5.3-3 Three-Dimensional MCBEND Model for Directly Loaded Fuel – Radial Detail

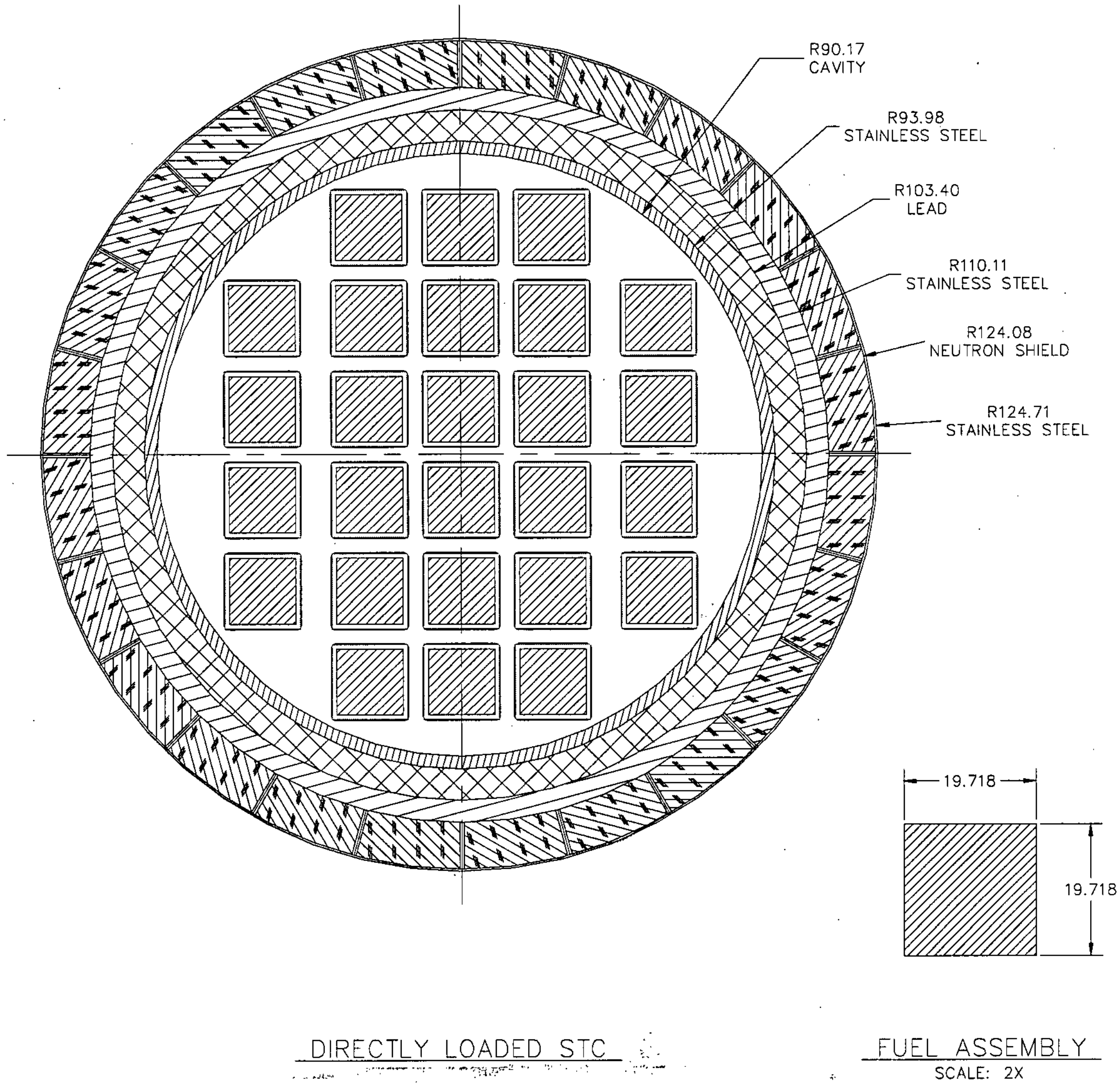


Figure 5.3-4 One-Dimensional Radial Shielding Model with Canistered Yankee Class Fuel

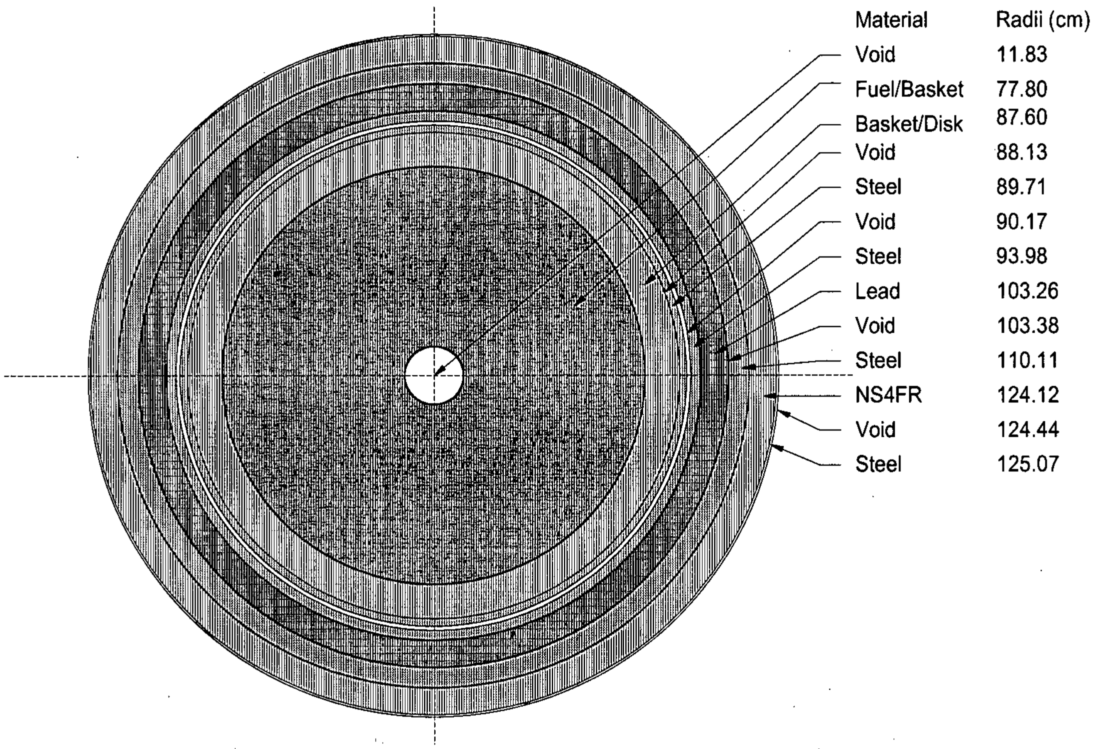


Figure 5.3-5 One-Dimensional Axial Shielding Model with Canistered Yankee Class Fuel

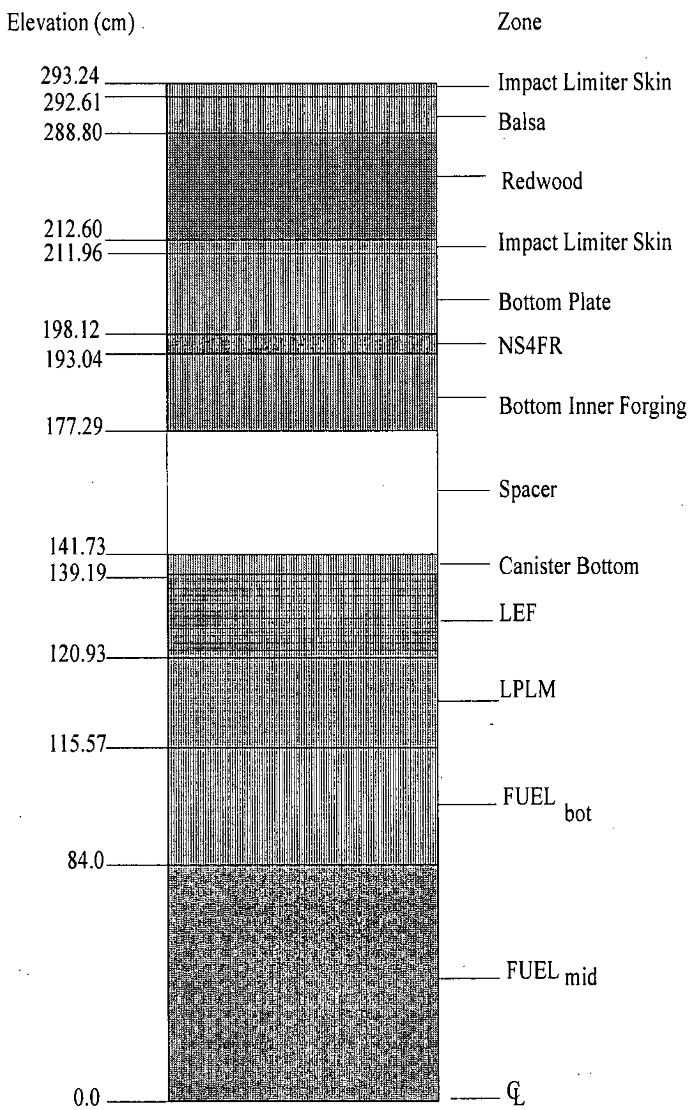


Figure 5.3-6 One-Dimensional Top Axial Model with Canistered Yankee Class Fuel

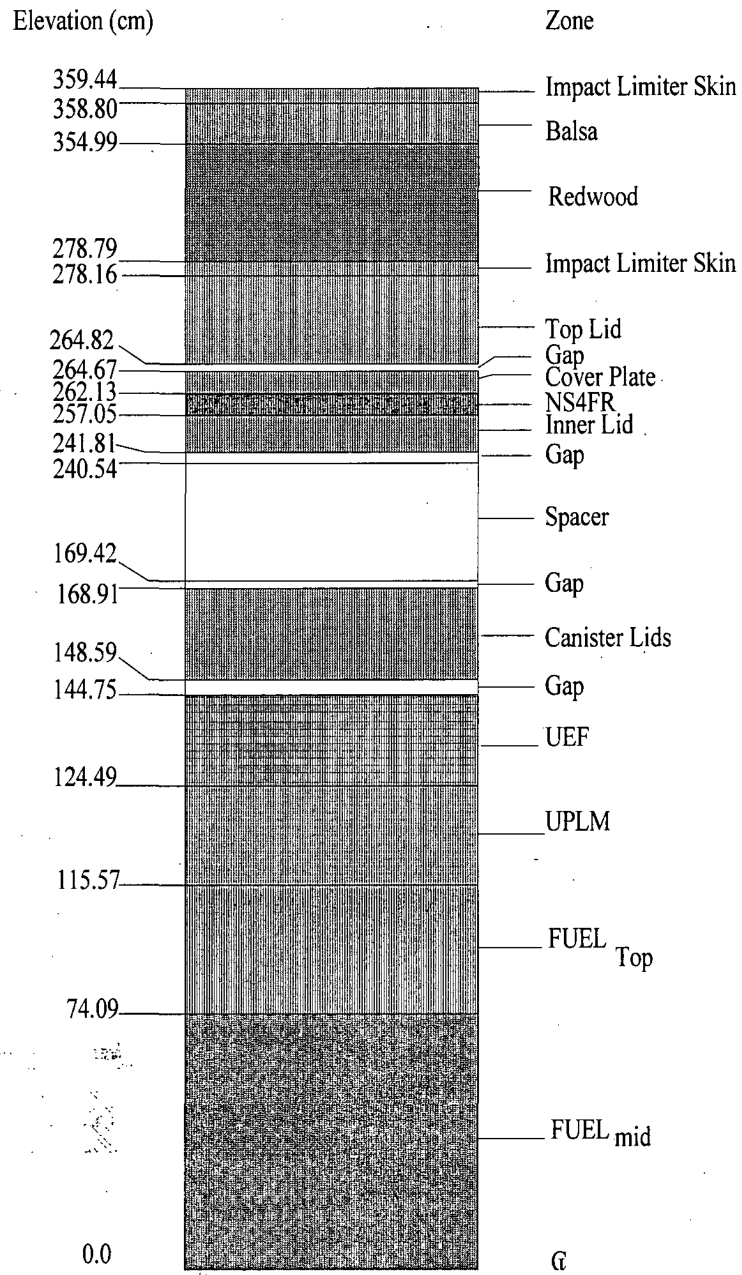


Figure 5.3-7 One-Dimensional Radial Shielding Model with Canistered Yankee GTCC Waste

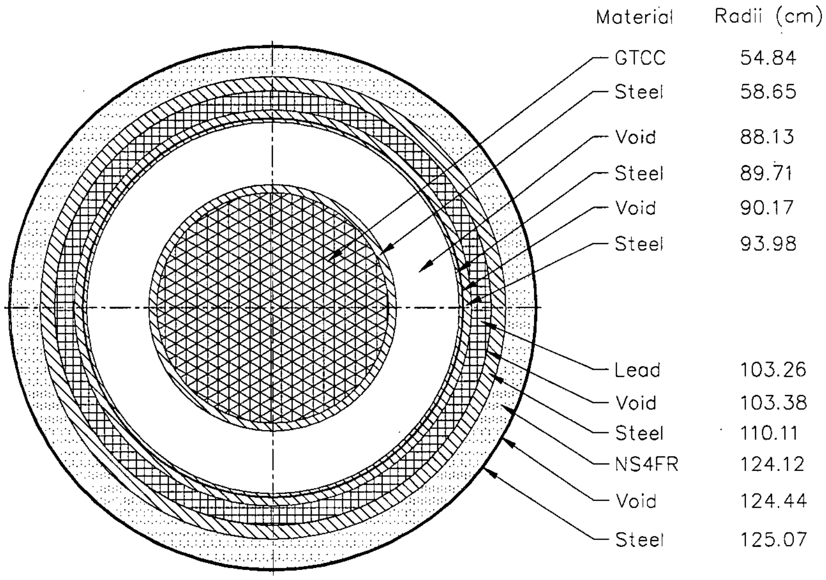


Figure 5.3-8 One-Dimensional Bottom Axial Model with Canistered Yankee GTCC Waste

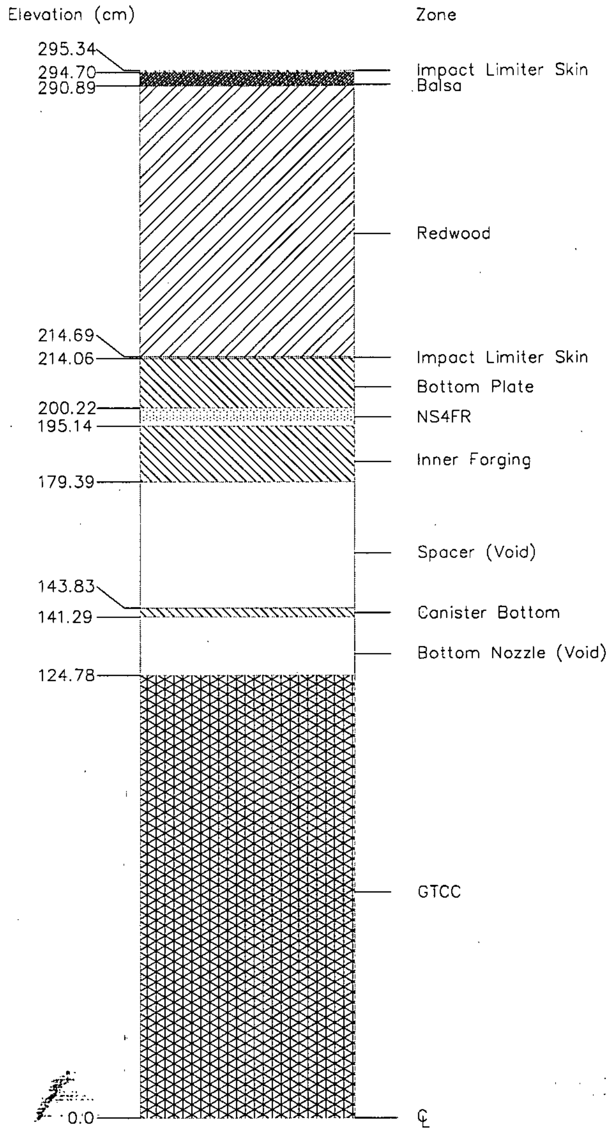


Figure 5.3-9 One-Dimensional Top Axial Model with Canistered Yankee GTCC Waste

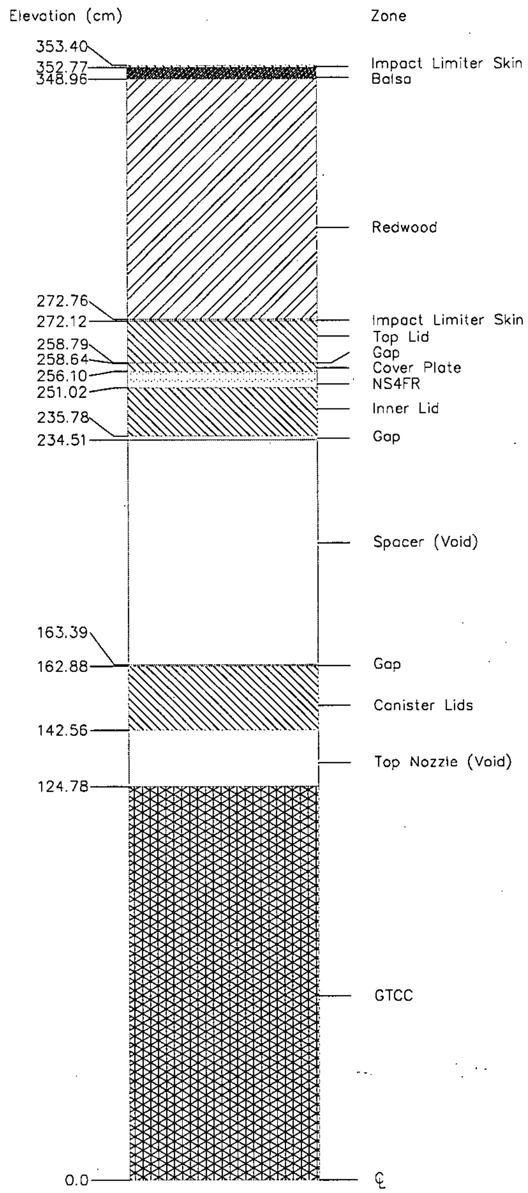


Figure 5.3-10 CY-MPC Three-Dimensional Canister Model Detail

[redacted]

Figure Withheld Under 10 CFR 2.390

(Dimensions in cm)

Figure 5.3-11 Three-Dimensional NAC-STC Model for CY-MPC Analysis

Figure Withheld Under 10 CFR 2.390

(Dimensions in cm)

Figure 5.3-12 Three-Dimensional Model of CY-MPC GTCC Waste Basket

Figure Withheld Under 10 CFR 2.390

(Dimensions in cm)

Table 5.3-1 Directly Loaded Fuel Region Homogenization

Reference Fuel Type	Component	Volume Fraction of Components			
		UO_2	Void	Clad	Interstitial
14×14	Fuel	3.1489E-01	--	--	--
	Gap	--	1.6671E-02	--	--
	Clad	--	--	8.3877E-02	--
	Guide Tube	--	--	1.2662E-02	--
	Instrument Tube	--	--	7.9139E-04	--
	Inside Tubes	--	--	--	3.7699E-02
	Interstitial	--	--	--	5.3341E-01
	Total	3.1489E-01	1.6671E-02	9.7331E-02	5.7111E-01
15×15	Fuel	3.0214E-01	--	--	--
	Gap	--	1.1135E-02	--	--
	Clad	--	--	8.6427E-02	--
	Guide Tube	--	--	6.1920E-03	--
	Instrument Tube	--	--	3.0960E-04	--
	Inside Tubes	--	--	--	4.7622E-02
	Interstitial	--	--	--	5.4618E-01
	Total	3.0214E-01	1.1135E-02	9.2929E-02	5.9380E-01
16×16	Fuel	2.9840E-01	--	--	--
	Gap	--	1.2993E-02	--	--
	Clad	--	--	1.0086E-01	--
	Guide Tube	--	--	5.4230E-03	--
	Instrument Tube	--	--	1.3558E-03	--
	Inside Tubes	--	--	--	6.7633E-02
	Interstitial	--	--	--	5.1334E-01
	Total	2.9840E-01	1.2993E-02	1.0763E-01	5.8097E-01
17×17	Fuel	3.0346E-01	--	--	--
	Gap	--	1.2613E-02	--	--
	Clad	--	--	9.2078E-02	--
	Guide Tube	--	--	7.3113E-03	--
	Instrument Tube	--	--	3.0464E-04	--
	Inside Tubes	--	--	--	5.4568E-02
	Interstitial	--	--	--	5.2967E-01
	Total	3.0346E-01	1.2613E-02	9.9694E-02	5.8424E-01

Table 5.3-2 Directly Loaded Fuel Homogenized Elemental Densities

Element	Density [atom/b-cm]			
	14x14 (3.92 g/cm^3)	**15x15 (3.75 g/cm^3)**	**16x16 (3.81 g/cm^3)**	**17x17 (3.79 g/cm^3)**
Cr	7.38366E-06	7.04970E-06	8.16503E-06	7.56288E-06
Fe	1.37490E-05	1.31272E-05	1.52040E-05	1.40828E-05
Hf	2.15094E-07	2.05366E-07	2.37856E-07	2.20315E-07
Ni	6.54113E-07	6.24528E-07	7.23334E-07	6.69990E-07
O	1.46478E-02	1.40545E-02	1.38846E-02	1.40137E-02
Sn	4.85117E-05	4.63175E-05	5.36454E-05	4.96892E-05
U	7.31477E-03	7.01858E-03	6.93178E-03	6.99729E-03
Zr	4.12775E-03	3.94106E-03	4.56457E-03	4.22794E-03

Table 5.3-3 Directly Loaded Fuel Assembly Activated Hardware Region Homogenization

Reference Fuel Type	Region	Mass SS [kg/assy]	SS Volume [cm^3/assy]	Height [cm]	Volume [cm^3/assy]	Volume Fraction
14×14	Lower Nozzle	7.89	9.9659E+02	8.6944	3.3804E+03	2.9482E-01
	Upper Plenum	8.05	1.0164E+03	22.8016	8.8653E+03	1.1465E-01
	Upper Nozzle	9.89	1.2487E+03	8.8900	3.4564E+03	3.6128E-01
15×15	Lower Nozzle	5.68	7.1717E+02	10.7607	4.9559E+03	1.4471E-01
	Upper Plenum	4.12	5.2020E+02	21.2941	9.8070E+03	5.3044E-02
	Upper Nozzle	11.84	1.4949E+03	8.8392	4.0709E+03	3.6723E-01
16×16	Lower Nozzle	5.40	6.8182E+02	11.9685	5.0661E+03	1.3458E-01
	Upper Plenum	10.70	1.3510E+03	25.1358	1.0640E+04	1.2698E-01
	Upper Nozzle	9.50	1.1995E+03	17.3253	7.3336E+03	1.6356E-01
17×17	Lower Nozzle	6.31	7.9634E+02	10.4324	4.7831E+03	1.6649E-01
	Upper Plenum	5.41	6.8308E+02	25.6684	1.1768E+04	5.8043E-02
	Upper Nozzle	7.85	9.9116E+02	8.8392	4.0526E+03	2.4457E-01

Table 5.3-4 Directly Loaded Fuel Assembly Zircaloy Hardware Region Homogenization

Reference Fuel Type	Region	Mass Zirc [kg/assy]	Zirc Volume [cm^3/assy]	Height [cm]	Volume [cm^3/assy]	Volume Fraction
14×14	Lower Nozzle	1.84	2.8103E+02	8.6944	3.3804E+03	8.3137E-02
	Upper Plenum	4.98	7.6064E+02	22.8016	8.8653E+03	8.5800E-02
15×15	Lower Nozzle	2.10	3.2029E+02	10.7607	4.9559E+03	6.4628E-02
	Upper Plenum	6.99	1.0670E+03	21.2941	9.8070E+03	1.0880E-01
16×16	Lower Nozzle	2.59	3.9492E+02	11.9685	5.0661E+03	7.7953E-02
	Upper Plenum	7.97	1.2170E+03	25.1358	1.0640E+04	1.1439E-01
17×17	Lower Nozzle	2.79	4.2540E+02	10.4324	4.7831E+03	8.8938E-02
	Upper Plenum	6.85	1.0462E+03	25.6684	1.1768E+04	8.8896E-02

Table 5.3-5 Regional Densities for Directly Loaded Cask Structural and Shield Materials

Material	Element	Density [atom/b-cm]	Density [g/cm^3]
Stainless Steel	Cr	1.65112E-02	7.92
	Fe	6.31986E-02	
	Ni	6.50094E-03	
Zircaloy	Cr	7.58615E-05	6.55
	Fe	1.41261E-04	
	Hf	2.20993E-06	
	Ni	6.72052E-06	
	O	2.46540E-04	
	Sn	4.98421E-04	
	Zr	4.24095E-02	
Aluminum	Al	6.02626E-02	2.70
Lead	Pb	3.20871E-02	11.04
NS-4-FR	Al	7.80000E-03	1.63
	B	4.27500E-04	
	C	2.26000E-02	
	H	5.85000E-02	
	N	1.39000E-03	
	O	2.61000E-02	
Heat Fin	Cu	3.62309E-02	8.35
	Fe	3.61117E-02	
	Cr	9.43448E-03	
	Ni	3.71464E-03	
Balsa	C	2.78553E-03	0.125
	H	4.64261E-03	
	O	2.32135E-03	
NS-4-FR (Fire)	Al	7.80000E-03	0.81
	B	4.27500E-04	
	C	2.26000E-02	

Table 5.3-6 Yankee Class Fuel and Yankee GTCC Material Compositions

Zone/Material	Density (g/cc)	Nuclides	Density (atom/b-cm)
Middle Fuel Zone			
UO_2	2.2769	^{234}U	2.79304E-07
		^{235}U	3.65635E-05
		^{238}U	5.04141E-03
		O	1.01565E-02
Zircaloy	0.6417	Zr	4.23638E-03
SS304	0.3420	Cr	7.52598E-04
		Mn	7.49779E-05
		Fe	2.56318E-03
		Ni	3.33394E-04
Aluminum	0.1091	Al	2.43503E-03
B_4C	0.0101	^{10}B	8.76394E-05
		^{11}B	3.52760E-04
		C	1.10100E-04
Middle Basket/Disk Zone			
SS304	0.9543	Cr	2.10001E-03
		Mn	2.09215E-04
		Fe	7.15218E-03
		Ni	9.30286E-04
Aluminum	0.2920	Al	6.51722E-03
Top Fuel/Basket Zone			
UO_2	2.2769	^{234}U	2.79304E-07
		^{235}U	3.65635E-05
		^{238}U O	5.04141E-03 1.01565E-02
Zircaloy		Zr	4.04558E-03
SS304	0.3084	Cr	6.78658E-04
		Mn	6.76116E-05
		Fe	2.31136E-03
		Ni	3.00639E-04
Aluminum	0.0622	Al	1.38826E-03
B4C	0.0101	^{10}B	8.76394E-05
		^{11}B	3.52760E-04
		C	1.10100E-04
Top Plenum Zone			
Zircaloy	0.5718	Zr	3.77491E-03
SS304	0.4821	Cr	1.48517E-03
		Mn	1.05692E-04
		Fe	3.61319E-03
		Ni	4.69968E-04

Table 5.3-6 Yankee Class Fuel and Yankee GTCC Material Compositions (Continued)

Material/Zone	Density (g/cc)	Nuclides	Density (atom/b-cm)
Top End Fitting Zone			
SS304	0.6749	Cr	1.74286E-02
		Mn	1.47961E-04
		Fe	5.05816E-03
		Ni	6.57917E-04
Bottom Fuel/Basket Zone			
UO_2	2.2769	^{234}U	2.79304E-07
		^{235}U	3.65635E-05
		^{238}U	5.04141E-03
		O	1.01565E-02
Zircaloy	0.6128	Zr	4.04558E-03
SS304	0.2350	Cr	6.49170E-04
		Mn	6.46739E-05
		Fe	2.21093E-03
		Ni	2.87577E-04
Aluminum	0.0622	Al	1.38826E-03
B_4C	0.0101	^{10}B	8.76394E-05
		^{11}B	3.52760E-04
		C	1.10100E-04
Bottom Plenum Zone			
Zircaloy	0.6128	Zr	4.0455E-03
SS304	1.0529	Cr	2.31699E-03
		Mn	2.30831E-03
		Fe	7.89115E-03
		Ni	1.02640E-03
Bottom Endfitting Zone			
SS304	0.9664	Cr	2.12664E-03
		Mn	2.11867E-04
		Fe	7.24287E-03
		Ni	9.42082E-04
GTCC Waste and Container			
SS304	3.29	Cr	7.2399E-03
		Mn	7.2128E-04
		Fe	2.4658E-02
		Ni	3.2072E-03

Table 5.3-7 Connecticut Yankee Stainless Steel Clad Fuel Region Homogenization

Component	Volume Fraction of Components			
	UO_2	Void	Clad	Interstitial
Fuel	3.3010E-01	--	--	--
Gap	--	9.5568E-03	--	--
Clad	--	--	6.0055E-02	--
Guide Tube	--	--	5.6120E-03	--
Instrument Tube	--	--	2.9439E-04	--
Inside Tubes	--	--	--	6.0931E-02
Interstitial	--	--	--	5.3345E-01
Total	3.3010E-01	9.5568E-03	6.5962E-02	5.9438E-01

Table 5.3-8 Connecticut Yankee Zircaloy Clad Fuel Region Homogenization

Component	Volume Fraction of Components			
	UO_2	Void	Clad	Interstitial
Fuel	3.0394E-01	--	--	--
Gap	--	9.0410E-03	--	--
Clad	--	--	8.9574E-02	--
Guide Tube	--	--	7.7242E-03	--
Instrument Tube	--	--	3.8621E-04	--
Inside Tubes	--	--	--	5.7525E-02
Interstitial	--	--	--	5.3181E-01
Total	3.0394E-01	9.0410E-03	9.7684E-02	5.8934E-01

Table 5.3-9 Connecticut Yankee Homogenized Fuel Regional Densities

Stainless Steel Clad		**Zircaloy Clad**	
Element	**Density [atom/b-cm]**	**Element**	**Density [atom/b-cm]**
Cr	1.08911E-03	Cr	7.41045E-06
Fe	4.16871E-03	Fe	1.37989E-05
Ni	4.28815E-04	Hf	2.15875E-07
O	1.53301E-02	Ni	6.56487E-07
U	7.66861E-03	O	1.41392E-02
--	--	Sn	4.86877E-05
--	--	U	7.06088E-03
--	--	Zr	4.14273E-03

Table 5.3-10 Connecticut Yankee Stainless Steel Clad Fuel Assembly Hardware Region Homogenization

Region	**Mass SS [kg/cask]**	**SS Volume [cm^3]**	**Height [cm]**	**Volume [cm^3]**	**Volume Fraction**
Lower Nozzle	230.10	2.9053E+04	8.0975	9.6963E+04	2.9963E-01
Lower End Plug	65.96	8.3277E+03	1.7399	2.0834E+04	3.9971E-01
Fuel Hardware	2673.64	3.3758E+05	309.3720	3.7045E+06	9.1126E-02
Upper Plenum	100.85	1.2734E+04	9.0162	1.0796E+05	1.1795E-01
Upper End Plug	65.96	8.3277E+03	1.7399	2.0834E+04	3.9971E-01
Upper Nozzle	292.24	3.6899E+04	17.2466	2.0652E+05	1.7867E-01

Table 5.3-11 Connecticut Yankee Zircaloy Clad Fuel Assembly Hardware Region Homogenization

Region	Mass SS [kg/cask]	SS Volume [cm^3]	Height [cm]	Volume [cm^3]	Volume Fraction
Lower Nozzle	141.44	1.7859E+04	8.0975	9.6963E+04	1.8418E-01
Lower End Plug	0.0	0.0000E+00	1.7399	2.0834E+04	0.0000E+00
Fuel Hardware	504.79	6.3736E+04	307.5940	3.6832E+06	1.7304E-02
Upper Plenum	133.56	1.6864E+04	10.7942	1.2925E+05	1.3047E-01
Upper End Plug	0.0	0.0000E+00	1.7399	2.0834E+04	0.0000E+00
Upper Nozzle	307.84	3.8869E+04	17.2466	2.0652E+05	1.8821E-01

Table 5.3-12 Regional Densities for CY-MPC Structural and Shield Materials

Material	Element	Density [atom/b-cm]
Stainless Steel	Cr	1.65112E-02
	Fe	6.31986E-02
	Ni	6.50094E-03
BORAL Aluminum Clad	Al	3.35910E-02
	B	4.63378E-02
	C	1.21776E-02
Aluminum	Al	6.02626E-02
Lead	Pb	3.20871E-02
NS-4-FR	Al	7.80000E-03
	B	4.27500E-04
	C	2.26000E-02
	H	5.85000E-02
	N	1.39000E-03
	O	2.61000E-02
Heat Fin	Cu	3.62309E-02
	Fe	3.61117E-02
	Cr	9.43448E-03
	Ni	3.71464E-03
Balsa	C	2.78553E-03
	H	4.64261E-03
	O	2.32135E-03
GTCC Waste	Cr	4.52571-03
	Fe	1.73227E-02
	Ni	1.78191E-03

5.4 Shielding Evaluation

The techniques used to perform gamma and neutron dose rate calculations for the NAC-STC in the directly loaded and canistered configurations are described below, including descriptions of the computer codes and methods that were used in the shielding analyses of the cask.

5.4.1 Computer Code Descriptions and Results

5.4.1.1 Directly Loaded Fuel Configuration

To calculate three-dimensional NAC-STC dose rates and define a minimum cool time table, a response function approach is taken to the shielding evaluation. Instead of running numerous direct-solution cases at a discrete matrix of burnups, enrichments, and cool times, three-dimensional dose rate response function cases are executed, thereby evaluating the dose contribution of a "unit" source in each significant energy group in each source region. Six sets of response functions are required based on the defined source regions: fuel gamma, fuel neutron, fuel n-gamma, lower end-fitting gamma, upper plenum gamma and upper end-fitting gamma. Fuel hardware contributions to dose rates are evaluated using the fuel gamma response functions. For each source region, a subset of the 28 neutron and 22 gamma energy groups is evaluated to increase the efficiency of the analysis. Fuel gamma doses are calculated using gamma groups 7 through 16; fuel neutron and fuel n-gamma doses are calculated using neutron groups 2 through 15; and hardware sources are calculated using gamma groups 12 through 14. Neutron groups 1 and 16 through 28 contain no neutron source. The hardware source is dominated by the ^{60}Co source, which resides in groups 12 through 14. Fuel gamma groups 7 through 16 are selected based on the integrated source energy in each group (Source magnitude drops by a factor of 1,000 when moving from fuel group 7 to group 6.). The choice of energy groups evaluated is verified by running "direct" solutions using the complete spectrum and demonstrating that the total dose is reproduced within the Monte Carlo error of the analysis. Sample comparisons of the dose response method (DRM) to direct-solution cases are shown in Figures 5.4-7 and 5.4-8 for normal and accident conditions, respectively. As shown, the dose response method reproduces direct solution results within the uncertainty of the analysis. Since the dose response method evaluates each source energy line individually, and therefore avoids statistical sampling within the energy group structure of the source, the results of the dose response method tend towards smaller Monte Carlo uncertainty bands.

Calculational Methods

The shielding evaluation of the directly loaded configuration is performed using MCBEND. Source terms include fuel neutron, fuel gamma and gamma contributions from activated hardware. As described in Section 5.2.1.3, the evaluation includes the effect of fuel burnup peaking on fuel neutron and gamma source terms.

The MCBEND shielding model described in Section 5.3.1 is utilized with the source terms described in Section 5.2.1 to estimate the dose rate profiles at various distances from the side, top and bottom of the cask for both normal and accident conditions. The method of solution is continuous energy Monte Carlo with an adjoint diffusion solution for generating importance meshes. Radial biasing is performed within the MCBEND code to estimate dose rates on the side of the cask. Axial biasing is performed to estimates dose rates on the top and bottom of the cask.

The MCBEND code has been validated against various classical shielding problems, including fast and thermal neutron sources penetrating through single material slab geometries of iron, graphite and water. The validation suite also includes fast neutron transmission through alternating slabs of iron and water. Of particular interest is a benchmark of MCBEND to gamma and neutron dose rates outside a metal transport cask, where agreement between measurement and calculation is within 20% for the majority of dose locations.

MCBEND results are calculated using the JEF2.2 neutron cross-section library and the ANSWERS gamma library.

MCBEND Flux-to-Dose Conversion Factors

The ANSI/ANS 6.1.1-1977 flux-to-dose rate conversion factors are used in all shielding evaluations for directly loaded fuel. The ANSI/ANS gamma and neutron dose conversion factors are shown in Table 5.4-1 and Table 5.4-2. The number of energy/conversion factor pairs was increased to 133 neutron and 371 gamma pairs by a log-log interpolation scheme indicated as appropriate in ANSI/ANS 6.1.1-1977.

Loading Table for Directly Loaded Fuel

Three-dimensional radial response functions are generated for PWR fuel assemblies for both normal and accident conditions. Based on preliminary analysis, two bounding axial shift scenarios have been established: 1) maximum fuel assembly shift upward in the cask cavity without a corresponding shift in the basket and 2) no fuel assembly or basket shift. For axial biasing, the limiting shift scenario corresponds exactly to the position of the fuel assembly in the cavity, i.e., top dose rates are maximized when the fuel assembly is shifted up and bottom dose rates are maximized when the fuel assembly is as far down in the cavity as possible. For radial biasing, the two different shift scenarios are limiting for different transport conditions. The maximum fuel assembly axial shift is limiting for normal conditions because upper plenum and upper end fitting hardware move adjacent to the location in the radial shield where the radial lead shield ends. The limiting shift is downward for accident conditions due to the bottom axial lead slump, which is adjacent to the lower end fitting hardware source.

The first step in determining limiting PWR dose rates for the directly loaded cask is the generation of dose rate response functions for generation of minimum cool time tables. For each array size, at each of 4 burnup, 15 enrichment, and 18 cool time combinations, dose rate profiles are calculated for both normal and accident transport conditions. Using these dose rate profiles, the maximum radial dose rates at 2 meters from the railcar are tabulated for normal conditions.

Minimum cool times are calculated to ensure that a decay heat limit of 850 W/assembly is not exceeded and that the dose rate at 2 meters from the railcar does not exceed 9.5 mrem/hr. The 9.5 mrem/hr analysis limit was chosen to provide margin against the 10 mrem/hr regulatory limit. Cool times needed to reach these limits are calculated using linear interpolation on the entire array of maximum dose rates. The linear interpolation is valid because of the exponential decrease in source term and, thus, dose rate as a function of time. The interpolated cool time is rounded up to the next integer year. A sample minimum cool time generation for the 14×14 reference assembly at 40,000 MWD/MTU is shown in Table 5.4-3. Repeating this analysis for all fuel types and burnups results in the complete loading table shown in Table 5.4-5. Based on the loading table, maximum radial dose rates for each fuel type are shown in Table 5.4-4.

The minimum cool times are used to calculate maximum accident condition dose rates at 1 meter from the cask. The 1000 mrem/hr limit is not exceeded at any of the calculated minimum cool times.

Based on the radial dose rate results for normal and accident conditions and their application to the minimum cool time table, the 14×14 reference assembly provides maximum dose rates. Thus, top axial and bottom axial response functions have been executed for this assembly only. This ensures that the maximum axial dose rates for the directly loaded system are captured, and that variations in burnup, enrichment and minimum cool time are thoroughly examined.

A summary of the limiting source terms for each transport condition and detector biasing is given below. All limiting source terms are taken from the 14×14 reference fuel assembly.

Detector Biasing	Normal Conditions			Accident Conditions		
	Burnup [MWD/MTU]	**Enrichment [wt % ^{235}U]**	**Cool Time [Years]**	**Burnup [MWD/MTU]**	**Enrichment [wt % ^{235}U]**	**Cool Time [Years]**
Radial	40,000	2.3	10	45,000	2.3	14
Top Axial	30,000	2.3	6	45,000	2.3	14
Bottom Axial	40,000	2.3	10	45,000	2.3	14

<u>Three-Dimensional Dose Rates for Directly Loaded Fuel</u>

Further detail on the three-dimensional dose rates are presented in Figures 5.4-1 through 5.4-6 for the limiting 14×14 reference assembly. Maximum dose rates are tabulated in Tables 5.4-6 and 5.4-7.

The maximum normal conditions surface dose rate is 366 mrem/hr at an axial elevation between the radial neutron shield and the upper impact limiter. At 1 meter from the surface of the neutron shield shell, the maximum dose rate is 20.3 mrem/hr. This dose rate defines the transport index. The maximum normal conditions dose rate at 2 meters from the cask railcar is 9.5 mrem/hr and occurs at an axial elevation adjacent to the upper plenum and upper end-fitting elevations. The maximum accident conditions dose rate at 1 meter from the cask is 665 mrem/hr and occurs at the cask midplane. The top and bottom axial dose rates are small when compared to the radial dose rate for the same transport conditions.

Dose rate variations from heat fins in the neutron shield are examined explicitly using azimuthal detectors that span the entire length of the neutron shield. As shown in Figure 5.4-4, peaks in the neutron dose rate correspond to dips in the gamma dose rate, and vice versa. Thus, the neutron dose rate increase resulting from the ducting is offset by the reduction of the gamma dose rate resulting from the additional shielding provided by the fins.

Detector descriptions for dose rates on the side of the STC are given in Tables 5.4-8 and 5.4-9 for normal and accident conditions, respectively. Note that an axial height of 0.0 cm corresponds to the bottom of the STC cavity.

5.4.1.2 Canistered Yankee Class Fuel and GTCC Waste

Shielding evaluations of canistered Yankee Class fuel and GTCC waste are performed with SCALE 4.3 for the PC (ORNL, 1995). In particular, SCALE 4.3 shielding analysis sequence SAS2H (Herman, 1995) is used to generate source terms for the design basis fuel and GTCC waste hardware and SAS1 (Knight, 1995) is used to perform one-dimensional radial and axial shielding analysis. Transverse leakage is accounted for by the use of radial and axial bucklings. The 27 group neutron, 18 group gamma, coupled cross section library (27N-18COUPLE) based on ENDF/B-IV (Jordan, 1995) is used in all shielding evaluations. Fuel source terms include fuel neutron, fuel gamma, and activated hardware gamma. GTCC waste hardware source terms are based on core baffle activated hardware characterization from dose rate measurements and baffle material chemical assay. Dose rate evaluations include the effect of fuel burnup peaking on fuel neutron and gamma source terms.

For the four Yankee Class fuel types, a nominal decrease in enrichment is evaluated to account for tolerances applied to enrichment specifications during fabrication. The evaluation shows that a small reduction in the batch-averaged minimum enrichments does not significantly affect calculated dose rates as shown by the minimal increase in source strength:

Fuel Type	Minimum Enrichment (wt % ^{235}U)	Percent Increase in Source (%)			
		Decay Heat	Neutron	Gamma	Hardware
CE	3.66	0.2	2.2	0.1	0.6
Exxon	3.46	0.2	2.2	0.0	0.7
UN	3.96	0.1	2.2	0.1	0.6
WE	4.90	0.1	2.2	0.0	0.5

5.4.1.3 Canistered CY-MPC Fuel and GTCC Waste

The shielding evaluations of the NAC-STC with canistered CY-MPC fuel or GTCC waste are performed with MCBEND version 9E (MCBEND). For the fuel evaluations, source terms include fuel neutron, fuel gamma and gamma contributions from activated hardware. As described in Section 5.2.3.4, these evaluations include the effect of fuel burnup peaking on fuel neutron and gamma source terms. The resulting dose rate profiles are reported as a function of distance from the radial and axial surfaces of the NAC-STC cask.

The MCBEND shielding models described in Section 5.3.3 are utilized with the source terms described in Section 5.2.3 to estimate the dose rate profiles along the surfaces of the transport cask. The method of solution is continuous energy Monte Carlo with an adjoint diffusion solution for generating importance meshes. Radial biasing is performed within the MCBEND code to estimate dose rates on the side of the transport cask, and axial biasing is performed to estimate dose rates on the top and bottom surfaces of the cask.

MCBEND Flux-to-Dose Conversion Factors

The ANSI/ANS 6.1.1-1977 flux-to-dose rate conversion factors are used in all CY-MPC shielding evaluations. Tables 5.4-10 and 5.4-11 show the regrouped flux-to-dose conversion factors on the MCBEND standard 28 group neutron and 22 group gamma energy boundaries.

CY-MPC Three-Dimensional Dose Rates

The CY-MPC three-dimensional model dose rates are presented in Figures 5.4-9 through 5.4-14 for the stainless steel clad fuel at 38,000 MWD/MTU and 10-year cool time and the Zircaloy clad fuel at 43,000 MWD/MTU and 10-year cool time. CY GTCC three-dimensional model dose rates are presented in Figures 5.4-15 and 5.4-16 for the design basis core baffle source at 10-year cool time. Dose rates at specified detector locations are presented in Tables 5.4-12 through 5.4-19 for stainless steel and Zircaloy clad fuel. For GTCC waste, the maximum and average dose rates at specified detector locations are presented in Tables 5.4-20 though 5.4-23.

For the design basis fuel sources, the maximum normal conditions surface dose rate is 49 mrem/hr at an axial elevation between the radial neutron shield and the upper impact limiter. The maximum normal conditions dose rate at two meters from the cask railcar is 3.6 mrem/hr and occurs at the cask midplane. The maximum accident conditions dose rate at one meter from the cask is 369 mrem/hr and occurs at the cask midplane. The top and bottom axial dose rates are small when compared to the radial dose rate for the same transport conditions.

Damaged fuel dose rates are calculated using the design basis Zircaloy clad fuel as a basis and filling the void regions in the fuel assembly non-fuel regions with UO_2. This moves a significant neutron and gamma source close to the positions of least shielding. For damaged fuel sources, the maximum normal conditions surface dose rate increases to 110 mrem/hr, also at the gap between the radial neutron shield and the upper impact limiter. The maximum normal conditions dose rate at two meters from the cask increases to 3.8 mrem/hr. The maximum accident conditions dose rate at one meter from the cask increases to 376 mrem/hr. An increase in the top axial and bottom axial dose rates is observed; however, the top and bottom axial dose rates remain small when compared to the radial dose rates.

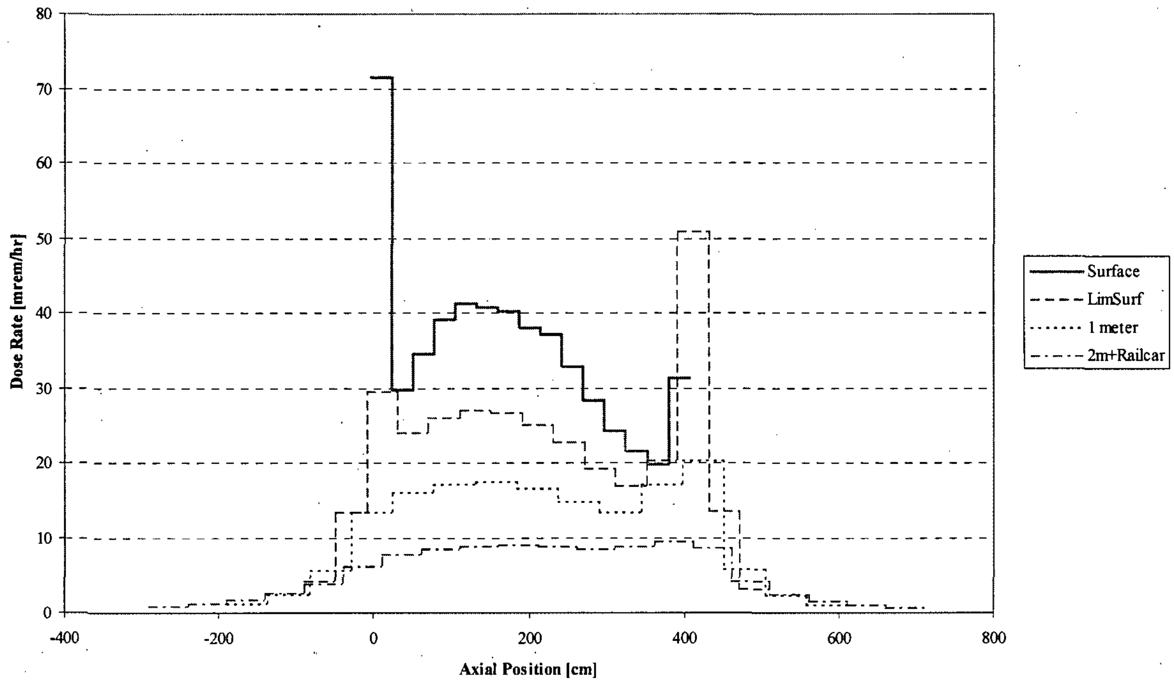
For the design basis GTCC waste, the maximum normal conditions radial surface dose rate is 6.1 mrem/hr and occurs at the cask midplane (the bottom axial surface dose rate is 4.2 mrem/hr). The maximum normal conditions dose rate at two meters from the cask is 1.5 mrem/hr and also occurs at the cask midplane (the bottom axial dose rate is 0.7 mrem/hr). The maximum accident conditions dose rate at one meter from the cask is 25.0 mrem/hr and occurs at the axial elevation of the modeled bottom axial lead slump due to gamma streaming and the minimal shielding of the canister bottom plate. Top axial dose rates are small in comparison to the radial and bottom axial dose rates because of the stainless steel lid structure.

The dose rate contributions from the activated Reactor Control Cluster Assemblies are small compared to those from the fuel sources. A full complement of 26 Reactor Control Cluster Assemblies cooled to a minimum of 10 years leads to an additional maximum radial surface dose rate of 0.6 mrem/hr for normal conditions and 3.2 mrem/hr for accident conditions at an axial position adjacent to the bottom of the fuel. The contribution to the Reactor Control Cluster Assemblies to the dose rate at an axial position adjacent to the fuel midplane is less than 1 mrem/hr for both normal and accident conditions. Hence, no significant increase in cask radial maximum dose rate occurs due to the inclusion of the cluster assemblies. Since the activated portion of the Reactor Control Cluster Assemblies resides in the bottom of the fuel, no significant increase in top axial dose rates is observed.

Additional dose rates due to inclusion of up to eight activated flow mixers inserted into the top nozzles of fuel assemblies in the center-most basket locations (positions 7, 8, 12, 13, 14, 15, 19, and 20) is small. The radial surface dose rate contribution from the flow mixers is a maximum of 0.4 mrem/hr for normal conditions and 7.2 mrem/hr for accident conditions. The top axial surface dose rate contribution from the flow mixers is less than 1 mrem/hr for both normal and accident conditions. The small dose rate increase is due to the effective self-shielding of the material by the surrounding fuel assemblies and the limited radial extent of the material with respect to the canister lids.

The dose rate increase due to the inclusion of up to two assemblies with a maximum of two irradiated stainless steel filler rods per assembly is less than 1% of the total dose rate at any surface of the NAC-STC. Assemblies containing irradiated stainless steel rods may only be loaded in basket positions 13 and 14, as shown in Figure 6.3-3.

Figure 5.4-1 Radial Dose Rate Profiles for Directly Loaded Fuel in Normal Conditions of Transport



Note: The dose rate at the surface of the cask between the neutron shield and the upper impact limiter is 366.3 (0.2%) mrem/hr.

Figure 5.4-2 Radial Dose Rate Profile by Source Type at 2 meters from the Railcar for Directly Loaded Fuel in Normal Conditions of Transport

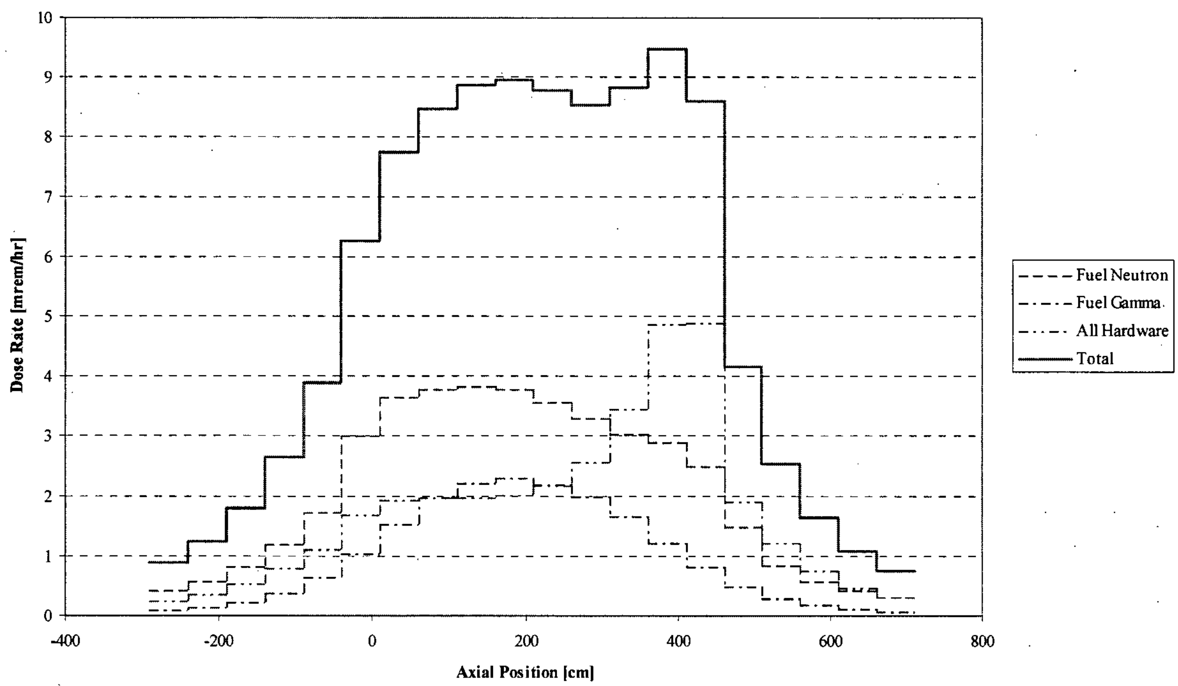


Figure 5.4-3 Azimuthal Radial Surface Dose Rate Profile by Source Type at Rotation Trunnion Elevation for Directly Loaded Fuel in Normal Conditions of Transport

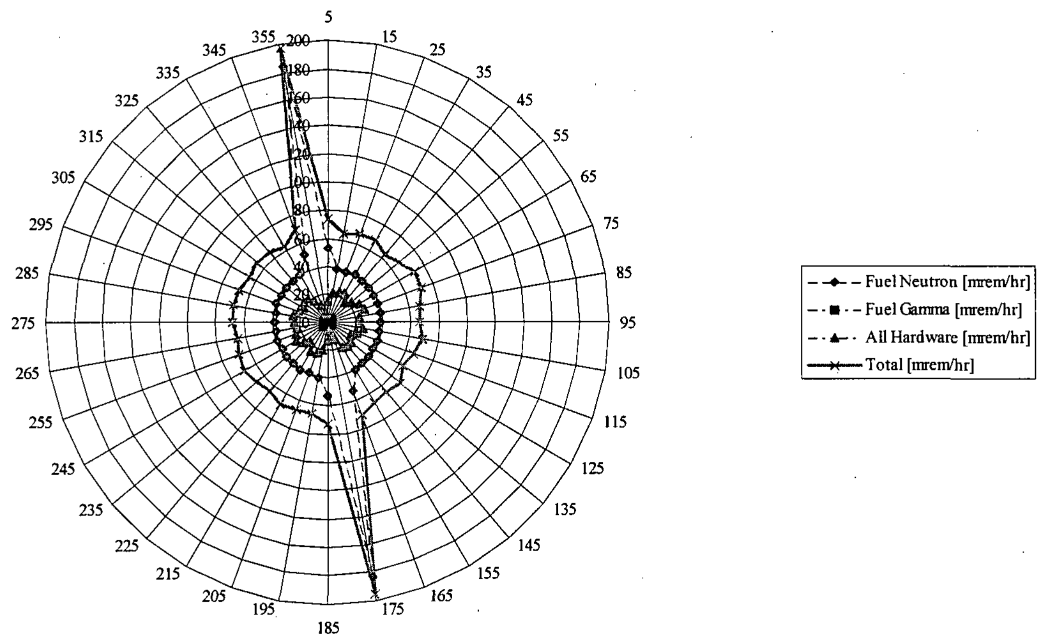


Figure 5.4-4 Azimuthal Radial Surface Dose Rate Profile by Source Type over Heat Fin Axial Extent for Directly Loaded Fuel in Normal Conditions of Transport

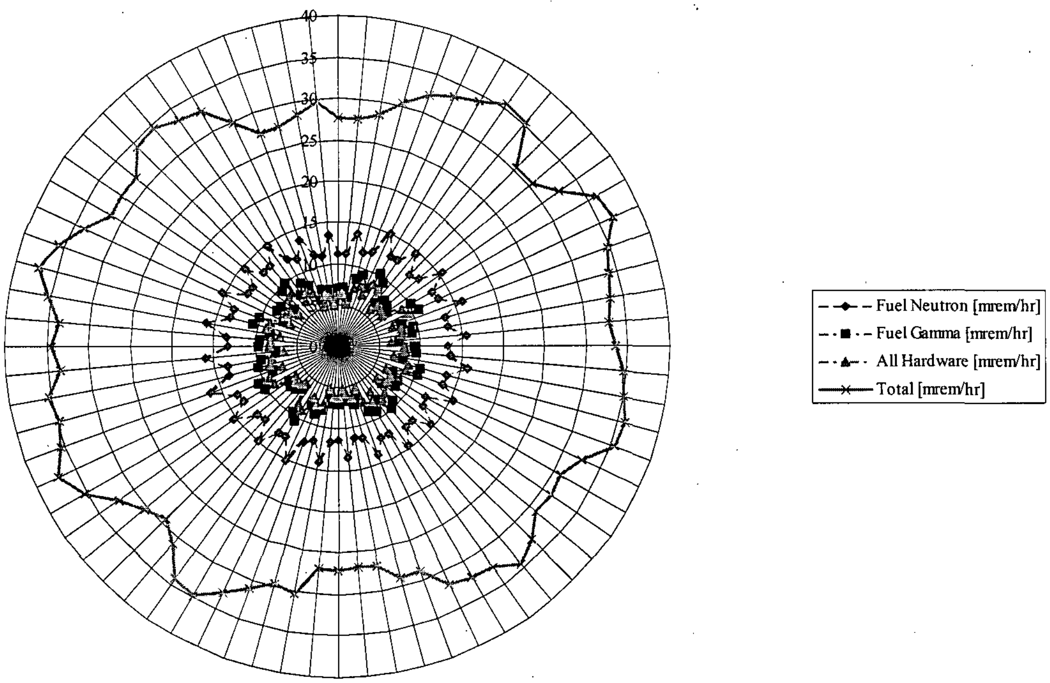


Figure 5.4-5 Radial Dose Rate Profile by Source Type at 1 meter for Directly Loaded Fuel in the Accident Condition

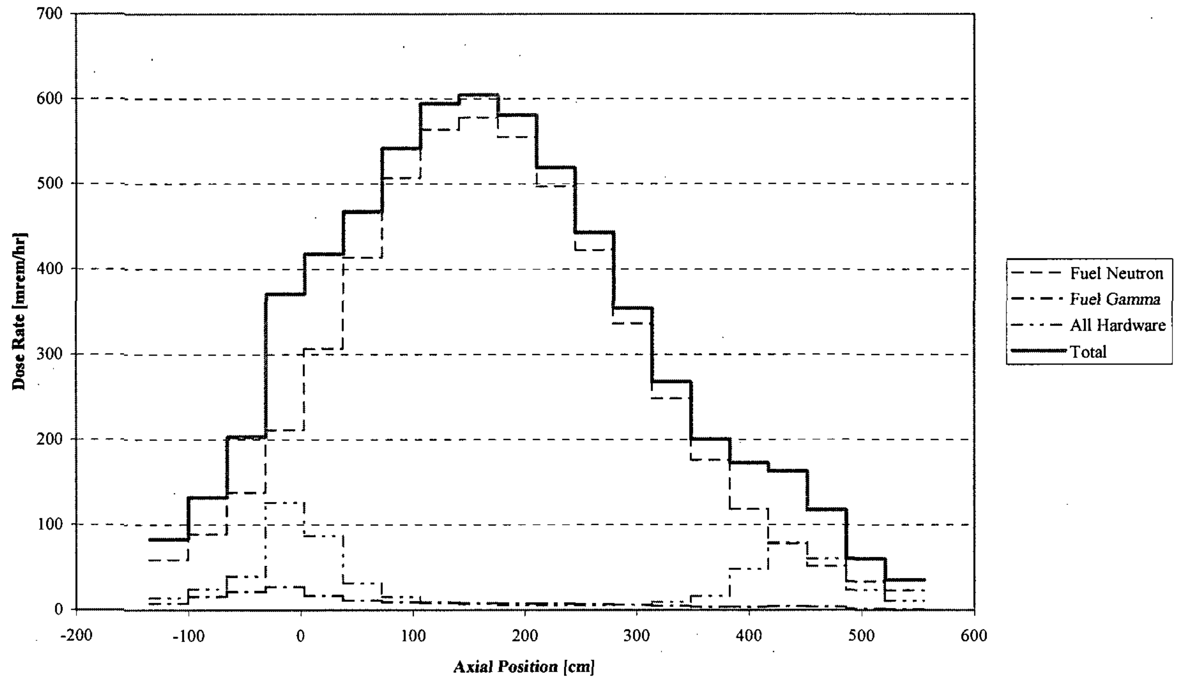


Figure 5.4-6 Azimuthal Radial Dose Rate Profile at 1 meter for Directly Loaded Fuel in the Accident Condition

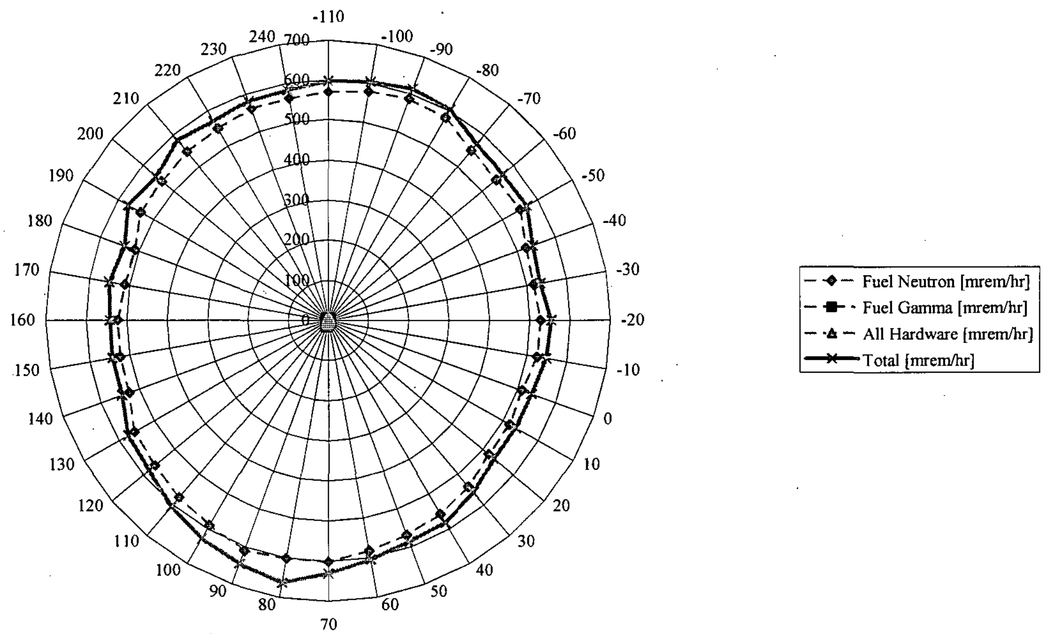


Figure 5.4-7 Graphical Comparison of Normal Conditions Radial 2m+Railcar Dose Rate Profile for DRM and Direct Solution – 14×14 Assembly at 40,000 MWD/MTU, 3.7 wt % ^{235}U, 7 Years Cool Time

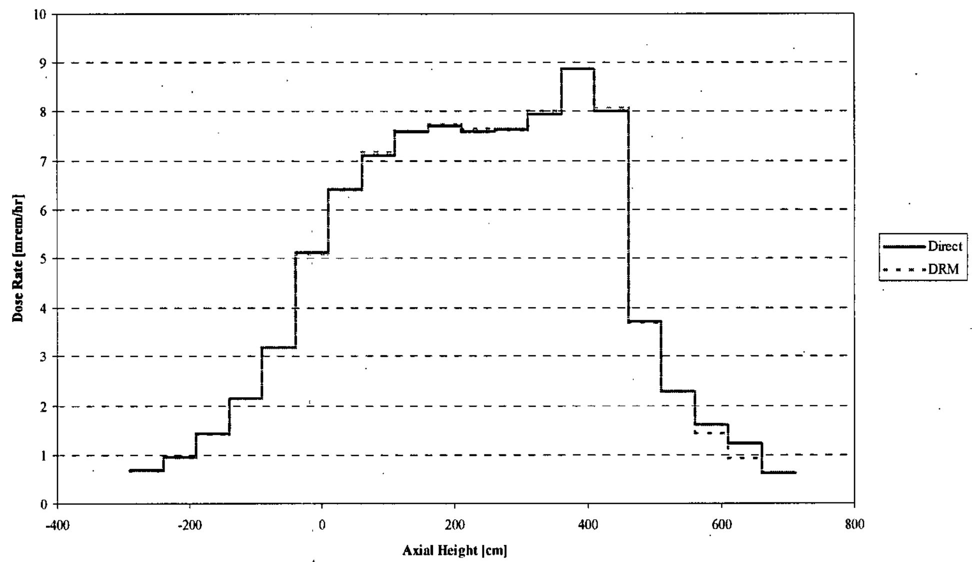


Figure 5.4-8 Graphical Comparison of Accident Conditions Radial 1m Dose Rate Profile for DRM and Direct Solution – 15×15 Assembly at 40,000 MWD/MTU, 3.7 wt % ^{235}U, 7 Years Cool Time

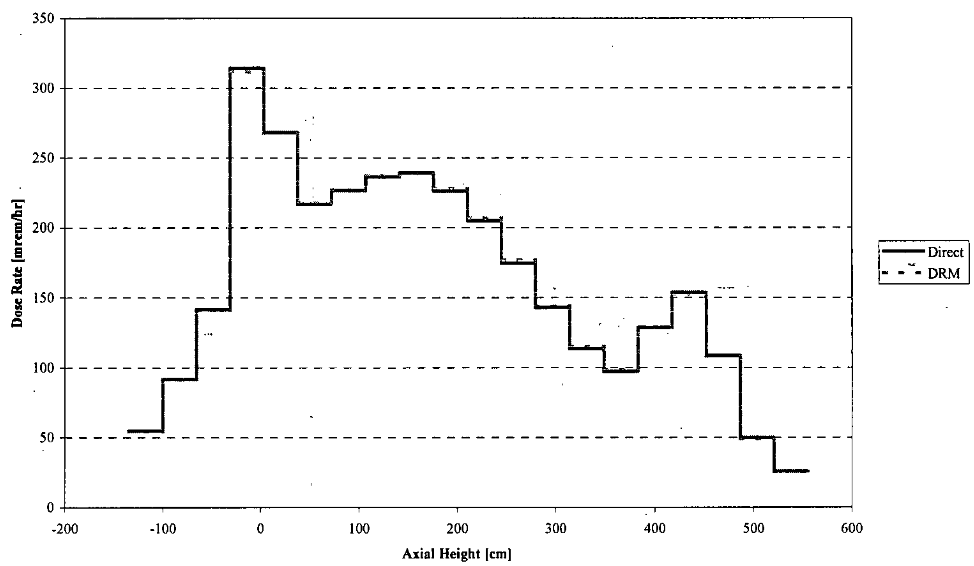
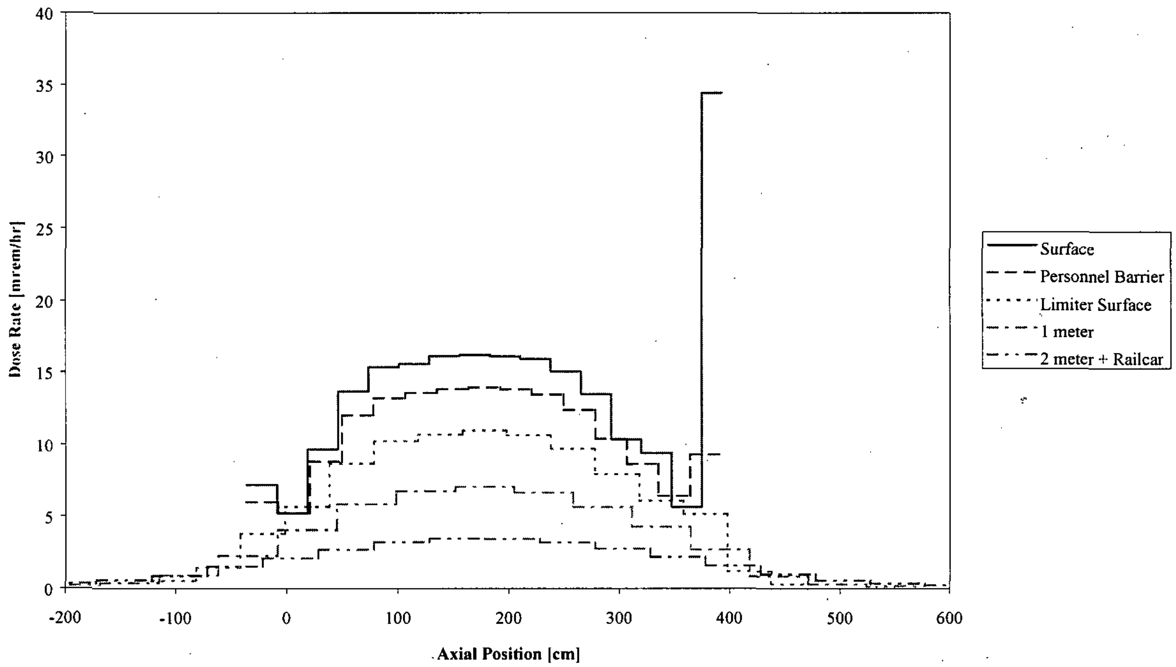
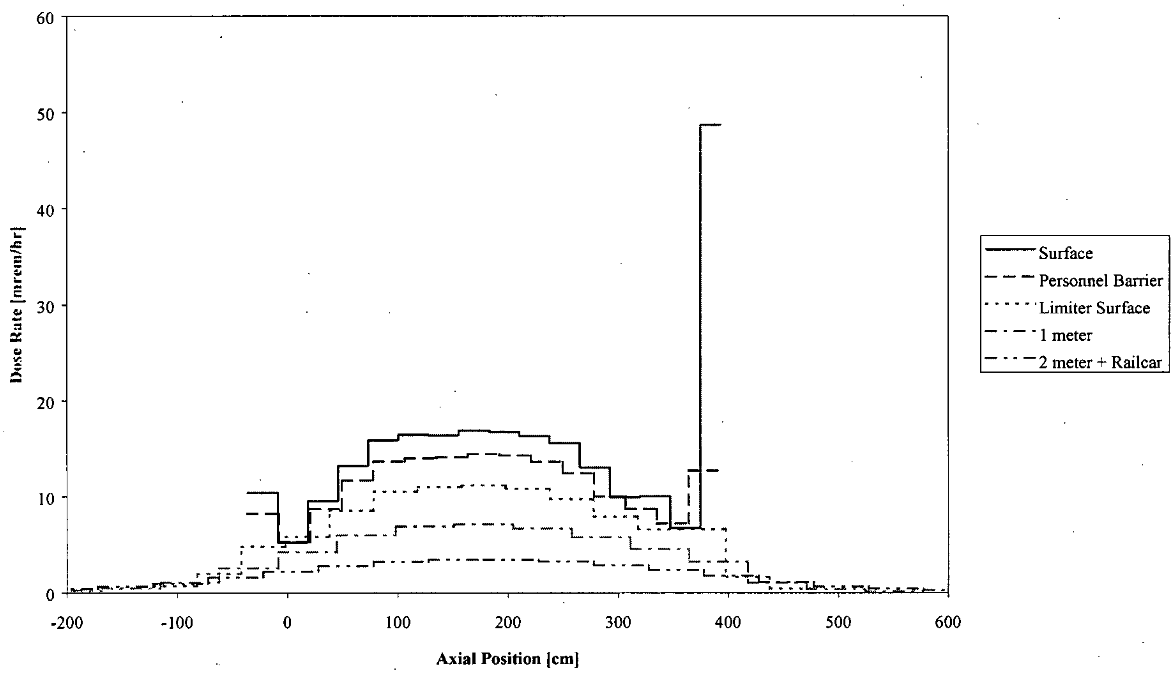


Figure 5.4-9 NAC-STC Radial Dose Rate Profile – Normal Conditions – Design Basis Connecticut Yankee Stainless Steel Clad Fuel



Note: The surface peak dose rate is due to neutrons streaming through the gap in neutron shielding between the neutron shield and the top impact limiter.

Figure 5.4-10 NAC-STC Radial Dose Rate Profile – Normal Conditions – Design Basis Connecticut Yankee Zircaloy Clad Fuel



Note: The surface peak dose rate is due to neutrons streaming through the gap in neutron shielding between the neutron shield and the top impact limiter.

Figure 5.4-11 NAC-STC CY-MPC Azimuthal Heat Fin Dose Rate Variations – Normal Conditions – Design Basis Stainless Steel Clad Fuel

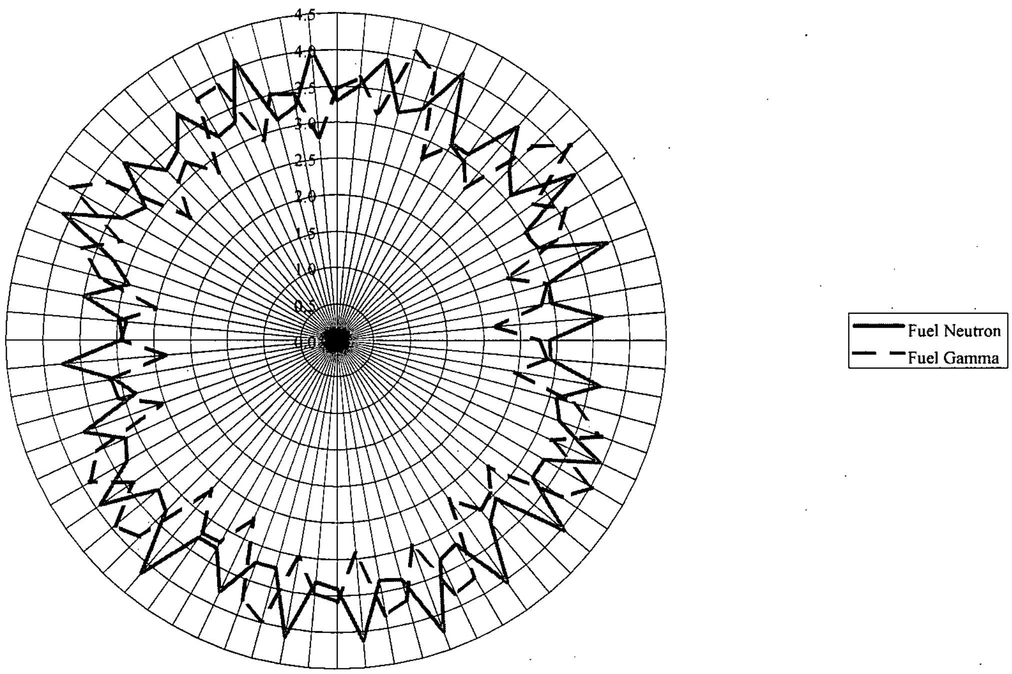


Figure 5.4-12 NAC-STC CY-MPC Azimuthal Heat Fin Dose Rate Variations – Normal Conditions – Design Basis Zircaloy Clad Fuel

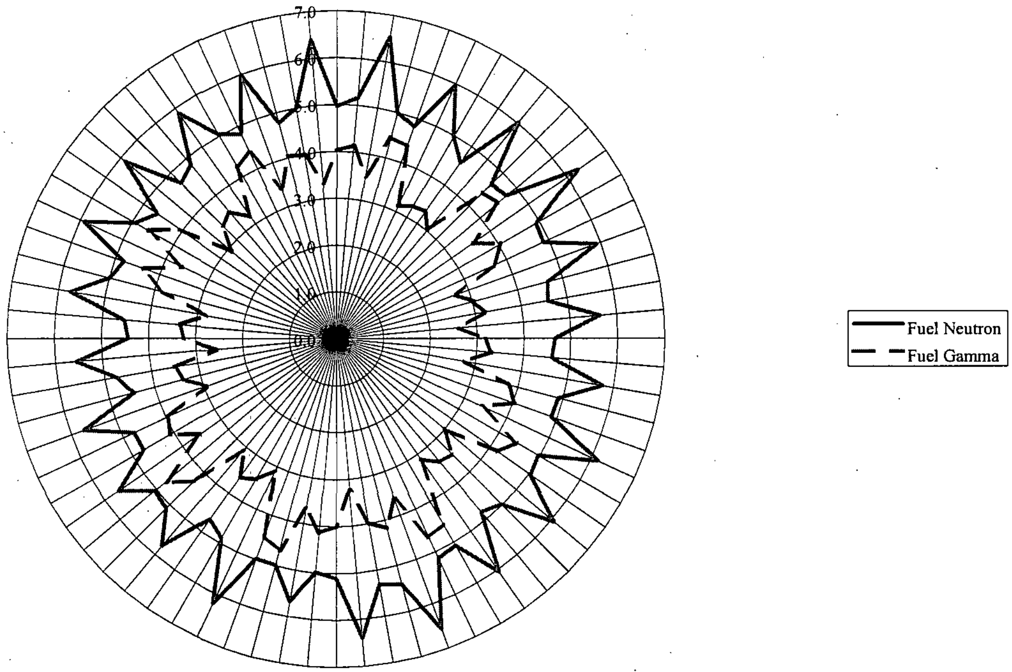


Figure 5.4-13 NAC-STC CY-MPC Radial Dose Rate Profile – Accident Conditions – Design Basis Stainless Steel Clad Fuel

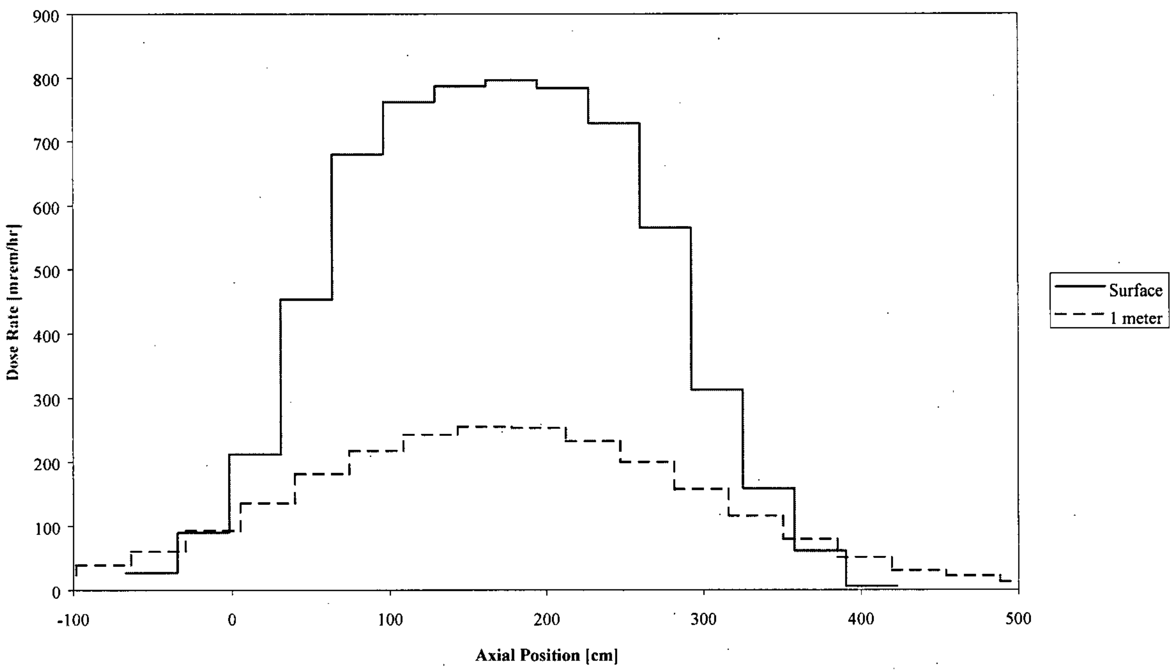


Figure 5.4-14 NAC-STC CY-MPC Radial Dose Rate Profile – Accident Conditions – Design Basis Zircaloy Clad Fuel

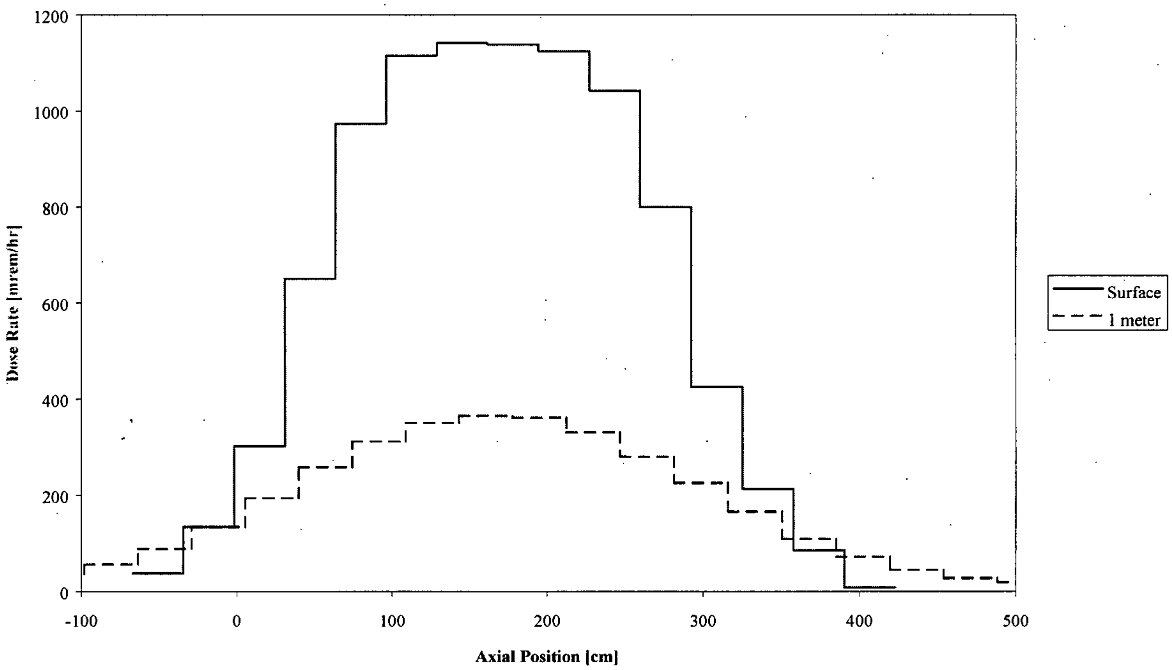


Figure 5.4-15 NAC-STC CY-MPC Radial Dose Rate Profile – Normal Conditions – GTCC Waste

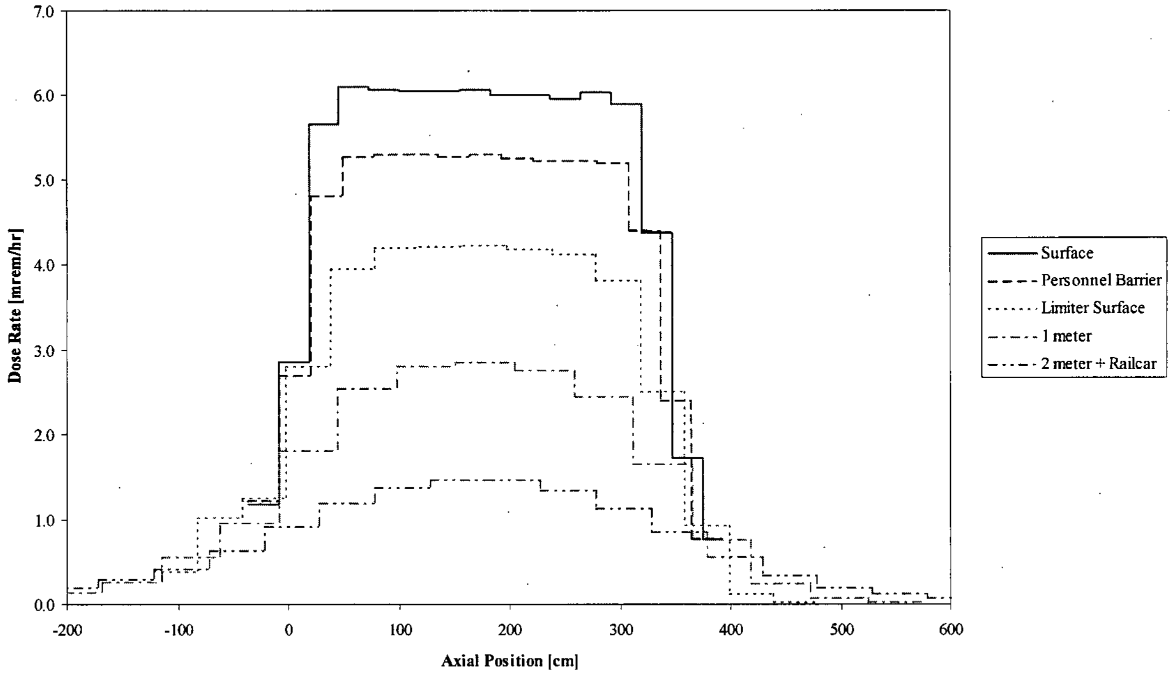
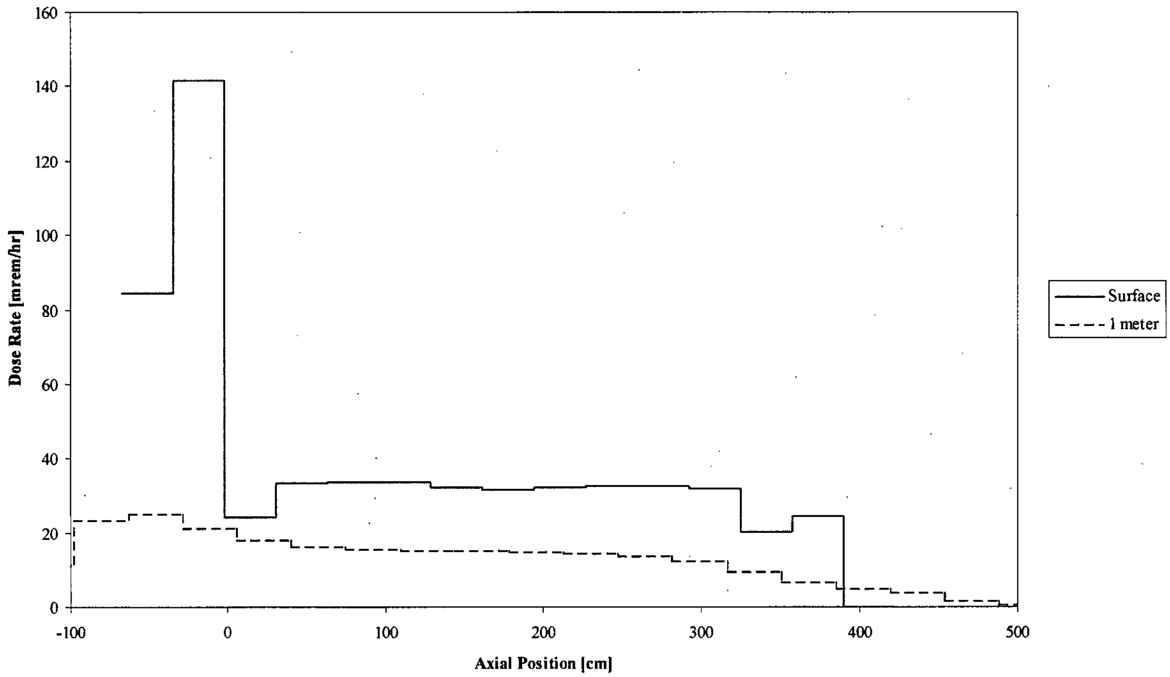


Figure 5.4-16 NAC-STC CY-MPC Radial Dose Rate Profile – Accident Conditions – GTCC Waste



Note: Surface peak is due to gamma streaming through the void created by the modeled bottom axial lead slump and minimal shielding of the canister bottom plate. A similar peak is not observed near the top of the transport cask because of the additional shielding of the canister lids.

Table 5.4-1 ANSI/ANS 6.1.1-1977 Neutron Flux-to-Dose Conversion Factors

Energy [MeV]	**Response [(rem/hr)/(n/cm^2/sec)]**
20.0	2.27E-04
14.0	2.08E-04
10.0	1.47E-04
7.0	1.47E-04
5.0	1.56E-04
2.5	1.25E-04
1.0	1.32E-04
5.0E-01	9.26E-05
1.0E-01	2.17E-05
1.0E-02	3.56E-06
1.0E-03	3.76E-06
1.0E-04	4.18E-06
1.0E-05	4.54E-06
1.0E-06	4.46E-06
1.0E-07	3.67E-06
2.5E-08	3.67E-06

Table 5.4-2 ANSI/ANS 6.1.1-1977 Gamma Flux-to-Dose Conversion Factors

Energy, E [MeV]	**Response [(rem/hr)/(γ/cm²/sec)]**	**Energy, E [MeV]**	**Response [(rem/hr)/(γ/cm²/sec)]**
15.0	1.33E-05	1.0	1.98E-06
13.0	1.18E-05	0.8	1.68E-06
11.0	1.03E-05	0.7	1.52E-06
9.0	8.77E-06	0.65	1.44E-06
7.5	7.66E-06	0.6	1.36E-06
6.75	7.11E-06	0.55	1.27E-06
6.25	6.74E-06	0.5	1.17E-06
5.75	6.37E-06	0.45	1.08E-06
5.25	6.01E-06	0.4	9.85E-07
5.0	5.80E-06	0.35	8.78E-07
4.75	5.60E-06	0.3	7.59E-07
4.25	5.23E-06	0.25	6.31E-07
3.75	4.83E-06	0.2	5.01E-07
3.25	4.41E-06	0.15	3.79E-07
2.8	4.01E-06	0.1	2.83E-07
2.6	3.82E-06	0.07	2.58E-07
2.2	3.42E-06	0.05	2.90E-07
1.8	2.99E-06	0.03	5.82E-07
1.4	2.51E-06	0.01	3.96E-06

Table 5.4-3 Minimum Cooling Time Evaluation for 14×14 Reference Fuel

Enrichment [wt % ^{235}U]	Minimum Cooling Time (Years) 40,000 MWD/MTU			Active Constraint
	Decay Heat 850 W/assy	2m+Railcar 9.5 mrem/hr	Limiting	
1.7	-	-	-	-
1.9	6.2	11.6	12	2m+Railcar
2.1	6.1	10.8	11	2m+Railcar
2.3	6.0	10.0	10	2m+Railcar
2.5	5.9	9.3	10	2m+Railcar
2.7	5.8	8.7	9	2m+Railcar
2.9	5.8	8.2	9	2m+Railcar
3.1	5.7	7.7	8	2m+Railcar
3.3	5.6	7.3	8	2m+Railcar
3.5	5.6	6.9	7	2m+Railcar
3.7	5.5	6.5	7	2m+Railcar
3.9	5.5	6.2	7	2m+Railcar
4.1	5.4	5.9	6	2m+Railcar
4.3	5.4	5.7	6	2m+Railcar
4.5	5.3	5.6	6	2m+Railcar

Table 5.4-4 Radial Dose Rate Loading Table Results for Directly Loaded Fuel in Normal Conditions of Transport

Assembly	Source Term			Radial Dose Rate [mrem/hr]	
	Burnup [MWD/MTU]	Enrichment [wt % ^{235}U]	Cool Time [years]	Surface	2m+Railcar
14×14	40,000	2.3	10	366.3	9.5
15×15	40,000	2.5	9	337.8	9.4
16×16	40,000	1.9	9	317.4	9.2
17×17	40,000	2.3	9	358.9	9.2

Table 5.4-5 Loading Table for Directly Loaded PWR Fuel

Minimum Initial Enrichment wt % ^{235}U (E)	Burnup ≤30 GWD/MTU Minimum Cooling Time [years]				30< Burnup ≤35 GWD/MTU Minimum Cooling Time [years]			
	14×14	15×15	16×16	17×17	14×14	15×15	16×16	17×17
1.7 ≤ E < 1.9	8	7	6	7	10	10	7	9
1.9 ≤ E < 2.1	7	7	5	7	9	9	7	8
2.1 ≤ E < 2.3	7	7	5	6	9	8	6	8
2.3 ≤ E < 2.5	6	6	5	6	8	8	6	7
2.5 ≤ E < 2.7	6	6	5	6	8	7	6	7
2.7 ≤ E < 2.9	6	6	5	5	7	7	5	6
2.9 ≤ E < 3.1	6	5	5	5	7	7	5	6
3.1 ≤ E < 3.3	5	5	5	5	7	6	5	6
3.3 ≤ E < 3.5	5	5	5	5	6	6	5	6
3.5 ≤ E < 3.7	5	5	5	5	6	6	5	6
3.7 ≤ E < 3.9	5	5	5	5	6	6	5	6
3.9 ≤ E < 4.1	5	5	5	5	6	6	5	6
4.1 ≤ E < 4.3	5	5	5	5	5	6	5	6
4.3 ≤ E < 4.5	-	-	-	5	-	-	-	6
E ≥ 4.5	-	-	-	5	-	-	-	6

Minimum Initial Enrichment wt % ^{235}U (E)	35< Burnup ≤40 GWD/MTU Minimum Cooling Time [years]				40< Burnup ≤45 GWD/MTU Minimum Cooling Time [years]			
	14×14	15×15	16×16	17×17	14×14	15×15	16×16	17×17
1.7 ≤ E < 1.9	-	-	-	-	-	-	-	-
1.9 ≤ E < 2.1	12	13	9	11	-	-	-	-
2.1 ≤ E < 2.3	11	11	8	10	-	-	-	-
2.3 ≤ E < 2.5	10	10	8	9	14	15	12	14
2.5 ≤ E < 2.7	10	9	7	9	13	14	10	12
2.7 ≤ E < 2.9	9	9	7	8	12	12	9	11
2.9 ≤ E < 3.1	9	8	6	8	11	11	8	10
3.1 ≤ E < 3.3	8	8	6	7	10	10	8	9
3.3 ≤ E < 3.5	8	7	6	7	10	10	7	9
3.5 ≤ E < 3.7	7	7	6	7	9	9	7	9
3.7 ≤ E < 3.9	7	7	6	7	9	9	7	9
3.9 ≤ E < 4.1	7	7	6	7	8	9	7	9
4.1 ≤ E < 4.3	6	7	6	7	8	8	7	9
4.3 ≤ E < 4.5	-	-	-	7	-	-	-	8
E ≥ 4.5	-	-	-	7	-	-	-	8

Table 5.4-6 Detector Maximum Dose Rates for Directly Loaded Fuel in Normal Conditions of Transport

Detector	Source	Surface		2 meter	
		mrem/hr	RSD	mrem/hr	RSD
Top Axial	Fuel Neutron	0.4	0.2%	0.1	0.2%
	Fuel Gamma	0.2	0.8%	0.0	1.1%
	Fuel Hardware	0.3	1.8%	0.0	2.2%
	Fuel N-Gamma	0.1	1.3%	0.0	1.4%
	Upper Plenum	2.1	0.5%	0.4	0.5%
	Upper Nozzle	3.0	0.6%	0.6	0.6%
	Lower Nozzle	0.0	0.0%	0.0	0.0%
	Total	6.1	0.3%	1.3	0.3%
Radial	Fuel Neutron	152.2	0.3%	2.9	0.3%
	Fuel Gamma	2.2	3.8%	1.2	0.8%
	Fuel Hardware	6.1	5.7%	0.5	4.4%
	Fuel N-Gamma	1.4	4.7%	0.8	0.9%
	Upper Plenum	87.2	0.4%	1.8	0.4%
	Upper Nozzle	117.3	0.4%	2.2	0.5%
	Lower Nozzle	0.0	15.0%	0.0	0.8%
	Total	366.3	0.2%	9.5	0.3%
Bottom Axial	Fuel Neutron	4.0	0.3%	0.7	0.2%
	Fuel Gamma	0.7	1.1%	0.1	0.7%
	Fuel Hardware	2.3	0.9%	0.4	4.1%
	Fuel N-Gamma	0.4	1.3%	0.1	0.9%
	Upper Plenum	0.0	0.0%	0.0	0.0%
	Upper Nozzle	0.0	0.0%	0.0	0.0%
	Lower Nozzle	7.0	0.8%	1.3	0.7%
	Total	14.3	0.4%	2.6	0.7%

Note: Dose rates at 2 meter locations radially are 2 meters from the railcar. Dose rates at 2 meter locations axially are measured from the ends of the impact limiters.

Table 5.4-7 Detector Maximum Dose Rates for Directly Loaded Fuel in Accident Conditions

Detector	Source	Surface		1 meter	
		mrem/hr	RSD	mrem/hr	RSD
Top Axial	Fuel Neutron	31.2	0.5%	23.3	0.9%
	Fuel Gamma	1.8	2.6%	1.2	2.0%
	Fuel Hardware	1.5	4.6%	0.9	30.2%
	Fuel N-Gamma	0.5	1.3%	0.4	2.8%
	Upper Plenum	11.8	1.0%	6.2	1.0%
	Upper Nozzle	4.8	1.7%	2.0	2.0%
	Lower Nozzle	0.0	0.0%	0.0	0.0%
	Total	51.7	0.5%	34.1	1.1%
Radial	Fuel Neutron	1585.5	0.2%	577.8	0.2%
	Fuel Gamma	15.2	1.5%	8.1	0.9%
	Fuel Hardware	27.8	12.2%	11.8	11.7%
	Fuel N-Gamma	8.3	1.8%	4.3	1.1%
	Upper Plenum	0.0	0.0%	0.1	2.6%
	Upper Nozzle	0.0	0.0%	0.1	5.4%
	Lower Nozzle	0.0	44.5%	2.4	0.6%
	Total	1636.7	0.3%	604.6	0.3%
Bottom Axial	Fuel Neutron	119.3	0.3%	51.2	6.3%
	Fuel Gamma	20.5	1.2%	5.4	1.3%
	Fuel Hardware	5.0	4.7%	1.4	4.4%
	Fuel N-Gamma	5.4	1.1%	1.5	1.2%
	Upper Plenum	0.0	0.0%	0.0	0.0%
	Upper Nozzle	0.0	0.0%	0.0	0.0%
	Lower Nozzle	36.3	1.1%	9.6	1.3%
	Total	186.5	0.3%	69.1	4.7%

Note: The azimuthal maximum radial dose rates are 1728.3 (1.8%) and 663.9 (4.4%) mrem/hr at the surface and at 1 meter from the surface, respectively.

Table 5.4-8 Directly Loaded Radial Detector Description for Normal Conditions of Transport

Description	Inner Radius [cm]	Axial				Azimuthal	
		Lower [cm]	Upper [cm]	Divisions	Band [cm]	Divisions	Start Angle
Surface	124.71	-3.81	406.70	15	27.37	1	0
Package	110.11	406.70	425.60	1	18.90	1	0
Heat Fin	125.71	44.38	405.50	1	361.12	72	2.5
Trunnion	126.71	-3.81	19.05	1	22.86	36	5
2m+Railcar	357.48	-289.92	710.69	20	50.03	1	0

Table 5.4-9 Directly Loaded Radial Detector Description for Accident Conditions of Transport

Description	Inner Radius [cm]	Axial				Azimuthal	
		Lower [cm]	Upper [cm]	Divisions	Band [cm]	Divisions	Start Angle
Surface	124.71	-34.67	455.45	15	32.67	1	0
Surface Azi.	125.71	185.68	215.68	1	30.00	36	-110
1m	210.11	-134.67	555.45	20	34.51	1	0
1m Azi.	211.11	185.68	215.68	1	30.00	36	-110

Table 5.4-10 CY-MPC Neutron Flux-to-Dose Conversion Factors

Group	Upper E [MeV]	Lower E [MeV]	Response [(mrem/hr)/(n/cm^2/sec)]
1	1.46E+01	1.36E+01	2.0533E-01
2	1.36E+01	1.25E+01	1.8999E-01
3	1.25E+01	1.13E+01	1.7250E-01
4	1.13E+01	1.00E+01	1.5399E-01
5	1.00E+01	8.25E+00	1.4700E-01
6	8.25E+00	7.00E+00	1.4700E-01
7	7.00E+00	6.07E+00	1.4929E-01
8	6.07E+00	4.72E+00	1.5348E-01
9	4.72E+00	3.68E+00	1.4580E-01
10	3.68E+00	2.87E+00	1.3478E-01
11	2.87E+00	1.74E+00	1.2657E-01
12	1.74E+00	6.40E-01	1.2570E-01
13	6.40E-01	3.90E-01	8.8205E-02
14	3.90E-01	1.10E-01	4.6004E-02
15	1.10E-01	6.74E-02	1.8108E-02
16	6.74E-02	2.48E-02	1.0774E-02
17	2.48E-02	9.12E-03	4.9057E-03
18	9.12E-03	2.95E-03	3.6168E-03
19	2.95E-03	9.61E-04	3.7152E-03
20	9.61E-04	3.54E-04	3.8611E-03
21	3.54E-04	1.66E-04	4.0252E-03
22	1.66E-04	4.81E-05	4.1919E-03
23	4.81E-05	1.60E-05	4.3795E-03
24	1.60E-05	4.00E-06	4.5200E-03
25	4.00E-06	1.50E-06	4.4895E-03
26	1.50E-06	5.50E-07	4.3924E-03
27	5.50E-07	7.09E-08	3.9685E-03
28	7.09E-08	0.00E+00	2.3759E-03

Table 5.4-11 CY–MPC Gamma Flux-to-Dose Conversion Factors

Group	Upper E [MeV]	Lower E [MeV]	Response [(mrem/hr)/(γ/cm^2/sec)]
1	1.40E+01	1.20E+01	1.1728E-02
2	1.20E+01	1.00E+01	1.0225E-02
3	1.00E+01	8.00E+00	8.7164E-03
4	8.00E+00	6.50E+00	7.4457E-03
5	6.50E+00	5.00E+00	6.3551E-03
6	5.00E+00	4.00E+00	5.3991E-03
7	4.00E+00	3.00E+00	4.5984E-03
8	3.00E+00	2.50E+00	3.9449E-03
9	2.50E+00	2.00E+00	3.4485E-03
10	2.00E+00	1.66E+00	2.9982E-03
11	1.66E+00	1.44E+00	2.6706E-03
12	1.44E+00	1.22E+00	2.3929E-03
13	1.22E+00	1.00E+00	2.1055E-03
14	1.00E+00	8.00E-01	1.8164E-03
15	8.00E-01	6.00E-01	1.5143E-03
16	6.00E-01	4.00E-01	1.1686E-03
17	4.00E-01	3.00E-01	8.6947E-04
18	3.00E-01	2.00E-01	6.2398E-04
19	2.00E-01	1.00E-01	3.8050E-04
20	1.00E-01	5.00E-02	2.7163E-04
21	5.00E-02	2.00E-02	5.8620E-04
22	2.00E-02	1.00E-02	2.3540E-03

Table 5.4-12 NAC-STC CY-MPC Detector Maximum Dose Rates – Normal Conditions – Design Basis Stainless Steel Clad Fuel

Detector	Source	Surface		2 meter	
		mrem/hr	**RSD**	**mrem/hr**	**RSD**
Top Axial	Fuel Neutron	0.1	0.5%	0.1	2.8%
	Fuel Gamma	0.0	4.5%	0.0	7.1%
	Fuel Hardware	0.0	3.4%	0.0	4.6%
	Fuel N-Gamma	0.1	5.3%	0.0	7.3%
	Upper Plenum	0.0	1.9%	0.0	2.0%
	Upper Nozzle	0.0	1.0%	0.0	0.9%
	Lower Nozzle	0.0	0.0%	0.0	0.0%
	Total	0.3	2.4%	0.1	2.1%
Radial	Fuel Neutron	30.2	0.5%	0.9	0.6%
	Fuel Gamma	0.0	14.0%	0.9	0.7%
	Fuel Hardware	0.1	16.6%	1.5	0.8%
	Fuel N-Gamma	1.4	5.9%	0.2	14.9%
	Upper Plenum	0.3	1.6%	0.0	0.5%
	Upper Nozzle	2.1	0.6%	0.0	0.4%
	Lower Nozzle	0.0	58.0%	0.0	0.9%
	Total	34.0	0.5%	3.6	1.0%
Bottom Axial	Fuel Neutron	0.5	0.4%	0.1	1.2%
	Fuel Gamma	0.1	1.0%	0.0	0.9%
	Fuel Hardware	0.1	1.2%	0.0	1.0%
	Fuel N-Gamma	0.3	1.6%	0.0	1.6%
	Upper Plenum	0.0	0.0%	0.0	0.0%
	Upper Nozzle	0.0	0.0%	0.0	0.0%
	Lower Nozzle	0.6	0.6%	0.1	0.5%
	Total	1.6	0.4%	0.3	0.5%

Note: Dose rates at 2 meter location radially are 2 meters from the railcar. Dose rates at 2 meter locations axially are measured from the ends of the impact limiters.

Table 5.4-13 NAC-STC CY-MPC Detector Maximum Dose Rates – Normal Conditions – Design Basis Zircaloy Clad Fuel

Detector	Source	Surface		2 meter	
		mrem/hr	**RSD**	**mrem/hr**	**RSD**
Top Axial	Fuel Neutron	0.2	0.7%	0.1	3.7%
	Fuel Gamma	0.0	6.5%	0.0	5.0%
	Fuel Hardware	0.0	7.7%	0.0	3.9%
	Fuel N-Gamma	0.2	2.1%	0.0	3.9%
	Upper Plenum	0.0	2.1%	0.0	2.4%
	Upper Nozzle	0.0	0.6%	0.0	0.6%
	Lower Nozzle	0.0	0.0%	0.0	0.0%
	Total	0.4	1.0%	0.2	2.2%
Radial	Fuel Neutron	43.6	0.4%	1.3	0.5%
	Fuel Gamma	0.0	11.4%	1.0	0.9%
	Fuel Hardware	0.0	18.1%	0.8	0.7%
	Fuel N-Gamma	2.8	10.9%	0.3	7.5%
	Upper Plenum	0.3	1.6%	0.0	0.4%
	Upper Nozzle	2.4	0.6%	0.1	0.3%
	Lower Nozzle	0.0	100.0%	0.0	0.8%
	Total	49.1	0.7%	3.6	0.8%
Bottom Axial	Fuel Neutron	0.8	0.4%	0.1	0.9%
	Fuel Gamma	0.1	0.8%	0.0	0.7%
	Fuel Hardware	0.1	1.1%	0.0	0.9%
	Fuel N-Gamma	0.6	6.2%	0.1	4.4%
	Upper Plenum	0.0	0.0%	0.0	0.0%
	Upper Nozzle	0.0	0.0%	0.0	0.0%
	Lower Nozzle	0.4	0.6%	0.1	0.5%
	Total	2.0	1.8%	0.3	1.1%

Note: Dose rates at 2 meter location radially are 2 meters from the railcar. Dose rates at 2 meter locations axially are measured from the ends of the impact limiters.

Table 5.4-14 NAC-STC CY-MPC Detector Maximum Dose Rates – Accident Conditions – Design Basis Stainless Steel Clad Fuel

Detector	Source	Surface		1 meter	
		mrem/hr	RSD	mrem/hr	RSD
Top Axial	Fuel Neutron	2.1	0.6%	9.5	1.7%
	Fuel Gamma	0.0	5.1%	0.1	30.0%
	Fuel Hardware	0.0	2.6%	0.1	12.8%
	Fuel N-Gamma	0.2	11.8%	0.0	7.0%
	Upper Plenum	0.0	7.1%	0.2	5.7%
	Upper Nozzle	0.0	6.5%	0.8	0.9%
	Lower Nozzle	0.0	0.0%	0.0	0.0%
	Total	2.4	1.3%	10.8	1.5%
Radial	Fuel Neutron	746	0.6%	234	0.4%
	Fuel Gamma	21	5.4%	9	2.4%
	Fuel Hardware	31	2.8%	14	1.3%
	Fuel N-Gamma	9	59.3%	1	15.2%
	Upper Plenum	0	0.0%	0	2.1%
	Upper Nozzle	0	0.0%	0	1.2%
	Lower Nozzle	0	0.0%	0	3.6%
	Total	806	0.9%	259	0.4%
Bottom Axial	Fuel Neutron	4.7	0.5%	12.3	3.2%
	Fuel Gamma	0.3	1.0%	0.0	12.8%
	Fuel Hardware	0.4	1.1%	0.1	14.3%
	Fuel N-Gamma	1.1	1.9%	0.1	32.3%
	Upper Plenum	0.0	0.0%	0.0	0.0%
	Upper Nozzle	0.0	0.0%	0.0	0.0%
	Lower Nozzle	2.0	0.7%	0.5	12.0%
	Total	8.5	0.4%	13.0	3.1%

Table 5.4-15 NAC-STC CY-MPC Detector Maximum Dose Rates – Accident Conditions – Design Basis Zircaloy Clad Fuel

Detector	Source	Surface		1 meter	
		mrem/hr	**RSD**	**mrem/hr**	**RSD**
Top Axial	Fuel Neutron	3.1	0.6%	14.1	1.7%
	Fuel Gamma	0.0	2.1%	0.1	10.9%
	Fuel Hardware	0.0	4.4%	0.1	18.5%
	Fuel N-Gamma	0.3	5.4%	0.1	6.3%
	Upper Plenum	0.0	4.6%	0.2	2.6%
	Upper Nozzle	0.0	4.6%	1.0	1.0%
	Lower Nozzle	0.0	0.0%	0.0	0.0%
	Total	3.4	0.8%	15.4	1.6%
Radial	Fuel Neutron	1,123	0.6%	348	0.4%
	Fuel Gamma	23	3.3%	10	1.6%
	Fuel Hardware	19	3.2%	8	1.6%
	Fuel N-Gamma	5	31.0%	2	13.7%
	Upper Plenum	0	0.0%	0	2.1%
	Upper Nozzle	0	0.0%	0	1.7%
	Lower Nozzle	0	0.0%	0	7.1%
	Total	1,170	0.6%	369	0.4%
Bottom Axial	Fuel Neutron	7.6	0.5%	17.6	3.4%
	Fuel Gamma	0.4	1.1%	0.2	43.1%
	Fuel Hardware	0.3	0.8%	0.1	12.3%
	Fuel N-Gamma	1.7	3.9%	0.3	25.8%
	Upper Plenum	0.0	0.0%	0.0	0.0%
	Upper Nozzle	0.0	0.0%	0.0	0.0%
	Lower Nozzle	1.3	0.7%	0.4	12.1%
	Total	11.3	0.7%	18.5	3.3%

Table 5.4-16 NAC-STC CY-MPC Detector Average Dose Rates – Normal Conditions – Design Basis Stainless Steel Clad Fuel

Detector	Surface		2 meter	
	mrem/hr	RSD	mrem/hr	RSD
Top Axial	0.2	2.3%	0.1	3.4%
Radial	14.3	6.3%	1.6	5.3%
Bottom Axial	0.7	1.5%	0.2	3.2%

Note: Dose rates at 2 meter location radially are 2 meters from the railcar. Dose rates at 2 meter locations axially are measured from the ends of the impact limiters.

Table 5.4-17 NAC-STC CY-MPC Detector Average Dose Rates – Normal Conditions – Design Basis Zircaloy Clad Fuel

Detector	Surface		2 meter	
	mrem/hr	RSD	mrem/hr	RSD
Top Axial	0.3	1.4%	0.1	2.8%
Radial	15.5	1.2%	1.7	1.0%
Bottom Axial	1.0	2.0%	0.2	2.7%

Note: Dose rates at 2 meter location radially are 2 meters from the railcar. Dose rates at 2 meter locations axially are measured from the ends of the impact limiters.

Table 5.4-18 NAC-STC CY-MPC Detector Average Dose Rates – Accident Conditions – Design Basis Stainless Steel Clad Fuel

Detector	Surface		1 meter	
	mrem/hr	RSD	mrem/hr	RSD
Top Axial	1.5	1.0%	4.3	2.3%
Radial	444	0.8%	125	0.6%
Bottom Axial	5.0	0.6%	5.8	5.9%

Table 5.4-19 NAC-STC CY-MPC Detector Average Dose Rates – Accident Conditions – Design Basis Zircaloy Clad Fuel

Detector	Surface		1 meter	
	mrem/hr	RSD	mrem/hr	RSD
Top Axial	2.1	0.9%	6.2	2.3%
Radial	636	0.6%	178	0.6%
Bottom Axial	6.9	1.0%	8.3	4.5%

Table 5.4-20 NAC-STC CY-MPC Detector Maximum Dose Rates – Normal Conditions – Design Basis GTCC Waste

Detector	Surface		2 meter	
	mrem/hr	RSD	mrem/hr	RSD
Top Axial	<0.1	1.2%	<0.1	1.4%
Radial	6.1	0.6%	1.5	0.3%
Bottom Axial	4.2	0.2%	0.7	0.2%

Note: Dose rates at 2 meter location radially are 2 meters from the railcar. Dose rates at 2 meter locations axially are measured from the ends of the impact limiters.

Table 5.4-21 NAC-STC CY-MPC Detector Maximum Dose Rates – Accident Conditions – Design Basis GTCC Waste

Detector	Surface		1 meter	
	mrem/hr	RSD	mrem/hr	RSD
Top Axial	<0.1	8.5%	0.4	11.4%
Radial	141.4	10.8%	25.0	5.7%
Bottom Axial	16.7	0.2%	5.2	0.2%

Table 5.4-22 NAC-STC CY-MPC Detector Average Dose Rates – Normal Conditions – Design Basis GTCC Waste

Detector	Surface		2 meter	
	mrem/hr	**RSD**	**mrem/hr**	**RSD**
Top Axial	<0.1	2.2%	<0.1	4.8%
Radial	4.8	0.7%	0.6	0.4%
Bottom Axial	1.1	0.3%	0.2	1.0%

Note: Dose rates at 2 meter location radially are 2 meters from the railcar. Dose rates at 2 meter locations axially are measured from the ends of the impact limiters.

Table 5.4-23 NAC-STC CY-MPC Detector Average Dose Rates – Accident Conditions – Design Basis GTCC Waste

Detector	Surface		1 meter	
	mrem/hr	**RSD**	**mrem/hr**	**RSD**
Top Axial	<0.1	12.7%	0.1	13.5%
Radial	39.2	10.2%	12.5	5.0%
Bottom Axial	5.9	0.4%	2.3	3.5%

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5.5 Sample Input Files

This section contains sample input files employed in the shielding evaluations of the NAC-STC.

5.5.1 Sample Input Files for Directly Loaded Fuel

Sample input files for directly loaded fuel are provided in Figures 5.5-1 through 5.5-4.

Figure 5.5-1 SAS2H Input File for Directly Loaded 14×14 Fuel at 40,000 MWD/MTU and 2.3 wt % ^{235}U

```
=SAS2H       PARM=(HALT09,SKIPSHIPDATA)
Class 1 - aa14b - STC Hybrid14 (Rev 0) - 2.3 w/o U235, 40000 MWD/MTU, 5 - 16 years cool time
27GROUPNDF4 LATTICECELL
UO2         1 0.950 900 92235 2.3 92238 97.7 END
ZIRCALLOY  2 1.0 620 END
H2O         3 DEN=0.725 1.0 580 END
ARBM-BORMOD 0.725 1 1 0 0 5000 100 3 550.0E-6 580 END
ZIRCALLOY  4 1.0 580 END
H2O         5 DEN=0.725 0.9476 580 END
ZIRCALLOY  5 0.0524 580 END
END COMP
SQUAREPITCH 1.4122 0.9332 1 3 1.0719 2 0.9576 0 END
NPIN=179 FUEL=368.808 NCYC=3 NLIB=3 PRIN=6 LIGH=5
INPL=1 NUMH=16 NUMI=1 MXTUBE=4 ORTU=0.6102 SRTU=0.5239 END
POWER=13.7183 BURN=402.7954 DOWN=60 END
POWER=13.7183 BURN=402.7954 DOWN=60 END
POWER=13.7183 BURN=402.7954 DOWN=1461 END
FE 0.6738 CR 0.1900 NI 0.1150 MN 0.0200 CO 0.0012
END
=ORIGENS
0$$  A4 21 A8 26 A10 51 71  E
1$$  1 1T
COOLING 5 - 16 YEARS AND FISSION PRODUCT GAMMA REBIN
3$$  21 0 1 28 A33 22 E
54$$  A8 1 E T
35$$  0 T
56$$  0 9 A13 -2 5 3 E
57**  4.0 E T
COOLING 5 - 16 YEARS AND FISSION PRODUCT GAMMA REBIN
SINGLE REACTOR ASSEMBLY
60** 5.0 6.0 7.0 8.0 9.0 10.0 12.0 14.0 16.0
65$$  A4 1 A7 1 A10 1 A25 1 A28 1 A31 1 A46 1 A49 1 A52 1 E
61**  F.00000001
81$$  2 51 26 1 E
82$$  F6
83**  1.40e+7  1.20e+7  1.00e+7  8.00e+6   6.50e+6  5.00e+6
      4.00e+6  3.00e+6  2.50e+6  2.00e+6   1.66e+6  1.44e+6
      1.22e+6  1.00e+6  0.80e+6  0.60e+6   0.40e+6  0.30e+6
      0.20e+6  0.10e+6  0.05e+6  0.02e+6   0.01e+6
84**  1.46e+7  1.36e+7  1.25e+7  1.125e+7  1.00e+7
      8.25e+6  7.00e+6  6.07e+6  4.72e+6   3.68e+6
      2.87e+6  1.74e+6  0.64e+6  0.39e+6   0.11e+6
      6.74e+4  2.48e+4  9.12e+3  2.95e+3   9.61e+2
      3.54e+2  1.66e+2  4.81e+1  1.60e+1   4.00e+0
      1.50e+0  5.50e-1  7.09e-2  1.00e-5   T
FISSION PRODUCT GAMMA SPECTRA IN AEA GROUPS
FISSION PRODUCT GAMMA SPECTRA IN AEA GROUPS
FISSION PRODUCT GAMMA SPECTRA IN AEA GROUPS
FISSION PRODUCT GAMMA SPECTRA IN AEA GROUPS
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FISSION PRODUCT GAMMA SPECTRA IN AEA GROUPS
FISSION PRODUCT GAMMA SPECTRA IN AEA GROUPS
FISSION PRODUCT GAMMA SPECTRA IN AEA GROUPS
56$$ F0  T
END
=ORIGENS
0$$  A4 21 A8 26 A10 51 71  E
1$$  1 1T
COOLING 5 - 16 YEARS AND ACTINIDE GAMMA REBIN
3$$  21 0 1 28 A33 22 E
54$$  A8 1 E T
35$$  0 T
56$$  0 9 A13 -2 5 3 E
57**  4.0 E T
COOLING 5 - 16 YEARS AND ACTINIDE GAMMA REBIN
SINGLE REACTOR ASSEMBLY
60** 5.0 6.0 7.0 8.0 9.0 10.0 12.0 14.0 16.0
65$$  A4 1 A7 1 A10 1 A25 1 A28 1 A31 1 A46 1 A49 1 A52 1 E
61**  F.00000001
```

Figure 5.5-1 SAS2H Input File for Directly Loaded 14×14 Fuel at 40,000 MWD/MTU and 2.3 wt % ^{235}U (continued)

```
81$$  2 51 26 1 E
82$$  F5
83**  1.40e+7  1.20e+7  1.00e+7  8.00e+6   6.50e+6  5.00e+6
      4.00e+6  3.00e+6  2.50e+6  2.00e+6   1.66e+6  1.44e+6
      1.22e+6  1.00e+6  0.80e+6  0.60e+6   0.40e+6  0.30e+6
      0.20e+6  0.10e+6  0.05e+6  0.02e+6   0.01e+6
84**  1.46e+7  1.36e+7  1.25e+7  1.125e+7  1.00e+7
      8.25e+6  7.00e+6  6.07e+6  4.72e+6   3.68e+6
      2.87e+6  1.74e+6  0.64e+6  0.39e+6   0.11e+6
      6.74e+4  2.48e+4  9.12e+3  2.95e+3   9.61e+2
      3.54e+2  1.66e+2  4.81e+1  1.60e+1   4.00e+0
      1.50e+0  5.50e-1  7.09e-2  1.00e-5   T
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
56$$ F0  T
END
=ORIGENS
0$$  A4 21 A8 26 A10 51 71  E
1$$  1 1T
COOLING 5 - 16 YEARS AND LIGHT ELEMENT GAMMA REBIN
3$$  21 0 1 28 A33 22 E
54$$  A8 1 E T
35$$  0 T
56$$  0 9 A13 -2 5 3 E
57**  4.0 E T
COOLING 5 - 16 YEARS AND LIGHT ELEMENT GAMMA REBIN
SINGLE REACTOR ASSEMBLY
60** 5.0 6.0 7.0 8.0 9.0 10.0 12.0 14.0 16.0
65$$  A4 1 A7 1 A10 1 A25 1 A28 1 A31 1 A46 1 A49 1 A52 1 E
61**  F.00000001
81$$  2 51 26 1 E
82$$  F4
83**  1.40e+7  1.20e+7  1.00e+7  8.00e+6   6.50e+6  5.00e+6
      4.00e+6  3.00e+6  2.50e+6  2.00e+6   1.66e+6  1.44e+6
      1.22e+6  1.00e+6  0.80e+6  0.60e+6   0.40e+6  0.30e+6
      0.20e+6  0.10e+6  0.05e+6  0.02e+6   0.01e+6
84**  1.46e+7  1.36e+7  1.25e+7  1.125e+7  1.00e+7
      8.25e+6  7.00e+6  6.07e+6  4.72e+6   3.68e+6
      2.87e+6  1.74e+6  0.64e+6  0.39e+6   0.11e+6
      6.74e+4  2.48e+4  9.12e+3  2.95e+3   9.61e+2
      3.54e+2  1.66e+2  4.81e+1  1.60e+1   4.00e+0
      1.50e+0  5.50e-1  7.09e-2  1.00e-5   T
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
56$$ F0  T
END
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions

```
columns 1 200
*
*   NAC-STC - aa14b_07g - Fuel Gamma - Radial
*   Dry Cavity Conditions
*   Normal Transport Conditions
*   Transport Model Revision v1.5.1.0
*   Shielding Revision v1.5
*   STC Source Profile
*   Cobalt Concentration of 1.2 g/kg
*   Fuel Assembly Shift = Cavity, Basket Shift = None
*
* Parameters
*
@samps =    10000000

*
* Unit 1 Control Data
*
begin control data
    run
    sample limit     @samps
    time limit     1000m
    seeds    33113    94930
    chime every    [@samps/10]    samples
    report interim results
    sbd    30s
    dump intervals    1
end

*
* Unit 3 Output Control
*
*begin output control
*    suppress inflows
*end

*
* Unit 4 Material Geometry
*
begin material geometry
* Fuel Assembly Type A - Class 1 - aa14b - STC Hybrid14 (Rev 0)
PART    1    NEST
BOX    M5         0.0000    0.0000    0.0000    19.7180    19.7180    8.6944    ! lower nozzle
BOX    M1    S    0.0000    0.0000    0.0000    19.7180    19.7180    377.5024    ! fuel
BOX    M7         0.0000    0.0000    0.0000    19.7180    19.7180    400.3040    ! top plenum
BOX    M6         0.0000    0.0000    0.0000    19.7180    19.7180    409.1940    ! upper nozzle
* Fuel Assembly Type B - Class 1 - aa14b - STC Hybrid14 (Rev 0)
PART    2    NEST
BOX    M5         0.0000    0.0000    0.0000    19.7180    19.7180    8.6944    ! lower nozzle
BOX    M1    S    0.0000    0.0000    0.0000    19.7180    19.7180    377.5024    ! fuel
BOX    M7         0.0000    0.0000    0.0000    19.7180    19.7180    400.3040    ! top plenum
BOX    M6         0.0000    0.0000    0.0000    19.7180    19.7180    409.1940    ! upper nozzle
* Fuel Assembly in Tube (Type A) v1.1
PART    3
BOX    1    1.4135    1.4135    9.9060    19.7180    19.7180    409.1940    ! Fuel assembly
BOX    2    0.1219    0.1219    0.0000    22.3012    22.3012    419.1000    ! Space inside tube
BOX    3    0.0000    0.0000    6.3500    22.5450    22.5450    392.9380    ! Fuel tube
BOX    4    0.0000    0.0000    0.0000    22.5450    22.5450    419.1000    ! Container body - extent of basket cavity
ZONES
/Fuel Assembly/    P1    +1
/Space in Tube/    H5    +2    -1
/Fuel Tube/    M8    +3    -2
/Container/    H5    +4    -3    -2    -1
VOLUMES UNITY
* Fuel Assembly in Tube (Type B) v1.1
PART    4
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
BOX    1    1.4135    1.4135    9.9060    19.7180    19.7180    409.1940    ! Fuel assembly
BOX    2    0.1219    0.1219    0.0000    22.3012    22.3012    419.1000    ! Space inside tube
BOX    3    0.0000    0.0000    6.3500    22.5450    22.5450    392.9380    ! Fuel tube
BOX    4    0.0000    0.0000    0.0000    22.5450    22.5450    419.1000    ! Container body - extent of basket cavity
ZONES
/Fuel Assembly/    P2    +1
/Space in Tube/    H5    +2    -1
/Fuel Tube/    M8    +3    -2
/Container/    H5    +4    -3    -2    -1
VOLUMES UNITY
*  Type A Disk Opening with Tube v1.2
PART    5    CLUSTER
BOX    P3    0.4547    0.4547    0.0000    22.5450    22.5450    419.1000    ! Fuel tube type A with fuel assy
BOX    H5    0.0000    0.0000    0.0000    23.4544    23.4544    419.1000    ! Support disk opening width
*  Type B Disk Opening with Tube v1.2
PART    6    CLUSTER
BOX    P4    0.4547    0.4547    0.0000    22.5450    22.5450    419.1000    ! Fuel tube type B with fuel assy
BOX    H5    0.0000    0.0000    0.0000    23.4544    23.4544    419.1000    ! Support disk opening width
* STC Basket v1.2
PART    7
BOX    1    -38.9153    56.2432    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 1
BOX    2    -11.7272    56.2432    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 2
BOX    3    15.4610    56.2432    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 3
BOX    4    -70.7136    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 4
BOX    5    -38.9153    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 5
BOX    6    -11.7272    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 6
BOX    7    15.4610    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 7
BOX    8    47.2592    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 8
BOX    9    -70.7136    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 9
BOX    10    -38.9153    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 10
BOX    11    -11.7272    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 11
BOX    12    15.4610    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 12
BOX    13    47.2592    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 13
BOX    14    -70.7136    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 14
BOX    15    -38.9153    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 15
BOX    16    -11.7272    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 16
BOX    17    15.4610    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 17
BOX    18    47.2592    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 18
BOX    19    -70.7136    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 19
BOX    20    -38.9153    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 20
BOX    21    -11.7272    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 21
BOX    22    15.4610    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 22
BOX    23    47.2592    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 23
BOX    24    -38.9153    -79.6976    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 24
BOX    25    -11.7272    -79.6976    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 25
BOX    26    15.4610    -79.6976    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 26
ZROD    27    0.0000    0.0000    0.0000    89.9922    419.1000    ! Basket stack to cavity height
ZONES
/Opening01/    P5    +1
/Opening02/    P5    +2
/Opening03/    P5    +3
/Opening04/    P6    +4
/Opening05/    P5    +5
/Opening06/    P5    +6
/Opening07/    P5    +7
/Opening08/    P6    +8
/Opening09/    P5    +9
/Opening10/    P5    +10
/Opening11/    P5    +11
/Opening12/    P5    +12
/Opening13/    P5    +13
/Opening14/    P5    +14
/Opening15/    P5    +15
/Opening16/    P5    +16
/Opening17/    P5    +17
/Opening18/    P5    +18
/Opening19/    P6    +19
/Opening20/    P5    +20
/Opening21/    P5    +21
/Opening22/    P5    +22
/Opening23/    P6    +23
/Opening24/    P5    +24
/Opening25/    P5    +25
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
/Opening26/    P5    +26
/Basket/    H1    +27    -1    -2    -3    -4    -5
        -6    -7    -8    -9    -10    -11
        -12    -13    -14    -15    -16    -17
        -18    -19    -20    -21    -22    -23
        -24    -25    -26
VOLUMES    UNITY
* Basket in Cask Cavity v1.2
PART    8    NEST
ZROD    P7    0.0000    0.0000    0.0000    89.9922    419.1000        ! Basket inserted - Includes gap to lid
ZROD    H5    0.0000    0.0000    0.0000    90.1700    419.1000        ! Inserts flood matl to id of stc
* Transport Cask Inner Lid - With Ports v1.5.1.0
PART    9
ZROD    1    0.0000    0.0000    0.0000    100.3300    18.0848        ! Inner lid base
ZROD    2    0.0000    0.0000    18.0848    92.5957    4.7752        ! Inner lid cap
ZROD    3    0.0000    77.9907    0.0000    8.2931    22.8600        ! Drain port
ZROD    4    0.0000    -77.9907    0.0000    8.2931    22.8600        ! Vent port
ZROD    5    0.0000    0.0000    15.2400    85.6234    5.0800        ! Neutron shield
ZROD    6    0.0000    77.9907    15.2400    10.1600    5.0800        ! Cut circle 1 for neutron shield
ZROD    7    0.0000    -77.9907    15.2400    10.1600    5.0800        ! Cut circle 2 for neutron shield
BOX    8    -10.1600    77.9907    15.2400    20.3200    7.6327    5.0800        ! Cut box 1 for neutron shield
BOX    9    -10.1600    -85.6234    15.2400    20.3200    7.6327    5.0800        ! Cut box 2 for neutron shield
ZROD    10    0.0000    0.0000    0.0000    100.3300    22.8600        ! Container
ZONES
/Container/    M0    +10    -1    -2
/LidBase1/    M16    +1    -3    -4    -5    -6    -7
        -8    -9
/LidBase2/    M16    +1    +8    -6
/LidBase3/    M16    +1    +9    -7
/LidBase4/    M16    +1    +6    -3
/LidBase5/    M16    +1    +7    -4
/Nshield/    M15    +5    -6    -7    -8    -9
/LidCap1/    M16    +2    -3    -4    -5    -6    -7
        -8    -9
/LidCap2/    M16    +2    +8    -6
/LidCap3/    M16    +2    +9    -7
/LidCap4/    M16    +2    +6    -3
/LidCap5/    M16    +2    +7    -4
/DrainPort/    P10    +3
/VentPort/    P10    +4
VOLUMES UNITY
* Transport Cask Inner Lid Port Model - With Covers v1.5.1.0
PART    10    CLUSTER
ZROD    M0    0.0000    0.0000    0.0000    1.2700    10.8966        ! Bottom cylinder
ZROD    M0    0.0000    0.0000    10.8966    4.1275    7.5184        ! Middle cylinder
ZROD    M16    0.0000    0.0000    18.4150    8.2931    2.5400        ! Cover
ZROD    M0    0.0000    0.0000    20.9550    8.2931    1.9050        ! Top cylinder
ZROD    M16    0.0000    0.0000    0.0000    8.2931    22.8600        ! Inner lid material
*Transport Cask - Normal Conditions v1.5.1.0
PART    11
ZROD    1    0.0000    0.0000    -34.6710    110.1090    490.1184        ! Transport Cask
ZROD    2    0.0000    0.0000    0.0000    90.1700    419.1000        ! Cavity
ZROD    3    0.0000    0.0000    -20.8280    100.1776    5.0800        ! Bottom neutron shield
ZROD    4    0.0000    0.0000    419.1000    100.3300    22.8600        ! Inner lid
ZROD    5    0.0000    0.0000    0.0000    103.4034    408.9400        ! Lead shield cavity
ZROD    6    0.0000    0.0000    0.0000    95.2500    30.4800        ! Inner shell lower
ZCONE    7    0.0000    0.0000    30.4800    95.2500    93.9800    7.6200        ! Inner shell lower cone
ZROD    8    0.0000    0.0000    38.1000    93.9800    332.7400        ! Inner shell middle
ZCONE    9    0.0000    0.0000    370.8400    93.9800    95.2500    7.6200        ! Inner shell upper cone
ZROD    10    0.0000    0.0000    378.4600    95.2500    30.4800        ! Inner shell upper
ZROD    11    0.0000    0.0000    0.0000    103.2891    408.9400        ! Lead shield
ZROD    12    0.0000    0.0000    -3.8100    124.7140    410.5148        ! Radial neutron shield shell
ZROD    13    0.0000    0.0000    -2.6100    124.0790    408.1148        ! Radial neutron shield
ZP    14    2.4700                    ! Insulation (void) cut plane
ZCONE    15    0.0000    0.0000    19.0500    124.7140    113.9190    24.1300        ! Top of rotating trunnion
BOX    16    -124.7140    -12.7000    -3.8100    249.4280    25.4000    22.8600        ! Bottom of rotating trunnion
BOX    17    -114.2238    -12.7000    -3.8100    228.4476    25.4000    22.8600        ! Bottom of rotating trunnion base
BOX    18    -124.7140    -7.6200    -3.8100    249.4280    15.2400    15.2400        ! Trunnion void box
XROD    19    -124.7140    0.0000    11.4300    7.6200    249.4280        ! Trunnion void circle
BOX    20    -124.7140    -12.7000    -3.8100    249.4280    25.4000    46.9900        ! Trunnion extent box
ZSEC    21    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    14.6584    15.3416    ! Heat fin 1
ZSEC    22    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    29.6584    30.3416    ! Heat fin 2
ZSEC    23    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    44.6584    45.3416    ! Heat fin 3
ZSEC    24    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    59.6584    60.3416    ! Heat fin 4
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
ZSEC  25  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  74.6584   75.3416   ! Heat fin 5
ZSEC  26  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  89.6584   90.3416   ! Heat fin 6
ZSEC  27  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  104.6584  105.3416  ! Heat fin 7
ZSEC  28  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  119.6584  120.3416  ! Heat fin 8
ZSEC  29  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  134.6584  135.3416  ! Heat fin 9
ZSEC  30  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  149.6584  150.3416  ! Heat fin 10
ZSEC  31  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  164.6584  165.3416  ! Heat fin 11
ZSEC  32  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  179.6584  180.3416  ! Heat fin 12
ZSEC  33  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  194.6584  195.3416  ! Heat fin 13
ZSEC  34  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  209.6584  210.3416  ! Heat fin 14
ZSEC  35  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  224.6584  225.3416  ! Heat fin 15
ZSEC  36  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  239.6584  240.3416  ! Heat fin 16
ZSEC  37  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  254.6584  255.3416  ! Heat fin 17
ZSEC  38  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  269.6584  270.3416  ! Heat fin 18
ZSEC  39  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  284.6584  285.3416  ! Heat fin 19
ZSEC  40  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  299.6584  300.3416  ! Heat fin 20
ZSEC  41  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  314.6584  315.3416  ! Heat fin 21
ZSEC  42  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  329.6584  330.3416  ! Heat fin 22
ZSEC  43  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  344.6584  345.3416  ! Heat fin 23
ZSEC  44  0.0000  0.0000  -2.6100   110.1090  124.0790  408.1148  359.6584  360.3416  ! Heat fin 24
ZROD  45  0.0000  0.0000  425.6024  162.5600  85.0900            ! Upper impact limiter
ZROD  46  0.0000  0.0000  -89.9160  162.5600  85.0900            ! Lower impact limiter
ZROD  47  0.0000  0.0000  426.2374  161.9250  83.8200            ! Inside upper limiter shell
ZROD  48  0.0000  0.0000  -89.2810  161.9250  83.8200            ! Inside lower limiter shell
ZROD  49  0.0000  0.0000  425.6024  110.7440  30.4800            ! Upper end cap
ZROD  50  0.0000  0.0000  -35.3060  110.7440  30.4800            ! Lower end cap
ZROD  51  0.0000  0.0000  -89.9160  162.5600  600.6084           ! Container
ZROD  52  0.0000  0.0000  -3.8100   125.7140  27.3677            ! Surface detector #1
ZROD  53  0.0000  0.0000  23.5577   125.7140  27.3677            ! Surface detector #2
ZROD  54  0.0000  0.0000  50.9253   125.7140  27.3677            ! Surface detector #3
ZROD  55  0.0000  0.0000  78.2930   125.7140  27.3677            ! Surface detector #4
ZROD  56  0.0000  0.0000  105.6606  125.7140  27.3677            ! Surface detector #5
ZROD  57  0.0000  0.0000  133.0283  125.7140  27.3677            ! Surface detector #6
ZROD  58  0.0000  0.0000  160.3959  125.7140  27.3677            ! Surface detector #7
ZROD  59  0.0000  0.0000  187.7636  125.7140  27.3677            ! Surface detector #8
ZROD  60  0.0000  0.0000  215.1312  125.7140  27.3677            ! Surface detector #9
ZROD  61  0.0000  0.0000  242.4989  125.7140  27.3677            ! Surface detector #10
ZROD  62  0.0000  0.0000  269.8665  125.7140  27.3677            ! Surface detector #11
ZROD  63  0.0000  0.0000  297.2342  125.7140  27.3677            ! Surface detector #12
ZROD  64  0.0000  0.0000  324.6018  125.7140  27.3677            ! Surface detector #13
ZROD  65  0.0000  0.0000  351.9695  125.7140  27.3677            ! Surface detector #14
ZROD  66  0.0000  0.0000  379.3371  125.7140  27.3677            ! Surface detector #15
ZROD  67  0.0000  0.0000  406.7048  111.1090  18.8976            ! Package detector betw. NS and UpLim
ZSEC  68  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  2.5000    7.5000    ! Heat fin azi detector #1
ZSEC  69  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  7.5000    12.5000   ! Heat fin azi detector #2
ZSEC  70  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  12.5000   17.5000   ! Heat fin azi detector #3
ZSEC  71  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  17.5000   22.5000   ! Heat fin azi detector #4
ZSEC  72  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  22.5000   27.5000   ! Heat fin azi detector #5
ZSEC  73  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  27.5000   32.5000   ! Heat fin azi detector #6
ZSEC  74  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  32.5000   37.5000   ! Heat fin azi detector #7
ZSEC  75  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  37.5000   42.5000   ! Heat fin azi detector #8
ZSEC  76  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  42.5000   47.5000   ! Heat fin azi detector #9
ZSEC  77  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  47.5000   52.5000   ! Heat fin azi detector #10
ZSEC  78  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  52.5000   57.5000   ! Heat fin azi detector #11
ZSEC  79  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  57.5000   62.5000   ! Heat fin azi detector #12
ZSEC  80  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  62.5000   67.5000   ! Heat fin azi detector #13
ZSEC  81  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  67.5000   72.5000   ! Heat fin azi detector #14
ZSEC  82  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  72.5000   77.5000   ! Heat fin azi detector #15
ZSEC  83  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  77.5000   82.5000   ! Heat fin azi detector #16
ZSEC  84  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  82.5000   87.5000   ! Heat fin azi detector #17
ZSEC  85  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  87.5000   92.5000   ! Heat fin azi detector #18
ZSEC  86  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  92.5000   97.5000   ! Heat fin azi detector #19
ZSEC  87  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  97.5000   102.5000  ! Heat fin azi detector #20
ZSEC  88  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  102.5000  107.5000  ! Heat fin azi detector #21
ZSEC  89  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  107.5000  112.5000  ! Heat fin azi detector #22
ZSEC  90  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  112.5000  117.5000  ! Heat fin azi detector #23
ZSEC  91  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  117.5000  122.5000  ! Heat fin azi detector #24
ZSEC  92  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  122.5000  127.5000  ! Heat fin azi detector #25
ZSEC  93  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  127.5000  132.5000  ! Heat fin azi detector #26
ZSEC  94  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  132.5000  137.5000  ! Heat fin azi detector #27
ZSEC  95  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  137.5000  142.5000  ! Heat fin azi detector #28
ZSEC  96  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  142.5000  147.5000  ! Heat fin azi detector #29
ZSEC  97  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  147.5000  152.5000  ! Heat fin azi detector #30
ZSEC  98  0.0000  0.0000  44.3800   125.7140  126.7140  361.1248  152.5000  157.5000  ! Heat fin azi detector #31
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Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
ZSEC  99   0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  157.5000  162.5000 ! Heat fin azi detector #32
ZSEC  100  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  162.5000  167.5000 ! Heat fin azi detector #33
ZSEC  101  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  167.5000  172.5000 ! Heat fin azi detector #34
ZSEC  102  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  172.5000  177.5000 ! Heat fin azi detector #35
ZSEC  103  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  177.5000  182.5000 ! Heat fin azi detector #36
ZSEC  104  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  182.5000  187.5000 ! Heat fin azi detector #37
ZSEC  105  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  187.5000  192.5000 ! Heat fin azi detector #38
ZSEC  106  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  192.5000  197.5000 ! Heat fin azi detector #39
ZSEC  107  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  197.5000  202.5000 ! Heat fin azi detector #40
ZSEC  108  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  202.5000  207.5000 ! Heat fin azi detector #41
ZSEC  109  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  207.5000  212.5000 ! Heat fin azi detector #42
ZSEC  110  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  212.5000  217.5000 ! Heat fin azi detector #43
ZSEC  111  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  217.5000  222.5000 ! Heat fin azi detector #44
ZSEC  112  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  222.5000  227.5000 ! Heat fin azi detector #45
ZSEC  113  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  227.5000  232.5000 ! Heat fin azi detector #46
ZSEC  114  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  232.5000  237.5000 ! Heat fin azi detector #47
ZSEC  115  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  237.5000  242.5000 ! Heat fin azi detector #48
ZSEC  116  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  242.5000  247.5000 ! Heat fin azi detector #49
ZSEC  117  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  247.5000  252.5000 ! Heat fin azi detector #50
ZSEC  118  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  252.5000  257.5000 ! Heat fin azi detector #51
ZSEC  119  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  257.5000  262.5000 ! Heat fin azi detector #52
ZSEC  120  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  262.5000  267.5000 ! Heat fin azi detector #53
ZSEC  121  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  267.5000  272.5000 ! Heat fin azi detector #54
ZSEC  122  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  272.5000  277.5000 ! Heat fin azi detector #55
ZSEC  123  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  277.5000  282.5000 ! Heat fin azi detector #56
ZSEC  124  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  282.5000  287.5000 ! Heat fin azi detector #57
ZSEC  125  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  287.5000  292.5000 ! Heat fin azi detector #58
ZSEC  126  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  292.5000  297.5000 ! Heat fin azi detector #59
ZSEC  127  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  297.5000  302.5000 ! Heat fin azi detector #60
ZSEC  128  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  302.5000  307.5000 ! Heat fin azi detector #61
ZSEC  129  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  307.5000  312.5000 ! Heat fin azi detector #62
ZSEC  130  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  312.5000  317.5000 ! Heat fin azi detector #63
ZSEC  131  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  317.5000  322.5000 ! Heat fin azi detector #64
ZSEC  132  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  322.5000  327.5000 ! Heat fin azi detector #65
ZSEC  133  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  327.5000  332.5000 ! Heat fin azi detector #66
ZSEC  134  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  332.5000  337.5000 ! Heat fin azi detector #67
ZSEC  135  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  337.5000  342.5000 ! Heat fin azi detector #68
ZSEC  136  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  342.5000  347.5000 ! Heat fin azi detector #69
ZSEC  137  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  347.5000  352.5000 ! Heat fin azi detector #70
ZSEC  138  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  352.5000  357.5000 ! Heat fin azi detector #71
ZSEC  139  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  357.5000  362.5000 ! Heat fin azi detector #72
ZSEC  140  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  5.0000    15.0000   ! Rotating trunnion det#1
ZSEC  141  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  15.0000   25.0000   ! Rotating trunnion det#2
ZSEC  142  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  25.0000   35.0000   ! Rotating trunnion det#3
ZSEC  143  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  35.0000   45.0000   ! Rotating trunnion det#4
ZSEC  144  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  45.0000   55.0000   ! Rotating trunnion det#5
ZSEC  145  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  55.0000   65.0000   ! Rotating trunnion det#6
ZSEC  146  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  65.0000   75.0000   ! Rotating trunnion det#7
ZSEC  147  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  75.0000   85.0000   ! Rotating trunnion det#8
ZSEC  148  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  85.0000   95.0000   ! Rotating trunnion det#9
ZSEC  149  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  95.0000   105.0000  ! Rotating trunnion det#10
ZSEC  150  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  105.0000  115.0000  ! Rotating trunnion det#11
ZSEC  151  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  115.0000  125.0000  ! Rotating trunnion det#12
ZSEC  152  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  125.0000  135.0000  ! Rotating trunnion det#13
ZSEC  153  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  135.0000  145.0000  ! Rotating trunnion det#14
ZSEC  154  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  145.0000  155.0000  ! Rotating trunnion det#15
ZSEC  155  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  155.0000  165.0000  ! Rotating trunnion det#16
ZSEC  156  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  165.0000  175.0000  ! Rotating trunnion det#17
ZSEC  157  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  175.0000  185.0000  ! Rotating trunnion det#18
ZSEC  158  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  185.0000  195.0000  ! Rotating trunnion det#19
ZSEC  159  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  195.0000  205.0000  ! Rotating trunnion det#20
ZSEC  160  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  205.0000  215.0000  ! Rotating trunnion det#21
ZSEC  161  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  215.0000  225.0000  ! Rotating trunnion det#22
ZSEC  162  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  225.0000  235.0000  ! Rotating trunnion det#23
ZSEC  163  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  235.0000  245.0000  ! Rotating trunnion det#24
ZSEC  164  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  245.0000  255.0000  ! Rotating trunnion det#25
ZSEC  165  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  255.0000  265.0000  ! Rotating trunnion det#26
ZSEC  166  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  265.0000  275.0000  ! Rotating trunnion det#27
ZSEC  167  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  275.0000  285.0000  ! Rotating trunnion det#28
ZSEC  168  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  285.0000  295.0000  ! Rotating trunnion det#29
ZSEC  169  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  295.0000  305.0000  ! Rotating trunnion det#30
ZSEC  170  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  305.0000  315.0000  ! Rotating trunnion det#31
ZSEC  171  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  315.0000  325.0000  ! Rotating trunnion det#32
ZSEC  172  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  325.0000  335.0000  ! Rotating trunnion det#33
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
ZSEC   173   0.0000   0.0000   -3.8100   126.7140   127.7140   22.8600   335.0000   345.0000   ! Rotating trunnion det#34
ZSEC   174   0.0000   0.0000   -3.8100   126.7140   127.7140   22.8600   345.0000   355.0000   ! Rotating trunnion det#35
ZSEC   175   0.0000   0.0000   -3.8100   126.7140   127.7140   22.8600   355.0000   365.0000   ! Rotating trunnion det#36
ZROD   176   0.0000   0.0000   -4.8260   135.7630   430.4284      ! Personnel barrier surface
ZROD   177   0.0000   0.0000   -4.8260   136.7630   28.6952     ! Personnel barrier det #1
ZROD   178   0.0000   0.0000   23.8692   136.7630   28.6952     ! Personnel barrier det #2
ZROD   179   0.0000   0.0000   52.5645   136.7630   28.6952     ! Personnel barrier det #3
ZROD   180   0.0000   0.0000   81.2597   136.7630   28.6952     ! Personnel barrier det #4
ZROD   181   0.0000   0.0000   109.9549   136.7630   28.6952    ! Personnel barrier det #5
ZROD   182   0.0000   0.0000   138.6501   136.7630   28.6952    ! Personnel barrier det #6
ZROD   183   0.0000   0.0000   167.3454   136.7630   28.6952    ! Personnel barrier det #7
ZROD   184   0.0000   0.0000   196.0406   136.7630   28.6952    ! Personnel barrier det #8
ZROD   185   0.0000   0.0000   224.7358   136.7630   28.6952    ! Personnel barrier det #9
ZROD   186   0.0000   0.0000   253.4310   136.7630   28.6952    ! Personnel barrier det #10
ZROD   187   0.0000   0.0000   282.1263   136.7630   28.6952    ! Personnel barrier det #11
ZROD   188   0.0000   0.0000   310.8215   136.7630   28.6952    ! Personnel barrier det #12
ZROD   189   0.0000   0.0000   339.5167   136.7630   28.6952    ! Personnel barrier det #13
ZROD   190   0.0000   0.0000   368.2119   136.7630   28.6952    ! Personnel barrier det #14
ZROD   191   0.0000   0.0000   396.9072   136.7630   28.6952    ! Personnel barrier det #15
ZONES
/Cavity/    P8    +2
/OuterShell/    M16    +1    -2    -3    -4    -5
/InnerShell1/    M16    +6    -2
/InnerShell2/    M16    +7    -2
/InnerShell3/    M16    +8    -2
/InnerShell4/    M16    +9    -2
/InnerShell5/    M16    +10    -2
/InnerLid/    P9    +4
/BotNShield/    M15    +3
/LeadShield/    M14    +11    -6    -7    -8    -9    -10
/LeadShieldGap/    M0    +5    -11
/RadNShieldShell1/    M16    +12    -13    -1    -20
/RadNShieldShell2/    M16    +12    -13    -1    +20    -15    -16
/RadNShield1/    M15    +13    -1    -21    -22    -23    -24    -25
        -26    -27    -28    -29    -30    -31    -32
        -33    -34    -35    -36    -37    -38    -39
        -40    -41    -42    -43    -44    +14    -20
/RadNShield2/    M15    +13    -1    -32    -44    +20    -15    -16
/InsulationVoid/    M0    +13    -1    -14    -20
/RotTrunUpper/    M16    +15    -1    +20    +12
/RotTrunLower/    M16    +17    -1    +12
/RotTrunSide/    M16    +16    +12    -17    -18    -19
/RotTrunBoxVoid/    M0    +18    +12    -17
/RotTrunCircVoid/    M0    +19    -18    -17    +12
/HeatFin1/    M18    +21    +14
/HeatFin2/    M18    +22    +14
/HeatFin3/    M18    +23    +14
/HeatFin4/    M18    +24    +14
/HeatFin5/    M18    +25    +14
/HeatFin6/    M18    +26    +14
/HeatFin7/    M18    +27    +14
/HeatFin8/    M18    +28    +14
/HeatFin9/    M18    +29    +14
/HeatFin10/    M18    +30    +14
/HeatFin11/    M18    +31    +14
/HeatFin12/    M18    +32    +14    -15    -16
/HeatFin13/    M18    +33    +14
/HeatFin14/    M18    +34    +14
/HeatFin15/    M18    +35    +14
/HeatFin16/    M18    +36    +14
/HeatFin17/    M18    +37    +14
/HeatFin18/    M18    +38    +14
/HeatFin19/    M18    +39    +14
/HeatFin20/    M18    +40    +14
/HeatFin21/    M18    +41    +14
/HeatFin22/    M18    +42    +14
/HeatFin23/    M18    +43    +14
/HeatFin24/    M18    +44    +14    -15    -16
/UpLimShell/    M16    +45    -47    -49
/UpLimEnd/    M16    +49    -1
/LoLimShell/    M16    +46    -48    -50
/LoLimEnd/    M16    +50    -1
/UpBalsa/    M19    +47    -49
/LoBalsa/    M19    +48    -50
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
/InsidePersBarr/    M0    +176    -1    -12    -45    -46    -67    -52
         -53    -54    -55    -56    -57    -58    -59
         -60    -61    -62    -63    -64    -65    -66
         -68    -69    -70    -71    -72    -73    -74
         -75    -76    -77    -78    -79    -80    -81
         -82    -83    -84    -85    -86    -87    -88
         -89    -90    -91    -92    -93    -94    -95
         -96    -97    -98    -99    -100    -101    -102
         -103    -104    -105    -106    -107    -108    -109
         -110    -111    -112    -113    -114    -115    -116
         -117    -118    -119    -120    -121    -122    -123
         -124    -125    -126    -127    -128    -129    -130
         -131    -132    -133    -134    -135    -136    -137
         -138    -139    -140    -141    -142    -143    -144
         -145    -146    -147    -148    -149    -150    -151
         -152    -153    -154    -155    -156    -157    -158
         -159    -160    -161    -162    -163    -164    -165
         -166    -167    -168    -169    -170    -171    -172
         -173    -174    -175
/SurfaceDet1/    M0    +52    -12
/SurfaceDet2/    M0    +53    -12
/SurfaceDet3/    M0    +54    -12
/SurfaceDet4/    M0    +55    -12
/SurfaceDet5/    M0    +56    -12
/SurfaceDet6/    M0    +57    -12
/SurfaceDet7/    M0    +58    -12
/SurfaceDet8/    M0    +59    -12
/SurfaceDet9/    M0    +60    -12
/SurfaceDet10/    M0    +61    -12
/SurfaceDet11/    M0    +62    -12
/SurfaceDet12/    M0    +63    -12
/SurfaceDet13/    M0    +64    -12
/SurfaceDet14/    M0    +65    -12
/SurfaceDet15/    M0    +66    -12
/PackageDet/    M0    +67    -1
/HeatFinAziDet1/    M0    +68
/HeatFinAziDet2/    M0    +69
/HeatFinAziDet3/    M0    +70
/HeatFinAziDet4/    M0    +71
/HeatFinAziDet5/    M0    +72
/HeatFinAziDet6/    M0    +73
/HeatFinAziDet7/    M0    +74
/HeatFinAziDet8/    M0    +75
/HeatFinAziDet9/    M0    +76
/HeatFinAziDet10/    M0    +77
/HeatFinAziDet11/    M0    +78
/HeatFinAziDet12/    M0    +79
/HeatFinAziDet13/    M0    +80
/HeatFinAziDet14/    M0    +81
/HeatFinAziDet15/    M0    +82
/HeatFinAziDet16/    M0    +83
/HeatFinAziDet17/    M0    +84
/HeatFinAziDet18/    M0    +85
/HeatFinAziDet19/    M0    +86
/HeatFinAziDet20/    M0    +87
/HeatFinAziDet21/    M0    +88
/HeatFinAziDet22/    M0    +89
/HeatFinAziDet23/    M0    +90
/HeatFinAziDet24/    M0    +91
/HeatFinAziDet25/    M0    +92
/HeatFinAziDet26/    M0    +93
/HeatFinAziDet27/    M0    +94
/HeatFinAziDet28/    M0    +95
/HeatFinAziDet29/    M0    +96
/HeatFinAziDet30/    M0    +97
/HeatFinAziDet31/    M0    +98
/HeatFinAziDet32/    M0    +99
/HeatFinAziDet33/    M0    +100
/HeatFinAziDet34/    M0    +101
/HeatFinAziDet35/    M0    +102
/HeatFinAziDet36/    M0    +103
/HeatFinAziDet37/    M0    +104
/HeatFinAziDet38/    M0    +105
/HeatFinAziDet39/    M0    +106
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
/HeatFinAziDet40/   M0   +107
/HeatFinAziDet41/   M0   +108
/HeatFinAziDet42/   M0   +109
/HeatFinAziDet43/   M0   +110
/HeatFinAziDet44/   M0   +111
/HeatFinAziDet45/   M0   +112
/HeatFinAziDet46/   M0   +113
/HeatFinAziDet47/   M0   +114
/HeatFinAziDet48/   M0   +115
/HeatFinAziDet49/   M0   +116
/HeatFinAziDet50/   M0   +117
/HeatFinAziDet51/   M0   +118
/HeatFinAziDet52/   M0   +119
/HeatFinAziDet53/   M0   +120
/HeatFinAziDet54/   M0   +121
/HeatFinAziDet55/   M0   +122
/HeatFinAziDet56/   M0   +123
/HeatFinAziDet57/   M0   +124
/HeatFinAziDet58/   M0   +125
/HeatFinAziDet59/   M0   +126
/HeatFinAziDet60/   M0   +127
/HeatFinAziDet61/   M0   +128
/HeatFinAziDet62/   M0   +129
/HeatFinAziDet63/   M0   +130
/HeatFinAziDet64/   M0   +131
/HeatFinAziDet65/   M0   +132
/HeatFinAziDet66/   M0   +133
/HeatFinAziDet67/   M0   +134
/HeatFinAziDet68/   M0   +135
/HeatFinAziDet69/   M0   +136
/HeatFinAziDet70/   M0   +137
/HeatFinAziDet71/   M0   +138
/HeatFinAziDet72/   M0   +139
/RotTrunDet1/   M0   +140
/RotTrunDet2/   M0   +141
/RotTrunDet3/   M0   +142
/RotTrunDet4/   M0   +143
/RotTrunDet5/   M0   +144
/RotTrunDet6/   M0   +145
/RotTrunDet7/   M0   +146
/RotTrunDet8/   M0   +147
/RotTrunDet9/   M0   +148
/RotTrunDet10/   M0   +149
/RotTrunDet11/   M0   +150
/RotTrunDet12/   M0   +151
/RotTrunDet13/   M0   +152
/RotTrunDet14/   M0   +153
/RotTrunDet15/   M0   +154
/RotTrunDet16/   M0   +155
/RotTrunDet17/   M0   +156
/RotTrunDet18/   M0   +157
/RotTrunDet19/   M0   +158
/RotTrunDet20/   M0   +159
/RotTrunDet21/   M0   +160
/RotTrunDet22/   M0   +161
/RotTrunDet23/   M0   +162
/RotTrunDet24/   M0   +163
/RotTrunDet25/   M0   +164
/RotTrunDet26/   M0   +165
/RotTrunDet27/   M0   +166
/RotTrunDet28/   M0   +167
/RotTrunDet29/   M0   +168
/RotTrunDet30/   M0   +169
/RotTrunDet31/   M0   +170
/RotTrunDet32/   M0   +171
/RotTrunDet33/   M0   +172
/RotTrunDet34/   M0   +173
/RotTrunDet35/   M0   +174
/RotTrunDet36/   M0   +175
/PersBarrDet1/   M0   +177   -176
/PersBarrDet2/   M0   +178   -176
/PersBarrDet3/   M0   +179   -176
/PersBarrDet4/   M0   +180   -176
/PersBarrDet5/   M0   +181   -176
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
/PersBarrDet6/    M0    +182    -176
/PersBarrDet7/    M0    +183    -176
/PersBarrDet8/    M0    +184    -176
/PersBarrDet9/    M0    +185    -176
/PersBarrDet10/    M0    +186    -176
/PersBarrDet11/    M0    +187    -176
/PersBarrDet12/    M0    +188    -176
/PersBarrDet13/    M0    +189    -176
/PersBarrDet14/    M0    +190    -176
/PersBarrDet15/    M0    +191    -176
/Container/    M0    +51    -45    -46    -177    -178    -179    -180
        -181    -182    -183    -184    -185    -186    -187
        -188    -189    -190    -191
VOLUMES    52*1.0        15*2.1531E+04        1.3133E+04        72*3.9775E+03
        36*5.0756E+02        15*2.4568E+04        1.0
* Transport Cask Detector Description v1.5.1.0
PART    12
* Radial Detector DRA (Surface) Bodies
* Radial Detector DRA+ (Package) Bodies
* Radial Detector DRAA (HeatFin) Bodies
* Radial Detector DRAB (RotTrun) Bodies
* Radial Detector DRB (PersBarr) Bodies
* Radial Detector DRC (LimSurf) Bodies
ZROD    1    0.0000    0.0000    -89.9160  162.5600  600.6084
ZROD    2    0.0000    0.0000    -89.9160  163.5600  40.0406
ZROD    3    0.0000    0.0000    -49.8754  163.5600  40.0406
ZROD    4    0.0000    0.0000    -9.8349   163.5600  40.0406
ZROD    5    0.0000    0.0000    30.2057   163.5600  40.0406
ZROD    6    0.0000    0.0000    70.2462   163.5600  40.0406
ZROD    7    0.0000    0.0000    110.2868  163.5600  40.0406
ZROD    8    0.0000    0.0000    150.3274  163.5600  40.0406
ZROD    9    0.0000    0.0000    190.3679  163.5600  40.0406
ZROD    10   0.0000    0.0000    230.4085  163.5600  40.0406
ZROD    11   0.0000    0.0000    270.4490  163.5600  40.0406
ZROD    12   0.0000    0.0000    310.4896  163.5600  40.0406
ZROD    13   0.0000    0.0000    350.5302  163.5600  40.0406
ZROD    14   0.0000    0.0000    390.5707  163.5600  40.0406
ZROD    15   0.0000    0.0000    430.6113  163.5600  40.0406
ZROD    16   0.0000    0.0000    470.6518  163.5600  40.0406
* Radial Detector DRD (1m) Bodies
ZROD    17   0.0000    0.0000    -189.9160 224.7140  800.6084
ZROD    18   0.0000    0.0000    -189.9160 225.7140  53.3739
ZROD    19   0.0000    0.0000    -136.5421 225.7140  53.3739
ZROD    20   0.0000    0.0000    -83.1682  225.7140  53.3739
ZROD    21   0.0000    0.0000    -29.7943  225.7140  53.3739
ZROD    22   0.0000    0.0000    23.5796   225.7140  53.3739
ZROD    23   0.0000    0.0000    76.9535   225.7140  53.3739
ZROD    24   0.0000    0.0000    130.3274  225.7140  53.3739
ZROD    25   0.0000    0.0000    183.7013  225.7140  53.3739
ZROD    26   0.0000    0.0000    237.0751  225.7140  53.3739
ZROD    27   0.0000    0.0000    290.4490  225.7140  53.3739
ZROD    28   0.0000    0.0000    343.8229  225.7140  53.3739
ZROD    29   0.0000    0.0000    397.1968  225.7140  53.3739
ZROD    30   0.0000    0.0000    450.5707  225.7140  53.3739
ZROD    31   0.0000    0.0000    503.9446  225.7140  53.3739
ZROD    32   0.0000    0.0000    557.3185  225.7140  53.3739
* Radial Detector DRE (1m+LimSurf) Bodies
ZROD    33   0.0000    0.0000    -239.9160 262.5600  900.6084
ZROD    34   0.0000    0.0000    -239.9160 263.5600  60.0406
ZROD    35   0.0000    0.0000    -179.8754 263.5600  60.0406
ZROD    36   0.0000    0.0000    -119.8349 263.5600  60.0406
ZROD    37   0.0000    0.0000    -59.7943  263.5600  60.0406
ZROD    38   0.0000    0.0000    0.2462    263.5600  60.0406
ZROD    39   0.0000    0.0000    60.2868   263.5600  60.0406
ZROD    40   0.0000    0.0000    120.3274  263.5600  60.0406
ZROD    41   0.0000    0.0000    180.3679  263.5600  60.0406
ZROD    42   0.0000    0.0000    240.4085  263.5600  60.0406
ZROD    43   0.0000    0.0000    300.4490  263.5600  60.0406
ZROD    44   0.0000    0.0000    360.4896  263.5600  60.0406
ZROD    45   0.0000    0.0000    420.5302  263.5600  60.0406
ZROD    46   0.0000    0.0000    480.5707  263.5600  60.0406
ZROD    47   0.0000    0.0000    540.6113  263.5600  60.0406
ZROD    48   0.0000    0.0000    600.6518  263.5600  60.0406
* Radial Detector DRF (2m+Railcar) Bodies
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
ZROD     49              0.0000    0.0000    -289.9160 357.4800  1000.6084
ZROD     50              0.0000    0.0000    -289.9160 358.4800  50.0304
ZROD     51              0.0000    0.0000    -239.8856 358.4800  50.0304
ZROD     52              0.0000    0.0000    -189.8552 358.4800  50.0304
ZROD     53              0.0000    0.0000    -139.8247 358.4800  50.0304
ZROD     54              0.0000    0.0000    -89.7943  358.4800  50.0304
ZROD     55              0.0000    0.0000    -39.7639  358.4800  50.0304
ZROD     56              0.0000    0.0000    10.2665   358.4800  50.0304
ZROD     57              0.0000    0.0000    60.2969   358.4800  50.0304
ZROD     58              0.0000    0.0000    110.3274  358.4800  50.0304
ZROD     59              0.0000    0.0000    160.3578  358.4800  50.0304
ZROD     60              0.0000    0.0000    210.3882  358.4800  50.0304
ZROD     61              0.0000    0.0000    260.4186  358.4800  50.0304
ZROD     62              0.0000    0.0000    310.4490  358.4800  50.0304
ZROD     63              0.0000    0.0000    360.4795  358.4800  50.0304
ZROD     64              0.0000    0.0000    410.5099  358.4800  50.0304
ZROD     65              0.0000    0.0000    460.5403  358.4800  50.0304
ZROD     66              0.0000    0.0000    510.5707  358.4800  50.0304
ZROD     67              0.0000    0.0000    560.6011  358.4800  50.0304
ZROD     68              0.0000    0.0000    610.6316  358.4800  50.0304
ZROD     69              0.0000    0.0000    660.6620  358.4800  50.0304
* Radial Detector DRG (4m) Bodies
ZROD     70              0.0000    0.0000    -489.9160 524.7140  1400.6084
ZROD     71              0.0000    0.0000    -489.9160 525.7140  70.0304
ZROD     72              0.0000    0.0000    -419.8856 525.7140  70.0304
ZROD     73              0.0000    0.0000    -349.8552 525.7140  70.0304
ZROD     74              0.0000    0.0000    -279.8247 525.7140  70.0304
ZROD     75              0.0000    0.0000    -209.7943 525.7140  70.0304
ZROD     76              0.0000    0.0000    -139.7639 525.7140  70.0304
ZROD     77              0.0000    0.0000    -69.7335  525.7140  70.0304
ZROD     78              0.0000    0.0000    0.2969    525.7140  70.0304
ZROD     79              0.0000    0.0000    70.3274   525.7140  70.0304
ZROD     80              0.0000    0.0000    140.3578  525.7140  70.0304
ZROD     81              0.0000    0.0000    210.3882  525.7140  70.0304
ZROD     82              0.0000    0.0000    280.4186  525.7140  70.0304
ZROD     83              0.0000    0.0000    350.4490  525.7140  70.0304
ZROD     84              0.0000    0.0000    420.4795  525.7140  70.0304
ZROD     85              0.0000    0.0000    490.5099  525.7140  70.0304
ZROD     86              0.0000    0.0000    560.5403  525.7140  70.0304
ZROD     87              0.0000    0.0000    630.5707  525.7140  70.0304
ZROD     88              0.0000    0.0000    700.6011  525.7140  70.0304
ZROD     89              0.0000    0.0000    770.6316  525.7140  70.0304
ZROD     90              0.0000    0.0000    840.6620  525.7140  70.0304
* World
ZROD     91              0.0000    0.0000    -539.9160 574.7140  1500.6084
* External Void
ZROD     92              0.0000    0.0000    -589.9160 624.7140  1600.6084

ZONES
/TransportCask/    P11      +1
* Detector DRC (LimSurf)
/DRC01/   M0       +2       -1
/DRC02/   M0       +3       -1
/DRC03/   M0       +4       -1
/DRC04/   M0       +5       -1
/DRC05/   M0       +6       -1
/DRC06/   M0       +7       -1
/DRC07/   M0       +8       -1
/DRC08/   M0       +9       -1
/DRC09/   M0       +10      -1
/DRC10/   M0       +11      -1
/DRC11/   M0       +12      -1
/DRC12/   M0       +13      -1
/DRC13/   M0       +14      -1
/DRC14/   M0       +15      -1
/DRC15/   M0       +16      -1
/Void/    M0       +17      -1
                   -2       -3       -4       -5       -6       -7
                   -8       -9       -10      -11      -12      -13
                   -14      -15      -16
* Detector DRD (1m)
/DRD01/   M0       +18      -17
/DRD02/   M0       +19      -17
/DRD03/   M0       +20      -17
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
/DRD04/   M0        +21      -17
/DRD05/   M0        +22      -17
/DRD06/   M0        +23      -17
/DRD07/   M0        +24      -17
/DRD08/   M0        +25      -17
/DRD09/   M0        +26      -17
/DRD10/   M0        +27      -17
/DRD11/   M0        +28      -17
/DRD12/   M0        +29      -17
/DRD13/   M0        +30      -17
/DRD14/   M0        +31      -17
/DRD15/   M0        +32      -17
/Void/    M0        +33      -17
                    -18      -19      -20      -21      -22      -23
                    -24      -25      -26      -27      -28      -29
                    -30      -31      -32
* Detector DRE (1m+LimSurf)
/DRE01/   M0        +34      -33
/DRE02/   M0        +35      -33
/DRE03/   M0        +36      -33
/DRE04/   M0        +37      -33
/DRE05/   M0        +38      -33
/DRE06/   M0        +39      -33
/DRE07/   M0        +40      -33
/DRE08/   M0        +41      -33
/DRE09/   M0        +42      -33
/DRE10/   M0        +43      -33
/DRE11/   M0        +44      -33
/DRE12/   M0        +45      -33
/DRE13/   M0        +46      -33
/DRE14/   M0        +47      -33
/DRE15/   M0        +48      -33
/Void/    M0        +49      -33
                    -34      -35      -36      -37      -38      -39
                    -40      -41      -42      -43      -44      -45
                    -46      -47      -48
* Detector DRF (2m+Railcar)
/DRF01/   M0        +50      -49
/DRF02/   M0        +51      -49
/DRF03/   M0        +52      -49
/DRF04/   M0        +53      -49
/DRF05/   M0        +54      -49
/DRF06/   M0        +55      -49
/DRF07/   M0        +56      -49
/DRF08/   M0        +57      -49
/DRF09/   M0        +58      -49
/DRF10/   M0        +59      -49
/DRF11/   M0        +60      -49
/DRF12/   M0        +61      -49
/DRF13/   M0        +62      -49
/DRF14/   M0        +63      -49
/DRF15/   M0        +64      -49
/DRF16/   M0        +65      -49
/DRF17/   M0        +66      -49
/DRF18/   M0        +67      -49
/DRF19/   M0        +68      -49
/DRF20/   M0        +69      -49
/Void/    M0        +70      -49
                    -50      -51      -52      -53      -54      -55
                    -56      -57      -58      -59      -60      -61
                    -62      -63      -64      -65      -66      -67
                    -68      -69
* Detector DRG (4m)
/DRG01/   M0        +71      -70
/DRG02/   M0        +72      -70
/DRG03/   M0        +73      -70
/DRG04/   M0        +74      -70
/DRG05/   M0        +75      -70
/DRG06/   M0        +76      -70
/DRG07/   M0        +77      -70
/DRG08/   M0        +78      -70
/DRG09/   M0        +79      -70
/DRG10/   M0        +80      -70
/DRG11/   M0        +81      -70
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
/DRG12/   M0        +82      -70
/DRG13/   M0        +83      -70
/DRG14/   M0        +84      -70
/DRG15/   M0        +85      -70
/DRG16/   M0        +86      -70
/DRG17/   M0        +87      -70
/DRG18/   M0        +88      -70
/DRG19/   M0        +89      -70
/DRG20/   M0        +90      -70
/Void/    M0        +91      -70
                    -71      -72       -73      -74       -75      -76
                    -77      -78       -79      -80       -81      -82
                    -83      -84       -85      -86       -87      -88
                    -89      -90
/ExtVoid/ M-2000    +92      -91
Volumes
                    1.0      15*4.1023E+04      1.0       15*7.5527E+04      1.0      15*9.9238E+04
                    1.0      20*1.1253E+05      1.0       20*2.3110E+05      1.0      1.0
end

*
* Unit 5 Splitting Geometry for Radial Detectors - Gamma
*
begin splitting geometry
    r    35    fill    0.0000
                    n    10    89.9922
                    n    1     93.9800
                    n    16     103.4034
                    n    1     110.1090
                    n    5     124.0790
                    n    1     124.7140
                    n    1     167.5600

    z    48    fill    -94.9160
                    n    1     -89.9160
                    n    1     -89.2810
                    n    2     -35.3060
                    n    1     -34.6710
                    n    2     -20.8280
                    n    2     -15.7480
                    n    3     0.0000
                    n    5     18.6004
                    n    13     387.4084
                    n    2     410.2100
                    n    3     419.1000
                !    n    0     419.1000
                    n    3     434.3400
                    n    2     439.4200
                    n    3     455.4474
                    n    1     456.0824
                    n    2     510.0574
                    n    1     510.6924
                    n    1     515.6924

end

*
* Unit 6 - Source Geometry for Fuel Gamma
*
begin source geometry
    r    10    fill    0.0000    n    10    89.9922
    z    13
        18.6004    27.8206    37.0408    55.4812    92.3620    166.1236
        239.8852   276.7660   313.6468   350.5276   359.7478   368.9680
        378.1882   387.4084
end

*
* Unit 7
*
begin energy data
    gamma    dice
    importance    standard    22    groups
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
    scoring    as    importance
    simple    source    histogram    weighting    automatic
end

*
* Unit 8 Importance Map - Radial
*
begin importance map
    calculate
    targets    15
    part    12
    zones
        2    3    4    5    6
        7    8    9    10    11
        12    13    14    15    16
    strengths
        1.0E+02    1.0E+02    5.0E+01    5.0E+01    5.0E+01
        1.0E+01    1.0E+01    1.0E+00    1.0E+01    1.0E+01
        5.0E+01    5.0E+01    5.0E+01    1.0E+02    1.0E+02
    defer mixing
    void density    0.10
    track
!    coupled source
!    write gamma importances to 32
!    write unformatted file to 31
!    use method d
end

*
* Unit 9 Scoring Data - Radial
*
begin scoring data
    flux
    part    11
    from    53    to    67    ! DRA
    some    68            ! DRA+
    from    69    to    140    ! DRAA
    from    141    to    176    ! DRAB
    from    177    to    191    ! DRB
    part    12
    from    2    to    16    ! DRC
    from    18    to    32    ! DRD
    from    34    to    48    ! DRE
    from    50    to    69    ! DRF
    from    71    to    90    ! DRG
    responses    sos    ditto
    contributions to responses        ditto
    ! score distribution for response
    ! weight distribution    total
end

*
* Unit 10 Response Data
*
begin response data
* Scaled to mrem/hr
/ansi ans-6.1.1-1977 photon flux-dose conversion factors - mcnp table h.2 - mrem/
        function pairs
        1.5000E+01        1.3300E-02
        1.4787E+01        1.3142E-02
        1.4577E+01        1.2985E-02
        1.4370E+01        1.2831E-02
        1.4166E+01        1.2678E-02
        1.3964E+01        1.2528E-02
        1.3766E+01        1.2379E-02
        1.3570E+01        1.2231E-02
        1.3377E+01        1.2086E-02
        1.3187E+01        1.1942E-02
        1.3000E+01        1.1800E-02
        1.2785E+01        1.1641E-02
        1.2573E+01        1.1483E-02
        1.2365E+01        1.1328E-02
        1.2160E+01        1.1175E-02
        1.1958E+01        1.1025E-02
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
1.1760E+01    1.0876E-02
1.1565E+01    1.0729E-02
1.1374E+01    1.0584E-02
1.1185E+01    1.0441E-02
1.1000E+01    1.0300E-02
1.0781E+01    1.0136E-02
1.0567E+01    9.9740E-03
1.0357E+01    9.8149E-03
1.0152E+01    9.6583E-03
9.9499E+00    9.5043E-03
9.7522E+00    9.3526E-03
9.5585E+00    9.2035E-03
9.3686E+00    9.0566E-03
9.1824E+00    8.9122E-03
9.0000E+00    8.7700E-03
8.8374E+00    8.6521E-03
8.6777E+00    8.5358E-03
8.5210E+00    8.4211E-03
8.3670E+00    8.3079E-03
8.2158E+00    8.1962E-03
8.0674E+00    8.0861E-03
7.9216E+00    7.9774E-03
7.7785E+00    7.8701E-03
7.6380E+00    7.7644E-03
7.5000E+00    7.6600E-03
7.4214E+00    7.6031E-03
7.3436E+00    7.5467E-03
7.2666E+00    7.4907E-03
7.1905E+00    7.4351E-03
7.1151E+00    7.3799E-03
7.0406E+00    7.3251E-03
6.9668E+00    7.2707E-03
6.8937E+00    7.2167E-03
6.8215E+00    7.1632E-03
6.7500E+00    7.1100E-03
6.6983E+00    7.0721E-03
6.6469E+00    7.0344E-03
6.5959E+00    6.9969E-03
6.5454E+00    6.9596E-03
6.4952E+00    6.9225E-03
6.4454E+00    6.8856E-03
6.3960E+00    6.8489E-03
6.3469E+00    6.8124E-03
6.2983E+00    6.7761E-03
6.2500E+00    6.7400E-03
6.1981E+00    6.7021E-03
6.1466E+00    6.6643E-03
6.0956E+00    6.6268E-03
6.0450E+00    6.5895E-03
5.9948E+00    6.5524E-03
5.9450E+00    6.5155E-03
5.8956E+00    6.4788E-03
5.8467E+00    6.4423E-03
5.7981E+00    6.4061E-03
5.7500E+00    6.3700E-03
5.6979E+00    6.3331E-03
5.6463E+00    6.2963E-03
5.5952E+00    6.2598E-03
5.5445E+00    6.2235E-03
5.4943E+00    6.1874E-03
5.4446E+00    6.1515E-03
5.3953E+00    6.1158E-03
5.3464E+00    6.0803E-03
5.2980E+00    6.0451E-03
5.2500E+00    6.0100E-03
5.2244E+00    5.9887E-03
5.1990E+00    5.9674E-03
5.1737E+00    5.9462E-03
5.1485E+00    5.9251E-03
5.1235E+00    5.9041E-03
5.0985E+00    5.8831E-03
5.0737E+00    5.8622E-03
5.0490E+00    5.8414E-03
5.0245E+00    5.8207E-03
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
5.0000E+00      5.8000E-03
4.9744E+00      5.7797E-03
4.9490E+00      5.7594E-03
4.9236E+00      5.7393E-03
4.8985E+00      5.7192E-03
4.8734E+00      5.6991E-03
4.8485E+00      5.6792E-03
4.8237E+00      5.6593E-03
4.7990E+00      5.6394E-03
4.7744E+00      5.6197E-03
4.7500E+00      5.6000E-03
4.6975E+00      5.5619E-03
4.6455E+00      5.5240E-03
4.5941E+00      5.4863E-03
4.5433E+00      5.4490E-03
4.4931E+00      5.4118E-03
4.4434E+00      5.3750E-03
4.3942E+00      5.3384E-03
4.3456E+00      5.3020E-03
4.2975E+00      5.2659E-03
4.2500E+00      5.2300E-03
4.1971E+00      5.1886E-03
4.1449E+00      5.1474E-03
4.0934E+00      5.1066E-03
4.0425E+00      5.0662E-03
3.9922E+00      5.0260E-03
3.9425E+00      4.9862E-03
3.8935E+00      4.9467E-03
3.8451E+00      4.9075E-03
3.7972E+00      4.8686E-03
3.7500E+00      4.8300E-03
3.6967E+00      4.7863E-03
3.6442E+00      4.7429E-03
3.5924E+00      4.7000E-03
3.5414E+00      4.6574E-03
3.4911E+00      4.6152E-03
3.4415E+00      4.5734E-03
3.3926E+00      4.5320E-03
3.3444E+00      4.4910E-03
3.2968E+00      4.4503E-03
3.2500E+00      4.4100E-03
3.2019E+00      4.3683E-03
3.1546E+00      4.3269E-03
3.1079E+00      4.2860E-03
3.0619E+00      4.2454E-03
3.0166E+00      4.2052E-03
2.9720E+00      4.1655E-03
2.9280E+00      4.1260E-03
2.8847E+00      4.0870E-03
2.8420E+00      4.0483E-03
2.8000E+00      4.0100E-03
2.7793E+00      3.9906E-03
2.7588E+00      3.9713E-03
2.7384E+00      3.9520E-03
2.7182E+00      3.9329E-03
2.6981E+00      3.9138E-03
2.6782E+00      3.8949E-03
2.6585E+00      3.8760E-03
2.6388E+00      3.8573E-03
2.6193E+00      3.8386E-03
2.6000E+00      3.8200E-03
2.5569E+00      3.7780E-03
2.5146E+00      3.7364E-03
2.4729E+00      3.6953E-03
2.4319E+00      3.6547E-03
2.3917E+00      3.6145E-03
2.3520E+00      3.5747E-03
2.3131E+00      3.5354E-03
2.2747E+00      3.4965E-03
2.2371E+00      3.4580E-03
2.2000E+00      3.4200E-03
2.1563E+00      3.3744E-03
2.1135E+00      3.3293E-03
2.0715E+00      3.2849E-03
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
2.0303E+00    3.2410E-03
1.9900E+00    3.1978E-03
1.9504E+00    3.1551E-03
1.9117E+00    3.1130E-03
1.8737E+00    3.0714E-03
1.8365E+00    3.0304E-03
1.8000E+00    2.9900E-03
1.7553E+00    2.9381E-03
1.7118E+00    2.8872E-03
1.6693E+00    2.8371E-03
1.6279E+00    2.7879E-03
1.5875E+00    2.7395E-03
1.5481E+00    2.6920E-03
1.5096E+00    2.6453E-03
1.4722E+00    2.5994E-03
1.4356E+00    2.5543E-03
1.4000E+00    2.5100E-03
1.3537E+00    2.4512E-03
1.3089E+00    2.3937E-03
1.2656E+00    2.3376E-03
1.2237E+00    2.2828E-03
1.1832E+00    2.2293E-03
1.1441E+00    2.1771E-03
1.1062E+00    2.1260E-03
1.0696E+00    2.0762E-03
1.0342E+00    2.0275E-03
1.0000E+00    1.9800E-03
9.7793E-01    1.9477E-03
9.5635E-01    1.9160E-03
9.3525E-01    1.8848E-03
9.1461E-01    1.8541E-03
8.9443E-01    1.8238E-03
8.7469E-01    1.7941E-03
8.5539E-01    1.7649E-03
8.3651E-01    1.7361E-03
8.1805E-01    1.7078E-03
8.0000E-01    1.6800E-03
7.8939E-01    1.6633E-03
7.7892E-01    1.6467E-03
7.6859E-01    1.6303E-03
7.5839E-01    1.6141E-03
7.4833E-01    1.5980E-03
7.3841E-01    1.5821E-03
7.2861E-01    1.5663E-03
7.1895E-01    1.5507E-03
7.0941E-01    1.5353E-03
7.0000E-01    1.5200E-03
6.9483E-01    1.5118E-03
6.8970E-01    1.5037E-03
6.8461E-01    1.4955E-03
6.7955E-01    1.4875E-03
6.7454E-01    1.4795E-03
6.6956E-01    1.4715E-03
6.6461E-01    1.4635E-03
6.5971E-01    1.4557E-03
6.5483E-01    1.4478E-03
6.5000E-01    1.4400E-03
6.4482E-01    1.4318E-03
6.3968E-01    1.4236E-03
6.3458E-01    1.4155E-03
6.2952E-01    1.4075E-03
6.2450E-01    1.3994E-03
6.1952E-01    1.3915E-03
6.1458E-01    1.3835E-03
6.0968E-01    1.3756E-03
6.0482E-01    1.3678E-03
6.0000E-01    1.3600E-03
5.9480E-01    1.3507E-03
5.8965E-01    1.3415E-03
5.8454E-01    1.3324E-03
5.7948E-01    1.3233E-03
5.7446E-01    1.3142E-03
5.6948E-01    1.3053E-03
5.6455E-01    1.2964E-03
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
5.5966E-01        1.2875E-03
5.5481E-01        1.2787E-03
5.5000E-01        1.2700E-03
5.4478E-01        1.2596E-03
5.3962E-01        1.2493E-03
5.3450E-01        1.2391E-03
5.2943E-01        1.2290E-03
5.2440E-01        1.2190E-03
5.1943E-01        1.2090E-03
5.1450E-01        1.1991E-03
5.0962E-01        1.1893E-03
5.0479E-01        1.1796E-03
5.0000E-01        1.1700E-03
4.9476E-01        1.1607E-03
4.8957E-01        1.1514E-03
4.8444E-01        1.1422E-03
4.7937E-01        1.1331E-03
4.7434E-01        1.1241E-03
4.6937E-01        1.1151E-03
4.6445E-01        1.1062E-03
4.5958E-01        1.0974E-03
4.5477E-01        1.0887E-03
4.5000E-01        1.0800E-03
4.4473E-01        1.0701E-03
4.3952E-01        1.0603E-03
4.3438E-01        1.0506E-03
4.2929E-01        1.0409E-03
4.2426E-01        1.0314E-03
4.1930E-01        1.0220E-03
4.1439E-01        1.0126E-03
4.0953E-01        1.0033E-03
4.0474E-01        9.9411E-04
4.0000E-01        9.8500E-04
3.9469E-01        9.7374E-04
3.8946E-01        9.6260E-04
3.8429E-01        9.5160E-04
3.7920E-01        9.4072E-04
3.7417E-01        9.2996E-04
3.6920E-01        9.1933E-04
3.6431E-01        9.0882E-04
3.5947E-01        8.9843E-04
3.5470E-01        8.8815E-04
3.5000E-01        8.7800E-04
3.4465E-01        8.6531E-04
3.3937E-01        8.5279E-04
3.3418E-01        8.4046E-04
3.2907E-01        8.2831E-04
3.2404E-01        8.1633E-04
3.1908E-01        8.0453E-04
3.1420E-01        7.9290E-04
3.0939E-01        7.8143E-04
3.0466E-01        7.7014E-04
3.0000E-01        7.5900E-04
2.9458E-01        7.4511E-04
2.8926E-01        7.3147E-04
2.8403E-01        7.1809E-04
2.7890E-01        7.0495E-04
2.7386E-01        6.9205E-04
2.6891E-01        6.7938E-04
2.6405E-01        6.6695E-04
2.5928E-01        6.5474E-04
2.5460E-01        6.4276E-04
2.5000E-01        6.3100E-04
2.4448E-01        6.1661E-04
2.3909E-01        6.0255E-04
2.3381E-01        5.8881E-04
2.2865E-01        5.7538E-04
2.2361E-01        5.6226E-04
2.1867E-01        5.4943E-04
2.1385E-01        5.3690E-04
2.0913E-01        5.2466E-04
2.0451E-01        5.1269E-04
2.0000E-01        5.0100E-04
1.9433E-01        4.8721E-04
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
          1.8882E-01          4.7380E-04
          1.8346E-01          4.6076E-04
          1.7826E-01          4.4808E-04
          1.7321E-01          4.3575E-04
          1.6829E-01          4.2376E-04
          1.6352E-01          4.1210E-04
          1.5888E-01          4.0075E-04
          1.5438E-01          3.8973E-04
          1.5000E-01          3.7900E-04
          1.4404E-01          3.6809E-04
          1.3832E-01          3.5749E-04
          1.3282E-01          3.4720E-04
          1.2754E-01          3.3721E-04
          1.2247E-01          3.2750E-04
          1.1761E-01          3.1807E-04
          1.1293E-01          3.0892E-04
          1.0845E-01          3.0002E-04
          1.0414E-01          2.9139E-04
          1.0000E-01          2.8300E-04
          9.6496E-02          2.8039E-04
          9.3115E-02          2.7781E-04
          8.9852E-02          2.7526E-04
          8.6704E-02          2.7272E-04
          8.3666E-02          2.7021E-04
          8.0734E-02          2.6772E-04
          7.7906E-02          2.6526E-04
          7.5176E-02          2.6282E-04
          7.2542E-02          2.6040E-04
          7.0000E-02          2.5800E-04
          6.7684E-02          2.6103E-04
          6.5444E-02          2.6410E-04
          6.3279E-02          2.6721E-04
          6.1185E-02          2.7035E-04
          5.9161E-02          2.7353E-04
          5.7203E-02          2.7675E-04
          5.5311E-02          2.8000E-04
          5.3481E-02          2.8330E-04
          5.1711E-02          2.8663E-04
          5.0000E-02          2.9000E-04
          4.7510E-02          3.1092E-04
          4.5144E-02          3.3335E-04
          4.2896E-02          3.5740E-04
          4.0760E-02          3.8318E-04
          3.8730E-02          4.1083E-04
          3.6801E-02          4.4047E-04
          3.4968E-02          4.7224E-04
          3.3227E-02          5.0631E-04
          3.1572E-02          5.4284E-04
          3.0000E-02          5.8200E-04
          2.6879E-02          7.0502E-04
          2.4082E-02          8.5404E-04
          2.1577E-02          1.0346E-03
          1.9332E-02          1.2532E-03
          1.7321E-02          1.5181E-03
          1.5518E-02          1.8390E-03
          1.3904E-02          2.2277E-03
          1.2457E-02          2.6986E-03
          1.1161E-02          3.2690E-03
          1.0000E-02          3.9600E-03
end

*
* Unit 13 Hole Data
*
begin hole data
* STC Basket Hole Description v1.2
* Hole    1    General Basket Structure
PLATE
0    0    1
7
417.8300    0           ! Top of Basket
389.4976    -2           ! Top of Highest Support Disk
326.4316    -7           ! Resume support disk only
79.2376     -4          ! Start of support+heat disk region
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
17.4396    -6           ! Bottom of Lowest Support Disk
0.0000     -3           ! Bottom of Basket
0.0000     0           ! Basket Offset
0

* Hole     2    Top Weldment Disk - no structure above the weldment disk
RZMESH
2               ! number of radial points
85.5472
89.9922
3               ! number of axial intervals
389.4976               ! Top of diskstack
400.5580               ! Bottom of weldment
403.0980               ! Top of weldment plate
417.8300               ! Void to top of basket
0    0          ! Material below weldment
10    10          ! Plate Material
0    10          ! Flange
0               ! Outside material

* Hole     3    Bottom Weldment Disk - no structure in the weldment disk support
RZMESH
1               ! number of radial points
89.9922
1               ! number of axial intervals
3.8100
6.3500               ! Coordinates inherited from PLATE Hole
10               ! Plate Material
0               ! Outside material

* Hole     4    Support disk and heat transfer disk stack
PLATE
origin    0    0    79.2376    ! Origin
0    0    1
4
cell    12.3597           ! Sets up a repeating lattice of cells.
12.3597    0           ! flood matl
7.6086    0           ! water gap
6.0211    11           ! aluminium disk
1.2700    0           ! water gap
9               ! steel disk

* Hole     5    Flood material model
PLATE
0    0    1
1
417.8300    0           ! Above flooded region
0               ! Flooded region

* Hole     6    Support disk stack lower
PLATE
origin    0    0    17.4396    ! Origin
0    0    1
2
cell    12.3596           ! Sets up a repeating lattice of cells
12.3596    0           ! flood matl
1.2700    0           ! water gap
9               ! steel disk

* Hole     7    Support disk stack upper
PLATE
origin    0    0    326.4316    ! Origin
0    0    1
2
cell    12.3596           ! Sets up a repeating lattice of cells
12.3596    0           ! flood matl
1.2700    0           ! water gap
9               ! steel disk

end

*
* Unit 15 Source Strength - Fuel Gamma
*
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
* Class 1 - aa14b - STC Hybrid14 (Rev 0) - Fuel Gamma - Group 7 Reponse
begin source strength
    component        6.9739E-06    ! 1/volume (1/1.4339E+05)
    component    r    10*1.0
    component    z
        4.2500E-01    6.7500E-01    9.0000E-01    1.1000E+00    1.2000E+00    1.1500E+00
        1.0750E+00    1.0000E+00    8.6500E-01    7.4000E-01    6.5000E-01    5.5000E-01
        4.5000E-01
    component    energy
        6*0.0
        1.0000E+00
        15*0.0

end

*
* Unit 16 Simple Source Weights
*
*begin source weights
*
*end

*
* Unit 31 Tabular Output
*
begin tabular output
    /Case trnNrmDryRadFg_aa14b_07g - Det DRA - Surface - Response/
    response    interim
    number    some    1
    region    from    121    to    135
    output to file    also
    /Case trnNrmDryRadFg_aa14b_07g - Det DRB - PersBarr - Response/
    response
    number    some    1
    region    from    245    to    259
    output to file    also
    /Case trnNrmDryRadFg_aa14b_07g - Det DRC - LimSurf - Response/
    response
    number    some    1
    region    from    262    to    276
    output to file    also
    /Case trnNrmDryRadFg_aa14b_07g - Det DRD - 1m - Response/
    response
    number    some    1
    region    from    278    to    292
    output to file    also
    /Case trnNrmDryRadFg_aa14b_07g - Det DRE - 1m+LimSurf - Response/
    response
    number    some    1
    region    from    294    to    308
    output to file    also
end

*
* Unit 32 Material Specification
*
begin material specification
type    gamma
normalise
nmixtures    3
weight    mixture    1
            u235    3.2615E-02
            u238    8.4888E-01
            o    1.1850E-01
atoms    mixture    2
            h    6.6667E-01
            o    3.3333E-01
atoms    mixture    3
            c    2.8571E-01
            h    4.7619E-01
            o    2.3810E-01
*
* Materials List - Dry Conditions - v1.2 - Class 1 - aa14b - STC Hybrid14 (Rev 0) Fuel
*
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
nmaterials    20
volume                          ! Homogenized aa14b Fuel
material    1
    mixture    1    density    10.4120    prop    3.1489E-01    ! UO2 mixture at 3.7%
    void              prop    1.6671E-02    ! Gap
    zircalloy         density    6.5500    prop    9.7331E-02    ! Tube, clad
    void              prop    5.7111E-01    ! Interstitial, inside tubes
volume                          ! Fuel pin cladding
material    2
    zircalloy         density    6.5500    prop    1.0000
volume                          ! Water In Lattice and Tube
material    3
    mixture    2    density    0.9982    prop    1.0000    ! mixH2O
volume                          ! Water In Fuel Rod Clad Gap
material    4
    mixture    2    density    0.9982    prop    1.0000    ! mixH2O
volume                          ! Lower Nozzle Material
material    5
    stainless 3041 steel        density    7.9200    prop    0.2948
    zircalloy         density    6.5500    prop    0.0831
    void              prop    0.6220
volume                          ! Upper Nozzle Material
material    6
    stainless 3041 steel        density    7.9200    prop    0.3613
    void              prop    0.6387
volume                          ! Upper Plenum Material
material    7
    stainless 3041 steel        density    7.9200    prop    0.1147
    zircalloy         density    6.5500    prop    0.0858
    void              prop    0.7995
*
* Materials List - Common Materials - v1.2
*
volume                          ! Tube wall and cover sheet
material    8
    stainless 3041 steel        density    7.9200    prop    1.0000
volume                          ! Structural Disk Material
material    9
    stainless 3041 steel        density    7.9200    prop    1.0000
volume                          ! Weldment Material
material    10
    stainless 3041 steel        density    7.9200    prop    1.0000
volume                          ! Heat Transfer Disk Material
material    11
    aluminium              prop    1.0000
volume                          ! Canister Material
material    12
    stainless 3041 steel        density    7.9200    prop    1.0000
atoms                           ! Transfer steel
material    13        density    0            !  (SCALE carbon steel)

        c           prop    3.9250E-03
        fe          prop    8.3498E-02
volume                          ! Lead
material    14
    pb      density    11.0400    prop    1.0000
atoms                           ! NS-4-FR
material    15        density    0            ! 0 means atom/b-cm
        b10          prop    8.5500E-05
        b11          prop    3.4200E-04
        al          prop    7.8000E-03
        h           prop    5.8500E-02
        o           prop    2.6100E-02
        c           prop    2.2600E-02
        n           prop    1.3900E-03
volume                          ! Stainless Steel 304
material    16
    stainless 3041 steel        density    7.9200    prop    1.0000
volume                          ! Vent port middle cylinder
material    17
    stainless 3041 steel        density    7.9200    prop    0.5000
    void              prop    0.5000
volume                          ! Heat fins for transport cask
material    18
```

Figure 5.5-2 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 7 – Normal Conditions (continued)

```
    cu        density    8.9200    prop    0.4286
    stainless 3041 steel       density    7.9200    prop    0.5714
volume                        ! Balsa
material    19
    mixture    3    density    0.1250    prop    1.0000
volume                        ! Redwood
material    20
    mixture    3    density    0.3870    prop    1.0000
end
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions

```
columns 1 200
*
*   NAC-STC - aa14b_02g - Fuel Neutron - Radial
*   Dry Cavity Conditions
*   Normal Transport Conditions
*   Transport Model Revision v1.5.1.0
*   Shielding Revision v1.5
*   STC Source Profile
*   Cobalt Concentration of 1.2 g/kg
*   Fuel Assembly Shift = Cavity, Basket Shift = None
*
* Parameters
*
@samps =    5000000

*
* Unit 1 Control Data
*
begin control data
    run
    sample limit     @samps
    time limit     1000m
    seeds    61444    14676
    chime every    [@samps/10]    samples
    report interim results
    sbd    30s
    dump intervals    1
end

*
* Unit 3 Output Control
*
*begin output control
*    suppress inflows
*end

*
* Unit 4 Material Geometry
*
begin material geometry
* Fuel Assembly Type A - Class 1 - aa14b - STC Hybrid14 (Rev 0)
PART    1    NEST
BOX    M5        0.0000    0.0000    0.0000    19.7180    19.7180    8.6944     ! lower nozzle
BOX    M1    S    0.0000    0.0000    0.0000    19.7180    19.7180    377.5024    ! fuel
BOX    M7        0.0000    0.0000    0.0000    19.7180    19.7180    400.3040    ! top plenum
BOX    M6        0.0000    0.0000    0.0000    19.7180    19.7180    409.1940    ! upper nozzle
* Fuel Assembly Type B - Class 1 - aa14b - STC Hybrid14 (Rev 0)
PART    2    NEST
BOX    M5        0.0000    0.0000    0.0000    19.7180    19.7180    8.6944     ! lower nozzle
BOX    M1    S    0.0000    0.0000    0.0000    19.7180    19.7180    377.5024    ! fuel
BOX    M7        0.0000    0.0000    0.0000    19.7180    19.7180    400.3040    ! top plenum
BOX    M6        0.0000    0.0000    0.0000    19.7180    19.7180    409.1940    ! upper nozzle
* Fuel Assembly in Tube (Type A) v1.1
PART    3
BOX    1    1.4135    1.4135    9.9060    19.7180    19.7180    409.1940    ! Fuel assembly
BOX    2    0.1219    0.1219    0.0000    22.3012    22.3012    419.1000    ! Space inside tube
BOX    3    0.0000    0.0000    6.3500    22.5450    22.5450    392.9380    ! Fuel tube
BOX    4    0.0000    0.0000    0.0000    22.5450    22.5450    419.1000    ! Container body - extent of basket cavity
ZONES
/Fuel Assembly/    P1    +1
/Space in Tube/    H5    +2    -1
/Fuel Tube/    M8    +3    -2
/Container/    H5    +4    -3    -2    -1
VOLUMES UNITY
* Fuel Assembly in Tube (Type B) v1.1
PART    4
BOX    1    1.4135    1.4135    9.9060    19.7180    19.7180    409.1940    ! Fuel assembly
BOX    2    0.1219    0.1219    0.0000    22.3012    22.3012    419.1000    ! Space inside tube
BOX    3    0.0000    0.0000    6.3500    22.5450    22.5450    392.9380    ! Fuel tube
BOX    4    0.0000    0.0000    0.0000    22.5450    22.5450    419.1000    ! Container body - extent of basket cavity
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
ZONES
/Fuel Assembly/    P2    +1
/Space in Tube/    H5    +2    -1
/Fuel Tube/    M8    +3    -2
/Container/    H5    +4    -3    -2    -1
VOLUMES UNITY
*  Type A Disk Opening with Tube v1.2
PART    5    CLUSTER
BOX   P3    0.4547    0.4547    0.0000    22.5450    22.5450    419.1000    ! Fuel tube type A with fuel assy
BOX   H5    0.0000    0.0000    0.0000    23.4544    23.4544    419.1000    ! Support disk opening width
*  Type B Disk Opening with Tube v1.2
PART    6    CLUSTER
BOX   P4    0.4547    0.4547    0.0000    22.5450    22.5450    419.1000    ! Fuel tube type B with fuel assy
BOX   H5    0.0000    0.0000    0.0000    23.4544    23.4544    419.1000    ! Support disk opening width
* STC Basket v1.2
PART    7
BOX   1    -38.9153    56.2432    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 1
BOX   2    -11.7272    56.2432    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 2
BOX   3    15.4610    56.2432    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 3
BOX   4    -70.7136    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 4
BOX   5    -38.9153    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 5
BOX   6    -11.7272    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 6
BOX   7    15.4610    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 7
BOX   8    47.2592    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 8
BOX   9    -70.7136    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 9
BOX   10    -38.9153    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 10
BOX   11    -11.7272    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 11
BOX   12    15.4610    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 12
BOX   13    47.2592    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 13
BOX   14    -70.7136    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 14
BOX   15    -38.9153    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 15
BOX   16    -11.7272    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 16
BOX   17    15.4610    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 17
BOX   18    47.2592    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 18
BOX   19    -70.7136    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 19
BOX   20    -38.9153    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 20
BOX   21    -11.7272    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 21
BOX   22    15.4610    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 22
BOX   23    47.2592    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 23
BOX   24    -38.9153    -79.6976    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 24
BOX   25    -11.7272    -79.6976    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 25
BOX   26    15.4610    -79.6976    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 26
ZROD   27    0.0000    0.0000    0.0000    89.9922    419.1000    ! Basket stack to cavity height
ZONES
/Opening01/    P5    +1
/Opening02/    P5    +2
/Opening03/    P5    +3
/Opening04/    P6    +4
/Opening05/    P5    +5
/Opening06/    P5    +6
/Opening07/    P5    +7
/Opening08/    P6    +8
/Opening09/    P5    +9
/Opening10/    P5    +10
/Opening11/    P5    +11
/Opening12/    P5    +12
/Opening13/    P5    +13
/Opening14/    P5    +14
/Opening15/    P5    +15
/Opening16/    P5    +16
/Opening17/    P5    +17
/Opening18/    P5    +18
/Opening19/    P6    +19
/Opening20/    P5    +20
/Opening21/    P5    +21
/Opening22/    P5    +22
/Opening23/    P6    +23
/Opening24/    P5    +24
/Opening25/    P5    +25
/Opening26/    P5    +26
/Basket/    H1    +27    -1    -2    -3    -4    -5
        -6    -7    -8    -9    -10    -11
        -12    -13    -14    -15    -16    -17
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
        -18    -19    -20    -21    -22    -23
        -24    -25    -26
VOLUMES    UNITY
* Basket in Cask Cavity v1.2
PART    8    NEST
ZROD    P7    0.0000    0.0000    0.0000    89.9922    419.1000        ! Basket inserted - Includes gap to lid
ZROD    H5    0.0000    0.0000    0.0000    90.1700    419.1000        ! Inserts flood matl to id of stc
* Transport Cask Inner Lid - With Ports v1.5.1.0
PART    9
ZROD    1    0.0000    0.0000    0.0000    100.3300    18.0848        ! Inner lid base
ZROD    2    0.0000    0.0000    18.0848    92.5957    4.7752        ! Inner lid cap
ZROD    3    0.0000    77.9907    0.0000    8.2931    22.8600        ! Drain port
ZROD    4    0.0000    -77.9907    0.0000    8.2931    22.8600        ! Vent port
ZROD    5    0.0000    0.0000    15.2400    85.6234    5.0800        ! Neutron shield
ZROD    6    0.0000    77.9907    15.2400    10.1600    5.0800        ! Cut circle 1 for neutron shield
ZROD    7    0.0000    -77.9907    15.2400    10.1600    5.0800        ! Cut circle 2 for neutron shield
BOX    8    -10.1600    77.9907    15.2400    20.3200    7.6327    5.0800        ! Cut box 1 for neutron shield
BOX    9    -10.1600    -85.6234    15.2400    20.3200    7.6327    5.0800        ! Cut box 2 for neutron shield
ZROD    10    0.0000    0.0000    0.0000    100.3300    22.8600        ! Container
ZONES
/Container/    M0    +10    -1    -2
/LidBase1/    M16    +1    -3    -4    -5    -6    -7
        -8    -9
/LidBase2/    M16    +1    +8    -6
/LidBase3/    M16    +1    +9    -7
/LidBase4/    M16    +1    +6    -3
/LidBase5/    M16    +1    +7    -4
/Nshield/    M15    +5    -6    -7    -8    -9
/LidCap1/    M16    +2    -3    -4    -5    -6    -7
        -8    -9
/LidCap2/    M16    +2    +8    -6
/LidCap3/    M16    +2    +9    -7
/LidCap4/    M16    +2    +6    -3
/LidCap5/    M16    +2    +7    -4
/DrainPort/    P10    +3
/VentPort/    P10    +4
VOLUMES UNITY
* Transport Cask Inner Lid Port Model - With Covers v1.5.1.0
PART    10    CLUSTER
ZROD    M0    0.0000    0.0000    0.0000    1.2700    10.8966        ! Bottom cylinder
ZROD    M0    0.0000    0.0000    10.8966    4.1275    7.5184        ! Middle cylinder
ZROD    M16    0.0000    0.0000    18.4150    8.2931    2.5400        ! Cover
ZROD    M0    0.0000    0.0000    20.9550    8.2931    1.9050        ! Top cylinder
ZROD    M16    0.0000    0.0000    0.0000    8.2931    22.8600        ! Inner lid material
*Transport Cask - Normal Conditions v1.5.1.0
PART    11
ZROD    1    0.0000    0.0000    -34.6710    110.1090    490.1184        ! Transport Cask
ZROD    2    0.0000    0.0000    0.0000    90.1700    419.1000        ! Cavity
ZROD    3    0.0000    0.0000    -20.8280    100.1776    5.0800        ! Bottom neutron shield
ZROD    4    0.0000    0.0000    419.1000    100.3300    22.8600        ! Inner lid
ZROD    5    0.0000    0.0000    0.0000    103.4034    408.9400        ! Lead shield cavity
ZROD    6    0.0000    0.0000    0.0000    95.2500    30.4800        ! Inner shell lower
ZCONE    7    0.0000    0.0000    30.4800    95.2500    93.9800    7.6200        ! Inner shell lower cone
ZROD    8    0.0000    0.0000    38.1000    93.9800    332.7400        ! Inner shell middle
ZCONE    9    0.0000    0.0000    370.8400    93.9800    95.2500    7.6200        ! Inner shell upper cone
ZROD    10    0.0000    0.0000    378.4600    95.2500    30.4800        ! Inner shell upper
ZROD    11    0.0000    0.0000    0.0000    103.2891    408.9400        ! Lead shield
ZROD    12    0.0000    0.0000    -3.8100    124.7140    410.5148        ! Radial neutron shield shell
ZROD    13    0.0000    0.0000    -2.6100    124.0790    408.1148        ! Radial neutron shield
ZP    14    2.4700                ! Insulation (void) cut plane
ZCONE    15    0.0000    0.0000    19.0500    124.7140    113.9190    24.1300        ! Top of rotating trunnion
BOX    16    -124.7140    -12.7000    -3.8100    249.4280    25.4000    22.8600        ! Bottom of rotating trunnion
BOX    17    -114.2238    -12.7000    -3.8100    228.4476    25.4000    22.8600        ! Bottom of rotating trunnion base
BOX    18    -124.7140    -7.6200    -3.8100    249.4280    15.2400    15.2400        ! Trunnion void box
XROD    19    -124.7140    0.0000    11.4300    7.6200    249.4280        ! Trunnion void circle
BOX    20    -124.7140    -12.7000    -3.8100    249.4280    25.4000    46.9900        ! Trunnion extent box
ZSEC    21    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    14.6584    15.3416    ! Heat fin 1
ZSEC    22    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    29.6584    30.3416    ! Heat fin 2
ZSEC    23    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    44.6584    45.3416    ! Heat fin 3
ZSEC    24    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    59.6584    60.3416    ! Heat fin 4
ZSEC    25    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    74.6584    75.3416    ! Heat fin 5
ZSEC    26    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    89.6584    90.3416    ! Heat fin 6
ZSEC    27    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    104.6584    105.3416    ! Heat fin 7
ZSEC    28    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    119.6584    120.3416    ! Heat fin 8
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Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
ZSEC   29   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   134.6584   135.3416   ! Heat fin 9
ZSEC   30   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   149.6584   150.3416   ! Heat fin 10
ZSEC   31   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   164.6584   165.3416   ! Heat fin 11
ZSEC   32   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   179.6584   180.3416   ! Heat fin 12
ZSEC   33   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   194.6584   195.3416   ! Heat fin 13
ZSEC   34   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   209.6584   210.3416   ! Heat fin 14
ZSEC   35   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   224.6584   225.3416   ! Heat fin 15
ZSEC   36   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   239.6584   240.3416   ! Heat fin 16
ZSEC   37   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   254.6584   255.3416   ! Heat fin 17
ZSEC   38   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   269.6584   270.3416   ! Heat fin 18
ZSEC   39   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   284.6584   285.3416   ! Heat fin 19
ZSEC   40   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   299.6584   300.3416   ! Heat fin 20
ZSEC   41   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   314.6584   315.3416   ! Heat fin 21
ZSEC   42   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   329.6584   330.3416   ! Heat fin 22
ZSEC   43   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   344.6584   345.3416   ! Heat fin 23
ZSEC   44   0.0000   0.0000   -2.6100   110.1090   124.0790   408.1148   359.6584   360.3416   ! Heat fin 24
ZROD   45   0.0000   0.0000   425.6024   162.5600   85.0900          ! Upper impact limiter
ZROD   46   0.0000   0.0000   -89.9160   162.5600   85.0900          ! Lower impact limiter
ZROD   47   0.0000   0.0000   426.2374   161.9250   83.8200          ! Inside upper limiter shell
ZROD   48   0.0000   0.0000   -89.2810   161.9250   83.8200          ! Inside lower limiter shell
ZROD   49   0.0000   0.0000   425.6024   110.7440   30.4800          ! Upper end cap
ZROD   50   0.0000   0.0000   -35.3060   110.7440   30.4800          ! Lower end cap
ZROD   51   0.0000   0.0000   -89.9160   162.5600   600.6084         ! Container
ZROD   52   0.0000   0.0000   -3.8100    125.7140   27.3677          ! Surface detector #1
ZROD   53   0.0000   0.0000   23.5577    125.7140   27.3677          ! Surface detector #2
ZROD   54   0.0000   0.0000   50.9253    125.7140   27.3677          ! Surface detector #3
ZROD   55   0.0000   0.0000   78.2930    125.7140   27.3677          ! Surface detector #4
ZROD   56   0.0000   0.0000   105.6606   125.7140   27.3677          ! Surface detector #5
ZROD   57   0.0000   0.0000   133.0283   125.7140   27.3677          ! Surface detector #6
ZROD   58   0.0000   0.0000   160.3959   125.7140   27.3677          ! Surface detector #7
ZROD   59   0.0000   0.0000   187.7636   125.7140   27.3677          ! Surface detector #8
ZROD   60   0.0000   0.0000   215.1312   125.7140   27.3677          ! Surface detector #9
ZROD   61   0.0000   0.0000   242.4989   125.7140   27.3677          ! Surface detector #10
ZROD   62   0.0000   0.0000   269.8665   125.7140   27.3677          ! Surface detector #11
ZROD   63   0.0000   0.0000   297.2342   125.7140   27.3677          ! Surface detector #12
ZROD   64   0.0000   0.0000   324.6018   125.7140   27.3677          ! Surface detector #13
ZROD   65   0.0000   0.0000   351.9695   125.7140   27.3677          ! Surface detector #14
ZROD   66   0.0000   0.0000   379.3371   125.7140   27.3677          ! Surface detector #15
ZROD   67   0.0000   0.0000   406.7048   111.1090   18.8976          ! Package detector betw. NS and UpLim
ZSEC   68   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   2.5000     7.5000     ! Heat fin azi detector #1
ZSEC   69   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   7.5000     12.5000    ! Heat fin azi detector #2
ZSEC   70   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   12.5000    17.5000    ! Heat fin azi detector #3
ZSEC   71   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   17.5000    22.5000    ! Heat fin azi detector #4
ZSEC   72   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   22.5000    27.5000    ! Heat fin azi detector #5
ZSEC   73   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   27.5000    32.5000    ! Heat fin azi detector #6
ZSEC   74   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   32.5000    37.5000    ! Heat fin azi detector #7
ZSEC   75   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   37.5000    42.5000    ! Heat fin azi detector #8
ZSEC   76   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   42.5000    47.5000    ! Heat fin azi detector #9
ZSEC   77   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   47.5000    52.5000    ! Heat fin azi detector #10
ZSEC   78   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   52.5000    57.5000    ! Heat fin azi detector #11
ZSEC   79   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   57.5000    62.5000    ! Heat fin azi detector #12
ZSEC   80   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   62.5000    67.5000    ! Heat fin azi detector #13
ZSEC   81   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   67.5000    72.5000    ! Heat fin azi detector #14
ZSEC   82   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   72.5000    77.5000    ! Heat fin azi detector #15
ZSEC   83   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   77.5000    82.5000    ! Heat fin azi detector #16
ZSEC   84   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   82.5000    87.5000    ! Heat fin azi detector #17
ZSEC   85   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   87.5000    92.5000    ! Heat fin azi detector #18
ZSEC   86   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   92.5000    97.5000    ! Heat fin azi detector #19
ZSEC   87   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   97.5000    102.5000   ! Heat fin azi detector #20
ZSEC   88   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   102.5000   107.5000   ! Heat fin azi detector #21
ZSEC   89   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   107.5000   112.5000   ! Heat fin azi detector #22
ZSEC   90   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   112.5000   117.5000   ! Heat fin azi detector #23
ZSEC   91   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   117.5000   122.5000   ! Heat fin azi detector #24
ZSEC   92   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   122.5000   127.5000   ! Heat fin azi detector #25
ZSEC   93   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   127.5000   132.5000   ! Heat fin azi detector #26
ZSEC   94   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   132.5000   137.5000   ! Heat fin azi detector #27
ZSEC   95   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   137.5000   142.5000   ! Heat fin azi detector #28
ZSEC   96   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   142.5000   147.5000   ! Heat fin azi detector #29
ZSEC   97   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   147.5000   152.5000   ! Heat fin azi detector #30
ZSEC   98   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   152.5000   157.5000   ! Heat fin azi detector #31
ZSEC   99   0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   157.5000   162.5000   ! Heat fin azi detector #32
ZSEC   100  0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   162.5000   167.5000   ! Heat fin azi detector #33
ZSEC   101  0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   167.5000   172.5000   ! Heat fin azi detector #34
ZSEC   102  0.0000   0.0000   44.3800   125.7140   126.7140   361.1248   172.5000   177.5000   ! Heat fin azi detector #35
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Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
ZSEC  103  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  177.5000  182.5000 ! Heat fin azi detector #36
ZSEC  104  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  182.5000  187.5000 ! Heat fin azi detector #37
ZSEC  105  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  187.5000  192.5000 ! Heat fin azi detector #38
ZSEC  106  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  192.5000  197.5000 ! Heat fin azi detector #39
ZSEC  107  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  197.5000  202.5000 ! Heat fin azi detector #40
ZSEC  108  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  202.5000  207.5000 ! Heat fin azi detector #41
ZSEC  109  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  207.5000  212.5000 ! Heat fin azi detector #42
ZSEC  110  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  212.5000  217.5000 ! Heat fin azi detector #43
ZSEC  111  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  217.5000  222.5000 ! Heat fin azi detector #44
ZSEC  112  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  222.5000  227.5000 ! Heat fin azi detector #45
ZSEC  113  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  227.5000  232.5000 ! Heat fin azi detector #46
ZSEC  114  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  232.5000  237.5000 ! Heat fin azi detector #47
ZSEC  115  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  237.5000  242.5000 ! Heat fin azi detector #48
ZSEC  116  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  242.5000  247.5000 ! Heat fin azi detector #49
ZSEC  117  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  247.5000  252.5000 ! Heat fin azi detector #50
ZSEC  118  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  252.5000  257.5000 ! Heat fin azi detector #51
ZSEC  119  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  257.5000  262.5000 ! Heat fin azi detector #52
ZSEC  120  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  262.5000  267.5000 ! Heat fin azi detector #53
ZSEC  121  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  267.5000  272.5000 ! Heat fin azi detector #54
ZSEC  122  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  272.5000  277.5000 ! Heat fin azi detector #55
ZSEC  123  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  277.5000  282.5000 ! Heat fin azi detector #56
ZSEC  124  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  282.5000  287.5000 ! Heat fin azi detector #57
ZSEC  125  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  287.5000  292.5000 ! Heat fin azi detector #58
ZSEC  126  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  292.5000  297.5000 ! Heat fin azi detector #59
ZSEC  127  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  297.5000  302.5000 ! Heat fin azi detector #60
ZSEC  128  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  302.5000  307.5000 ! Heat fin azi detector #61
ZSEC  129  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  307.5000  312.5000 ! Heat fin azi detector #62
ZSEC  130  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  312.5000  317.5000 ! Heat fin azi detector #63
ZSEC  131  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  317.5000  322.5000 ! Heat fin azi detector #64
ZSEC  132  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  322.5000  327.5000 ! Heat fin azi detector #65
ZSEC  133  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  327.5000  332.5000 ! Heat fin azi detector #66
ZSEC  134  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  332.5000  337.5000 ! Heat fin azi detector #67
ZSEC  135  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  337.5000  342.5000 ! Heat fin azi detector #68
ZSEC  136  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  342.5000  347.5000 ! Heat fin azi detector #69
ZSEC  137  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  347.5000  352.5000 ! Heat fin azi detector #70
ZSEC  138  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  352.5000  357.5000 ! Heat fin azi detector #71
ZSEC  139  0.0000  0.0000  44.3800  125.7140  126.7140  361.1248  357.5000  362.5000 ! Heat fin azi detector #72
ZSEC  140  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  5.0000   15.0000   ! Rotating trunnion det#1
ZSEC  141  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  15.0000  25.0000   ! Rotating trunnion det#2
ZSEC  142  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  25.0000  35.0000   ! Rotating trunnion det#3
ZSEC  143  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  35.0000  45.0000   ! Rotating trunnion det#4
ZSEC  144  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  45.0000  55.0000   ! Rotating trunnion det#5
ZSEC  145  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  55.0000  65.0000   ! Rotating trunnion det#6
ZSEC  146  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  65.0000  75.0000   ! Rotating trunnion det#7
ZSEC  147  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  75.0000  85.0000   ! Rotating trunnion det#8
ZSEC  148  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  85.0000  95.0000   ! Rotating trunnion det#9
ZSEC  149  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  95.0000  105.0000   ! Rotating trunnion det#10
ZSEC  150  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  105.0000  115.0000  ! Rotating trunnion det#11
ZSEC  151  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  115.0000  125.0000  ! Rotating trunnion det#12
ZSEC  152  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  125.0000  135.0000  ! Rotating trunnion det#13
ZSEC  153  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  135.0000  145.0000  ! Rotating trunnion det#14
ZSEC  154  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  145.0000  155.0000  ! Rotating trunnion det#15
ZSEC  155  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  155.0000  165.0000  ! Rotating trunnion det#16
ZSEC  156  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  165.0000  175.0000  ! Rotating trunnion det#17
ZSEC  157  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  175.0000  185.0000  ! Rotating trunnion det#18
ZSEC  158  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  185.0000  195.0000  ! Rotating trunnion det#19
ZSEC  159  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  195.0000  205.0000  ! Rotating trunnion det#20
ZSEC  160  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  205.0000  215.0000  ! Rotating trunnion det#21
ZSEC  161  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  215.0000  225.0000  ! Rotating trunnion det#22
ZSEC  162  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  225.0000  235.0000  ! Rotating trunnion det#23
ZSEC  163  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  235.0000  245.0000  ! Rotating trunnion det#24
ZSEC  164  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  245.0000  255.0000  ! Rotating trunnion det#25
ZSEC  165  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  255.0000  265.0000  ! Rotating trunnion det#26
ZSEC  166  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  265.0000  275.0000  ! Rotating trunnion det#27
ZSEC  167  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  275.0000  285.0000  ! Rotating trunnion det#28
ZSEC  168  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  285.0000  295.0000  ! Rotating trunnion det#29
ZSEC  169  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  295.0000  305.0000  ! Rotating trunnion det#30
ZSEC  170  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  305.0000  315.0000  ! Rotating trunnion det#31
ZSEC  171  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  315.0000  325.0000  ! Rotating trunnion det#32
ZSEC  172  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  325.0000  335.0000  ! Rotating trunnion det#33
ZSEC  173  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  335.0000  345.0000  ! Rotating trunnion det#34
ZSEC  174  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  345.0000  355.0000  ! Rotating trunnion det#35
ZSEC  175  0.0000  0.0000  -3.8100  126.7140  127.7140  22.8600  355.0000  365.0000  ! Rotating trunnion det#36
ZROD  176  0.0000  0.0000  -4.8260  135.7630  430.4284                    ! Personnel barrier surface
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
ZROD    177    0.0000    0.0000    -4.8260    136.7630    28.6952          ! Personnel barrier det #1
ZROD    178    0.0000    0.0000    23.8692    136.7630    28.6952          ! Personnel barrier det #2
ZROD    179    0.0000    0.0000    52.5645    136.7630    28.6952          ! Personnel barrier det #3
ZROD    180    0.0000    0.0000    81.2597    136.7630    28.6952          ! Personnel barrier det #4
ZROD    181    0.0000    0.0000    109.9549   136.7630    28.6952          ! Personnel barrier det #5
ZROD    182    0.0000    0.0000    138.6501   136.7630    28.6952          ! Personnel barrier det #6
ZROD    183    0.0000    0.0000    167.3454   136.7630    28.6952          ! Personnel barrier det #7
ZROD    184    0.0000    0.0000    196.0406   136.7630    28.6952          ! Personnel barrier det #8
ZROD    185    0.0000    0.0000    224.7358   136.7630    28.6952          ! Personnel barrier det #9
ZROD    186    0.0000    0.0000    253.4310   136.7630    28.6952          ! Personnel barrier det #10
ZROD    187    0.0000    0.0000    282.1263   136.7630    28.6952          ! Personnel barrier det #11
ZROD    188    0.0000    0.0000    310.8215   136.7630    28.6952          ! Personnel barrier det #12
ZROD    189    0.0000    0.0000    339.5167   136.7630    28.6952          ! Personnel barrier det #13
ZROD    190    0.0000    0.0000    368.2119   136.7630    28.6952          ! Personnel barrier det #14
ZROD    191    0.0000    0.0000    396.9072   136.7630    28.6952          ! Personnel barrier det #15
ZONES
/Cavity/    P8    +2
/OuterShell/    M16    +1    -2    -3    -4    -5
/InnerShell1/    M16    +6    -2
/InnerShell2/    M16    +7    -2
/InnerShell3/    M16    +8    -2
/InnerShell4/    M16    +9    -2
/InnerShell5/    M16    +10    -2
/InnerLid/    P9    +4
/BotNShield/    M15    +3
/LeadShield/    M14    +11    -6    -7    -8    -9    -10
/LeadShieldGap/    M0    +5    -11
/RadNShieldShell1/    M16    +12    -13    -1    -20
/RadNShieldShell2/    M16    +12    -13    -1    +20    -15    -16
/RadNShield1/    M15    +13    -1    -21    -22    -23    -24    -25
        -26    -27    -28    -29    -30    -31    -32
        -33    -34    -35    -36    -37    -38    -39
        -40    -41    -42    -43    -44    +14    -20
/RadNShield2/    M15    +13    -1    -32    -44    +20    -15    -16
/InsulationVoid/    M0    +13    -1    -14    -20
/RotTrunUpper/    M16    +15    -1    +20    +12
/RotTrunLower/    M16    +17    -1    +12
/RotTrunSide/    M16    +16    +12    -17    -18    -19
/RotTrunBoxVoid/    M0    +18    +12    -17
/RotTrunCircVoid/    M0    +19    -18    -17    +12
/HeatFin1/    M18    +21    +14
/HeatFin2/    M18    +22    +14
/HeatFin3/    M18    +23    +14
/HeatFin4/    M18    +24    +14
/HeatFin5/    M18    +25    +14
/HeatFin6/    M18    +26    +14
/HeatFin7/    M18    +27    +14
/HeatFin8/    M18    +28    +14
/HeatFin9/    M18    +29    +14
/HeatFin10/    M18    +30    +14
/HeatFin11/    M18    +31    +14
/HeatFin12/    M18    +32    +14    -15    -16
/HeatFin13/    M18    +33    +14
/HeatFin14/    M18    +34    +14
/HeatFin15/    M18    +35    +14
/HeatFin16/    M18    +36    +14
/HeatFin17/    M18    +37    +14
/HeatFin18/    M18    +38    +14
/HeatFin19/    M18    +39    +14
/HeatFin20/    M18    +40    +14
/HeatFin21/    M18    +41    +14
/HeatFin22/    M18    +42    +14
/HeatFin23/    M18    +43    +14
/HeatFin24/    M18    +44    +14    -15    -16
/UpLimShell/    M16    +45    -47    -49
/UpLimEnd/    M16    +49    -1
/LoLimShell/    M16    +46    -48    -50
/LoLimEnd/    M16    +50    -1
/UpBalsa/    M19    +47    -49
/LoBalsa/    M19    +48    -50
/InsidePersBarr/    M0    +176    -1    -12    -45    -46    -67    -52
        -53    -54    -55    -56    -57    -58    -59
        -60    -61    -62    -63    -64    -65    -66
        -68    -69    -70    -71    -72    -73    -74
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
        -75    -76    -77    -78    -79    -80    -81
        -82    -83    -84    -85    -86    -87    -88
        -89    -90    -91    -92    -93    -94    -95
        -96    -97    -98    -99    -100    -101    -102
        -103    -104    -105    -106    -107    -108    -109
        -110    -111    -112    -113    -114    -115    -116
        -117    -118    -119    -120    -121    -122    -123
        -124    -125    -126    -127    -128    -129    -130
        -131    -132    -133    -134    -135    -136    -137
        -138    -139    -140    -141    -142    -143    -144
        -145    -146    -147    -148    -149    -150    -151
        -152    -153    -154    -155    -156    -157    -158
        -159    -160    -161    -162    -163    -164    -165
        -166    -167    -168    -169    -170    -171    -172
        -173    -174    -175
/SurfaceDet1/    M0    +52    -12
/SurfaceDet2/    M0    +53    -12
/SurfaceDet3/    M0    +54    -12
/SurfaceDet4/    M0    +55    -12
/SurfaceDet5/    M0    +56    -12
/SurfaceDet6/    M0    +57    -12
/SurfaceDet7/    M0    +58    -12
/SurfaceDet8/    M0    +59    -12
/SurfaceDet9/    M0    +60    -12
/SurfaceDet10/    M0    +61    -12
/SurfaceDet11/    M0    +62    -12
/SurfaceDet12/    M0    +63    -12
/SurfaceDet13/    M0    +64    -12
/SurfaceDet14/    M0    +65    -12
/SurfaceDet15/    M0    +66    -12
/PackageDet/    M0    +67    -1
/HeatFinAziDet1/    M0    +68
/HeatFinAziDet2/    M0    +69
/HeatFinAziDet3/    M0    +70
/HeatFinAziDet4/    M0    +71
/HeatFinAziDet5/    M0    +72
/HeatFinAziDet6/    M0    +73
/HeatFinAziDet7/    M0    +74
/HeatFinAziDet8/    M0    +75
/HeatFinAziDet9/    M0    +76
/HeatFinAziDet10/    M0    +77
/HeatFinAziDet11/    M0    +78
/HeatFinAziDet12/    M0    +79
/HeatFinAziDet13/    M0    +80
/HeatFinAziDet14/    M0    +81
/HeatFinAziDet15/    M0    +82
/HeatFinAziDet16/    M0    +83
/HeatFinAziDet17/    M0    +84
/HeatFinAziDet18/    M0    +85
/HeatFinAziDet19/    M0    +86
/HeatFinAziDet20/    M0    +87
/HeatFinAziDet21/    M0    +88
/HeatFinAziDet22/    M0    +89
/HeatFinAziDet23/    M0    +90
/HeatFinAziDet24/    M0    +91
/HeatFinAziDet25/    M0    +92
/HeatFinAziDet26/    M0    +93
/HeatFinAziDet27/    M0    +94
/HeatFinAziDet28/    M0    +95
/HeatFinAziDet29/    M0    +96
/HeatFinAziDet30/    M0    +97
/HeatFinAziDet31/    M0    +98
/HeatFinAziDet32/    M0    +99
/HeatFinAziDet33/    M0    +100
/HeatFinAziDet34/    M0    +101
/HeatFinAziDet35/    M0    +102
/HeatFinAziDet36/    M0    +103
/HeatFinAziDet37/    M0    +104
/HeatFinAziDet38/    M0    +105
/HeatFinAziDet39/    M0    +106
/HeatFinAziDet40/    M0    +107
/HeatFinAziDet41/    M0    +108
/HeatFinAziDet42/    M0    +109
/HeatFinAziDet43/    M0    +110
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
/HeatFinAziDet44/    M0    +111
/HeatFinAziDet45/    M0    +112
/HeatFinAziDet46/    M0    +113
/HeatFinAziDet47/    M0    +114
/HeatFinAziDet48/    M0    +115
/HeatFinAziDet49/    M0    +116
/HeatFinAziDet50/    M0    +117
/HeatFinAziDet51/    M0    +118
/HeatFinAziDet52/    M0    +119
/HeatFinAziDet53/    M0    +120
/HeatFinAziDet54/    M0    +121
/HeatFinAziDet55/    M0    +122
/HeatFinAziDet56/    M0    +123
/HeatFinAziDet57/    M0    +124
/HeatFinAziDet58/    M0    +125
/HeatFinAziDet59/    M0    +126
/HeatFinAziDet60/    M0    +127
/HeatFinAziDet61/    M0    +128
/HeatFinAziDet62/    M0    +129
/HeatFinAziDet63/    M0    +130
/HeatFinAziDet64/    M0    +131
/HeatFinAziDet65/    M0    +132
/HeatFinAziDet66/    M0    +133
/HeatFinAziDet67/    M0    +134
/HeatFinAziDet68/    M0    +135
/HeatFinAziDet69/    M0    +136
/HeatFinAziDet70/    M0    +137
/HeatFinAziDet71/    M0    +138
/HeatFinAziDet72/    M0    +139
/RotTrunDet1/    M0    +140
/RotTrunDet2/    M0    +141
/RotTrunDet3/    M0    +142
/RotTrunDet4/    M0    +143
/RotTrunDet5/    M0    +144
/RotTrunDet6/    M0    +145
/RotTrunDet7/    M0    +146
/RotTrunDet8/    M0    +147
/RotTrunDet9/    M0    +148
/RotTrunDet10/    M0    +149
/RotTrunDet11/    M0    +150
/RotTrunDet12/    M0    +151
/RotTrunDet13/    M0    +152
/RotTrunDet14/    M0    +153
/RotTrunDet15/    M0    +154
/RotTrunDet16/    M0    +155
/RotTrunDet17/    M0    +156
/RotTrunDet18/    M0    +157
/RotTrunDet19/    M0    +158
/RotTrunDet20/    M0    +159
/RotTrunDet21/    M0    +160
/RotTrunDet22/    M0    +161
/RotTrunDet23/    M0    +162
/RotTrunDet24/    M0    +163
/RotTrunDet25/    M0    +164
/RotTrunDet26/    M0    +165
/RotTrunDet27/    M0    +166
/RotTrunDet28/    M0    +167
/RotTrunDet29/    M0    +168
/RotTrunDet30/    M0    +169
/RotTrunDet31/    M0    +170
/RotTrunDet32/    M0    +171
/RotTrunDet33/    M0    +172
/RotTrunDet34/    M0    +173
/RotTrunDet35/    M0    +174
/RotTrunDet36/    M0    +175
/PersBarrDet1/    M0    +177    -176
/PersBarrDet2/    M0    +178    -176
/PersBarrDet3/    M0    +179    -176
/PersBarrDet4/    M0    +180    -176
/PersBarrDet5/    M0    +181    -176
/PersBarrDet6/    M0    +182    -176
/PersBarrDet7/    M0    +183    -176
/PersBarrDet8/    M0    +184    -176
/PersBarrDet9/    M0    +185    -176
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
/PersBarrDet10/    M0    +186    -176
/PersBarrDet11/    M0    +187    -176
/PersBarrDet12/    M0    +188    -176
/PersBarrDet13/    M0    +189    -176
/PersBarrDet14/    M0    +190    -176
/PersBarrDet15/    M0    +191    -176
/Container/    M0    +51    -45    -46    -177    -178    -179    -180
        -181    -182    -183    -184    -185    -186    -187
        -188    -189    -190    -191
VOLUMES    52*1.0        15*2.1531E+04        1.3133E+04        72*3.9775E+03
       36*5.0756E+02        15*2.4568E+04        1.0
* Transport Cask Detector Description v1.5.1.0
PART    12
* Radial Detector DRA (Surface) Bodies
* Radial Detector DRA+ (Package) Bodies
* Radial Detector DRAA (HeatFin) Bodies
* Radial Detector DRAB (RotTrun) Bodies
* Radial Detector DRB (PersBarr) Bodies
* Radial Detector DRC (LimSurf) Bodies
ZROD     1              0.0000    0.0000    -89.9160  162.5600  600.6084
ZROD     2              0.0000    0.0000    -89.9160  163.5600  40.0406
ZROD     3              0.0000    0.0000    -49.8754  163.5600  40.0406
ZROD     4              0.0000    0.0000    -9.8349   163.5600  40.0406
ZROD     5              0.0000    0.0000    30.2057   163.5600  40.0406
ZROD     6              0.0000    0.0000    70.2462   163.5600  40.0406
ZROD     7              0.0000    0.0000    110.2868  163.5600  40.0406
ZROD     8              0.0000    0.0000    150.3274  163.5600  40.0406
ZROD     9              0.0000    0.0000    190.3679  163.5600  40.0406
ZROD     10             0.0000    0.0000    230.4085  163.5600  40.0406
ZROD     11             0.0000    0.0000    270.4490  163.5600  40.0406
ZROD     12             0.0000    0.0000    310.4896  163.5600  40.0406
ZROD     13             0.0000    0.0000    350.5302  163.5600  40.0406
ZROD     14             0.0000    0.0000    390.5707  163.5600  40.0406
ZROD     15             0.0000    0.0000    430.6113  163.5600  40.0406
ZROD     16             0.0000    0.0000    470.6518  163.5600  40.0406
* Radial Detector DRD (1m) Bodies
ZROD     17             0.0000    0.0000    -189.9160 224.7140  800.6084
ZROD     18             0.0000    0.0000    -189.9160 225.7140  53.3739
ZROD     19             0.0000    0.0000    -136.5421 225.7140  53.3739
ZROD     20             0.0000    0.0000    -83.1682  225.7140  53.3739
ZROD     21             0.0000    0.0000    -29.7943  225.7140  53.3739
ZROD     22             0.0000    0.0000    23.5796   225.7140  53.3739
ZROD     23             0.0000    0.0000    76.9535   225.7140  53.3739
ZROD     24             0.0000    0.0000    130.3274  225.7140  53.3739
ZROD     25             0.0000    0.0000    183.7013  225.7140  53.3739
ZROD     26             0.0000    0.0000    237.0751  225.7140  53.3739
ZROD     27             0.0000    0.0000    290.4490  225.7140  53.3739
ZROD     28             0.0000    0.0000    343.8229  225.7140  53.3739
ZROD     29             0.0000    0.0000    397.1968  225.7140  53.3739
ZROD     30             0.0000    0.0000    450.5707  225.7140  53.3739
ZROD     31             0.0000    0.0000    503.9446  225.7140  53.3739
ZROD     32             0.0000    0.0000    557.3185  225.7140  53.3739
* Radial Detector DRE (1m+LimSurf) Bodies
ZROD     33             0.0000    0.0000    -239.9160 262.5600  900.6084
ZROD     34             0.0000    0.0000    -239.9160 263.5600  60.0406
ZROD     35             0.0000    0.0000    -179.8754 263.5600  60.0406
ZROD     36             0.0000    0.0000    -119.8349 263.5600  60.0406
ZROD     37             0.0000    0.0000    -59.7943  263.5600  60.0406
ZROD     38             0.0000    0.0000    0.2462    263.5600  60.0406
ZROD     39             0.0000    0.0000    60.2868   263.5600  60.0406
ZROD     40             0.0000    0.0000    120.3274  263.5600  60.0406
ZROD     41             0.0000    0.0000    180.3679  263.5600  60.0406
ZROD     42             0.0000    0.0000    240.4085  263.5600  60.0406
ZROD     43             0.0000    0.0000    300.4490  263.5600  60.0406
ZROD     44             0.0000    0.0000    360.4896  263.5600  60.0406
ZROD     45             0.0000    0.0000    420.5302  263.5600  60.0406
ZROD     46             0.0000    0.0000    480.5707  263.5600  60.0406
ZROD     47             0.0000    0.0000    540.6113  263.5600  60.0406
ZROD     48             0.0000    0.0000    600.6518  263.5600  60.0406
* Radial Detector DRF (2m+Railcar) Bodies
ZROD     49             0.0000    0.0000    -289.9160 357.4800  1000.6084
ZROD     50             0.0000    0.0000    -289.9160 358.4800  50.0304
ZROD     51             0.0000    0.0000    -239.8856 358.4800  50.0304
ZROD     52             0.0000    0.0000    -189.8552 358.4800  50.0304
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
ZROD     53           0.0000   0.0000   -139.8247 358.4800  50.0304
ZROD     54           0.0000   0.0000   -89.7943  358.4800  50.0304
ZROD     55           0.0000   0.0000   -39.7639  358.4800  50.0304
ZROD     56           0.0000   0.0000   10.2665   358.4800  50.0304
ZROD     57           0.0000   0.0000   60.2969   358.4800  50.0304
ZROD     58           0.0000   0.0000   110.3274  358.4800  50.0304
ZROD     59           0.0000   0.0000   160.3578  358.4800  50.0304
ZROD     60           0.0000   0.0000   210.3882  358.4800  50.0304
ZROD     61           0.0000   0.0000   260.4186  358.4800  50.0304
ZROD     62           0.0000   0.0000   310.4490  358.4800  50.0304
ZROD     63           0.0000   0.0000   360.4795  358.4800  50.0304
ZROD     64           0.0000   0.0000   410.5099  358.4800  50.0304
ZROD     65           0.0000   0.0000   460.5403  358.4800  50.0304
ZROD     66           0.0000   0.0000   510.5707  358.4800  50.0304
ZROD     67           0.0000   0.0000   560.6011  358.4800  50.0304
ZROD     68           0.0000   0.0000   610.6316  358.4800  50.0304
ZROD     69           0.0000   0.0000   660.6620  358.4800  50.0304
* Radial Detector DRG (4m) Bodies
ZROD     70           0.0000   0.0000   -489.9160 524.7140  1400.6084
ZROD     71           0.0000   0.0000   -489.9160 525.7140  70.0304
ZROD     72           0.0000   0.0000   -419.8856 525.7140  70.0304
ZROD     73           0.0000   0.0000   -349.8552 525.7140  70.0304
ZROD     74           0.0000   0.0000   -279.8247 525.7140  70.0304
ZROD     75           0.0000   0.0000   -209.7943 525.7140  70.0304
ZROD     76           0.0000   0.0000   -139.7639 525.7140  70.0304
ZROD     77           0.0000   0.0000   -69.7335  525.7140  70.0304
ZROD     78           0.0000   0.0000   0.2969    525.7140  70.0304
ZROD     79           0.0000   0.0000   70.3274   525.7140  70.0304
ZROD     80           0.0000   0.0000   140.3578  525.7140  70.0304
ZROD     81           0.0000   0.0000   210.3882  525.7140  70.0304
ZROD     82           0.0000   0.0000   280.4186  525.7140  70.0304
ZROD     83           0.0000   0.0000   350.4490  525.7140  70.0304
ZROD     84           0.0000   0.0000   420.4795  525.7140  70.0304
ZROD     85           0.0000   0.0000   490.5099  525.7140  70.0304
ZROD     86           0.0000   0.0000   560.5403  525.7140  70.0304
ZROD     87           0.0000   0.0000   630.5707  525.7140  70.0304
ZROD     88           0.0000   0.0000   700.6011  525.7140  70.0304
ZROD     89           0.0000   0.0000   770.6316  525.7140  70.0304
ZROD     90           0.0000   0.0000   840.6620  525.7140  70.0304
* World
ZROD     91           0.0000   0.0000   -539.9160 574.7140  1500.6084
* External Void
ZROD     92           0.0000   0.0000   -589.9160 624.7140  1600.6084

ZONES
/TransportCask/   P11      +1
* Detector DRC (LimSurf)
/DRC01/  M0       +2       -1
/DRC02/  M0       +3       -1
/DRC03/  M0       +4       -1
/DRC04/  M0       +5       -1
/DRC05/  M0       +6       -1
/DRC06/  M0       +7       -1
/DRC07/  M0       +8       -1
/DRC08/  M0       +9       -1
/DRC09/  M0       +10      -1
/DRC10/  M0       +11      -1
/DRC11/  M0       +12      -1
/DRC12/  M0       +13      -1
/DRC13/  M0       +14      -1
/DRC14/  M0       +15      -1
/DRC15/  M0       +16      -1
/Void/   M0       +17      -1
                  -2       -3       -4       -5       -6       -7
                  -8       -9       -10      -11      -12      -13
                  -14      -15      -16
* Detector DRD (1m)
/DRD01/  M0       +18      -17
/DRD02/  M0       +19      -17
/DRD03/  M0       +20      -17
/DRD04/  M0       +21      -17
/DRD05/  M0       +22      -17
/DRD06/  M0       +23      -17
/DRD07/  M0       +24      -17
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
/DRD08/   M0       +25      -17
/DRD09/   M0       +26      -17
/DRD10/   M0       +27      -17
/DRD11/   M0       +28      -17
/DRD12/   M0       +29      -17
/DRD13/   M0       +30      -17
/DRD14/   M0       +31      -17
/DRD15/   M0       +32      -17
/Void/    M0       +33      -17
                   -18      -19      -20      -21      -22      -23
                   -24      -25      -26      -27      -28      -29
                   -30      -31      -32
* Detector DRE (1m+LimSurf)
/DRE01/   M0       +34      -33
/DRE02/   M0       +35      -33
/DRE03/   M0       +36      -33
/DRE04/   M0       +37      -33
/DRE05/   M0       +38      -33
/DRE06/   M0       +39      -33
/DRE07/   M0       +40      -33
/DRE08/   M0       +41      -33
/DRE09/   M0       +42      -33
/DRE10/   M0       +43      -33
/DRE11/   M0       +44      -33
/DRE12/   M0       +45      -33
/DRE13/   M0       +46      -33
/DRE14/   M0       +47      -33
/DRE15/   M0       +48      -33
/Void/    M0       +49      -33
                   -34      -35      -36      -37      -38      -39
                   -40      -41      -42      -43      -44      -45
                   -46      -47      -48
* Detector DRF (2m+Railcar)
/DRF01/   M0       +50      -49
/DRF02/   M0       +51      -49
/DRF03/   M0       +52      -49
/DRF04/   M0       +53      -49
/DRF05/   M0       +54      -49
/DRF06/   M0       +55      -49
/DRF07/   M0       +56      -49
/DRF08/   M0       +57      -49
/DRF09/   M0       +58      -49
/DRF10/   M0       +59      -49
/DRF11/   M0       +60      -49
/DRF12/   M0       +61      -49
/DRF13/   M0       +62      -49
/DRF14/   M0       +63      -49
/DRF15/   M0       +64      -49
/DRF16/   M0       +65      -49
/DRF17/   M0       +66      -49
/DRF18/   M0       +67      -49
/DRF19/   M0       +68      -49
/DRF20/   M0       +69      -49
/Void/    M0       +70      -49
                   -50      -51      -52      -53      -54      -55
                   -56      -57      -58      -59      -60      -61
                   -62      -63      -64      -65      -66      -67
                   -68      -69
* Detector DRG (4m)
/DRG01/   M0       +71      -70
/DRG02/   M0       +72      -70
/DRG03/   M0       +73      -70
/DRG04/   M0       +74      -70
/DRG05/   M0       +75      -70
/DRG06/   M0       +76      -70
/DRG07/   M0       +77      -70
/DRG08/   M0       +78      -70
/DRG09/   M0       +79      -70
/DRG10/   M0       +80      -70
/DRG11/   M0       +81      -70
/DRG12/   M0       +82      -70
/DRG13/   M0       +83      -70
/DRG14/   M0       +84      -70
/DRG15/   M0       +85      -70
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
/DRG16/   M0        +86       -70
/DRG17/   M0        +87       -70
/DRG18/   M0        +88       -70
/DRG19/   M0        +89       -70
/DRG20/   M0        +90       -70
/Void/    M0        +91       -70
                    -71       -72       -73       -74       -75       -76
                    -77       -78       -79       -80       -81       -82
                    -83       -84       -85       -86       -87       -88
                    -89       -90
/ExtVoid/ M-2000    +92       -91
Volumes
                    1.0       15*4.1023E+04       1.0       15*7.5527E+04       1.0       15*9.9238E+04
                    1.0       20*1.1253E+05       1.0       20*2.3110E+05       1.0       1.0
end

*
* Unit 5 Splitting Geometry for Radial Detectors - Neutron
*
begin splitting geometry
    r    29    fill    0.0000
                    n    10    89.9922
                    n    2     93.9800
                    n    2     103.4034
                    n    3     110.1090
                    n    10    124.0790
                    n    1     124.7140
                    n    1     167.5600


    z    61    fill    -94.9160
                    n    1     -89.9160
                    n    1     -89.2810
                    n    4     -35.3060
                    n    1     -34.6710
                    n    5     -20.8280
                    n    4     -15.7480
                    n    6     0.0000
                    n    1     18.6004
                    n    13    387.4084
                    n    1     410.2100
                    n    1     419.1000
                !    n    0     419.1000
                    n    6     434.3400
                    n    4     439.4200
                    n    6     455.4474
                    n    1     456.0824
                    n    4     510.0574
                    n    1     510.6924
                    n    1     515.6924

end

*
* Unit 6 - Source Geometry for Fuel Neutron
*
begin source geometry
    r    10    fill    0.0000    n    10    89.9922
    z    13
        18.6004    27.8206    37.0408    55.4812    92.3620    166.1236
        239.8852   276.7660   313.6468   350.5276   359.7478   368.9680
        378.1882   387.4084
end

*
* Unit 7
*
begin energy data
    neutron
    thermal treatment none
    importance    standard    28    groups
    scoring    as    importance
    simple    source    histogram    weighting    automatic
end
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
*
* Unit 8 Importance Map - Radial
*
begin importance map
    calculate
    targets    15
    part    12
    zones
        2    3    4    5    6
        7    8    9    10    11
        12    13    14    15    16
    strengths
        1.0E+02    1.0E+02    5.0E+01    5.0E+01    5.0E+01
        1.0E+01    1.0E+01    1.0E+00    1.0E+01    1.0E+01
        5.0E+01    5.0E+01    5.0E+01    1.0E+02    1.0E+02
    defer mixing
    void density    0.10
    track
!    coupled source
!    write gamma importances to 32
!    write unformatted file to 31
!    use method d
end

*
* Unit 9 Scoring Data - Radial
*
begin scoring data
    flux
    part    11
    from    53    to    67    ! DRA
    some    68              ! DRA+
    from    69    to    140    ! DRAA
    from    141    to    176    ! DRAB
    from    177    to    191    ! DRB
    part    12
    from    2    to    16    ! DRC
    from    18    to    32    ! DRD
    from    34    to    48    ! DRE
    from    50    to    69    ! DRF
    from    71    to    90    ! DRG
    responses    sos    ditto
    contributions to responses        ditto
    ! score distribution for response
    ! weight distribution    total
end

*
* Unit 10 Response Data
*
begin response data
* Scale to mrem/hr
/ncrp38 - ansi ans-6.1.1-1977 neutron flux-dose conversion factors - mcnp table h.1 - mrem/
function pairs
          2.0000E+01          2.2700E-01
          1.9299E+01          2.2502E-01
          1.8623E+01          2.2307E-01
          1.7970E+01          2.2112E-01
          1.7341E+01          2.1920E-01
          1.6733E+01          2.1729E-01
          1.6147E+01          2.1540E-01
          1.5581E+01          2.1353E-01
          1.5035E+01          2.1167E-01
          1.4508E+01          2.0983E-01
          1.4000E+01          2.0800E-01
          1.3537E+01          2.0090E-01
          1.3089E+01          1.9405E-01
          1.2656E+01          1.8743E-01
          1.2237E+01          1.8104E-01
          1.1832E+01          1.7486E-01
          1.1441E+01          1.6889E-01
          1.1062E+01          1.6313E-01
          1.0696E+01          1.5757E-01
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
1.0342E+01      1.5219E-01
1.0000E+01      1.4700E-01
7.0000E+00      1.4700E-01
6.7684E+00      1.4788E-01
6.5444E+00      1.4876E-01
6.3279E+00      1.4964E-01
6.1185E+00      1.5054E-01
5.9161E+00      1.5143E-01
5.7203E+00      1.5234E-01
5.5311E+00      1.5324E-01
5.3481E+00      1.5416E-01
5.1711E+00      1.5508E-01
5.0000E+00      1.5600E-01
4.6652E+00      1.5258E-01
4.3528E+00      1.4924E-01
4.0613E+00      1.4597E-01
3.7893E+00      1.4277E-01
3.5355E+00      1.3964E-01
3.2988E+00      1.3658E-01
3.0779E+00      1.3359E-01
2.8717E+00      1.3066E-01
2.6794E+00      1.2780E-01
2.5000E+00      1.2500E-01
2.2811E+00      1.2568E-01
2.0814E+00      1.2637E-01
1.8991E+00      1.2706E-01
1.7329E+00      1.2775E-01
1.5811E+00      1.2845E-01
1.4427E+00      1.2915E-01
1.3164E+00      1.2986E-01
1.2011E+00      1.3057E-01
1.0960E+00      1.3128E-01
1.0000E+00      1.3200E-01
9.3303E-01      1.2740E-01
8.7055E-01      1.2296E-01
8.1225E-01      1.1868E-01
7.5786E-01      1.1455E-01
7.0711E-01      1.1056E-01
6.5975E-01      1.0671E-01
6.1557E-01      1.0299E-01
5.7435E-01      9.9404E-02
5.3589E-01      9.5942E-02
5.0000E-01      9.2600E-02
4.2567E-01      8.0093E-02
3.6239E-01      6.9276E-02
3.0852E-01      5.9919E-02
2.6265E-01      5.1826E-02
2.2361E-01      4.4827E-02
1.9037E-01      3.8772E-02
1.6207E-01      3.3536E-02
1.3797E-01      2.9006E-02
1.1746E-01      2.5089E-02
1.0000E-01      2.1700E-02
7.9433E-02      1.8112E-02
6.3096E-02      1.5117E-02
5.0119E-02      1.2617E-02
3.9811E-02      1.0531E-02
3.1623E-02      8.7893E-03
2.5119E-02      7.3359E-03
1.9953E-02      6.1228E-03
1.5849E-02      5.1104E-03
1.2589E-02      4.2653E-03
1.0000E-02      3.5600E-03
7.9433E-03      3.5795E-03
6.3096E-03      3.5991E-03
5.0119E-03      3.6189E-03
3.9811E-03      3.6387E-03
3.1623E-03      3.6586E-03
2.5119E-03      3.6787E-03
1.9953E-03      3.6988E-03
1.5849E-03      3.7191E-03
1.2589E-03      3.7395E-03
1.0000E-03      3.7600E-03
7.9433E-04      3.8000E-03
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
          6.3096E-04          3.8405E-03
          5.0119E-04          3.8814E-03
          3.9811E-04          3.9227E-03
          3.1623E-04          3.9644E-03
          2.5119E-04          4.0066E-03
          1.9953E-04          4.0493E-03
          1.5849E-04          4.0924E-03
          1.2589E-04          4.1360E-03
          1.0000E-04          4.1800E-03
          7.9433E-05          4.2147E-03
          6.3096E-05          4.2496E-03
          5.0119E-05          4.2849E-03
          3.9811E-05          4.3204E-03
          3.1623E-05          4.3563E-03
          2.5119E-05          4.3924E-03
          1.9953E-05          4.4289E-03
          1.5849E-05          4.4656E-03
          1.2589E-05          4.5026E-03
          1.0000E-05          4.5400E-03
          7.9433E-06          4.5319E-03
          6.3096E-06          4.5239E-03
          5.0119E-06          4.5159E-03
          3.9811E-06          4.5078E-03
          3.1623E-06          4.4998E-03
          2.5119E-06          4.4918E-03
          1.9953E-06          4.4839E-03
          1.5849E-06          4.4759E-03
          1.2589E-06          4.4679E-03
          1.0000E-06          4.4600E-03
          7.9433E-07          4.3739E-03
          6.3096E-07          4.2894E-03
          5.0119E-07          4.2066E-03
          3.9811E-07          4.1254E-03
          3.1623E-07          4.0458E-03
          2.5119E-07          3.9677E-03
          1.9953E-07          3.8910E-03
          1.5849E-07          3.8159E-03
          1.2589E-07          3.7423E-03
          1.0000E-07          3.6700E-03
          2.5000E-08          3.6700E-03
end

*
* Unit 13 Hole Data
*
begin hole data
* STC Basket Hole Description v1.2
* Hole    1    General Basket Structure
PLATE
0    0    1
7
417.8300    0          ! Top of Basket
389.4976    -2          ! Top of Highest Support Disk
326.4316    -7          ! Resume support disk only
79.2376    -4          ! Start of support+heat disk region
17.4396    -6          ! Bottom of Lowest Support Disk
0.0000    -3          ! Bottom of Basket
0.0000    0          ! Basket Offset
0

* Hole    2    Top Weldment Disk - no structure above the weldment disk
RZMESH
2             ! number of radial points
85.5472
89.9922
3             ! number of axial intervals
389.4976            ! Top of diskstack
400.5580            ! Bottom of weldment
403.0980            ! Top of weldment plate
417.8300            ! Void to top of basket
0    0          ! Material below weldment
10    10          ! Plate Material
0    10          ! Flange
0             ! Outside material
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
* Hole    3    Bottom Weldment Disk - no structure in the weldment disk support
RZMESH
1              ! number of radial points
89.9922
1              ! number of axial intervals
3.8100
6.3500              ! Coordinates inherited from PLATE Hole
10              ! Plate Material
0              ! Outside material

* Hole    4    Support disk and heat transfer disk stack
PLATE
origin    0    0    79.2376    ! Origin
0    0    1
4
cell    12.3597            ! Sets up a repeating lattice of cells
12.3597    0           ! flood matl
7.6086    0           ! water gap
6.0211    11           ! aluminium disk
1.2700    0           ! water gap
9              ! steel disk

* Hole    5    Flood material model
PLATE
0    0    1
1
417.8300    0           ! Above flooded region
0              ! Flooded region

* Hole    6    Support disk stack lower
PLATE
origin    0    0    17.4396    ! Origin
0    0    1
2
cell    12.3596            ! Sets up a repeating lattice of cells
12.3596    0           ! flood matl
1.2700    0           ! water gap
9              ! steel disk

* Hole    7    Support disk stack upper
PLATE
origin    0    0    326.4316    ! Origin
0    0    1
2
cell    12.3596            ! Sets up a repeating lattice of cells
12.3596    0           ! flood matl
1.2700    0           ! water gap
9              ! steel disk

end

*
* Unit 15 Source Strength - Fuel Neutron
*
* Class 1 - aa14b - STC Hybrid14 (Rev 0) - Fuel Neutron - Group 2 Reponse
begin source strength
    component        1.6667E+00    ! Subcritical multiplication factor
    component        6.9739E-06    ! 1/volume (1/1.4339E+05)
    component    r    10*1.0
    component    z
        4.3222E-02    2.3510E-01    6.9499E-01    1.5792E+00    2.1585E+00    1.8268E+00
        1.3619E+00    1.0170E+00    5.7791E-01    2.8622E-01    1.6890E-01    8.4742E-02
        3.7293E-02
    component    energy
        1*0.0
        1.0000E+00
        26*0.0


end

*
* Unit 16 Simple Source Weights
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
*
*begin source weights
*
*end
*
* Unit 31 Tabular Output
*
begin tabular output
    /Case trnNrmDryRadFn_aa14b_02g - Det DRA - Surface - Response/
    response    interim
    number    some    1
    region    from    121    to    135
    output to file    also
    /Case trnNrmDryRadFn_aa14b_02g - Det DRB - PersBarr - Response/
    response
    number    some    1
    region    from    245    to    259
    output to file    also
    /Case trnNrmDryRadFn_aa14b_02g - Det DRC - LimSurf - Response/
    response
    number    some    1
    region    from    262    to    276
    output to file    also
    /Case trnNrmDryRadFn_aa14b_02g - Det DRD - 1m - Response/
    response
    number    some    1
    region    from    278    to    292
    output to file    also
    /Case trnNrmDryRadFn_aa14b_02g - Det DRE - 1m+LimSurf - Response/
    response
    number    some    1
    region    from    294    to    308
    output to file    also
end
*
* Unit 32 Material Specification
*
begin material specification
type    dice
normalise
nmixtures    3
weight    mixture    1
            u235    3.2615E-02
            u238    8.4888E-01
            o    1.1850E-01
atoms    mixture    2
            h    6.6667E-01
            o    3.3333E-01
atoms    mixture    3
            c    2.8571E-01
            h    4.7619E-01
            o    2.3810E-01
*
* Materials List - Dry Conditions - v1.2 - Class 1 - aa14b - STC Hybrid14 (Rev 0) Fuel
*
nmaterials    20
volume                              ! Homogenized aa14b Fuel
material    1
    mixture    1    density    10.4120    prop    3.1489E-01    ! UO2 mixture at 3.7%
    void                prop    1.6671E-02    ! Gap
    zircalloy        density    6.5500    prop    9.7331E-02    ! Tube, clad
    void                prop    5.7111E-01    ! Interstitial, inside tubes
volume                              ! Fuel pin cladding
material    2
    zircalloy        density    6.5500    prop    1.0000
volume                              ! Water In Lattice and Tube
material    3
    mixture    2    density    0.9982    prop    1.0000    ! mixH2O
volume                              ! Water In Fuel Rod Clad Gap
material    4
    mixture    2    density    0.9982    prop    1.0000    ! mixH2O
volume                              ! Lower Nozzle Material
```

Figure 5.5-3 MCBEND Input File for Directly Loaded 14×14 Fuel Neutron Response from Energy Group 2 – Normal Conditions (continued)

```
material    5
    stainless 3041 steel        density    7.9200    prop    0.2948
    zircalloy         density    6.5500    prop    0.0831
    void                   prop    0.6220
volume                              ! Upper Nozzle Material
material    6
    stainless 3041 steel        density    7.9200    prop    0.3613
    void                   prop    0.6387
volume                              ! Upper Plenum Material
material    7
    stainless 3041 steel        density    7.9200    prop    0.1147
    zircalloy         density    6.5500    prop    0.0858
    void                   prop    0.7995
*
* Materials List - Common Materials - v1.2
*
volume                              ! Tube wall and cover sheet
material    8
    stainless 3041 steel        density    7.9200    prop    1.0000
volume                              ! Structural Disk Material
material    9
    stainless 3041 steel        density    7.9200    prop    1.0000
volume                              ! Weldment Material
material    10
    stainless 3041 steel        density    7.9200    prop    1.0000
volume                              ! Heat Transfer Disk Material
material    11
    aluminium                 prop    1.0000
volume                              ! Canister Material
material    12
    stainless 3041 steel        density    7.9200    prop    1.0000
atoms                              ! Transfer steel
material    13        density    0             !  (SCALE carbon steel)

        c            prop    3.9250E-03
        fe            prop    8.3498E-02
volume                              ! Lead
material    14
    pb        density    11.0400    prop    1.0000
atoms                              ! NS-4-FR
material    15        density    0             ! 0 means atom/b-cm
        b10            prop    8.5500E-05
        b11            prop    3.4200E-04
        al            prop    7.8000E-03
        h            prop    5.8500E-02
        o            prop    2.6100E-02
        c            prop    2.2600E-02
        n            prop    1.3900E-03
volume                              ! Stainless Steel 304
material    16
    stainless 3041 steel        density    7.9200    prop    1.0000
volume                              ! Vent port middle cylinder
material    17
    stainless 3041 steel        density    7.9200    prop    0.5000
    void                   prop    0.5000
volume                              ! Heat fins for transport cask
material    18
    cu        density    8.9200    prop    0.4286
    stainless 3041 steel        density    7.9200    prop    0.5714
volume                              ! Balsa
material    19
    mixture    3    density    0.1250    prop    1.0000
volume                              ! Redwood
material    20
    mixture    3    density    0.3870    prop    1.0000
end
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions

```
columns 1 200
*
*   NAC-STC - aa14b_07g - Fuel Gamma - Radial
*   Dry Cavity Conditions
*   Accident Transport Conditions
*   Transport Model Revision v1.6.2.0
*   Shielding Revision v1.6
*   STC Source Profile
*   Cobalt Concentration of 1.2 g/kg
*   Fuel Assembly Shift = None, Basket Shift = None
*
* Parameters
*
@samps =    10000000

*
* Unit 1 Control Data
*
begin control data
    run
    sample limit     @samps
    time limit     1000m
    seeds    82896    43596
    chime every    [@samps/10]    samples
    report interim results
    sbd    30s
    dump intervals    1
end

*
* Unit 3 Output Control
*
*begin output control
*    suppress inflows
*end

*
* Unit 4 Material Geometry
*
begin material geometry
* Fuel Assembly Type A - Class 1 - aa14b - STC Hybrid14 (Rev 0)
PART    1    NEST
BOX    M5         0.0000    0.0000    0.0000    19.7180    19.7180    8.6944    ! lower nozzle
BOX    M1    S    0.0000    0.0000    0.0000    19.7180    19.7180    377.5024    ! fuel
BOX    M7         0.0000    0.0000    0.0000    19.7180    19.7180    400.3040    ! top plenum
BOX    M6         0.0000    0.0000    0.0000    19.7180    19.7180    409.1940    ! upper nozzle
* Fuel Assembly Type B - Class 1 - aa14b - STC Hybrid14 (Rev 0)
PART    2    NEST
BOX    M5         0.0000    0.0000    0.0000    19.7180    19.7180    8.6944    ! lower nozzle
BOX    M1    S    0.0000    0.0000    0.0000    19.7180    19.7180    377.5024    ! fuel
BOX    M7         0.0000    0.0000    0.0000    19.7180    19.7180    400.3040    ! top plenum
BOX    M6         0.0000    0.0000    0.0000    19.7180    19.7180    409.1940    ! upper nozzle
* Fuel Assembly in Tube (Type A) v1.1
PART    3
BOX    1    1.4135    1.4135    0.0000    19.7180    19.7180    409.1940    ! Fuel assembly
BOX    2    0.1219    0.1219    0.0000    22.3012    22.3012    419.1000    ! Space inside tube
BOX    3    0.0000    0.0000    6.3500    22.5450    22.5450    392.9380    ! Fuel tube
BOX    4    0.0000    0.0000    0.0000    22.5450    22.5450    419.1000    ! Container body - extent of STC cavity
ZONES
/Fuel Assembly/    P1    +1
/Space in Tube/    H5    +2    -1
/Fuel Tube/    M8    +3    -2
/Container/    H5    +4    -3    -2    -1
VOLUMES UNITY
* Fuel Assembly in Tube (Type B) v1.1
PART    4
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
BOX    1    1.4135    1.4135    0.0000    19.7180    19.7180    409.1940    ! Fuel assembly
BOX    2    0.1219    0.1219    0.0000    22.3012    22.3012    419.1000    ! Space inside tube
BOX    3    0.0000    0.0000    6.3500    22.5450    22.5450    392.9380    ! Fuel tube
BOX    4    0.0000    0.0000    0.0000    22.5450    22.5450    419.1000    ! Container body - extent of STC cavity
ZONES
/Fuel Assembly/    P2    +1
/Space in Tube/    H5    +2    -1
/Fuel Tube/    M8    +3    -2
/Container/    H5    +4    -3    -2    -1
VOLUMES UNITY
*  Type A Disk Opening with Tube v1.2
PART    5    CLUSTER
BOX    P3    0.4547    0.4547    0.0000    22.5450    22.5450    419.1000    ! Fuel tube type A with fuel assy
BOX    H5    0.0000    0.0000    0.0000    23.4544    23.4544    419.1000    ! Support disk opening width
*  Type B Disk Opening with Tube v1.2
PART    6    CLUSTER
BOX    P4    0.4547    0.4547    0.0000    22.5450    22.5450    419.1000    ! Fuel tube type B with fuel assy
BOX    H5    0.0000    0.0000    0.0000    23.4544    23.4544    419.1000    ! Support disk opening width
* STC Basket v1.2
PART    7
BOX    1    -38.9153    56.2432    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 1
BOX    2    -11.7272    56.2432    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 2
BOX    3    15.4610    56.2432    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 3
BOX    4    -70.7136    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 4
BOX    5    -38.9153    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 5
BOX    6    -11.7272    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 6
BOX    7    15.4610    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 7
BOX    8    47.2592    29.0551    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 8
BOX    9    -70.7136    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 9
BOX    10    -38.9153    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 10
BOX    11    -11.7272    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 11
BOX    12    15.4610    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 12
BOX    13    47.2592    1.8669    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 13
BOX    14    -70.7136    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 14
BOX    15    -38.9153    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 15
BOX    16    -11.7272    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 16
BOX    17    15.4610    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 17
BOX    18    47.2592    -25.3213    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 18
BOX    19    -70.7136    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 19
BOX    20    -38.9153    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 20
BOX    21    -11.7272    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 21
BOX    22    15.4610    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 22
BOX    23    47.2592    -52.5094    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 23
BOX    24    -38.9153    -79.6976    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 24
BOX    25    -11.7272    -79.6976    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 25
BOX    26    15.4610    -79.6976    0.0000    23.4544    23.4544    419.1000    ! Basket Opening 26
ZROD    27    0.0000    0.0000    0.0000    89.9922    419.1000    ! Basket stack to cavity height
ZONES
/Opening01/    P5    +1
/Opening02/    P5    +2
/Opening03/    P5    +3
/Opening04/    P6    +4
/Opening05/    P5    +5
/Opening06/    P5    +6
/Opening07/    P5    +7
/Opening08/    P6    +8
/Opening09/    P5    +9
/Opening10/    P5    +10
/Opening11/    P5    +11
/Opening12/    P5    +12
/Opening13/    P5    +13
/Opening14/    P5    +14
/Opening15/    P5    +15
/Opening16/    P5    +16
/Opening17/    P5    +17
/Opening18/    P5    +18
/Opening19/    P6    +19
/Opening20/    P5    +20
/Opening21/    P5    +21
/Opening22/    P5    +22
/Opening23/    P6    +23
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
/Opening24/    P5    +24
/Opening25/    P5    +25
/Opening26/    P5    +26
/Basket/    H1    +27    -1    -2    -3    -4    -5
       -6    -7    -8    -9    -10    -11
       -12   -13   -14   -15   -16   -17
       -18   -19   -20   -21   -22   -23
       -24   -25   -26
VOLUMES    UNITY
* Basket in Cask Cavity v1.2
PART    8    NEST
ZROD    P7    0.0000    0.0000    0.0000    89.9922    419.1000        ! Basket inserted - Includes gap to lid
ZROD    H5    0.0000    0.0000    0.0000    90.1700    419.1000        ! Inserts flood matl to id of stc
* Transport Cask Inner Lid - With Ports v1.6.2.0
PART    9
ZROD    1    0.0000    0.0000    0.0000    100.3300    18.0848        ! Inner lid base
ZROD    2    0.0000    0.0000    18.0848    92.5957    4.7752        ! Inner lid cap
ZROD    3    0.0000    77.9907    0.0000    8.2931    22.8600        ! Drain port
ZROD    4    0.0000    -77.9907    0.0000    8.2931    22.8600        ! Vent port
ZROD    5    0.0000    0.0000    15.2400    85.6234    5.0800        ! Neutron shield
ZROD    6    0.0000    77.9907    15.2400    10.1600    5.0800        ! Cut circle 1 for neutron shield
ZROD    7    0.0000    -77.9907    15.2400    10.1600    5.0800        ! Cut circle 2 for neutron shield
BOX    8    -10.1600    77.9907    15.2400    20.3200    7.6327    5.0800        ! Cut box 1 for neutron shield
BOX    9    -10.1600    -85.6234    15.2400    20.3200    7.6327    5.0800        ! Cut box 2 for neutron shield
ZROD    10    0.0000    0.0000    0.0000    100.3300    22.8600        ! Container
ZONES
/Container/    M0    +10    -1    -2
/LidBase1/    M16    +1    -3    -4    -5    -6    -7
       -8    -9
/LidBase2/    M16    +1    +8    -6
/LidBase3/    M16    +1    +9    -7
/LidBase4/    M16    +1    +6    -3
/LidBase5/    M16    +1    +7    -4
/Nshield/    M15    +5    -6    -7    -8    -9
/LidCap1/    M16    +2    -3    -4    -5    -6    -7
       -8    -9
/LidCap2/    M16    +2    +8    -6
/LidCap3/    M16    +2    +9    -7
/LidCap4/    M16    +2    +6    -3
/LidCap5/    M16    +2    +7    -4
/DrainPort/    P10    +3
/VentPort/    P10    +4
VOLUMES UNITY
* Transport Cask Inner Lid Port Model - With Covers v1.6.2.0
PART    10    CLUSTER
ZROD    M0    0.0000    0.0000    0.0000    1.2700    10.8966        ! Bottom cylinder
ZROD    M0    0.0000    0.0000    10.8966    4.1275    7.5184        ! Middle cylinder
ZROD    M16    0.0000    0.0000    18.4150    8.2931    2.5400        ! Cover
ZROD    M0    0.0000    0.0000    20.9550    8.2931    1.9050        ! Top cylinder
ZROD    M16    0.0000    0.0000    0.0000    8.2931    22.8600        ! Inner lid material
* Transport Cask - Accident Conditions v1.6.2.0
PART    11
ZROD    1    0.0000    0.0000    -34.6710    110.1090    490.1184        ! Transport Cask
ZROD    2    0.0000    0.0000    0.0000    90.1700    419.1000        ! Cavity
ZROD    3    0.0000    0.0000    -20.8280    100.1776    5.0800        ! Bottom neutron shield
ZROD    4    0.0000    0.0000    419.1000    100.3300    22.8600        ! Inner lid
ZROD    5    0.0000    0.0000    0.0000    103.4034    408.9400        ! Lead shield cavity
ZROD    6    0.0000    0.0000    0.0000    95.2500    30.4800        ! Inner shell lower
ZCONE    7    0.0000    0.0000    30.4800    95.2500    93.9800    7.6200        ! Inner shell lower cone
ZROD    8    0.0000    0.0000    38.1000    93.9800    332.7400        ! Inner shell middle
ZCONE    9    0.0000    0.0000    370.8400    93.9800    95.2500    7.6200        ! Inner shell upper cone
ZROD    10    0.0000    0.0000    378.4600    95.2500    30.4800        ! Inner shell upper
ZP    11    402.9752                        ! Top axial lead slump cut plane
ZP    12    5.9648                        ! Bottom axial lead slump cut plane
YP    13    100.9322                        ! Radial lead slump cut plane
ZROD    14    0.0000    0.0000    -3.8100    124.7140    410.5148        ! Radial neutron shield shell
ZROD    15    0.0000    0.0000    -2.6100    124.0790    408.1148        ! Radial neutron shield
ZP    16    2.4700                        ! Insulation (void) cut plane
ZCONE    17    0.0000    0.0000    19.0500    124.7140    113.9190    24.1300        ! Top of rotating trunnion
BOX    18    -124.7140    -12.7000    -3.8100    249.4280    25.4000    22.8600        ! Bottom of rotating trunnion
BOX    19    -114.2238    -12.7000    -3.8100    228.4476    25.4000    22.8600        ! Bottom of rotating trunnion base
BOX    20    -124.7140    -7.6200    -3.8100    249.4280    15.2400    15.2400        ! Trunnion void box
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
XROD   21    -124.7140    0.0000    11.4300    7.6200    249.4280               ! Trunnion void circle
BOX    22   -124.7140    -12.7000    -3.8100   249.4280    25.4000    46.9900           ! Trunnion extent box
ZSEC   23    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    14.6584    15.3416    ! Heat fin 1
ZSEC   24    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    29.6584    30.3416    ! Heat fin 2
ZSEC   25    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    44.6584    45.3416    ! Heat fin 3
ZSEC   26    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    59.6584    60.3416    ! Heat fin 4
ZSEC   27    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    74.6584    75.3416    ! Heat fin 5
ZSEC   28    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    89.6584    90.3416    ! Heat fin 6
ZSEC   29    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    104.6584    105.3416    ! Heat fin 7
ZSEC   30    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    119.6584    120.3416    ! Heat fin 8
ZSEC   31    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    134.6584    135.3416    ! Heat fin 9
ZSEC   32    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    149.6584    150.3416    ! Heat fin 10
ZSEC   33    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    164.6584    165.3416    ! Heat fin 11
ZSEC   34    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    179.6584    180.3416    ! Heat fin 12
ZSEC   35    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    194.6584    195.3416    ! Heat fin 13
ZSEC   36    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    209.6584    210.3416    ! Heat fin 14
ZSEC   37    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    224.6584    225.3416    ! Heat fin 15
ZSEC   38    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    239.6584    240.3416    ! Heat fin 16
ZSEC   39    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    254.6584    255.3416    ! Heat fin 17
ZSEC   40    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    269.6584    270.3416    ! Heat fin 18
ZSEC   41    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    284.6584    285.3416    ! Heat fin 19
ZSEC   42    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    299.6584    300.3416    ! Heat fin 20
ZSEC   43    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    314.6584    315.3416    ! Heat fin 21
ZSEC   44    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    329.6584    330.3416    ! Heat fin 22
ZSEC   45    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    344.6584    345.3416    ! Heat fin 23
ZSEC   46    0.0000    0.0000    -2.6100    110.1090    124.0790    408.1148    359.6584    360.3416    ! Heat fin 24
ZROD   47    0.0000    0.0000    -34.6710    124.7140    490.1184               ! Container
ZONES
/Cavity/    P8    +2
/OuterShell/    M16    +1    -2    -3    -4    -5
/InnerShell1/    M16    +6    -2
/InnerShell2/    M16    +7    -2
/InnerShell3/    M16    +8    -2
/InnerShell4/    M16    +9    -2
/InnerShell5/    M16    +10    -2
/InnerLid/    P9    +4
/BotNShield/    M15    +3
/LeadShield/    M14    +5    -6    -7    -8    -9    -10
        +12    -11    -13
/TopSlumpVoid/    M0    +5    -10    +11
/BotSlumpVoid/    M0    +5    -6    -12
/RadVoid/    M0    +5    -11    +13    +12
/RadNShieldShell1/    M16    +14    -15    -1    -22
/RadNShieldShell2/    M16    +14    -15    -1    +22    -17    -18
/RadNShield1/    M21    +15    -1    -23    -24    -25    -26    -27    -28
        -29    -30    -31    -32    -33    -34    -35    -36
        -37    -38    -39    -40    -41    -42    -43    -44
        -45    -46    +16    -22
/RadNShield2/    M21    +15    -1    +22    -17    -18    -34    -46
/InsulationVoid/    M0    +15    -1    -16    -22
/RotTrunUpper/    M16    +17    +22    +14    -1
/RotTrunLower/    M16    +19    +14    -1
/RotTrunSide/    M16    +18    +14    -19    -20    -21
/RotTrunBoxVoid/    M0    +20    +14    -19
/RotTrunCircVoid/    M0    +21    +14    -19    -20
/HeatFin1/    M18    +23
/HeatFin2/    M18    +24
/HeatFin3/    M18    +25
/HeatFin4/    M18    +26
/HeatFin5/    M18    +27
/HeatFin6/    M18    +28
/HeatFin7/    M18    +29
/HeatFin8/    M18    +30
/HeatFin9/    M18    +31
/HeatFin10/    M18    +32
/HeatFin11/    M18    +33
/HeatFin12/    M18    +34    -17    -18
/HeatFin13/    M18    +35
/HeatFin14/    M18    +36
/HeatFin15/    M18    +37
/HeatFin16/    M18    +38
/HeatFin17/    M18    +39
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
/HeatFin18/   M18    +40
/HeatFin19/   M18    +41
/HeatFin20/   M18    +42
/HeatFin21/   M18    +43
/HeatFin22/   M18    +44
/HeatFin23/   M18    +45
/HeatFin24/   M18    +46    -17    -18
/Container/   M0    +47    -1    -14
VOLUMES UNITY
* Transport Cask Detector Description v1.6.2.0
PART    12
* Radial Detector DRA (Surface) Bodies
ZROD      1              0.0000    0.0000    -34.6710  124.7140  490.1184
ZROD      2              0.0000    0.0000    -34.6710  125.7140  32.6746
ZROD      3              0.0000    0.0000    -1.9964   125.7140  32.6746
ZROD      4              0.0000    0.0000    30.6781   125.7140  32.6746
ZROD      5              0.0000    0.0000    63.3527   125.7140  32.6746
ZROD      6              0.0000    0.0000    96.0272   125.7140  32.6746
ZROD      7              0.0000    0.0000    128.7018  125.7140  32.6746
ZROD      8              0.0000    0.0000    161.3764  125.7140  32.6746
ZROD      9              0.0000    0.0000    194.0509  125.7140  32.6746
ZROD      10             0.0000    0.0000    226.7255  125.7140  32.6746
ZROD      11             0.0000    0.0000    259.4000  125.7140  32.6746
ZROD      12             0.0000    0.0000    292.0746  125.7140  32.6746
ZROD      13             0.0000    0.0000    324.7492  125.7140  32.6746
ZROD      14             0.0000    0.0000    357.4237  125.7140  32.6746
ZROD      15             0.0000    0.0000    390.0983  125.7140  32.6746
ZROD      16             0.0000    0.0000    422.7728  125.7140  32.6746
* Radial Detector DRAA (SurfaceAzi) Bodies
ZROD      17             0.0000    0.0000    -35.6710  125.7140  492.1184
*   Band 1 Bodies
ZSEC      18             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   250.0000  260.0000
ZSEC      19             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   260.0000  270.0000
ZSEC      20             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   270.0000  280.0000
ZSEC      21             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   280.0000  290.0000
ZSEC      22             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   290.0000  300.0000
ZSEC      23             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   300.0000  310.0000
ZSEC      24             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   310.0000  320.0000
ZSEC      25             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   320.0000  330.0000
ZSEC      26             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   330.0000  340.0000
ZSEC      27             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   340.0000  350.0000
ZSEC      28             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   350.0000  360.0000
ZSEC      29             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   0.0000    10.0000
ZSEC      30             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   10.0000   20.0000
ZSEC      31             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   20.0000   30.0000
ZSEC      32             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   30.0000   40.0000
ZSEC      33             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   40.0000   50.0000
ZSEC      34             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   50.0000   60.0000
ZSEC      35             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   60.0000   70.0000
ZSEC      36             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   70.0000   80.0000
ZSEC      37             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   80.0000   90.0000
ZSEC      38             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   90.0000   100.0000
ZSEC      39             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   100.0000  110.0000
ZSEC      40             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   110.0000  120.0000
ZSEC      41             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   120.0000  130.0000
ZSEC      42             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   130.0000  140.0000
ZSEC      43             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   140.0000  150.0000
ZSEC      44             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   150.0000  160.0000
ZSEC      45             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   160.0000  170.0000
ZSEC      46             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   170.0000  180.0000
ZSEC      47             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   180.0000  190.0000
ZSEC      48             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   190.0000  200.0000
ZSEC      49             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   200.0000  210.0000
ZSEC      50             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   210.0000  220.0000
ZSEC      51             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   220.0000  230.0000
ZSEC      52             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   230.0000  240.0000
ZSEC      53             0.0000    0.0000    178.0984  125.7140  126.7140  30.0000   240.0000  250.0000
* Radial Detector DRB (1m) Bodies
ZROD      54             0.0000    0.0000    -134.6710 210.1090  690.1184
ZROD      55             0.0000    0.0000    -134.6710 211.1090  34.5059
ZROD      56             0.0000    0.0000    -100.1651 211.1090  34.5059
ZROD      57             0.0000    0.0000    -65.6592  211.1090  34.5059
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
ZROD      58              0.0000    0.0000    -31.1532  211.1090  34.5059
ZROD      59              0.0000    0.0000    3.3527    211.1090  34.5059
ZROD      60              0.0000    0.0000    37.8586   211.1090  34.5059
ZROD      61              0.0000    0.0000    72.3645   211.1090  34.5059
ZROD      62              0.0000    0.0000    106.8704  211.1090  34.5059
ZROD      63              0.0000    0.0000    141.3764  211.1090  34.5059
ZROD      64              0.0000    0.0000    175.8823  211.1090  34.5059
ZROD      65              0.0000    0.0000    210.3882  211.1090  34.5059
ZROD      66              0.0000    0.0000    244.8941  211.1090  34.5059
ZROD      67              0.0000    0.0000    279.4000  211.1090  34.5059
ZROD      68              0.0000    0.0000    313.9060  211.1090  34.5059
ZROD      69              0.0000    0.0000    348.4119  211.1090  34.5059
ZROD      70              0.0000    0.0000    382.9178  211.1090  34.5059
ZROD      71              0.0000    0.0000    417.4237  211.1090  34.5059
ZROD      72              0.0000    0.0000    451.9296  211.1090  34.5059
ZROD      73              0.0000    0.0000    486.4356  211.1090  34.5059
ZROD      74              0.0000    0.0000    520.9415  211.1090  34.5059
* Radial Detector DRBA (1mAzi) Bodies
ZROD      75              0.0000    0.0000    -135.6710 211.1090  692.1184
*   Band 1 Bodies
ZSEC      76              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   250.0000  260.0000
ZSEC      77              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   260.0000  270.0000
ZSEC      78              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   270.0000  280.0000
ZSEC      79              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   280.0000  290.0000
ZSEC      80              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   290.0000  300.0000
ZSEC      81              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   300.0000  310.0000
ZSEC      82              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   310.0000  320.0000
ZSEC      83              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   320.0000  330.0000
ZSEC      84              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   330.0000  340.0000
ZSEC      85              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   340.0000  350.0000
ZSEC      86              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   350.0000  360.0000
ZSEC      87              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   0.0000    10.0000
ZSEC      88              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   10.0000   20.0000
ZSEC      89              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   20.0000   30.0000
ZSEC      90              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   30.0000   40.0000
ZSEC      91              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   40.0000   50.0000
ZSEC      92              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   50.0000   60.0000
ZSEC      93              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   60.0000   70.0000
ZSEC      94              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   70.0000   80.0000
ZSEC      95              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   80.0000   90.0000
ZSEC      96              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   90.0000   100.0000
ZSEC      97              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   100.0000  110.0000
ZSEC      98              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   110.0000  120.0000
ZSEC      99              0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   120.0000  130.0000
ZSEC      100             0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   130.0000  140.0000
ZSEC      101             0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   140.0000  150.0000
ZSEC      102             0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   150.0000  160.0000
ZSEC      103             0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   160.0000  170.0000
ZSEC      104             0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   170.0000  180.0000
ZSEC      105             0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   180.0000  190.0000
ZSEC      106             0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   190.0000  200.0000
ZSEC      107             0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   200.0000  210.0000
ZSEC      108             0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   210.0000  220.0000
ZSEC      109             0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   220.0000  230.0000
ZSEC      110             0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   230.0000  240.0000
ZSEC      111             0.0000    0.0000    178.0984  211.1090  212.1090  30.0000   240.0000  250.0000
* World
ZROD      112             0.0000    0.0000    -185.6710 261.1090  792.1184
* External Void
ZROD      113             0.0000    0.0000    -235.6710 311.1090  892.1184

ZONES
/TransportCask/     P11       +1
* Detector DRA (Surface)
/DRA01/   M0        +2        -1
/DRA02/   M0        +3        -1
/DRA03/   M0        +4        -1
/DRA04/   M0        +5        -1
/DRA05/   M0        +6        -1
/DRA06/   M0        +7        -1
/DRA07/   M0        +8        -1
/DRA08/   M0        +9        -1
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
/DRA09/   M0        +10     -1
/DRA10/   M0        +11     -1
/DRA11/   M0        +12     -1
/DRA12/   M0        +13     -1
/DRA13/   M0        +14     -1
/DRA14/   M0        +15     -1
/DRA15/   M0        +16     -1
/Void/    M0        +17     -1
                    -2      -3      -4      -5      -6      -7
                    -8      -9      -10     -11     -12     -13
                    -14     -15     -16
* Detector DRAA (SurfaceAzi)
/DRAA0101/          M0      +18
/DRAA0102/          M0      +19
/DRAA0103/          M0      +20
/DRAA0104/          M0      +21
/DRAA0105/          M0      +22
/DRAA0106/          M0      +23
/DRAA0107/          M0      +24
/DRAA0108/          M0      +25
/DRAA0109/          M0      +26
/DRAA0110/          M0      +27
/DRAA0111/          M0      +28
/DRAA0112/          M0      +29
/DRAA0113/          M0      +30
/DRAA0114/          M0      +31
/DRAA0115/          M0      +32
/DRAA0116/          M0      +33
/DRAA0117/          M0      +34
/DRAA0118/          M0      +35
/DRAA0119/          M0      +36
/DRAA0120/          M0      +37
/DRAA0121/          M0      +38
/DRAA0122/          M0      +39
/DRAA0123/          M0      +40
/DRAA0124/          M0      +41
/DRAA0125/          M0      +42
/DRAA0126/          M0      +43
/DRAA0127/          M0      +44
/DRAA0128/          M0      +45
/DRAA0129/          M0      +46
/DRAA0130/          M0      +47
/DRAA0131/          M0      +48
/DRAA0132/          M0      +49
/DRAA0133/          M0      +50
/DRAA0134/          M0      +51
/DRAA0135/          M0      +52
/DRAA0136/          M0      +53
/Void/    M0        +54     -17
                    -18     -19     -20     -21     -22     -23
                    -24     -25     -26     -27     -28     -29
                    -30     -31     -32     -33     -34     -35
                    -36     -37     -38     -39     -40     -41
                    -42     -43     -44     -45     -46     -47
                    -48     -49     -50     -51     -52     -53
* Detector DRB (1m)
/DRB01/   M0        +55     -54
/DRB02/   M0        +56     -54
/DRB03/   M0        +57     -54
/DRB04/   M0        +58     -54
/DRB05/   M0        +59     -54
/DRB06/   M0        +60     -54
/DRB07/   M0        +61     -54
/DRB08/   M0        +62     -54
/DRB09/   M0        +63     -54
/DRB10/   M0        +64     -54
/DRB11/   M0        +65     -54
/DRB12/   M0        +66     -54
/DRB13/   M0        +67     -54
/DRB14/   M0        +68     -54
/DRB15/   M0        +69     -54
/DRB16/   M0        +70     -54
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
/DRB17/   M0        +71      -54
/DRB18/   M0        +72      -54
/DRB19/   M0        +73      -54
/DRB20/   M0        +74      -54
/Void/    M0        +75      -54
                    -55      -56      -57      -58      -59      -60
                    -61      -62      -63      -64      -65      -66
                    -67      -68      -69      -70      -71      -72
                    -73      -74
* Detector DRBA (1mAzi)
/DRBA0101/          M0       +76
/DRBA0102/          M0       +77
/DRBA0103/          M0       +78
/DRBA0104/          M0       +79
/DRBA0105/          M0       +80
/DRBA0106/          M0       +81
/DRBA0107/          M0       +82
/DRBA0108/          M0       +83
/DRBA0109/          M0       +84
/DRBA0110/          M0       +85
/DRBA0111/          M0       +86
/DRBA0112/          M0       +87
/DRBA0113/          M0       +88
/DRBA0114/          M0       +89
/DRBA0115/          M0       +90
/DRBA0116/          M0       +91
/DRBA0117/          M0       +92
/DRBA0118/          M0       +93
/DRBA0119/          M0       +94
/DRBA0120/          M0       +95
/DRBA0121/          M0       +96
/DRBA0122/          M0       +97
/DRBA0123/          M0       +98
/DRBA0124/          M0       +99
/DRBA0125/          M0       +100
/DRBA0126/          M0       +101
/DRBA0127/          M0       +102
/DRBA0128/          M0       +103
/DRBA0129/          M0       +104
/DRBA0130/          M0       +105
/DRBA0131/          M0       +106
/DRBA0132/          M0       +107
/DRBA0133/          M0       +108
/DRBA0134/          M0       +109
/DRBA0135/          M0       +110
/DRBA0136/          M0       +111
/Void/    M0        +112     -75
                    -76      -77      -78      -79      -80      -81
                    -82      -83      -84      -85      -86      -87
                    -88      -89      -90      -91      -92      -93
                    -94      -95      -96      -97      -98      -99
                    -100     -101     -102     -103     -104     -105
                    -106     -107     -108     -109     -110     -111
/ExtVoid/ M-2000    +113     -112
Volumes
                    1.0      15*2.5706E+04     1.0      36*6.6085E+02      1.0      20*4.5662E+04
                    1.0      36*1.1080E+03     1.0      1.0
end

*
* Unit 5 Splitting Geometry for Radial Detectors - Gamma
*
begin splitting geometry
    r    37    fill    0.0000
                    n    10    89.9922
                    n    1     93.9800
                    n    16    103.4034
                    n    3     110.1090
                    n    5     124.0790
                    n    1     124.7140
                    n    1     129.7140
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
    z    38    fill    -39.6710
                n    1    -34.6710
                n    2    -20.8280
                n    2    -15.7480
                n    3    0.0000
                n    2    8.6944
                n    13    377.5024
                n    2    400.3040
                n    3    409.1940
                n    1    419.1000
                n    3    434.3400
                n    2    439.4200
                n    3    455.4474
                n    1    460.4474

end

*
* Unit 6 - Source Geometry for Fuel Gamma
*
begin source geometry
    r    10    fill    0.0000    n    10    89.9922
    z    13
        8.6944    17.9146    27.1348    45.5752    82.4560    156.2176
        229.9792    266.8600    303.7408    340.6216    349.8418    359.0620
        368.2822    377.5024
end

*
* Unit 7
*
begin energy data
    gamma    dice
    importance    standard    22    groups
    scoring    as    importance
    simple    source    histogram    weighting    automatic
end

*
* Unit 8 Importance Map - Radial
*
begin importance map
    calculate
    targets    15
    part    12
    zones
        2    3    4    5    6
        7    8    9    10    11
        12    13    14    15    16
    strengths
        1.0E+02    1.0E+02    5.0E+01    5.0E+01    5.0E+01
        1.0E+01    1.0E+01    1.0E+00    1.0E+01    1.0E+01
        5.0E+01    5.0E+01    5.0E+01    1.0E+02    1.0E+02
    defer mixing
    void density    0.10
    track
!    coupled source
!    write gamma importances to 32
!    write unformatted file to 31
!    use method d
end

*
* Unit 9 Scoring Data - Radial
*
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
begin scoring data
    flux
    part    12
    from    2     to    16    ! DRA
    from    18     to    53    ! DRAA
    from    55     to    74    ! DRB
    from    76     to    111    ! DRBA
    responses    sos    ditto
    contributions to responses        ditto
    ! score distribution for response
    ! weight distribution    total
end

*
* Unit 10 Response Data
*
begin response data
* Scaled to mrem/hr
/ansi ans-6.1.1-1977 photon flux-dose conversion factors - mcnp table h.2 - mrem/
          function pairs
          1.5000E+01          1.3300E-02
          1.4787E+01          1.3142E-02
          1.4577E+01          1.2985E-02
          1.4370E+01          1.2831E-02
          1.4166E+01          1.2678E-02
          1.3964E+01          1.2528E-02
          1.3766E+01          1.2379E-02
          1.3570E+01          1.2231E-02
          1.3377E+01          1.2086E-02
          1.3187E+01          1.1942E-02
          1.3000E+01          1.1800E-02
          1.2785E+01          1.1641E-02
          1.2573E+01          1.1483E-02
          1.2365E+01          1.1328E-02
          1.2160E+01          1.1175E-02
          1.1958E+01          1.1025E-02
          1.1760E+01          1.0876E-02
          1.1565E+01          1.0729E-02
          1.1374E+01          1.0584E-02
          1.1185E+01          1.0441E-02
          1.1000E+01          1.0300E-02
          1.0781E+01          1.0136E-02
          1.0567E+01          9.9740E-03
          1.0357E+01          9.8149E-03
          1.0152E+01          9.6583E-03
          9.9499E+00          9.5043E-03
          9.7522E+00          9.3526E-03
          9.5585E+00          9.2035E-03
          9.3686E+00          9.0566E-03
          9.1824E+00          8.9122E-03
          9.0000E+00          8.7700E-03
          8.8374E+00          8.6521E-03
          8.6777E+00          8.5358E-03
          8.5210E+00          8.4211E-03
          8.3670E+00          8.3079E-03
          8.2158E+00          8.1962E-03
          8.0674E+00          8.0861E-03
          7.9216E+00          7.9774E-03
          7.7785E+00          7.8701E-03
          7.6380E+00          7.7644E-03
          7.5000E+00          7.6600E-03
          7.4214E+00          7.6031E-03
          7.3436E+00          7.5467E-03
          7.2666E+00          7.4907E-03
          7.1905E+00          7.4351E-03
          7.1151E+00          7.3799E-03
          7.0406E+00          7.3251E-03
          6.9668E+00          7.2707E-03
          6.8937E+00          7.2167E-03
          6.8215E+00          7.1632E-03
          6.7500E+00          7.1100E-03
          6.6983E+00          7.0721E-03
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
6.6469E+00        7.0344E-03
6.5959E+00        6.9969E-03
6.5454E+00        6.9596E-03
6.4952E+00        6.9225E-03
6.4454E+00        6.8856E-03
6.3960E+00        6.8489E-03
6.3469E+00        6.8124E-03
6.2983E+00        6.7761E-03
6.2500E+00        6.7400E-03
6.1981E+00        6.7021E-03
6.1466E+00        6.6643E-03
6.0956E+00        6.6268E-03
6.0450E+00        6.5895E-03
5.9948E+00        6.5524E-03
5.9450E+00        6.5155E-03
5.8956E+00        6.4788E-03
5.8467E+00        6.4423E-03
5.7981E+00        6.4061E-03
5.7500E+00        6.3700E-03
5.6979E+00        6.3331E-03
5.6463E+00        6.2963E-03
5.5952E+00        6.2598E-03
5.5445E+00        6.2235E-03
5.4943E+00        6.1874E-03
5.4446E+00        6.1515E-03
5.3953E+00        6.1158E-03
5.3464E+00        6.0803E-03
5.2980E+00        6.0451E-03
5.2500E+00        6.0100E-03
5.2244E+00        5.9887E-03
5.1990E+00        5.9674E-03
5.1737E+00        5.9462E-03
5.1485E+00        5.9251E-03
5.1235E+00        5.9041E-03
5.0985E+00        5.8831E-03
5.0737E+00        5.8622E-03
5.0490E+00        5.8414E-03
5.0245E+00        5.8207E-03
5.0000E+00        5.8000E-03
4.9744E+00        5.7797E-03
4.9490E+00        5.7594E-03
4.9236E+00        5.7393E-03
4.8985E+00        5.7192E-03
4.8734E+00        5.6991E-03
4.8485E+00        5.6792E-03
4.8237E+00        5.6593E-03
4.7990E+00        5.6394E-03
4.7744E+00        5.6197E-03
4.7500E+00        5.6000E-03
4.6975E+00        5.5619E-03
4.6455E+00        5.5240E-03
4.5941E+00        5.4863E-03
4.5433E+00        5.4490E-03
4.4931E+00        5.4118E-03
4.4434E+00        5.3750E-03
4.3942E+00        5.3384E-03
4.3456E+00        5.3020E-03
4.2975E+00        5.2659E-03
4.2500E+00        5.2300E-03
4.1971E+00        5.1886E-03
4.1449E+00        5.1474E-03
4.0934E+00        5.1066E-03
4.0425E+00        5.0662E-03
3.9922E+00        5.0260E-03
3.9425E+00        4.9862E-03
3.8935E+00        4.9467E-03
3.8451E+00        4.9075E-03
3.7972E+00        4.8686E-03
3.7500E+00        4.8300E-03
3.6967E+00        4.7863E-03
3.6442E+00        4.7429E-03
3.5924E+00        4.7000E-03
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
3.5414E+00      4.6574E-03
3.4911E+00      4.6152E-03
3.4415E+00      4.5734E-03
3.3926E+00      4.5320E-03
3.3444E+00      4.4910E-03
3.2968E+00      4.4503E-03
3.2500E+00      4.4100E-03
3.2019E+00      4.3683E-03
3.1546E+00      4.3269E-03
3.1079E+00      4.2860E-03
3.0619E+00      4.2454E-03
3.0166E+00      4.2052E-03
2.9720E+00      4.1655E-03
2.9280E+00      4.1260E-03
2.8847E+00      4.0870E-03
2.8420E+00      4.0483E-03
2.8000E+00      4.0100E-03
2.7793E+00      3.9906E-03
2.7588E+00      3.9713E-03
2.7384E+00      3.9520E-03
2.7182E+00      3.9329E-03
2.6981E+00      3.9138E-03
2.6782E+00      3.8949E-03
2.6585E+00      3.8760E-03
2.6388E+00      3.8573E-03
2.6193E+00      3.8386E-03
2.6000E+00      3.8200E-03
2.5569E+00      3.7780E-03
2.5146E+00      3.7364E-03
2.4729E+00      3.6953E-03
2.4319E+00      3.6547E-03
2.3917E+00      3.6145E-03
2.3520E+00      3.5747E-03
2.3131E+00      3.5354E-03
2.2747E+00      3.4965E-03
2.2371E+00      3.4580E-03
2.2000E+00      3.4200E-03
2.1563E+00      3.3744E-03
2.1135E+00      3.3293E-03
2.0715E+00      3.2849E-03
2.0303E+00      3.2410E-03
1.9900E+00      3.1978E-03
1.9504E+00      3.1551E-03
1.9117E+00      3.1130E-03
1.8737E+00      3.0714E-03
1.8365E+00      3.0304E-03
1.8000E+00      2.9900E-03
1.7553E+00      2.9381E-03
1.7118E+00      2.8872E-03
1.6693E+00      2.8371E-03
1.6279E+00      2.7879E-03
1.5875E+00      2.7395E-03
1.5481E+00      2.6920E-03
1.5096E+00      2.6453E-03
1.4722E+00      2.5994E-03
1.4356E+00      2.5543E-03
1.4000E+00      2.5100E-03
1.3537E+00      2.4512E-03
1.3089E+00      2.3937E-03
1.2656E+00      2.3376E-03
1.2237E+00      2.2828E-03
1.1832E+00      2.2293E-03
1.1441E+00      2.1771E-03
1.1062E+00      2.1260E-03
1.0696E+00      2.0762E-03
1.0342E+00      2.0275E-03
1.0000E+00      1.9800E-03
9.7793E-01      1.9477E-03
9.5635E-01      1.9160E-03
9.3525E-01      1.8848E-03
9.1461E-01      1.8541E-03
8.9443E-01      1.8238E-03
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
8.7469E-01          1.7941E-03
8.5539E-01          1.7649E-03
8.3651E-01          1.7361E-03
8.1805E-01          1.7078E-03
8.0000E-01          1.6800E-03
7.8939E-01          1.6633E-03
7.7892E-01          1.6467E-03
7.6859E-01          1.6303E-03
7.5839E-01          1.6141E-03
7.4833E-01          1.5980E-03
7.3841E-01          1.5821E-03
7.2861E-01          1.5663E-03
7.1895E-01          1.5507E-03
7.0941E-01          1.5353E-03
7.0000E-01          1.5200E-03
6.9483E-01          1.5118E-03
6.8970E-01          1.5037E-03
6.8461E-01          1.4955E-03
6.7955E-01          1.4875E-03
6.7454E-01          1.4795E-03
6.6956E-01          1.4715E-03
6.6461E-01          1.4635E-03
6.5971E-01          1.4557E-03
6.5483E-01          1.4478E-03
6.5000E-01          1.4400E-03
6.4482E-01          1.4318E-03
6.3968E-01          1.4236E-03
6.3458E-01          1.4155E-03
6.2952E-01          1.4075E-03
6.2450E-01          1.3994E-03
6.1952E-01          1.3915E-03
6.1458E-01          1.3835E-03
6.0968E-01          1.3756E-03
6.0482E-01          1.3678E-03
6.0000E-01          1.3600E-03
5.9480E-01          1.3507E-03
5.8965E-01          1.3415E-03
5.8454E-01          1.3324E-03
5.7948E-01          1.3233E-03
5.7446E-01          1.3142E-03
5.6948E-01          1.3053E-03
5.6455E-01          1.2964E-03
5.5966E-01          1.2875E-03
5.5481E-01          1.2787E-03
5.5000E-01          1.2700E-03
5.4478E-01          1.2596E-03
5.3962E-01          1.2493E-03
5.3450E-01          1.2391E-03
5.2943E-01          1.2290E-03
5.2440E-01          1.2190E-03
5.1943E-01          1.2090E-03
5.1450E-01          1.1991E-03
5.0962E-01          1.1893E-03
5.0479E-01          1.1796E-03
5.0000E-01          1.1700E-03
4.9476E-01          1.1607E-03
4.8957E-01          1.1514E-03
4.8444E-01          1.1422E-03
4.7937E-01          1.1331E-03
4.7434E-01          1.1241E-03
4.6937E-01          1.1151E-03
4.6445E-01          1.1062E-03
4.5958E-01          1.0974E-03
4.5477E-01          1.0887E-03
4.5000E-01          1.0800E-03
4.4473E-01          1.0701E-03
4.3952E-01          1.0603E-03
4.3438E-01          1.0506E-03
4.2929E-01          1.0409E-03
4.2426E-01          1.0314E-03
4.1930E-01          1.0220E-03
4.1439E-01          1.0126E-03
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
4.0953E-01      1.0033E-03
4.0474E-01      9.9411E-04
4.0000E-01      9.8500E-04
3.9469E-01      9.7374E-04
3.8946E-01      9.6260E-04
3.8429E-01      9.5160E-04
3.7920E-01      9.4072E-04
3.7417E-01      9.2996E-04
3.6920E-01      9.1933E-04
3.6431E-01      9.0882E-04
3.5947E-01      8.9843E-04
3.5470E-01      8.8815E-04
3.5000E-01      8.7800E-04
3.4465E-01      8.6531E-04
3.3937E-01      8.5279E-04
3.3418E-01      8.4046E-04
3.2907E-01      8.2831E-04
3.2404E-01      8.1633E-04
3.1908E-01      8.0453E-04
3.1420E-01      7.9290E-04
3.0939E-01      7.8143E-04
3.0466E-01      7.7014E-04
3.0000E-01      7.5900E-04
2.9458E-01      7.4511E-04
2.8926E-01      7.3147E-04
2.8403E-01      7.1809E-04
2.7890E-01      7.0495E-04
2.7386E-01      6.9205E-04
2.6891E-01      6.7938E-04
2.6405E-01      6.6695E-04
2.5928E-01      6.5474E-04
2.5460E-01      6.4276E-04
2.5000E-01      6.3100E-04
2.4448E-01      6.1661E-04
2.3909E-01      6.0255E-04
2.3381E-01      5.8881E-04
2.2865E-01      5.7538E-04
2.2361E-01      5.6226E-04
2.1867E-01      5.4943E-04
2.1385E-01      5.3690E-04
2.0913E-01      5.2466E-04
2.0451E-01      5.1269E-04
2.0000E-01      5.0100E-04
1.9433E-01      4.8721E-04
1.8882E-01      4.7380E-04
1.8346E-01      4.6076E-04
1.7826E-01      4.4808E-04
1.7321E-01      4.3575E-04
1.6829E-01      4.2376E-04
1.6352E-01      4.1210E-04
1.5888E-01      4.0075E-04
1.5438E-01      3.8973E-04
1.5000E-01      3.7900E-04
1.4404E-01      3.6809E-04
1.3832E-01      3.5749E-04
1.3282E-01      3.4720E-04
1.2754E-01      3.3721E-04
1.2247E-01      3.2750E-04
1.1761E-01      3.1807E-04
1.1293E-01      3.0892E-04
1.0845E-01      3.0002E-04
1.0414E-01      2.9139E-04
1.0000E-01      2.8300E-04
9.6496E-02      2.8039E-04
9.3115E-02      2.7781E-04
8.9852E-02      2.7526E-04
8.6704E-02      2.7272E-04
8.3666E-02      2.7021E-04
8.0734E-02      2.6772E-04
7.7906E-02      2.6526E-04
7.5176E-02      2.6282E-04
7.2542E-02      2.6040E-04
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
          7.0000E-02          2.5800E-04
          6.7684E-02          2.6103E-04
          6.5444E-02          2.6410E-04
          6.3279E-02          2.6721E-04
          6.1185E-02          2.7035E-04
          5.9161E-02          2.7353E-04
          5.7203E-02          2.7675E-04
          5.5311E-02          2.8000E-04
          5.3481E-02          2.8330E-04
          5.1711E-02          2.8663E-04
          5.0000E-02          2.9000E-04
          4.7510E-02          3.1092E-04
          4.5144E-02          3.3335E-04
          4.2896E-02          3.5740E-04
          4.0760E-02          3.8318E-04
          3.8730E-02          4.1083E-04
          3.6801E-02          4.4047E-04
          3.4968E-02          4.7224E-04
          3.3227E-02          5.0631E-04
          3.1572E-02          5.4284E-04
          3.0000E-02          5.8200E-04
          2.6879E-02          7.0502E-04
          2.4082E-02          8.5404E-04
          2.1577E-02          1.0346E-03
          1.9332E-02          1.2532E-03
          1.7321E-02          1.5181E-03
          1.5518E-02          1.8390E-03
          1.3904E-02          2.2277E-03
          1.2457E-02          2.6986E-03
          1.1161E-02          3.2690E-03
          1.0000E-02          3.9600E-03
end

*
* Unit 13 Hole Data
*
begin hole data
* STC Basket Hole Description v1.2
* Hole    1    General Basket Structure
PLATE
0    0    1
7
417.8300    0            ! Top of Basket
389.4976    -2            ! Top of Highest Support Disk
326.4316    -7            ! Resume support disk only
79.2376    -4            ! Start of support+heat disk region
17.4396    -6            ! Bottom of Lowest Support Disk
0.0000    -3            ! Bottom of Basket
0.0000    0            ! Basket Offset
0

* Hole    2    Top Weldment Disk - no structure above the weldment disk
RZMESH
2             ! number of radial points
85.5472
89.9922
3             ! number of axial intervals
389.4976            ! Top of diskstack
400.5580            ! Bottom of weldment
403.0980            ! Top of weldment plate
417.8300            ! Void to top of basket
0    0            ! Material below weldment
10    10            ! Plate Material
0    10            ! Flange
0             ! Outside material

* Hole    3    Bottom Weldment Disk - no structure in the weldment disk support
RZMESH
1             ! number of radial points
89.9922
1             ! number of axial intervals
3.8100
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
6.3500              ! Coordinates inherited from PLATE Hole
10                ! Plate Material
0                 ! Outside material

* Hole    4    Support disk and heat transfer disk stack
PLATE
origin    0    0    79.2376    ! Origin
0    0    1
4
cell    12.3597            ! Sets up a repeating lattice of cells
12.3597    0             ! flood matl
7.6086    0             ! water gap
6.0211    11             ! aluminium disk
1.2700    0             ! water gap
9                 ! steel disk

* Hole    5    Flood material model
PLATE
0    0    1
1
417.8300    0            ! Above flooded region
0                 ! Flooded region

* Hole    6    Support disk stack lower
PLATE
origin    0    0    17.4396    ! Origin
0    0    1
2
cell    12.3596            ! Sets up a repeating lattice of cells
12.3596    0             ! flood matl
1.2700    0             ! water gap
9                 ! steel disk

* Hole    7    Support disk stack upper
PLATE
origin    0    0    326.4316    ! Origin
0    0    1
2
cell    12.3596            ! Sets up a repeating lattice of cells
12.3596    0             ! flood matl
1.2700    0             ! water gap
9                 ! steel disk

end

*
* Unit 15 Source Strength - Fuel Gamma
*
* Class 1 - aa14b - STC Hybrid14 (Rev 0) - Fuel Gamma - Group 7 Reponse
begin source strength
    component        6.9739E-06    ! 1/volume (1/1.4339E+05)
    component    r    10*1.0
    component    z
        4.2500E-01    6.7500E-01    9.0000E-01    1.1000E+00    1.2000E+00    1.1500E+00
        1.0750E+00    1.0000E+00    8.6500E-01    7.4000E-01    6.5000E-01    5.5000E-01
        4.5000E-01
    component    energy
        6*0.0
        1.0000E+00
        15*0.0

end

*
* Unit 16 Simple Source Weights
*
*begin source weights
*
*end

*
* Unit 31 Tabular Output
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
*
begin tabular output
    /Case trnAccDryRadFg_aa14b_07g - Det DRA - Surface - Response/
    response    interim
    number    some    1
    region    from    118    to    132
    output to file    also
    /Case trnAccDryRadFg_aa14b_07g - Det DRAA - SurfaceAzi - Response/
    response
    number    some    1
    region    from    134    to    169
    output to file    also
    /Case trnAccDryRadFg_aa14b_07g - Det DRB - 1m - Response/
    response
    number    some    1
    region    from    171    to    190
    output to file    also
    /Case trnAccDryRadFg_aa14b_07g - Det DRBA - 1mAzi - Response/
    response
    number    some    1
    region    from    192    to    227
    output to file    also
end

*
* Unit 32 Material Specification
*
begin material specification
type    gamma
normalise
nmixtures    3
weight    mixture    1
            u235    3.2615E-02
            u238    8.4888E-01
            o    1.1850E-01
atoms    mixture    2
            h    6.6667E-01
            o    3.3333E-01
atoms    mixture    3
            c    2.8571E-01
            h    4.7619E-01
            o    2.3810E-01
*
* Materials List - Dry Conditions - v1.3 - Class 1 - aa14b - STC Hybrid14 (Rev 0) Fuel
*
nmaterials    21
volume                              ! Homogenized aa14b Fuel
material    1
    mixture    1    density    10.4120    prop    3.1489E-01    ! UO2 mixture at 3.7%
    void                prop    1.6671E-02    ! Gap
    zircalloy        density    6.5500    prop    9.7331E-02    ! Tube, clad
    void                prop    5.7111E-01    ! Interstitial, inside tubes
volume                              ! Fuel pin cladding
material    2
    zircalloy        density    6.5500    prop    1.0000
volume                              ! Water In Lattice and Tube
material    3
    mixture    2    density    0.9982    prop    1.0000    ! mixH2O
volume                              ! Water In Fuel Rod Clad Gap
material    4
    mixture    2    density    0.9982    prop    1.0000    ! mixH2O
volume                              ! Lower Nozzle Material
material    5
    stainless 3041 steel        density    7.9200    prop    0.2948
    zircalloy        density    6.5500    prop    0.0831
    void                prop    0.6220
volume                              ! Upper Nozzle Material
material    6
    stainless 3041 steel        density    7.9200    prop    0.3613
    void                prop    0.6387
volume                              ! Upper Plenum Material
material    7
```

Figure 5.5-4 MCBEND Input File for Directly Loaded 14×14 Fuel Gamma Response from Energy Group 7 – Accident Conditions (continued)

```
    stainless 3041 steel       density    7.9200    prop    0.1147
    zircalloy       density    6.5500    prop    0.0858
    void              prop    0.7995
*
* Materials List - Common Materials - v1.3
*
volume                          ! Tube wall and cover sheet
material    8
    stainless 3041 steel       density    7.9200    prop    1.0000
volume                          ! Structural Disk Material
material    9
    stainless 3041 steel       density    7.9200    prop    1.0000
volume                          ! Weldment Material
material    10
    stainless 3041 steel       density    7.9200    prop    1.0000
volume                          ! Heat Transfer Disk Material
material    11
    aluminium              prop    1.0000
volume                          ! Canister Material
material    12
    stainless 3041 steel       density    7.9200    prop    1.0000
atoms                          ! Transfer steel
material    13       density    0          !  (SCALE carbon steel)

        c            prop    3.9250E-03
        fe            prop    8.3498E-02
volume                          ! Lead
material    14
    pb       density    11.0400    prop    1.0000
atoms                          ! NS-4-FR
material    15       density    0          ! 0 means atom/b-cm
        b10           prop    8.5500E-05
        b11           prop    3.4200E-04
        al           prop    7.8000E-03
        h           prop    5.8500E-02
        o           prop    2.6100E-02
        c           prop    2.2600E-02
        n           prop    1.3900E-03
volume                          ! Stainless Steel 304
material    16
    stainless 3041 steel       density    7.9200    prop    1.0000
volume                          ! Vent port middle cylinder
material    17
    stainless 3041 steel       density    7.9200    prop    0.5000
    void              prop    0.5000
volume                          ! Heat fins for transport cask
material    18
    cu       density    8.9200    prop    0.4286
    stainless 3041 steel       density    7.9200    prop    0.5714
volume                          ! Balsa
material    19
    mixture    3    density    0.1250    prop    1.0000
volume                          ! Redwood
material    20
    mixture    3    density    0.3870    prop    1.0000
atoms                          ! NS-4-FR @ fire conditions
material    21       density    0          ! 0 means atom/b-cm
        b10           prop    8.5500E-05
        b11           prop    3.4200E-04
        al           prop    7.8000E-03
!        h           prop    5.8500E-02
!        o           prop    2.6100E-02
        c           prop    2.2600E-02
!        n           prop    1.3900E-03
end
```

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6.0 CRITICALITY EVALUATION

6.1 Discussion and Results

The NAC-STC is designed to safely transport spent fuel in two configurations. Fuel assemblies may be placed directly into a fuel basket installed in the cask cavity (directly loaded) or may be sealed in a transportable storage canister (canistered). In the directly loaded configuration, the NAC-STC can transport 26 PWR fuel assemblies. The design basis fuels for the directly loaded configuration are the Westinghouse, Exxon/ANF/SPC, Combustion Engineering and Framatome-Cogema PWR fuel assemblies described in Table 6.2-1. In the canistered configuration, the NAC-STC can transport up to 36 Yankee Class fuel assemblies or up to 26 Connecticut Yankee fuel assemblies. The canistered configuration containing Yankee Class fuel is referred to as the Yankee-MPC. The canistered configuration containing Connecticut Yankee fuel is referred to as the Connecticut Yankee MPC (CY-MPC). The Yankee Class fuel assemblies are described in Table 6.2-2. The Connecticut Yankee fuel assemblies are described in Table 6.2-4.

The NAC-STC can also transport canistered Greater Than Class C (GTCC) waste. Since the GTCC waste does not contain fissionable isotopes, a criticality evaluation is not required.

This chapter demonstrates that the NAC-STC with the design basis spent fuel meets the criticality requirements of 10 CFR 71 Sections 71.55 and 71.59 [1]. As demonstrated by the criticality analyses presented in Section 6.4 and summarized below, the NAC-STC remains subcritical under all conditions and is assigned a Criticality Safety Index (CSI) of 0 ($N = \infty$) in accordance with 10 CFR 71.59.

6.1.1 Directly Loaded Fuel

The NAC-STC is designed to transport 26 directly loaded PWR fuel assemblies with an initial enrichment up to 4.2 wt % ^{235}U, with the exception of fuel assemblies meeting the geometric constraints of the 17 x 17 Framatome-Cogema AFA design, which is limited to 4.5 wt % ^{235}U. Criticality control in the NAC-STC is achieved using a flux trap principle. Each of the basket tubes in the NAC-STC are surrounded by four BORAL or TalBor neutron absorber sheets which are held in place by steel cladding. The neutron absorber sheets have a minimum 0.02 g $^{10}B/cm^2$ loading. The spacing of the basket tubes is maintained by the steel support disks. These disks provide water gap spacings between tubes of 1.64 inch and 3.46 inch. When the cask is flooded with water, fast neutrons leaking from the fuel assemblies are thermalized in the water gaps and are absorbed in the neutron absorber sheets before causing a fission in an adjacent fuel assembly.

The SCALE 4.3 CSAS25 (SCALE 4.3, Landers and Petrie, 1995) calculational sequence is used to perform the NAC-STC criticality analysis. This sequence includes KENO-Va (Petrie) Monte Carlo analysis to determine the NAC-STC effective neutron multiplication factor (k_{eff}) under normal and accident conditions. The 27 group neutron library is used in all calculations, including those used to evaluate the sensitivity of the package to a range of moderator density and center-to-center spacing. The principal characteristics of the directly loaded assemblies are shown in Table 6.2-1. The most reactive directly loaded fuel assembly is the Framatome-Cogema 17 x 17 having an enrichment of 4.5 wt % ^{235}U. The analyses yielded the following maximum results:

Normal Conditions:	$k_{eff} \pm \sigma$	k_s
Loading – Moderator inside and dry outside	0.92541 ± 0.00086	0.93948
Transport – Dry inside and moderator outside	0.44315 ± 0.00032	0.44379
Hypothetical Accident Conditions:		
Fully Moderated	0.93388 ± 0.00083	0.94794

A typical CSAS25 input and output for Framatome-Cogema fuel is shown in Figure 6.7-10. Conservatisms contained in these analyses included: (1) 75 percent of the specified minimum ^{10}B loading in the BORAL or TalBor neutron absorber material; (2) infinite array of casks in the X-Y plane; (3) infinite fuel length with no inclusion of end leakage effects (standard basket configuration); (4) no structural material present in the assembly; (5) no dissolved boron in the cask cavity or surrounding loading or storage area; (6) no credit taken for fuel burnup or for the buildup of fission product neutron absorbers; and (7) moderator in the pellet to fuel rod clad gap during accident evaluations.

6.1.2 Canistered Yankee Class Fuel

The NAC-STC may transport a transportable storage canister containing up to 36 design basis Yankee Class fuel assemblies. Criticality control in the canister basket is also achieved using the flux trap principle. The flux trap controls the reactivity in the interior of each of the three basket configurations. In the first of the configurations, all fuel tubes are separated by a flux trap that is formed by surrounding the tube with stainless steel support disks and four 0.01g $^{10}B/cm^2$ (minimum) areal density BORAL sheets, which are held in place by stainless steel covers. This configuration is referred to as "standard" in following text. In the other configurations, the size of four fuel tubes (one outer tube in each quadrant of the basket) is increased to form either enlarged fuel tubes or screened damaged fuel cans. The BORAL sheets are removed from the outside of the enlarged tubes and damaged fuel cans to retain a similar width as that of a standard fuel tube. The damaged fuel cans contain Yankee Class fuel assemblies with up to 20 damaged or missing fuel rods. The remainder of the tubes have BORAL sheets on each of the four sides. The spacing of the basket tubes is maintained by the stainless steel support disks. These disks provide water gap spacing between tubes of 0.75, 0.81 or 0.875 inches, depending on the tube placement within the basket. When the cask is flooded with water, fast neutrons leaking from the fuel assemblies are thermalized in the water gaps and are absorbed in the BORAL sheets before causing a fission in an adjacent fuel assembly. This NAC-STC canistered basket can accommodate up to 36 Yankee Class Zircaloy-clad assemblies with a maximum initial enrichment of 4.03 wt % ^{235}U or 36 Yankee Class stainless steel-clad assemblies with a maximum initial enrichment of 4.97 wt % ^{235}U.

The Yankee-MPC may contain one or more Reconfigured Fuel Assemblies. The Reconfigured Fuel Assembly is designed to confine the Yankee Class spent fuel rods, or portions thereof, which are classified as failed fuel. The total number of full-length rods in a reconfigured fuel assembly is less than the number contained in a Yankee Class fuel assembly (maximum of 64 versus 256 rods). Consequently, the reactivity of the Reconfigured Fuel Assembly, even with the most reactive fuel rods, is less than the design basis fuel assembly used in criticality (see Section 6.4.3.1).

The SCALE 4.3 CSAS25 calculational sequence is used to perform the Yankee-MPC canistered fuel criticality analysis, based on the use of the most reactive Yankee Class fuel assembly. This sequence includes KENO-Va Monte Carlo analysis to determine the effective neutron multiplication factor (k_{eff}) under normal and accident conditions. The 27 group ENDF/B-IV neutron cross-section library is used in all calculations, including those used to evaluate the sensitivity of the package to a range of moderator density and center-to-center spacing. The most reactive Yankee Class fuel is the United Nuclear Type A. The principal characteristics of this assembly are shown in Table 6.2-2. Normal and accident conditions were evaluated as shown below. The wet loading condition results are shown for information only. In normal loading of canistered fuel into the NAC-STC transport cask, the canister will be dry inside and out. Fuel loading in the canister will take place in the transfer cask.

The analyses yielded the following maximum results for the standard and enlarged fuel tube configurations:

Yankee-MPC, Normal Transport	$k_{eff} \pm \sigma$	k_s
Loading - Moderator inside and dry outside	0.8761 ± 0.0007	0.8942
Transport - Dry Inside and moderator outside	0.4580 ± 0.0006	0.4760
Yankee-MPC, Hypothetical Accident		
Fully Moderated	0.8834 ± 0.0008	0.9014
Fully Moderated – Enlarged fuel tubes	0.9003 ± 0.0007	0.9183

The maximum bias and uncertainty adjusted reactivity for the basket containing the damaged fuel cans is 0.9388 for a hypothetical accident condition. Increased reactivity over the standard configuration is the result of a combining a higher reactivity damaged fuel payload, fuel assemblies with up to 20 fuel rods removed, with the removal of the BORAL absorber sheets from the damaged fuel can, increasing the system interaction.

Fully moderated includes water inside and outside of the cask, including the neutron shield region, and inside and outside of the fuel, including the fuel pellet and cladding gaps. Only the hypothetical accident condition is presented for the enlarged fuel tube case, since it represents the bounding configuration.

Conservatisms contained in these analyses included: (1) most reactive Yankee Class fuel assembly class with maximum U loading; (2) 75 percent of the specified minimum ^{10}B loading in the neutron absorber sheets; (3) infinite array of casks in the X-Y plane; (4) infinite fuel length with no inclusion of end leakage effects; (5) no structural material present in the assembly; (6) no dissolved boron in the cask cavity or surrounding loading or storage area; (7) no credit taken for fuel burnup or for the buildup of fission product neutron absorber sheets; and (8) moderator assumed in the gap between the pellet and fuel rod clad.

6.1.3 Canistered Connecticut Yankee Fuel

The NAC-STC may also transport a CY-MPC canister containing up to 26 Connecticut Yankee fuel assemblies. The criticality evaluation of the NAC-STC containing the CY-MPC is performed with the MONK8a [5] Monte Carlo Program for Nuclear Criticality Safety Analysis. This code employs the Monte Carlo technique in combination with JEF 2.2-based point energy neutron libraries to determine the effective neutron multiplication factor (k_{eff}). MONK8a, with the JEF 2.2 neutron cross-section libraries, is benchmarked by comparison to critical experiments relevant to Light Water Reactor fuel in storage and transport casks as shown in Section 6.5.2. The NUREG/CR-6361 [6] method-based verification performed for MONK8a has established an upper subcritical limit as a function of system parameters. For the Connecticut Yankee canistered fuel, the upper subcritical limit is 0.9425 (Section 6.5.2).

Criticality control in the CY-MPC basket is achieved using geometric control of the fuel assemblies along with the flux trap principle. Each of the fuel tubes in the basket is surrounded by four BORAL or TalBor neutron absorber sheets with a core areal density of 0.02g $^{10}B/cm^2$ (minimum). The sheets are held in place by stainless steel cladding. The center-to-center spacing of the fuel tubes is maintained by the stainless steel support disks.

Two configurations of the CY-MPC basket are available for loading: the standard 26-assembly basket configuration, and a 24-assembly basket configuration where two of the basket openings are blocked. The 26-assembly basket is analyzed for Zircaloy-clad assemblies with an initial enrichment of up to 3.93 wt % ^{235}U and for stainless steel clad assemblies with an initial enrichment of up to 4.03 wt % ^{235}U. These stainless steel clad fuel assemblies may also be loaded in the 24-assembly basket. Westinghouse Vantage 5 Zircaloy-clad assemblies with an initial enrichment of up to 4.61 wt % ^{235}U must be loaded in the 24-assembly basket. There are 53 Westinghouse Vantage 5H fuel assemblies in the Connecticut Yankee spent fuel inventory.

The remaining inventory may be loaded in either of the basket configurations. Evaluation of the CY-MPC reactivity is performed using the transfer cask shield geometry and considers the normal and accident conditions of transport. The reactivity of the transfer cask loaded with fuel is assumed to accurately represent the reactivity of the NAC-STC loaded with the same fuel. Additional conservative conditions and assumptions considered include the most reactive Connecticut Yankee fuel assembly type, 75% of the specified minimum ^{10}B loading in the neutron absorber, no credit taken for fuel burnup or for the buildup of fission product neutron absorber; worst case mechanical basket configuration, optimum moderation, including moderation in the gap between the pellet and fuel rod clad, and an infinite three-dimensional array of casks. The most reactive Connecticut Yankee fuel loading occurs with the 24-assembly basket fully loaded with Zircaloy-clad fuel assemblies with a maximum enrichment of 4.61 wt % ^{235}U. The 24-assembly basket configuration loaded with the most reactive fuel bounds the most reactive 26-assembly basket loading.

The maximum effective neutron multiplication factor from this loading is 0.3715 under dry conditions and 0.9327 under the postulated transport accident conditions involving full moderator intrusion. Including two standard deviations establishes a system reactivity threshold, $k_{eff} + 2\sigma$, of 0.9343, which is less than the subcritical limit of 0.9425. Consequently, the most reactive configuration of the canistered Connecticut Yankee fuel in the NAC-STC, containing the most reactive fuel assemblies in the most reactive configuration, is well below the regulatory criticality safety limit, including all biases and uncertainties under normal and accident conditions.

6.2 Package Fuel Loading

This section presents the physical descriptions of the fuel types to be loaded into the NAC-STC transport cask and describes the loading configurations of the fuel that are considered in the criticality safety evaluations. These configurations include directly loaded PWR fuel, canistered Yankee Class PWR fuel and canistered Connecticut Yankee PWR fuel.

Fuel assemblies with zero burnup are used in these analyses. The fresh fuel assumption is conservative because the fuel becomes less reactive as burnup increases. The criticality evaluations for the transport configurations for directly loaded fuel and for the Yankee-MPC configuration are performed assuming that all of the fuel assembly rods are in place. Consequently, to preclude a potential increase in reactivity due to empty fuel rod positions in a spent fuel assembly, any fuel rods removed from an assembly lattice must be replaced with solid rods fabricated from Zircaloy or stainless steel. A separate analysis of empty fuel rod positions is performed for the CY-MPC fuel configurations. Consequently, loading of Connecticut Yankee fuel assemblies with missing fuel rods is permitted. The loading of unenriched fuel assemblies is not evaluated and is not permitted in any NAC-STC fuel loading configuration.

Directly Loaded Fuel

The directly loaded fuel assembly characteristics are presented in Table 6.2-1. The cask analysis identified similar reactivity for the Westinghouse 17 x 17 OFA fuel assembly at 4.2 wt % ^{235}U and the Framatome-Cogema AFA 17 x 17 assembly at 4.5 wt % ^{235}U. As described in Section 6.4.2.1, the reactivity of these assemblies was higher than the reactivity of the remaining fuel assemblies evaluated for direct loading. To establish a bounding reactivity condition, the fuel characteristic envelope (i.e., fuel geometric parameters and fuel mass) of the Framatome-Cogema AFA 17 x 17 fuel assembly was expanded. The assembly with the expanded parameters, labeled the AFAM, is more reactive than the remaining directly loaded fuel assemblies and is used as a design basis fuel.

Canistered Yankee Class Fuel

The NAC-STC can safely transport up to 36 Yankee Class fuel assemblies loaded in the Yankee-MPC transportable storage canister. The most reactive design basis Yankee Class fuel is the United Nuclear Type A assembly, as described in Section 6.4.3.1. This assembly is used in the criticality calculations for the Yankee-MPC canistered configuration. The Yankee fuel classes to be transported in the Yankee-MPC canistered fuel configuration are presented in Table 6.2-2.

Design parameters of the Reconfigured Yankee Class assemblies are presented in Table 6.2-3. The Reconfigured Fuel Assembly is shown in Figures 6.2-1 and 6.2-2. The number of Yankee Class assemblies in the canister is limited by the total assembly weight of 30,600 pounds.

The NAC-MPC may also hold a recaged fuel assembly in any fuel loading position. A recaged fuel assembly consists of United Nuclear Yankee Class fuel rods placed in a Combustion Engineering fuel assembly lattice (skeleton). The impact on system reactivity of the recaged fuel assembly is documented in Section 6.4.3.1.

A limited number of Yankee Class fuel assemblies have fuel rods replaced with fill rods. The fill rods consist of hollow Zircaloy rods holding either Zircaloy or stainless steel slugs. The reactivity evaluation of fuel assemblies with these fill rods is presented in Section 6.4.3.6.

Certain fuel assemblies have enrichments nominally greater than the nominal maximum enrichments considered in the design basis analysis. These higher enrichments are considered in Section 6.4.3.1, and are shown not to be significant.

Canistered Connecticut Yankee Fuel

The fuel types to be transported in the CY-MPC canistered fuel configurations are presented in Table 6.2-4. Westinghouse Vantage 5H fuel assemblies must be loaded in the 24-assembly basket. The remaining fuel types may be loaded in either the 26-assembly or 24-assembly basket. In addition, loading of the damaged fuel cans and reconfigured fuel assemblies is physically restricted to the four oversized corner locations of the CY-MPC basket. Design parameters of the reconfigured Connecticut Yankee assemblies (CY reconfigured fuel assembly) are presented in Table 6.2-5.

Physical characteristics of the various Connecticut Yankee fuel assemblies to be accommodated are presented in Tables 1.2-4 and 6.2-4. Connecticut Yankee employed both Zircaloy and stainless steel clad 15 x 15 fuel assemblies having a cross-section as shown in Figure 6.2-3. Stainless steel clad fuel assemblies were originally utilized and were produced by Westinghouse, B&W, B&W (GUNF), Gulf General Atomic, and NUMEC. Westinghouse, Gulf General Atomic, NUMEC, and B&W also produced the Zircaloy-clad fuel assembly types.

Either CY-MPC basket configuration may contain CY reconfigured fuel assemblies. The CY reconfigured fuel assembly consists of a square 10 x 10 array of tubes, as shown in Figure 6.2-4, designed to confine and maintain geometric configuration of individual spent fuel rods, or portions thereof, or fuel pellets, which may be classified as damaged fuel or fuel debris. The total equivalent fuel mass in each tube is restricted to that of one spent fuel rod. The individual tubes are supported by tie plates in the upper and lower end fittings. The tie plates are closed with 250-micron screens to preclude the release of gross particulate material.

The total number of full-length fuel rods (100) that can be placed in the CY reconfigured fuel assembly is much less than the number that are in the fuel assemblies (204). Consequently, the reactivity of the CY reconfigured fuel assembly, even with the most reactive fuel rods, is less than the design basis fuel assembly used in criticality evaluations.

Either CY-MPC basket configuration may also contain damaged fuel cans. The damaged fuel can may hold a complete fuel assembly, a lattice or a failed rod storage canister. The outer dimensions of these cans require they be loaded in one of the four corner positions. The damaged fuel can is designed such that it can be handled in the same manner as a fuel assembly.

Figure 6.2-1 Yankee Class Reconfigured Fuel Assembly

Figure Withheld Under 10 CFR 2.390

Figure 6.2-2 Yankee Class Reconfigured Fuel Assembly Cross-Section

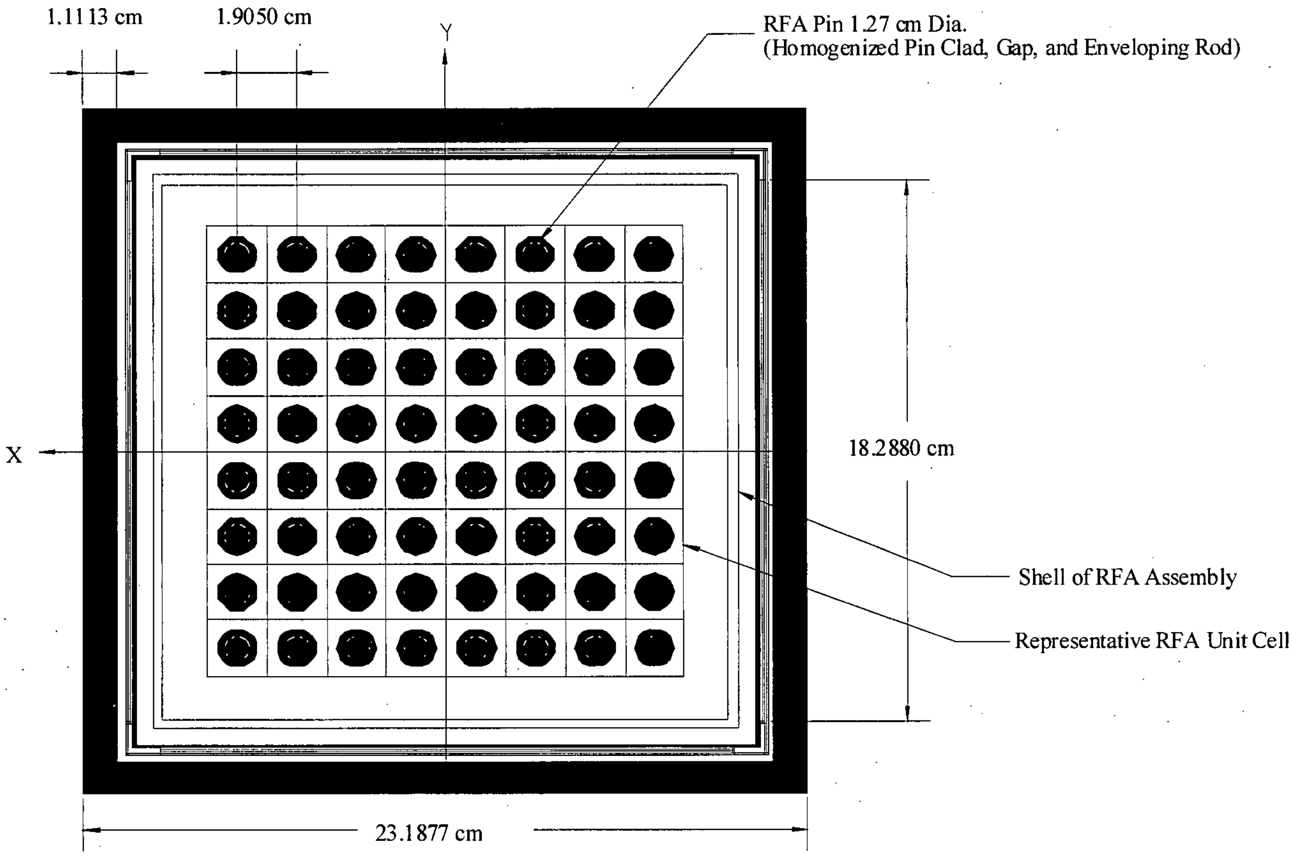

Figure 6.2-3 Connecticut Yankee 15 x 15 Fuel Assembly Array

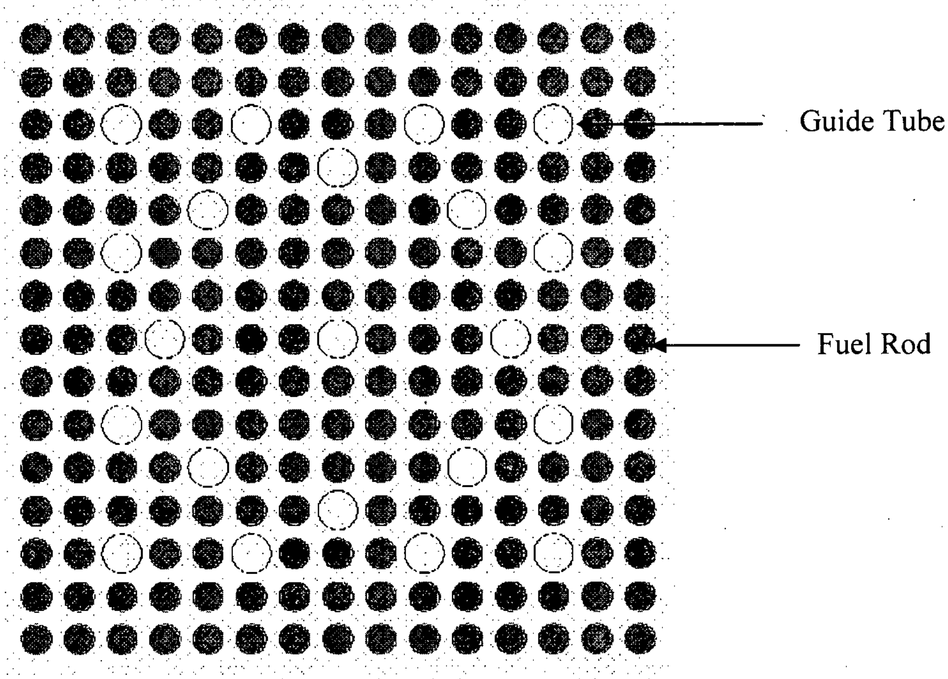

Figure 6.2-4 CY Reconfigured Fuel Assembly Array

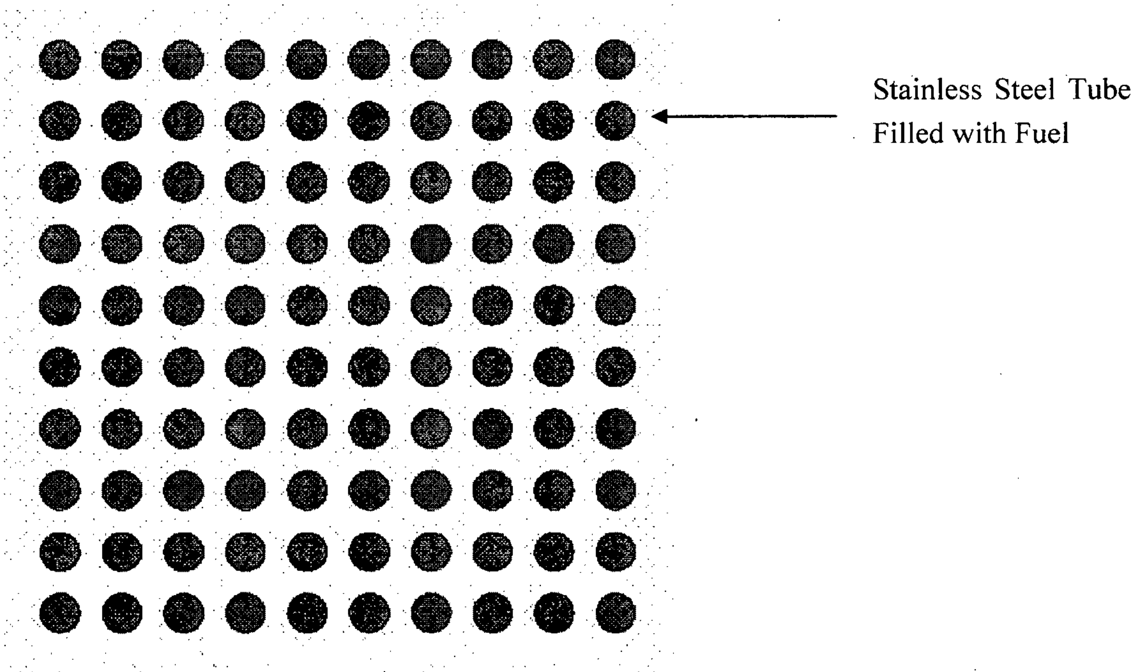

Table 6.2-1 Characteristics of Directly Loaded Fuel Assemblies

PWR Fuel Assembly Characteristics (Zirc-4 Clad) a Maximum Initial Enrichment of 4.2 wt % ^{235}U

Vendor	Array	Version	ID	Enrichment (wt % ^{235}U)	Max MTU[1]	Number of Fuel Rods	Pitch (in)	Rod Dia. (in)	Clad Thick. (in)	Pellet Dia (in)	Active Length (in)
CE	14 X 14	Std.	14A1	4.2	0.4037	176	0.5800	0.4400	0.0280	0.3765	137.0
CE	14 X 14	Ft Cal.	14A2	4.2	0.3772	176	0.5800	0.4400	0.0280	0.3765	128.0
Ex/ANF	14 X 14	CE	14A3	4.2	0.3814	176	0.5800	0.4400	0.0310	0.3700	134.0
WE	14 X 14	CE Model	14A4	4.2	0.4115	176	0.5800	0.4400	0.0260	0.3805	136.7
Ex/ANF	14 X 14	WE	14B1	4.2	0.3689	179	0.5560	0.4240	0.0300	0.3505	142.0
Ex/ANF	14 X 14	Praire Isl.	14B2	4.2	0.3741	179	0.5560	0.4170	0.0300	0.3505	144.0
WE	14 X 14	Std / ZCA	14B3	4.2	0.4144	179	0.5560	0.4220	0.0225	0.3674	145.2
WE	14 X 14	OFA	14B4	4.2	0.3612	179	0.5560	0.4000	0.0243	0.3444	144.0
WE	14 X 14	Std / ZCB	14B5	4.2	0.4144	179	0.5560	0.4220	0.0225	0.3674	145.2
Ex/ANF	15 X 15	WE	15A1	4.2	0.4410	204	0.5630	0.4240	0.0300	0.3565	144.0
WE	15 X 15	Std	15A2	4.2	0.4646	204	0.5630	0.4220	0.0242	0.3659	144.0
WE	15 X 15	Std / ZC	15A3	4.2	0.4646	204	0.5630	0.4220	0.0242	0.3659	144.0
WE	15 X 15	OFA	15A4	4.2	0.4646	204	0.5630	0.4220	0.0242	0.3659	144.0
CE	15 X 15	Palis.	15B1	4.2	0.4317	216	0.5500	0.4180	0.0260	0.3580	132.0
Ex/ANF	15 X 15	Palis	15B2	4.2	0.4310	216	0.5500	0.4170	0.0300	0.3580	131.8
CE	16 X 16	Lucie 2	16A1	4.2	0.4025	236	0.5060	0.3820	0.0250	0.3250	136.7
Ex/ANF	17 X 17	WE	17A1	4.2	0.4123	264	0.4960	0.3600	0.0250	0.3030	144.0
WE	17 X 17	Std	17A2	4.2	0.4671	264	0.4960	0.3740	0.0225	0.3225	144.0
WE	17 X 17	OFA	17A3	4.2	0.4282	264	0.4960	0.3600	0.0225	0.3088	144.0
WE	17 X 17	Vant 5	17A4	4.2	0.4282	264	0.4960	0.3600	0.0225	0.3088	144.0
FC	17 X 17	AFA	17A5	4.5	0.4669	264	0.4961	0.3740	0.0224	0.3224	144.0
FC	17 X 17	AFAM[2]	17A6	4.5	0.4693	264	0.5011	0.3714	0.0204	0.3230	144.25

Notes:
1.) Based on 95% theoretical density and the listed fuel assembly dimensions.
2.) Represents the AFA fuel assembly with expanded fuel characteristics.

Table 6.2-2 Characteristics of Canistered Yankee Class Fuel Assemblies

Parameter	CE Type A	CE Type B	Exxon Type A	Exxon Type B	Exxon Type A	Exxon Type B	Westinghouse Type A	Westinghouse Type B	United Nuclear Type A	United Nuclear Type B
Assembly Configuration	-	-	-	-	-	-	-	-	-	-
Assembly Array	16x16	16x16	16x16	16x16	16x16	16x16	18x18	18x18	16x16	16x16
Max. Enrichment (wt % ^{235}U)	3.90	3.90	4.00	4.00	3.70	3.70	4.94	4.94	4.00	4.00
Max. MTU[1]	0.2394	0.2384	0.2394	0.2384	0.2394	0.2384	0.2869	0.2860	0.2456	0.2446
Fuel Rod Configuration	-	-	-	-	-	-	-	-	-	-
Fuel Rod Pitch (cm)	1.1989	1.1989	1.1989	1.1989	1.1989	1.1989	1.0719	1.0719	1.1887	1.1887
Active Fuel Length (cm)	231.1400	231.1400	231.1400	231.1400	231.1400	231.1400	233.9975	233.9975	231.1400	231.1400
Rod OD (cm)	0.9271	0.9271	0.9271	0.9271	0.9271	0.9271	0.8636	0.8636	0.9271	0.9271
Clad ID (cm)	0.8052	0.8052	0.8052	0.8052	0.8052	0.8052	0.7569	0.7569	0.8052	0.8052
Pellet OD (cm)	0.7887	0.7887	0.7887	0.7887	0.7887	0.7887	0.7468	0.7468	0.7887	0.7887
Diametral Gap (cm)	0.0165	0.0165	0.0165	0.0165	0.0165	0.0165	0.0102	0.0102	0.0165	0.0165
Rods per Assembly	231	230	231	230	231	230	305	304	237	236
Fuel Material	UO_2	UO_2	UO_2	UO_2	UO_2	UO_2	UO_2	UO_2	UO_2	UO_2
Clad Material	Zircaloy	Zircaloy	Zircaloy	Zircaloy	Zircaloy	Zircaloy	SS 348	SS 348	Zircaloy	Zircaloy
Displacement Rod Configuration	-	-	-	-	-	-	-	-	-	-
Displacement Rod Material	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Zircaloy - 4	Zircaloy - 4
Displacement Rod Diameter (cm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9271	0.9271
Number Per Assembly	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	2
Guide Bar Configuration	-	-	-	-	-	-	-	-	-	-
Guide Bar Material	Zircaloy - 4	Zircaloy - 4	SS 304L	SS 304L	Zircaloy	Zircaloy	N/A	N/A	N/A	N/A
Guide Bar Width (cm)	1.0973	1.0973	1.0566	1.0566	1.0566	1.0566	N/A	N/A	N/A	N/A
Guide Bar Shape (cm)	Square	Square	Square	Square	Square	Square	N/A	N/A	N/A	N/A
Number Per Assembly	8	8	8	8	8	8	N/A	N/A	N/A	N/A
Instrument Tube Configuration	-	-	-	-	-	-	-	-	-	-
Instrument Tube ID (cm)	0.9970	0.9970	0.9970	0.9970	0.9970	0.9970	0.9995	0.9995	0.9995	0.9995
Instrument Tube OD (cm)	1.1481	1.1481	1.0884	1.0884	1.0884	1.0884	1.0884	1.0884	1.0884	1.0884
Number Per Assembly	1	1	1	1	1	1	1	1	1	1
Instrument Tube Material	Zircaloy - 4	Zircaloy - 4	SS 304	SS 304	Zircaloy	Zircaloy	SS 304	SS 304	SS 304	SS 304

1. Maximum MTU based on 95% of UO_2 theoretical density for the fuel pellet stack density.

Note: Certain fuel assemblies of the type specified may have a maximum enrichment up to 0.03 wt% ^{235}U higher than the value shown.

Table 6.2-3 Yankee Class Reconfigured Fuel Assembly Parameters

Parameter	CE Type A/B	Exxon Type A/B	West. Type A/B	United Nuclear Type A/B
ASSEMBLY CONFIGURATION				
Assembly Array	8x8	8x8	8x8	8x8
Max. Enrichment (wt % ^{235}U)	3.93	4.03	4.97	4.03
Max. kgU*	66.33	66.33	60.21	66.33
FUEL ROD CONFIGURATION (EACH ROD PLACED WITHIN ENCAPSULATING TUBE)				
Rod Pitch (cm)	1.905	1.905	1.905	1.905
Active Fuel Length (cm)	231.1400	231.1400	233.9975	231.1400
Rod OD (cm)	0.9271	0.9271	0.8636	0.9271
Clad ID (cm)	0.8052	0.8052	0.7569	0.8052
Pellet OD (cm)	0.7887	0.7887	0.7468	0.7887
Diametrical Gap (cm)	0.0165	0.0165	0.0102	0.0165
Max Rods per Assembly	64	64	64	64
Fuel Material	UO_2	UO_2	UO_2	UO_2
Clad Material	Zircaloy	Zircaloy	SS 348	Zircaloy
ENCAPSULATING TUBE				
Tube OD (cm)	1.27	1.27	1.27	1.27
Tube ID (cm)	1.1278	1.1278	1.1278	1.1278
Tube Material	SS-304	SS-304	SS-304	SS-304

* Maximum kgU based on 95% of UO_2 theoretical density for the fuel pellet stack density.

Table 6.2-4 Connecticut Yankee Design Basis Fuel Assembly Parameters

Vendor	WE	B&W	B&W, GGA, NUMEC	B&W (GUNF), GGA, NUMEC, WE
Array	15 X 15	15 X 15	15 X 15	15 X 15
Clad Material	Zircaloy	Zircaloy	Zircaloy	Stainless Steel
Maximum wt % ^{235}U	4.61	3.93	3.42	4.03
Maximum MTU[1]	0.3900	0.3742	0.3971	0.4337
Maximum Number of Fuel Rods	204	204	204	204
Maximum Pitch (in)	0.568	0.568	0.568	0.5702
Minimum Rod Diameter (in)	0.42	0.4194[2]	0.42	0.4175
Minimum Clad Thick (in)	0.0223	0.025	0.022	0.01375
Maximum Pellet Diameter (in)	0.3664	0.3615	0.3685	0.384
Maximum Active Length (in)	120.55	118.825	121.35	122.05
Minimum Guide Tube Thick (in)	0.013	0.008	0.008	0.008
Number Guide/Instrument Tubes	21	21	21	21
Guide/Instrument Tube Material	Zircaloy	Stainless Steel	Stainless Steel	Stainless Steel

1. Based on 95% of UO_2 theoretical density.
2. Results for a rod diameter of 0.42 in. in Section 6.4.2. Sensitivity analyses were performed to show that this rod diameter produced no statistically significant variation in the k_{eff} results.

Table 6.2-5 Connecticut Yankee Reconfigured Fuel Assembly Parameters

Parameter	Value
Array	10 x 10
Maximum Number of Fuel Rods	100
Maximum Enrichment (wt % ^{235}U)	4.61
Maximum kg U[1]	212
Maximum Tube Pitch (in)	0.81
Maximum Tube OD (in)	0.5675
Minimum Tube Thickness (in)	0.0315
Tube Material	SS 304

1. Based on 95% of UO_2 theoretical density.

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6.3 Criticality Model Specification

This section describes models used in the criticality evaluation of the directly loaded NAC-STC and the NAC-STC canistered fuel configurations. KENO-Va models are used in the criticality evaluation of the directly loaded NAC-STC and the Yankee-MPC canistered fuel configurations. The CY-MPC canistered fuel evaluation is performed using the MONK8a criticality code.

6.3.1 Calculational Methodology

The SCALE 4.3 CSAS25 calculational sequence is used to perform the NAC-STC criticality analysis for the directly loaded (uncanistered) and for canistered Yankee Class fuel. This sequence includes the SCALE Material Information Processor [7], BONAMI [8], NITAWL-II [9] and KENO-Va. The Material Information Processor generates number densities for standard compositions, prepares geometry data for resonance self-shielding, and creates data input files for the cross section processing codes. The BONAMI and NITAWL-II codes are used to prepare a resonance-corrected cross section library in AMPX working format. The KENO-Va code calculates the model k_{eff} using Monte Carlo techniques. The 27-group neutron library is used in the SCALE 4.5 criticality calculations. The validation of the CSAS25 sequence and the method statistics are addressed in Section 6.5.1. The KENO-Va models are described in Section 6.3.2.

The MONK8a Monte Carlo Program for Nuclear Criticality Safety Analysis is used to evaluate the CY-MPC system. This code employs the Monte Carlo technique in combination with JEF 2.2-based point energy neutron libraries for general neutron cross-section and thermal scatter in a water moderator to determine the effective neutron multiplication factor (k_{eff}). MONK8a, with the JEF 2.2 neutron cross-section libraries, is benchmarked by comparison to critical experiments relevant to Light Water Reactor fuel in storage and transport casks as shown in Section 6.5.2.

6.3.2 Description of Calculational Models

The NAC-STC KENO-Va model is derived from a radial slice of the cask at the central region. This section is the most reactive region due to the number of disks displacing water in the flux trap gap. The model is a stack of slices containing one aluminum disk, two identical water regions and one steel disk region (stack is aluminum, water, steel, water).

The cask body shielding regions of steel, lead, steel, NS-4-FR and steel surrounds each basket slice. Each cask slice is surrounded by a cuboid. The four slices are stacked into the KENO global unit. Periodic boundary conditions are imposed on the top and bottom to simulate an infinite cylinder, and reflecting boundary conditions are imposed on the sides simulating an infinite number of casks in the X-Y plane. Moderator density is varied both in the cask cavity regions normally filled with water and in the exterior cuboid.

For the directly loaded fuel configuration, the basket is modeled in each slice and contains 26 design basis fuel assemblies with a fuel density corresponding to 95% of the theoretical maximum. Enrichment varies from 4.2 wt % to 4.5 wt % ^{235}U. The fuel rod array is explicitly modeled in each of the 26 possible locations. For the Yankee-MPC canistered configuration, the basket model of each slice contains 36 Yankee Class design basis United Nuclear Type A fuel assemblies at a 4.0 wt % ^{235}U enrichment with a fuel density corresponding to 95% of the theoretical maximum. The fuel rod array is explicitly modeled in each of the 36 possible fuel locations.

The X-Y dimensions of the exterior cuboid are used to vary cask center-to-center spacing. Analysis of both normal and accident conditions use the same models except the models for accident conditions assume that the radial neutron shielding (NS-4-FR) is replaced by the external moderator. These models are shown in Figures 6.3-1 and 6.3-2.

An axially finite basket model is required for the damaged fuel can evaluation in which loose fuel may be located outside the neutron absorber sheet elevations. Details on the axially finite basket model are included in Section 6.4.3. Figure 6.3-5 depicts the location of the four loading positions for damaged fuel cans that also do not have BORAL sheets attached. These fuel cans are also modeled as simple square stainless steel boxes with an opening width of 7.99 inches and a wall thickness of 0.048 inch.

The MONK8a geometry modeling the CY-MPC is constructed as a finite model that accurately represents the geometry of the canister, the fuel and the basket. Figure 6.3-3 shows the cross-section of the structural disk that maintains separation of the fuel tubes in the cask. Also shown in the figure is a detail of the standard fuel tube that surrounds the fuel assembly and fits into the basket fuel position opening. Analyses of the CY-MPC normal and accident conditions are performed within the CY-MPC transfer cask shells. The geometry of these shells is shown in Figure 6.3-4. The MONK8a criticality code relies on a combinatorial logic geometry package. Therefore, intersecting simple geometry bodies are used to specify the fuel basket, canister, and cask components. The appropriate value of each of the geometry bodies is modified to determine the worst case basket/cask condition within each analysis.

6.3.3 Package Regional Densities

The package regional densities used in the criticality analyses are:

Material	Density (g/cc)
UO_2	10.41
Zircaloy	6.56
H_2O	0.9982
Steel	7.92
Lead	11.34
Aluminum	2.70
BORAL (core)	2.62
NS-4-FR	1.63

6.3.4 Fuel Region Densities

Fuel density corresponds to 95% of the theoretical density. Uranium isotope composition is provided for 4.0 and 4.5 wt % ^{235}U fuel. The level of enrichment varies for individual categories of design basis directly loaded Yankee and Connecticut Yankee fuel.

Material	Element	Density (atoms/barn-cm)
UO_2 (4.0 wt % ^{235}U)	^{235}U	9.406×10^{-4}
	^{238}U	2.229×10^{-2}
	O	4.646×10^{-2}
UO_2 (4.5 wt % ^{235}U)	^{235}U	1.058×10^{-3}
	^{238}U	2.217×10^{-2}
	O	4.646×10^{-2}
Zircaloy	Zr	4.331×10^{-2}
Stainless Steel		8.724×10^{-2}
H_2O (0.9982 g/cm^3)	H	6.677×10^{-2}
	O	3.338×10^{-2}

6.3.5 Water Reflector Densities

The water reflector material densities outside the cask under normal operating conditions are:

Material	Element	Density (atom/barn-cm) (directly loaded)
H_2O	H	6.677×10^{-2}
	O	3.338×10^{-2}

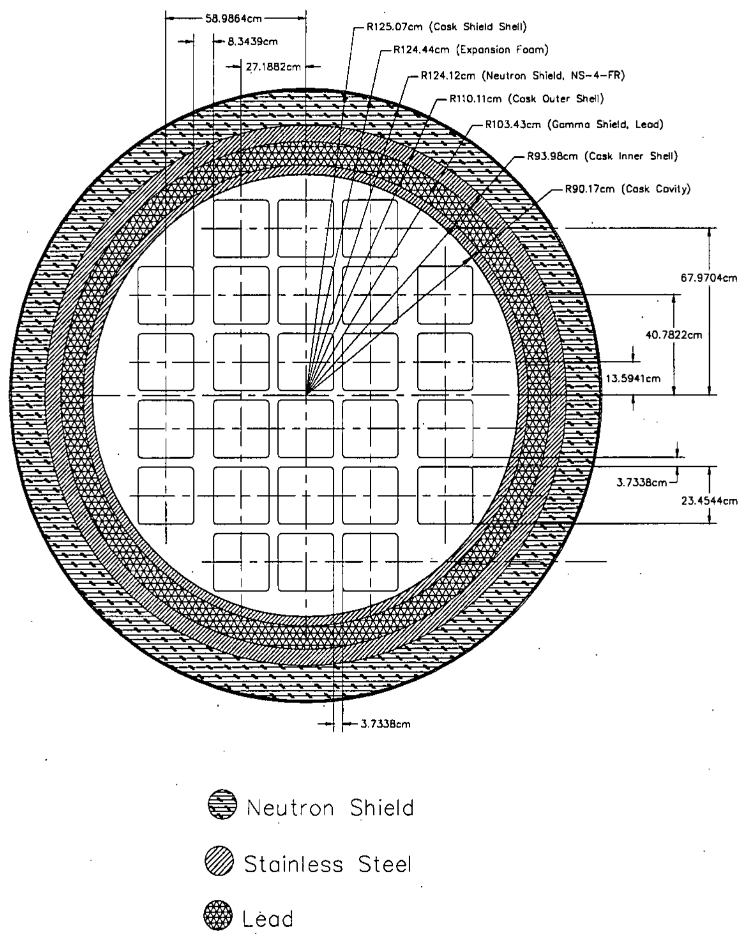
6.3.6 Cask Material Densities

The cask material densities for normal operating conditions are:

Material	Element	Density (atom/barn-cm) (directly loaded)	Density (atom/barn-cm) (canistered)
BORAL Core or TalBor[1]	^{10}B	7.098×10^{-3} (75% of Specified Minimum)	7.098×10^{-3} (75% of Specified Minimum)
	^{11}B	3.925×10^{-2}	3.925×10^{-2}
	C	1.220×10^{-2}	1.220×10^{-2}
	Al	3.358×10^{-2}	3.358×10^{-2}
Aluminum	Al	6.031×10^{-2}	6.031×10^{-2}
Stainless Steel, Type 304	Cr	1.743×10^{-2}	1.743×10^{-2}
	Fe	5.936×10^{-2}	5.936×10^{-2}
	Ni	7.721×10^{-3}	7.721×10^{-3}
	Mn	1.736×10^{-3}	1.736×10^{-3}
Lead	Pb	3.297×10^{-2}	3.297×10^{-2}
NS-4-FR	H	5.854×10^{-2}	5.841×10^{-2}
	O	2.609×10^{-2}	2.607×10^{-2}
	C	2.264×10^{-2}	2.265×10^{-2}
	N	1.394×10^{-3}	1.401×10^{-3}
	Al	7.763×10^{-3}	7.781×10^{-3}
	^{11}B	3.422×10^{-4}	3.565×10^{-4}
	^{10}B	8.553×10^{-5}	9.798×10^{-5}

1. TalBor is a 0.075-inch thick metal matrix material versus the core/clad BORAL material. The absorber density of TalBor is lower, but the required areal density is maintained.

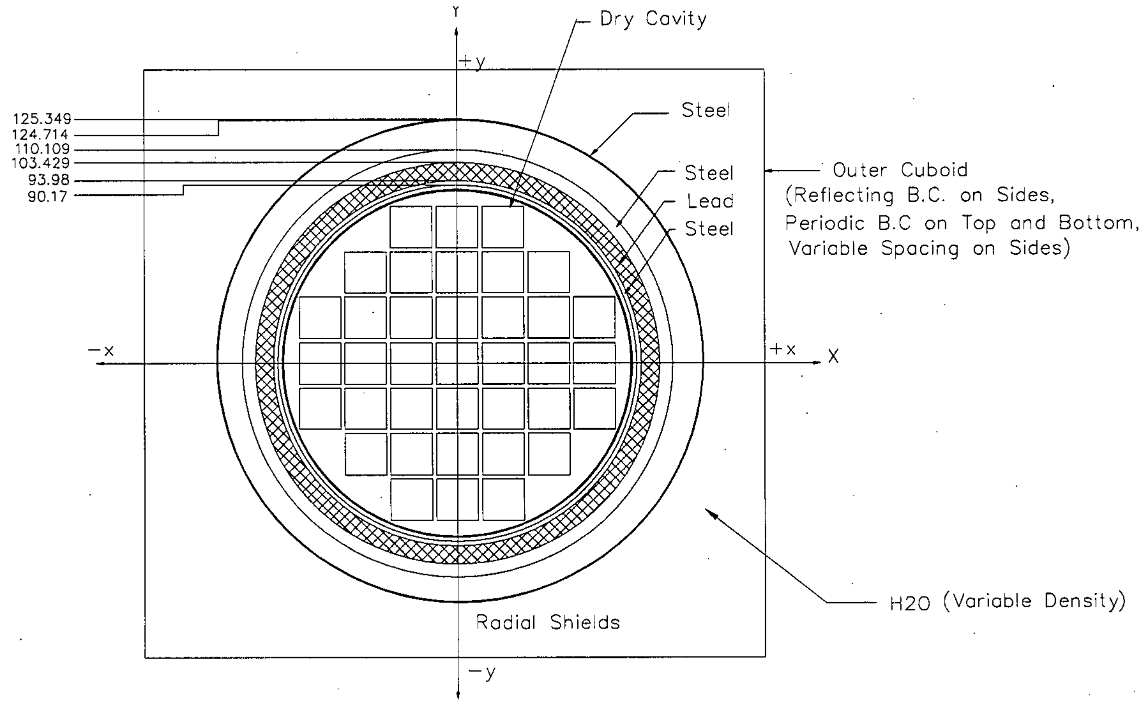
Figure 6.3-1 NAC-STC KENO-Va 26 Assembly Model - Directly Loaded Fuel Normal Conditions



Note: Disk Opening Coordinates are for Nominal
Basket Configuration

(All units are in centimeters)

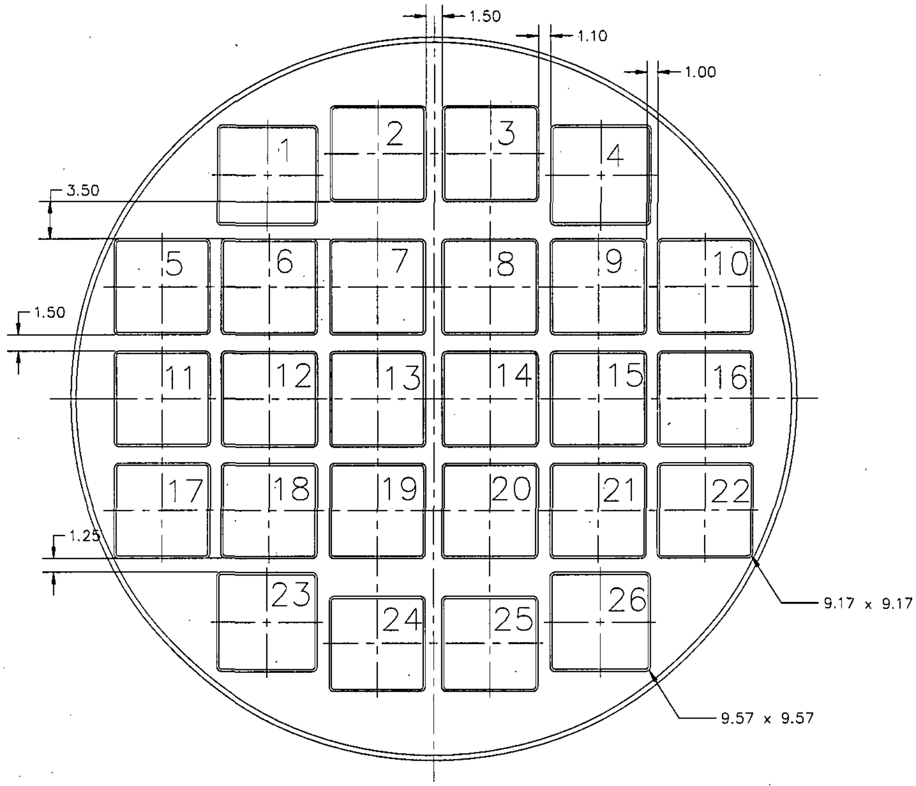
Figure 6.3-2 NAC-STC KENO-Va 36 Assembly Model For Yankee-MPC Canistered Fuel



Dimensions in centimeters.

Figure 6.3-3 CY-MPC Basket Structural Disk and Fuel Tube Detail

(Dimensions in Inches)



Note: In the 24-assembly configuration, fuel positions numbered 12 and 15 are blocked.

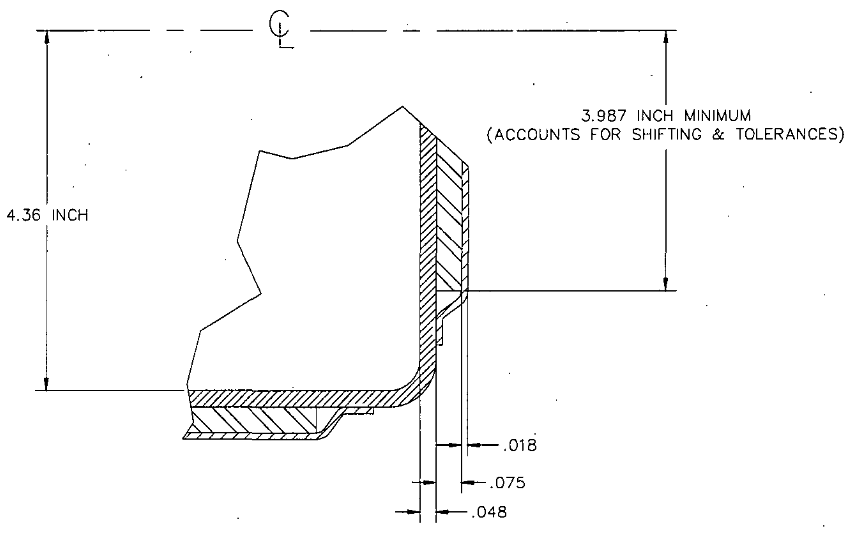


Figure 6.3-4 Transfer Cask Shells Used in the Evaluation of the CY-MPC

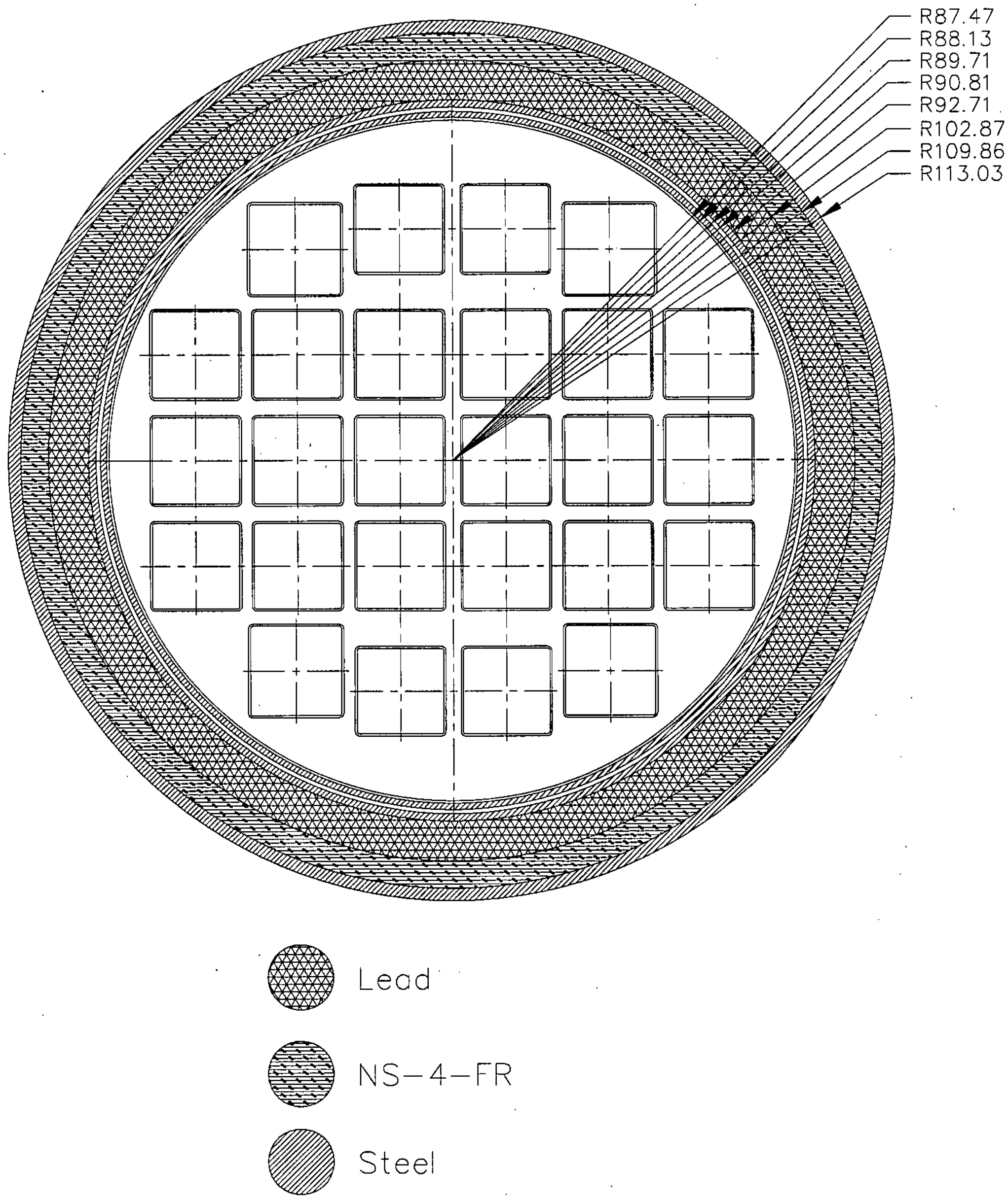
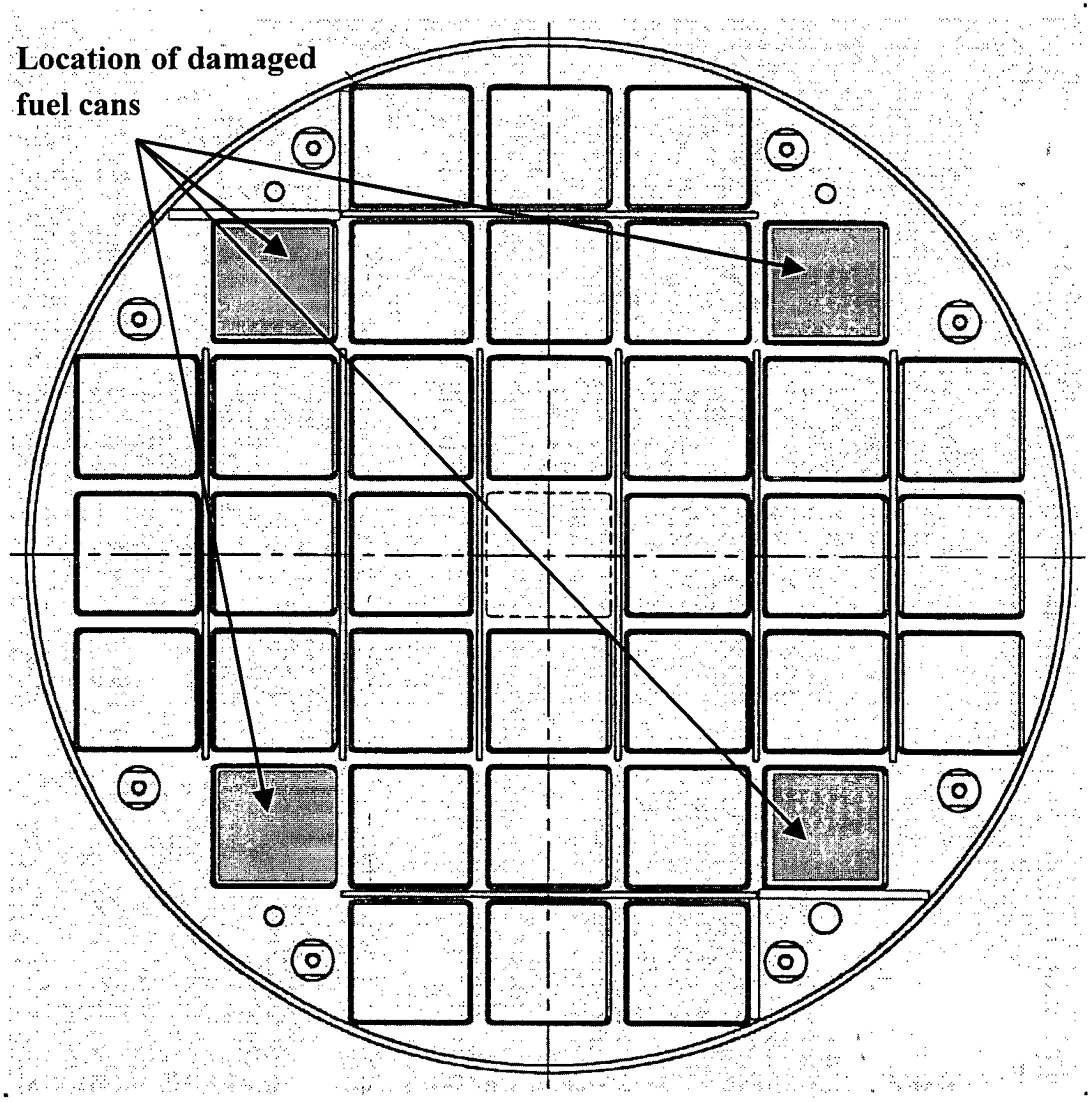


Figure 6.3-5 Damaged Fuel Can Locations



6.4 Criticality Calculation

This section demonstrates that the criticality safety of the NAC-STC, in either the directly loaded configuration, or the Yankee-MPC or CY-MPC canistered fuel configuration(s), satisfies the licensing requirements for the shipment of fissile material provided in 10 CFR 71.55 and 10 CFR 71.59.

10 CFR 71.55 and 10 CFR 71.59 require that the package remain subcritical under any credible condition, e.g., optimum interior/exterior moderation and reflection and credible configuration of the material. A criticality safety index is to be assigned to the fissile material package. This index reflects the number of packages (casks in this context) remaining subcritical in an array configuration.

Additional requirements imposed include the reduction in neutron absorber sheet ^{10}B from 100 to 75 percent and water in the pellet-to-cladding gap.

Undamaged Cask

Compliance with the requirements of paragraphs (b) and (d) of 10 CFR 71.55 is shown by modeling an undamaged cask surrounded by water. Requirements of paragraphs (a) through (c) of 10 CFR 71.59 are satisfied by providing a value of "N" equal to infinity and a CSI of 0 by imposing reflecting boundary conditions on the sides of the model simulating an infinite array of undamaged casks. Optimum interior and exterior moderation, including exterior full reflection by more than 20 cm of water, shows compliance with 10 CFR 71.55 paragraphs (b)(2), (b)(3) and (d)(3). Normal operating conditions for the canistered content transport cask include a dry canister cavity. The canister is loaded, dried, and seal welded inside a transfer cask. Only after the canister is dried and sealed is it placed into the transport cask. For conservatism, the interior of the canistered configurations is assumed to be fully flooded within the transport cask. This is identical to the analysis of loading operations for the directly loaded cask configuration. For canister loadings containing damaged fuel cans, preferential and uneven flooding conditions are evaluated. A representative set of exterior moderator density and cask pitch criticality evaluations shows compliance with 10 CFR 71 under dry cavity, transport conditions.

Damaged Cask

Compliance with the requirements of paragraph (e) of 10 CFR 71.55 is shown by modeling a damaged cask surrounded by water. Compliance with 10 CFR 71.59 is demonstrated by imposing reflection boundary conditions on the sides of the model to simulate an infinite array of damaged casks, thereby resulting in a CSI of 0. Optimum interior and exterior moderation, including exterior full reflection by more than 20 cm of water, shows compliance with 10 CFR 71.55 paragraphs (e)(2) and (e)(3) and 10 CFR 71.59 paragraph (a)(2).

A damaged transport cask is defined as having been subjected to the hypothetical accident conditions specified in 10 CFR 71. Under these conditions the cask containment is maintained, and the cavity, therefore, remains dry. However, to show the cask's capability to remain subcritical under optimum internal and external moderation, an internally flooded cask is analyzed. During the accident, the radial neutron shield is assumed to be lost as a result of fire and is replaced by the external moderator. Even though the fuel cladding is shown to remain intact following the cask drop, the pellet-to-clad gap is assumed to be filled with water. Introducing additional moderator into the normally under-moderated fuel assembly lattice increases reactivity.

6.4.1 Fuel Loading Optimization

The NAC-STC cask is designed to transport design basis PWR fuel assemblies in two (2) configurations, directly loaded fuel or canistered fuel. The criticality evaluation for directly loaded, uncanistered fuel is presented in Section 6.4.2. The analysis for canistered Yankee Class fuel in the Yankee-MPC is presented in Section 6.4.3. The analysis for canistered Connecticut Yankee fuel in the CY-MPC is presented in Section 6.4.4. These analyses illustrate that the maximum fuel loading, along with the most reactive configuration, is analyzed for each configuration. The configuration of fresh fuel in the cask, filled with water with no dissolved boron, and with the cask surrounded by water, is assumed to ensure that the maximum credible reactivity is simulated. Operationally, the canistered fuel configurations are loaded as previously sealed canisters, with both the cask and canister being in a dry condition.

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6.4.2 Criticality Results for Directly Loaded, Uncanistered Fuel

6.4.2.1 Most Reactive Assembly – Directly Loaded Fuel

A simplified KENO-Va calculation of the design basis assemblies for the directly loaded, uncanistered fuel condition described in Table 6.2-1, is performed to determine the most reactive fuel type. In this simplified model, a unit cell of the NAC-STC basket with the steel and aluminum webbing properly spaced axially is described. Reflecting boundary conditions are imposed on the sides, top and bottom simulating an infinite array of basket cells. All fuel assemblies are at the same fuel density, 95% of theoretical maximum. The k-infinity of the fuel assemblies in the NAC-STC basket are shown below. Also shown is the reactivity difference between the Westinghouse 17 x 17 OFA and the remaining evaluated assembly types. The difference is expressed as the ratio of the multiplication factor difference (Δk) and the Monte Carlo uncertainty.

Assembly	**Enrichment wt % ^{235}U**	**k_{eff}**	**σ**	**Δk/σ**
B&W 15x15 Mark B4	4.2	0.92051	0.00178	-5.09
B&W 17x17 Mark C	4.2	0.92371	0.00151	-3.88
CE 14x14	4.2	0.89363	0.00174	-20.66
CE 16x16 SYS 80	4.2	0.89376	0.00170	-21.06
West 14x14 Std	4.2	0.88147	0.00176	-27.33
West 14x14 OFA	4.2	0.89349	0.00180	-20.04
West 15x15	4.2	0.92326	0.00179	-3.53
West 17x17	4.2	0.91766	0.00180	-6.62
West 17x17 OFA	4.2	0.92957	0.00166	0.00
Exxon/ANF 14x14 CE	4.2	0.89413	0.00156	-22.72
Exxon/ANF 14x14 WE	4.2	0.87193	0.00169	-34.11
Exxon/ANF 15x15 WE	4.2	0.91629	0.00175	-7.59
Exxon/ANF 17x17 WE	4.2	0.92345	0.00172	-3.56
F-C AFA 17x17	4.2	0.91686	0.00171	-7.4
F-C AFA 17x17	4.5	0.93014	0.00163	0.3
F-C AFAM 17x17	4.2	0.92838	0.00185	-0.4
F-C AFAM 17x17	4.5	0.94089	0.00172	6.7

The most reactive fuel assemblies at 4.2 wt % ^{235}U are the Modified Framatome-Cogema AFA assembly (AFAM), and the Westinghouse 17 x 17 OFA. The standard 17 x 17 Westinghouse and AFA fuels are significantly lower in reactivity. Maximum reactivity is obtained from the 4.5 wt % ^{235}U enriched Framatome-Cogema fuel. Specific evaluations for fuel enriched above 4.2 wt % ^{235}U are shown in Section 6.4.2.5.

Mechanical perturbation and moderator density studies are performed with the 4.2 wt % ^{235}U enriched Westinghouse 17 x 17 OFA. While enrichments over 4.2 wt. % ^{235}U are allowed for the AFA fuel types, the reactivity trends versus basket parameters, component movement, and moderator density are applicable to the higher enriched fuel. Modification to the enrichment level and the adjustment in fuel cross-section parameters will modify the magnitude of the reactivity change produced by the perturbation, but follow the same trend.

In particular, the H/U (moderator to fuel) ratio of the AFA and AFA modified fuels at 4.5 wt. % ^{235}U are below that of the Westinghouse 17x17 OFA assembly at 4.2 wt.% ^{235}U. Section 6.4.2.3 and 6.4.2.4 demonstrate that the Westinghouse fuel assembly is under-moderated. The AFA fuel assembly, with a lower H/U ratio, is therefore also under-moderated and does not require any additional moderator density studies. Increase in reactivity for the AFA modified assembly is associated with an increased fuel fissile material mass, compared to the Westinghouse standard and OFA 17x17 assemblies, in conjunction with an improved H/U ratio compared to the Westinghouse 17x17 standard assembly (but below that of the OFA assembly). The fissile material change has no impact on the relative flux trap behavior (i.e., tube movement) and will not impact the fuel assembly movement reactivity behavior (note that the fuel assembly is similar in size, < 0.09 inches wider, to the Westinghouse 17x17 assemblies). As shown in Section 6.4.2.2 the most reactive configuration concentrates fissile material in the center of the cask. The small change in fuel geometry (a slightly wider fuel assembly) has no impact on this behavior in that the fuel is still concentrated in the cask center and only the spacing between the center and the outer fuel assembly rings is slightly reduced (producing a higher reactivity system). Section 6.4.2.5 contains the criticality evaluation of AFAM fuel type at the most reactive system configuration.

6.4.2.2 Most Reactive Mechanical Configuration – Directly Loaded Fuel

Using the full cask model with the 4.2 wt % ^{235}U enriched Westinghouse 17 x 17 OFA fuel assembly, an evaluation of the effect of different directly loaded basket perturbations is made. This criticality analysis determines the most reactive basket mechanical configuration by altering the nominal model with the design basis assembly and comparing the perturbed k_{eff} to the nominal result. If Δk_{eff} ($k_{perturbed}$-$k_{nominal}$) is positive, the tolerance causes an increase in reactivity.

Conversely, if Δk_{eff} is negative, the tolerance causes a decrease in reactivity. To account for the statistical nature of the Monte Carlo analysis, and to determine if the change in reactivity is statistically significant, the Δk_{eff} is divided by the Monte Carlo uncertainty (σ) to arrive at a weight reactivity difference ($\Delta k_{eff}/\sigma$). Two sets of perturbations are assessed in the evaluation of criticality control: fabrication tolerances and component movement within the basket.

Four major fabrication tolerances are evaluated: 1) The fuel tube opening; 2) The disk opening; 3) The disk thickness; and, 4) The disk opening placement. The tolerances applied in the evaluation are ± 0.0762 cm for the tube opening, ± 0.0508 cm on the disk thickness, and ± 0.0381 cm on the disk opening size. The disk opening location tolerance is within a 0.0381 cm radius circle from the nominal location. The tolerance analysis results are:

Analysis	**k_{eff}**	**σ**	**Δk_{eff}**	**$\Delta k_{eff}/\sigma$**
Nominal Basket	0.90143	0.00090	----	----
Geometric Tolerances				
Min Tube	0.89494	0.00089	-0.00649	-7.292
Max Tube	0.90485	0.00085	0.00342	4.024
Min Disk Opening	0.89955	0.00087	-0.00188	-2.161
Max Disk Opening	0.90002	0.00086	-0.00141	-1.640
Shift Openings In	0.90169	0.00088	0.00026	0.295
Shift Openings Out	0.89799	0.00084	-0.00344	-4.095
Min Disk Thickness	0.89900	0.00087	-0.00243	-2.793
Max Disk Thickness	0.90073	0.00087	-0.00070	-0.805

Based on reactivity analysis, the only statistically significant change in reactivity occurs due to an increase in tube opening width. Increasing the fuel tube opening brings more moderator into the gap between the assembly and the tube lowering the efficiency of the neutron absorber sheets, hence increasing the reactivity of the system.

Two major component movements within the basket are evaluated: the assembly within the tube and the tube within the basket. Component movement is evaluated toward the top, right, top right, cask center, and cask periphery. Due to symmetry of the basket the remaining directions do not require analysis. To complete the analysis sequence, a combined radially inward shift of both fuel tube and assembly are evaluated.

As shown in the following table, based on the mechanical perturbation analysis, the maximum reactivity configuration of the basket is one in which both the fuel tube and fuel assembly are shifted toward the cask center.

Analysis	k_{eff}	σ	Δk_{eff}	$\Delta k_{eff}/\sigma$
Nominal Basket	0.90143	0.00090	----	----
Mechanical Perturbations				
Assembly Shift Top Right	0.89811	0.00119	-0.00332	-2.790
Assembly Shift Top	0.89788	0.00122	-0.00355	-2.910
Assembly Shift Right	0.89763	0.00120	-0.00380	-3.167
Assembly Shift Radial In	0.90245	0.00130	0.00102	0.785
Assembly Shift Radial Out	0.89556	0.00119	-0.00587	-4.933
Fuel Tube Shift Top Right	0.89931	0.00124	-0.00212	-1.710
Fuel Tube Shift Top	0.90174	0.00118	0.00031	0.263
Fuel Tube Shift Right	0.89869	0.00121	-0.00274	-2.264
Fuel Tube Shift Radial In	0.90363	0.00126	0.00220	1.746
Fuel Tube Shift Radial Out	0.89361	0.00120	-0.00782	-6.517
Combined Analysis				
Tube + Assembly Radial In	0.90867	0.00120	0.00724	6.033

Thus, the following most reactive mechanical configuration is imposed on the NAC-STC directly loaded cask model: assemblies and fuel tubes moved toward the center of the basket, and maximum fuel tube opening.

6.4.2.3 Normal Conditions – Directly Loaded Fuel

Criticality results under normal conditions include variations in moderator density from 1.0 g/cc to 0.1 g/cc and cask center-to-center spacing from 250 cm (touching) to 300 cm. The results are shown in Tables 6.4.2-1 and 6.4.2-2. Table 6.4.2-1 shows the expected reactivity conditions during loading, i.e., wet inside and outside, as well as variation in moderator density due to draining and drying. Table 6.4.2-1 shows that cask reactivity is relatively insensitive to variations in cask center-to-center spacing. This results in a k_{eff} of 0.9129 ± 0.0009. The CSAS25 input and output for this case is shown in Figure 6.7-1. Simultaneous variation in moderator density inside and outside the cask shows a monotonic decrease in reactivity. There appears to be no optimum reactivity at low density conditions. The maximum k_{eff} in the dry situation is 0.4929 ± 0.0013, at a cask pitch of 300 cm.

Table 6.4.2-2 shows the expected reactivity conditions during normal transport, i.e., dry inside and wet outside. When the cask cavity is dry, k_{eff} of the package is very low and is insensitive to variations of moderator density outside and cask center-to-center spacing. The maximum k_{eff} for this situation is 0.4096 ± 0.0009, at a cask pitch of 270 cm.

Including statistical and method uncertainties, all results for the normal condition are below the 0.95 NRC criticality safety limit. Thus, compliance with 10 CFR 71.55 (b) and (d), as well as 10 CFR 71.75 (a) is demonstrated.

6.4.2.4 Hypothetical Accident Conditions – Directly Loaded Fuel

Criticality results under hypothetical accident conditions include variations in exterior moderator density from 1.0 g/cc to 0.1 g/cc (dry), as well as cask center-to-center spacing from 250 cm (touching) to 300 cm. The results are shown in Table 6.4.2-3. Under accident conditions, moderator is allowed in the neutron shield region and outside the cask. The maximum k_{eff} for this situation is 0.9190 ± 0.0009. With the cask cavity dry, the k_{eff} of the package is low and insensitive to moderator density and cask spacing variation. The CSAS25 input and output for this case is shown in Figure 6.7-2.

Including statistical and method uncertainties, all results for the accident condition are well below the 0.95 NRC criticality safety limit. Thus, compliance with 10 CFR 71.55 (e) and 10 CFR 71.75 (b) is demonstrated.

6.4.2.5 High Enrichment Evaluation, 4.5 wt% ^{235}U

As shown in Section 6.4.2.1, the maximum reactivity directly loaded fuel assemblies are the 4.5 wt. % ^{235}U enriched Framatome-Cogema 17x17 configurations identified as type AFA and AFAM. The AFA fuel type at 4.5 wt. % ^{235}U is similar in reactivity to that of the Westinghouse 17x17 OFA at 4.2 wt. % ^{235}U. The modified version of the Framatome-Cogema fuel assembly, labeled AFAM, raises the fissile mass and moderator to fuel ratio, both of which increase system reactivity. Increasing the pellet diameter and active fuel length raises the fissile material mass in the assembly. The moderator-to-fuel ratio is increased by reducing the fuel rod outer diameter and the fuel clad and guide tube thickness. To provide maximum directly loaded fuel assembly reactivities, the AFAM assembly is evaluated in the cask model at the worst-case configuration documented in Section 6.4.2.2. This configuration involves a shifted radial inward fuel assembly and fuel tube with a maximum tolerance tube opening. Evaluations are performed at normal and accident conditions. Accident conditions involve flooding the pellet to clad gap and assume removal of the neutron shield. As documented in Sections 6.4.2.3 and 6.4.2.4, no statistically significant differences in reactivity occur as a function of cask spacing and exterior moderator density.

When flooding 100% of the pellet to clad gaps, in the under-moderated fuel assembly lattice during hypothetical accident condition, variations in reactivity may be seen due to changes in fuel pellet diameter (i.e., an increased pellet diameter displaces moderator and may result in a combined decrease in system reactivity). For the modified AFA assembly (AFAM) the majority of reactivity increase observed is the result of an increased fuel rod pitch. Modification to the pellet diameter, within the range expected from a standard PWR fuel assembly (± 0.0005 inch), does not produce a resolvable impact on system reactivity. Since the increased pellet diameter provides for a larger fissile mass in the typically dry pellet to clad gap configuration, the increased pellet diameter was retained for the flooded gap analysis.

Normal Conditions:	**$k_{eff} \pm \sigma$**	**k_s**
Loading – Moderator inside and dry outside	0.92541 ± 0.00086	0.93948
Transport – Dry inside and moderator outside	0.44315 ± 0.00032	0.44379
Hypothetical Accident Conditions:		
Fully Moderated	0.93388 ± 0.00083	0.94794

To satisfy 10 CFR 71.55(b)(3), an analysis of the reflection of the containment system (inner shell) by water is performed for a single cask. This evaluation resulted in k_{eff} values of 0.92473 for a single flooded intact cask fully water reflected and 0.92454 for a containment system fully water reflected. There is no statistically significant difference between the cases.

Table 6.4.2-1 Criticality Results for Normal Conditions of Direct Fuel Loading

Cask Pitch	H_2O Inside	H_2O Outside	Neutron Shield	^{10}B	k_{eff}	σ	k_s
250 cm	1.0	1.0	Yes	75 %	0.91291	0.00086	0.92698
270 cm	1.0	1.0	Yes	75 %	0.91137	0.00085	0.92543
300 cm	1.0	1.0	Yes	75 %	0.91086	0.00087	0.92493
250 cm	0.8	0.8	Yes	75 %	0.84595	0.00083	0.86001
270 cm	0.8	0.8	Yes	75 %	0.84564	0.00083	0.85970
300 cm	0.8	0.8	Yes	75 %	0.84631	0.00083	0.86037
250 cm	0.6	0.6	Yes	75 %	0.76900	0.00114	0.78319
270 cm	0.6	0.6	Yes	75 %	0.76642	0.00110	0.78059
300 cm	0.6	0.6	Yes	75 %	0.76671	0.00117	0.78092
250 cm	0.4	0.4	Yes	75 %	0.67331	0.00106	0.68746
270 cm	0.4	0.4	Yes	75 %	0.67276	0.00104	0.68691
300 cm	0.4	0.4	Yes	75 %	0.67441	0.00110	0.68858
250 cm	0.2	0.2	Yes	75 %	0.55708	0.00121	0.57131
270 cm	0.2	0.2	Yes	75 %	0.55593	0.00120	0.57015
300 cm	0.2	0.2	Yes	75 %	0.55529	0.00110	0.56946
250 cm	0.1	0.1	Yes	75 %	0.49153	0.00123	0.50577
270 cm	0.1	0.1	Yes	75 %	0.49294	0.00130	0.50722
300 cm	0.1	0.1	Yes	75 %	0.49293	0.00134	0.50723

Table 6.4.2-2 Criticality Results for Normal Conditions of Transport of Directly Loaded Fuel

Cask Pitch	H_2O Inside	H_2O Outside	Neutron Shield	^{10}B	k_{eff}	σ	k_s
250 cm	0.0001	1.0	Yes	75 %	0.40726	0.00084	0.42132
270 cm	0.0001	1.0	Yes	75 %	0.40776	0.00106	0.42191
300 cm	0.0001	1.0	Yes	75 %	0.40638	0.00086	0.42045
250 cm	0.0001	0.8	Yes	75 %	0.40775	0.00096	0.42186
270 cm	0.0001	0.8	Yes	75 %	0.40756	0.00092	0.42165
300 cm	0.0001	0.8	Yes	75 %	0.40704	0.00100	0.42117
250 cm	0.0001	0.6	Yes	75 %	0.40862	0.00085	0.42268
270 cm	0.0001	0.6	Yes	75 %	0.40788	0.00085	0.42194
300 cm	0.0001	0.6	Yes	75 %	0.40823	0.00081	0.42228
250 cm	0.0001	0.4	Yes	75 %	0.40805	0.00091	0.42214
270 cm	0.0001	0.4	Yes	75 %	0.40706	0.00080	0.42111
300 cm	0.0001	0.4	Yes	75 %	0.40580	0.00091	0.41989
250 cm	0.0001	0.2	Yes	75 %	0.40931	0.00092	0.42340
270 cm	0.0001	0.2	Yes	75 %	0.40933	0.00098	0.42345
300 cm	0.0001	0.2	Yes	75 %	0.40683	0.00082	0.42088
250 cm	0.0001	0.1	Yes	75 %	0.40663	0.00085	0.42069
270 cm	0.0001	0.1	Yes	75 %	0.40955	0.00094	0.42365
300 cm	0.0001	0.1	Yes	75 %	0.40796	0.00091	0.42205

Table 6.4.2-3 Criticality Results for Directly Loaded Fuel in Hypothetical Accident Conditions

Cask Pitch	H_2O Inside	H_2O Outside	Neutron Shield	^{10}B	k_{eff}	σ	k_s
250 cm	1.0	1.0	No	75 %	0.91902	0.00085	0.93308
270 cm	1.0	1.0	No	75 %	0.91787	0.00086	0.93194
300 cm	1.0	1.0	No	75 %	0.91799	0.00087	0.93206
250 cm	0.8	0.8	No	75 %	0.85275	0.00084	0.86681
270 cm	0.8	0.8	No	75 %	0.85247	0.00085	0.86653
300 cm	0.8	0.8	No	75 %	0.85157	0.00087	0.86564
250 cm	0.6	0.6	No	75 %	0.77755	0.00084	0.79161
270 cm	0.6	0.6	No	75 %	0.77531	0.00084	0.78937
300 cm	0.6	0.6	No	75 %	0.77623	0.00083	0.79029
250 cm	0.4	0.4	No	75 %	0.67887	0.00075	0.69290
270 cm	0.4	0.4	No	75 %	0.67727	0.00105	0.69142
300 cm	0.4	0.4	No	75 %	0.68166	0.00099	0.69578
250 cm	0.2	0.2	No	75 %	0.56011	0.00059	0.57409
270 cm	0.2	0.2	No	75 %	0.55940	0.00118	0.57361
300 cm	0.2	0.2	No	75 %	0.56053	0.00119	0.57475
250 cm	0.1	0.1	No	75 %	0.49514	0.00044	0.50908
270 cm	0.1	0.1	No	75 %	0.49439	0.00135	0.50870
300 cm	0.1	0.1	No	75 %	0.49446	0.00122	0.50870

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6.4.3 Criticality Results for Canistered Yankee Class Fuel

This section establishes the most reactive Yankee Class fuel and the most reactive configuration of the fuel within the canister basket. These results are used to calculate the effective neutron multiplication factor for the transfer cask and storage cask assuming full moderation. Sections 6.4.3.2 through 6.4.3.4 contain the results for the basket in the transport configuration without enlarged fuel tubes, while Section 6.4.3.5 extends the evaluation results to the basket with four enlarged fuel tubes.

6.4.3.1 Most Reactive Assembly

A simplified KENO-Va calculation of the Yankee Class design basis assemblies, described in Table 6.2-2, is performed to determine the most reactive assembly. In this simplified model, a unit cell of the NAC-STC canister basket, with the stainless steel and aluminum webbing properly spaced axially, is described. Reflecting boundary conditions are imposed on the sides, top and bottom simulating an infinite array of basket cells. Using the basket cell model, a k_{eff} value was obtained for each assembly type. The results of the evaluation are shown in Table 6.4.3-3.

The results of Table 6.4.3-3 show that either the United Nuclear Type A or Type B assembly has the highest multiplication factor of the Yankee Class fuel vendor categories. As shown in Table 6.4.3-3, even though the Type A assembly has an additional fuel rod, it is difficult to resolve the difference between Type A and Type B fuel assemblies. With the additional fuel rod, the United Nuclear Type A has the highest UO_2 mass; therefore, this assembly is selected as the most reactive design basis fuel assembly and is used in subsequent cask criticality analysis.

The basket cell model described above is applied to determine the most reactive Reconfigured Fuel Assembly configuration. Based on the rod parameters for the Yankee type reconfigured assembly in Table 6.2-3, only two unique types of fuel rods are modeled. One representing the CE, Exxon, and UNC fuel rods with Zircaloy clad, and the other representing the Westinghouse steel clad fuel rods. The CE, Exxon, and UNC fuel rod group is evaluated at a bounding enrichment of 4.0 wt % ^{235}U. To ensure a maximum reactivity calculation the reconfigured assembly is modeled once with a full load, 64 rods, and once with a half load, 32 rods. The 32 rod configuration consists of evenly distributed rods in the 64 tube lattice. The reactivity evaluation of the Reconfigured Fuel Assembly assumes water ingress into the tube to rod gap and into the rod to fuel pellet gap. The maximum reactivity CSAS25 input and output for the Reconfigured Fuel Assembly evaluation are presented in Figure 6.7-7.

Configuration	**Initial Enrichment**	**Number of Rods**	k_{eff}	σ
Intact United Nuclear Type A Assembly	4.0 wt % ^{235}U	237	0.8974	0.0009
Reconfigured - Zircaloy Clad Fuel Rods	4.0 wt % ^{235}U	64	0.6280	0.0007
Reconfigured - Zircaloy Clad Fuel Rods	4.0 wt % ^{235}U	32	0.4458	0.0006
Reconfigured - Steel Clad Fuel Rods	4.94 wt % ^{235}U	64	0.6145	0.0006

Based on this evaluation, the reconfigured assembly composed of 64 Zircaloy clad fuel rods is the most limiting reconfigured assembly. Its reactivity is significantly lower than that of the limiting intact assembly.

An evaluation of the recaged fuel assembly, containing United Nuclear fuel rods in a CE lattice, did not result in a statistically different reactivity than the United Nuclear Type A or B assembly. Moving the higher enrichment United Nuclear rods into the CE lattice increased reactivity in the recaged assembly Type B cage to a k_{eff} of 0.8983 from a CE base assembly reactivity of 0.8939.

Additional analyses were performed to account for certain United Nuclear, Combustion Engineering, Exxon and Westinghouse Type A and Type B fuel assemblies having nominally higher maximum enrichment than that considered in the design basis. The base case unit cell models of the United Nuclear, Combustion Engineering, Exxon and Westinghouse fuel were modified to increase the enrichment of the fuel to 4.03 wt % ^{235}U, 3.93 wt % ^{235}U, 4.03 wt % ^{235}U and 4.97 wt % ^{235}U, respectively. These nominal increases resulted from variances in the method in which the enrichment tolerance was applied during fabrication.

The calculated differences in reactivity for these fuel assemblies show that the increased enrichments do not result in a statistically significant increase in reactivity for all fuel types, except the Westinghouse Type A fuel. However, the reactivity of the Westinghouse Type A fuel with increased enrichment is significantly less than the United Nuclear Type A or B fuel at the nominal enrichment. No statistically significant differences in reactivity exist between the United Nuclear Type A or Type B fuels at 4.00 or 4.03 wt % ^{235}U. Therefore, the design basis analysis, which uses United Nuclear Type A fuel at 4.00 wt % ^{235}U, is adequate to demonstrate the criticality safety.

6.4.3.2 Most Reactive Mechanical Configuration

Using the fuel/basket model with the design basis fuel assembly, an evaluation of the effect of different NAC-STC basket perturbations is made. This criticality analysis determines the most reactive basket mechanical configuration by altering the nominal fuel/basket model with the design basis assembly and comparing the perturbed k_{eff} to the nominal result. If Δk_{eff} ($k_{perturbed}$ - $k_{nominal}$) is positive, the tolerance causes an increase in reactivity. Conversely, if Δk_{eff} is negative, the tolerance causes a decrease in reactivity. Two sets of perturbations are assessed in this evaluation of the criticality control: fabrication tolerances and component movement within the basket.

Four major fabrication tolerances are evaluated: the fuel tube opening, the disk opening, the disk thickness and the disk opening placement. Modifications to the nominal fuel/basket model dimensions are made based on the basket and fuel tube tolerances. The tolerances applied in this evaluation are ±0.0762 cm for the tube opening, ±0.0508 cm for the disk thickness, and ±0.0381 cm on the disk fuel tube opening size. The disk opening location tolerance is within a 0.0381 cm radius circle from the nominal position. The tolerance analysis results are:

Analysis	k_{eff}	σ	Δk_{eff}
Nominal	0.8981	0.0007	-
Fuel Tube Maximum Opening	0.9018	0.0007	0.0037
Fuel Tube Minimum Opening	0.8916	0.0007	-0.0065
Disk Maximum Opening	0.8972	0.0007	-0.0009
Disk Minimum Opening	0.8991	0.0008	0.0010
Disk Maximum Thickness	0.8987	0.0008	0.0006
Disk Minimum Thickness	0.8972	0.0008	-0.0009
Loose Packed Disk Opening	0.8974	0.0008	-0.0007
Close Packed Disk Opening	0.8993	0.0007	0.0012

The results show that the most reactive set of basket tolerances are maximum fuel tube opening, minimum disk opening, maximum disk thickness, and minimum (close packed) disk opening placement.

Increasing the fuel tube opening brings more moderator into the gap between the assembly and the tube lowering the efficiency of the neutron absorber sheets, hence increasing the reactivity of the system. Minimizing the disk opening and maximizing the disk thickness removes water from the flux trap, consequently increasing k_{eff}. Finally, decreasing the web thickness, decreases the flux trap size and also moves assemblies closer together producing an increase in k_{eff}. With respect to fabrication tolerances, this is the most reactive configuration.

Two major component movements within the basket are evaluated: the assembly within the tube and the tube within the basket. Unique to this package is the Yankee Class diagonally symmetric fuel assembly. Consequently, movement toward three corners must be evaluated as opposed to one corner for a fully symmetric assembly. This assembly produces five movement perturbations: fuel tube movement to the upper right corner, the upper left corner, the lower left corner and side to side. Shown below are the assembly movement analysis results.

Assembly Movement	**Boundary Conditions**	k_{eff}	σ	Δk_{eff}
Nominal	Reflective	0.8981	0.0007	-
Upper Right Corner	Mirrored	0.8954	0.0007	-0.0027
Upper Right Corner	Periodic	0.8943	0.0007	-0.0038
Lower Left Corner	Mirrored	0.8977	0.0007	-0.0004
Lower Left Corner	Periodic	0.8978	0.0008	-0.0003
Upper Left Corner	Mirrored	0.8963	0.0007	-0.0018
Upper Left Corner	Periodic	0.8961	0.0008	-0.0020
Right Side	Mirrored	0.8949	0.0007	-0.0032
Right Side	Periodic	0.8951	0.0007	-0.0030
Left Side	Mirrored	0.8978	0.0007	-0.0003
Left Side	Periodic	0.8972	0.0007	-0.0009

These results show that the most reactive assembly position is centered within the basket tube.

Similar to the fuel assembly movement analysis, five possible fuel tube movements are evaluated: the upper right corner, the upper left corner, the lower left corner and side to side. Mirror and periodic boundary conditions on the sides of the model are evaluated.

The results of the tube movement evaluations are:

Tube Movement	Boundary Conditions	k_{eff}	σ	Δk_{eff}
Nominal	Reflective	0.8981	0.0007	-
Upper Right Corner	Mirrored	0.8999	0.0007	0.0018
Upper Right Corner	Periodic	0.8979	0.0007	-0.0002
Lower Left Corner	Mirrored	0.8984	0.0008	0.0003
Lower Left Corner	Periodic	0.8962	0.0007	-0.0019
Upper Left Corner	Mirrored	0.8991	0.0008	0.0010
Upper Left Corner	Periodic	0.8959	0.0007	-0.0022
Right Side	Mirrored	0.9005	0.0008	0.0024
Right Side	Periodic	0.8966	0.0007	-0.0015
Left Side	Mirrored	0.8968	0.0007	-0.0013
Left Side	Periodic	0.8976	0.0007	-0.0005

These results indicate that the most reactive fuel tube location is shifted to the right side of the tube with mirrored boundary conditions. This result is reasonable given the orientation of the assembly. Shifting the tube to the right side with mirrored boundary conditions moves a complete fuel rod row of two assemblies closer together, hence, pushing the largest amount of fuel together and minimizing the flux trap gap between tubes. In general, these results show that moving the tubes towards each other with the fuel assembly centered in the tube is the most reactive component configuration.

Based on the canistered fuel/basket model, the most reactive mechanical configuration occurs with the assemblies centered in the tubes, fuel tubes moved toward the center of the basket, maximum fuel tube opening, minimum disk opening, maximum disk thickness and close packed disk opening locations. The most reactive configuration documented by the fuel/basket analysis serves as the base model for the normal and accident analyses optimum moderation studies.

Directly loaded basket analyses indicate that the assembly centered in tube configuration may not represent the most reactive configuration in the cask analysis. The fuel/basket model clusters the fuel in groups of four (mirrored boundary), or shifts the fuel to one side of the tube (periodic boundary) and therefore does not represent the closest fuel material approach feasible in a radial inward moved model. To document the maximum reactivity configuration both tube and assembly movement analysis are repeated in the full cask model.

The k_{eff} of these analysis are compared to the nominal cask model:

Position	k_{eff}	σ	Δk_{eff}
Nominal	0.8637	0.0007	---
Tubes Moved Toward the Basket Center	0.8689	0.0008	0.0052
Tubes Moved Toward the Basket Shell	0.8596	0.0008	-0.0041
Assemblies Moved Toward the Basket Center	0.8677	0.0007	0.0040
Assemblies Moved Toward the Basket Shell	0.8590	0.0008	-0.0047

Based on the cask analysis of the basket model without enlarged fuel tubes, moving the assembly toward the cask center configuration adds a Δk_{eff} of 0.004 to the reactivity of the nominal configuration. The model documented as the worst-case mechanical configuration in the fuel/basket and enlarged fuel tube evaluations is not adjusted from its assembly-centered configuration. The Δk_{eff} associated with the assembly movement is accounted for by adding the Δk_{eff} of 0.004 to the KENO-Va neutron multiplication factor (k_{eff}) during k_s calculations.

6.4.3.3 Normal Conditions

Yankee Class fuel assemblies will be sealed inside a canister that is welded shut. Consequently, the canistered fuel is dry under normal conditions of loading and transport. Criticality results under normal conditions exclude variations in moderator density, but include cask center-to-center spacing from 250 cm (touching) to 300 cm. Moderator density is taken to be 0.0001 g/cc (dry). The results for normal conditions of transport are shown in Table 6.4.3-1. Table 6.4.3-1 shows that cask reactivity is relatively insensitive to variations in cask center-to-center spacing. This results in a keff of 0.4580 ± 0.0006. The CSAS25 input and output for this case is shown in Figures 6.7-3 and 6.7-4, respectively. For conservatism a cask criticality analysis of a flooded, nominal condition, cask array is performed. The maximum reactivity for this configuration is a keff of 0.8761± 0.0007.

Including statistical and method uncertainties, all results for the normal condition are below the 0.95 NRC criticality safety limit. Thus, compliance with 10 CFR 71.55 (b) and (d) as well as 10 CFR 71.75 (a) is demonstrated.

6.4.3.4 Hypothetical Accident Conditions

Criticality results under hypothetical accident conditions include variations in moderator density from 1.0 g/cc to 0.1 g/cc (dry) as well as cask center-to-center spacing from 250.698 cm (touching) to 300 cm. The results are shown in Table 6.4.3-2. Under accident conditions, the cask and fuel is considered to be fully moderated as described in Section 6.1.2. The maximum k_{eff}, including uncertainties, for this situation is 0.9014. The CSAS25 input and output for this case is shown in Figures 6.7-5 and 6.7-6, respectively.

Including statistical and method uncertainties, all results for the accident condition are well below the 0.95 NRC criticality safety limit. Thus, compliance with 10 CFR 71.55 (e) is demonstrated.

6.4.3.5 Hypothetical Accident Evaluation for a Basket Containing Enlarged Fuel Tubes

The maximum reactivity, fully moderated, cask model is evaluated with four enlarged fuel tubes replacing the standard (neutron absorber sheets on four sides) fuel tube on the basket periphery. As expected, the reactivity of these systems increases slightly due the increased neutron interaction between fuel tubes in those locations where neutron absorber sheets were removed. Adjusting for the 0.004 Δk_{eff} associated with the assembly movement in the tubes, results in a maximum bias and uncertainty adjusted k_{eff} (k_s) of 0.9183 for the hypothetical accident condition involving full moderator intrusion. Figure 6.7-8 shows input and output files for the enlarged fuel tube case. Transport maximum reactivities for the enlarged fuel tube basket are, therefore, well below the 0.95 criticality safety limit.

6.4.3.6 Evaluation of Non-solid Replacement Rods in Yankee Class Fuel

The Yankee Class spent fuel inventory contains a limited number of fuel assemblies with replacement rods. These replacement rods include displacement rods and fill rods. Any assembly that contains fill rods that displace at least the same amount of moderator (in the fully flooded condition, including the fuel-clad gap) as the nominal fuel rods is allowed to be loaded into the NAC-STC. This is permissible because the modified assembly would be less reactive than its original configuration due to a lower fissile mass.

Some Yankee Class fuel assemblies have had up to 9 fuel rods replaced with fill rods that will not displace the same amount of moderator (in the fully flooded condition, including the fuel-clad gap) as the original fuel rods. The subject assemblies have hollow Zircaloy fill rods that contain stainless steel slugs or Zircaloy slugs. Fully flooded unit cell analyses are performed to evaluate these assemblies. The first unit cell analysis models the most reactive United Nuclear Type A assembly with no fill rods and floods the fuel-clad gap of all fuel rods to establish a base case reactivity. The second set of analyses models two geometries of a United Nuclear Type A assembly with 12 fill rods that contain stainless steel slugs. The gap between the cladding and the slug or pellets in all rods is flooded. The diameter of the stainless steel slugs ranges from 0.265 to 0.275 inch. However, stainless steel slug diameters of up to 0.308 inches are evaluated. The results of the analyses, documented in Table 6.4.3-4, show that replacing up to 12 fuel rods with fill rods that contain stainless steel slugs with a minimum diameter of 0.265 inches decreases the system reactivity significantly.

The third set of analyses models multiple geometries of a United Nuclear Type A assembly with 12 fill rods that contain Zircaloy slugs. These models also flood the gap between the cladding and the slug or pellets of all rods. The diameter of the Zircaloy slugs ranges from 0.290 to 0.308 inch. The change in reactivity between these models and the base case, documented in Table 6.4.3-5, demonstrates that replacing up to 12 fuel rods with fill rods that contain Zircaloy slugs with a minimum diameter of 0.290 inches does not have a statistically significant impact on system reactivity. Therefore, Yankee Class fuel assemblies having up to 12 fuel rods replaced with non-solid fill rods that contain stainless steel slugs with a minimum diameter of 0.265 inches, or Zircaloy slugs with a minimum diameter of 0.290 inches, are allowed contents.

Six United Nuclear Type B assemblies in the Yankee Class inventory have two displacement rods that vary in geometry from the displacement rod dimensions listed in Table 6.2-1. To analyze these assemblies, the unit cell model of the United Nuclear Type B assembly referred to in Section 6.4.3.1 is modified to model the subject displacement rods as empty rod positions. The change in reactivity due to this configuration, $\Delta k_{eff} = 0.00021$, is within the statistical uncertainty of the code. Based on this evaluation, the United Nuclear Type B assemblies displacement rod dimension has no noticeable impact on system reactivity, and any displacement rod dimension is permissible for loading.

6.4.3.7 Basket Containing Damaged Fuel Cans

To provide flexibility and to allow loading of damaged fuel rods without placement of the damaged rods into the Yankee Class Reconfigured Fuel Assembly, a damaged fuel can basket configuration is evaluated. To accommodate damaged fuel assemblies, the four fuel tubes have been replaced with screened damaged fuel cans. The damaged fuel can is designed to preclude the release of pellets and gross particulate into the canister cavity. The evaluation of a canister loaded with four (4) damaged fuel cans considers each damaged fuel can to contain a Yankee Class assembly with up to 20 damaged or missing fuel rods and considers 100% dispersal of the fuel from these rods within the damaged fuel can.

All of the spent fuel assemblies containing fuel rods that are classified as damaged shall be stored in a damaged fuel can. The damaged fuel cans are located in the four corner locations of the basket, as shown in Figure 6.3-5.

The analysis of a canister containing four damaged fuel cans is performed in multiple steps. Damaged fuel is evaluated in a missing rod configuration followed by a loose fuel evaluation. The loose fuel evaluation considers the fissile material to be located within the fuel rod lattice or above and below the active fuel region, but within the fuel can. The evaluation is performed within the transport cask overpack.

Missing Rod Geometry

Initially, the most reactive missing rod geometry is determined for each Yankee Class fuel type. Assuming that a damaged fuel rod is a missing or empty fuel rod location is conservative as this increases the H/U ratio of the undermoderated assembly. Evaluating up to 20 missing rods in various configurations establishes an increased H/U ratio within the assembly and thus the most reactive (20) missing rod or damaged rod geometry. The determination of the most reactive missing rod geometry is conducted using the fuel tube unit cell models employed in Section 6.4.3.1. The results of this evaluation, which are documented in Tables 6.4.3-6 through 6.4.3-9, show that the most reactive missing rod geometry occurs with United Nuclear Type A fuel assemblies that have all 20 damaged rods modeled as missing rods. This missing rod geometry is shown in Figure 6.4.3-1.

The most reactive missing rod geometry is then modeled in the damaged fuel can in each of the four corner locations of the basket to provide an initial accident condition reactivity. In the mechanical configuration documented in Section 6.4.3.2, this loading configuration increases the reactivity of the system, Δk_{eff} = 0.00435, over that containing intact fuel in the enlarged fuel tubes. Therefore, a detailed study is performed to determine the reactivity of the system resulting from maximizing interaction between the intact assemblies in the basket and the contents of the damaged fuel cans. Maximum interaction occurs when the orientation of each assembly is such that the two sides of the intact assemblies that have a complete row of fuel rods face the two complete fuel rod rows of the fuel assemblies in damaged fuel cans. In addition, fuel assemblies and fuel tubes are shifted toward the damaged fuel can location. This configuration, damaged fuel cans containing assemblies with missing rods combined with a basket geometry that maximizes interaction between all contents of the basket, increases reactivity, Δk_{eff}, by 0.02461. This loading configuration, which results in a system reactivity ($k_{eff} \pm \sigma$) of 0.92480 ±

0.00073, is shown in Figure 6.4.3-2. The input/output file for this case is provided in Figure 6.7-11.

Dispersed Fuel Evaluation

To determine the effect on reactivity due to the dispersed damaged fuel occupying the void regions within each damaged fuel can, all dispersed fuel in each analysis is modeled as a homogeneous mixture of UO_2 and water. The volume fractions of the fuel versus the water are varied from 0%-100%. By varying the fuel fraction up to 100%, this evaluation addresses UO_2 masses significantly larger than what is available from 20 damaged Yankee Class fuel rods.

In the first dispersed fuel evaluation, the loose fuel is evaluated between the remaining rods of the most reactive missing rod geometry. The results of this analysis, provided in Table 6.4.3-10, show that this scenario decreases the reactivity of the system compared to just placing the most reactive missing rod array within each can. This is because adding fuel to the bounding missing rod array, with an increased moderator to fuel ratio, reduces the reactivity of the system as this effectively returns the system to an undermoderated state.

Loose fuel is also considered above and below the active fuel region of the most reactive missing rod array. Locating fuel outside the fuel rod active fuel region may also place fissile material outside the neutron absorber sheet axial extends. Previous criticality evaluations were based on an infinite height, repeating stack of aluminum and steel disks separated by spacers, which would not adequately account for this material. This analysis is, therefore, performed within a finite height cask model that represents the canister cavity in two regions: the region of the basket between the top and bottom support disks, and the regions within the transportable storage canister cavity that are above and below the top and bottom support disks. This model conservatively extends the active fuel height of all assemblies to match the disk elevations and conservatively truncates neutron absorber sheet elevation to the same height. A mirror boundary is placed in the middle of the region between the ends of the truncated neutron absorber and the extent of the canister cavity. This conservatively models an infinite height, alternating stacks of active fuel with neutron absorber sheet coverage and the regions without coverage. For simplicity, the height of the region below the neutron poison is modeled with the same height as the region above the neutron poison. Figure 6.4.3-3 provides a graphical representation of the various axial regions of the model.

This height is modeled first at 7.5 cm to conservatively encompass half the minimum height of the region between the neutron absorber and the canister bottom (~16.5 cm). By placing a mirror boundary condition at the end of each 7.5 cm region, an effective 15 cm of fuel debris is uncovered. This model conservatively replaces the lids with active fuel and effectively eliminates axial leakage. The 7.5 cm height is then increased to 15 cm to encompass half the maximum height of the region between the neutron absorber and the shield lid (~28 cm).

The results of these studies, provided in Tables 6.4.3-11 and 6.4.3-12, show the possible mixture of fuel and water above and below the neutron poison sheet coverage; therefore, mixtures above and below the active fuel region will not increase the reactivity of the system beyond that of the infinite height model of each damaged fuel can containing an assembly with the most reactive (20) missing rod array, $k_{eff} \pm 2\sigma = 0.92480 \pm 0.00073$.

Evaluation of a Preferential Flooding and Uneven Draining

Preferential flooding of the canister cavity and the damaged fuel can cavity is also considered. The model utilized—an infinite height, repeating stack of aluminum and steel disks separated by spacers—considers the most reactive fuel assemblies and the most reactive damaged fuel can contents. The density of the moderator filling the canister cavity is initially set to zero to model a dry canister cavity, while the void regions in each damaged fuel can are filled with full density moderator. The density of the moderator filling the canister cavity is then incrementally increased to full density. A study is also performed with a fully flooded canister cavity, while the density of the moderator occupying the void regions in each damaged fuel can is initially set to zero and then incrementally increased to full density. The results of these moderator density variations, provided in Table 6.4.3-13, demonstrate that the most reactive configuration for both the canister cavity and the damaged fuel cans occurs with full density water.

A case modeling a partially flooded canister loaded with four fully flooded damaged fuel cans in an uneven draining condition (post-accident) is also evaluated. The geometry of this case is taken from the axially finite basket model with 7.5 cm regions above and below the active fuel and, thus, above and below the neutron absorber. The canister cavity is modeled with full density moderator along the entire axial extent of the active fuel. The four damaged fuel cans are hypothetically assumed to remain fully flooded along the entire axial extent of each can. The material occupying the 7.5 cm regions above and below the active fuel in each damaged fuel can is taken to be 10% UO_2 and 90% water. As shown in Table 6.4.3-11, this damaged fuel can content results in the maximum increase in reactivity compared to the same geometry with no loose damaged fuel. The UO_2 volume fraction of the loose damaged fuel mixture is closer to what would be expected from only 20 rods than the UO_2 mixture volume fractions employed in the other cases. The resulting geometry, shown in Figure 6.4.3-4, bounds a hypothetical uneven draining of a canister containing damaged fuel cans. The calculated reactivity of this configuration, $k_{eff} \pm 2\sigma = 0.92004$, is within the statistical uncertainty band of the fully flooded condition of the same geometry.

Summary of Most Reactive Fuel Loading for a Basket Containing Damaged Fuel Cans

All the criticality safety analyses result in a system reactivity that is bounded by the infinite height model of a fully flooded canister loaded with 32 intact United Nuclear Type A assemblies and four damaged fuel cans, each containing a United Nuclear Type A assembly with a maximum of 20 damaged or missing fuel rods. This configuration results in a system reactivity ($k_{eff} \pm \sigma_{mc}$) of 0.92480 ± 0.00073. The maximum system reactivity for this configuration, $k_{eff} + 2\sigma_{mc} = 0.92625$, is less than the USL of 0.9361. The maximum system reactivity including the code bias and the bias uncertainty, $k_s = k_{eff}+0.0052+(0.0087^2+(2\sigma_{mc})^2)^{(1/2)}$, is calculated to be 0.93883, which is below 0.95. Thus, assemblies with up to 20 damaged or missing rods are allowed contents in a damaged fuel can.

Figure 6.4.3-1 Most Reactive Missing Rod Geometry

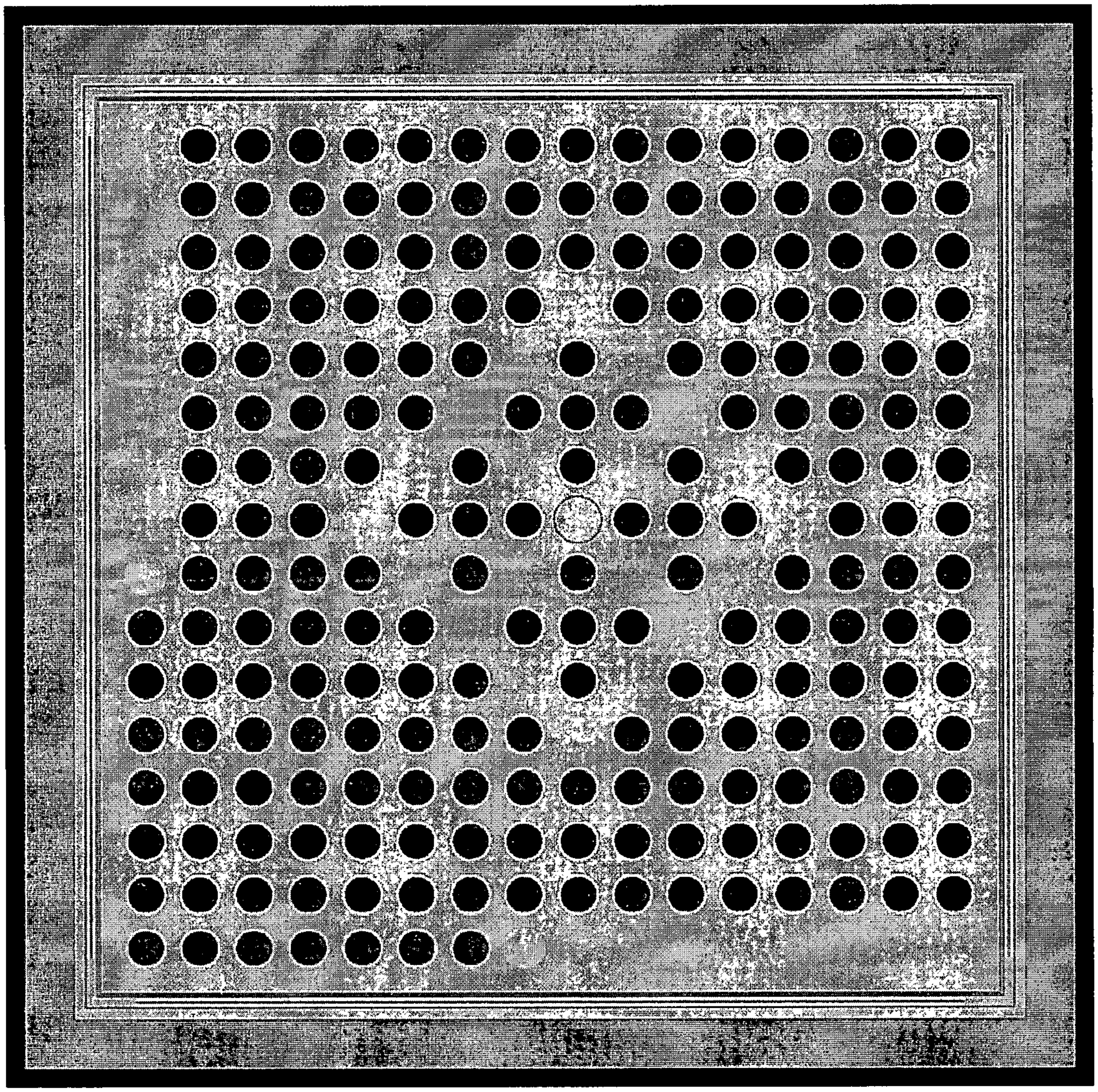

Figure 6.4.3-2 Most Reactive Missing Rod Array in the Damaged Fuel Can

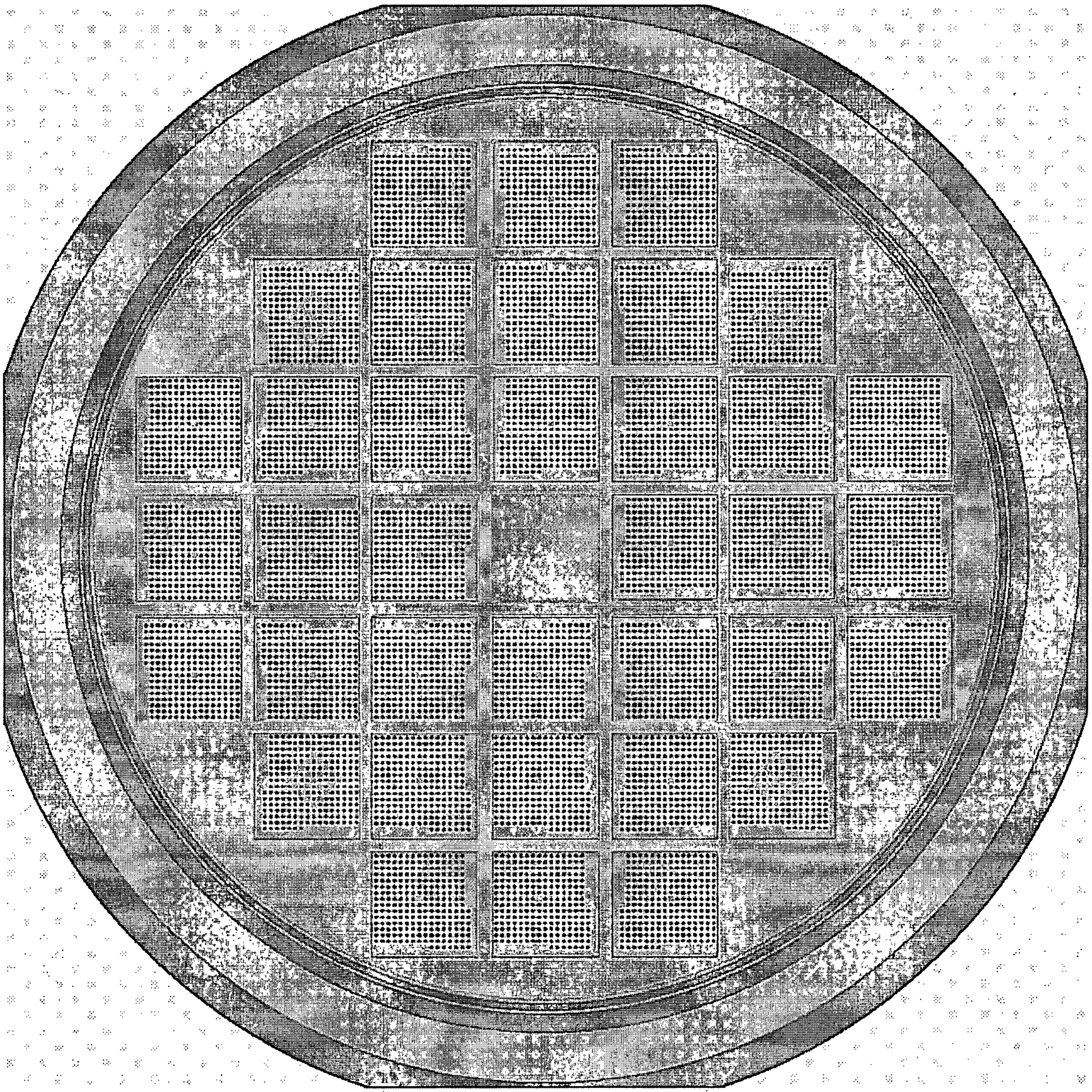

Figure 6.4.3-3 Damaged Fuel Can – 7.5 cm Regions without Neutron Absorber Coverage

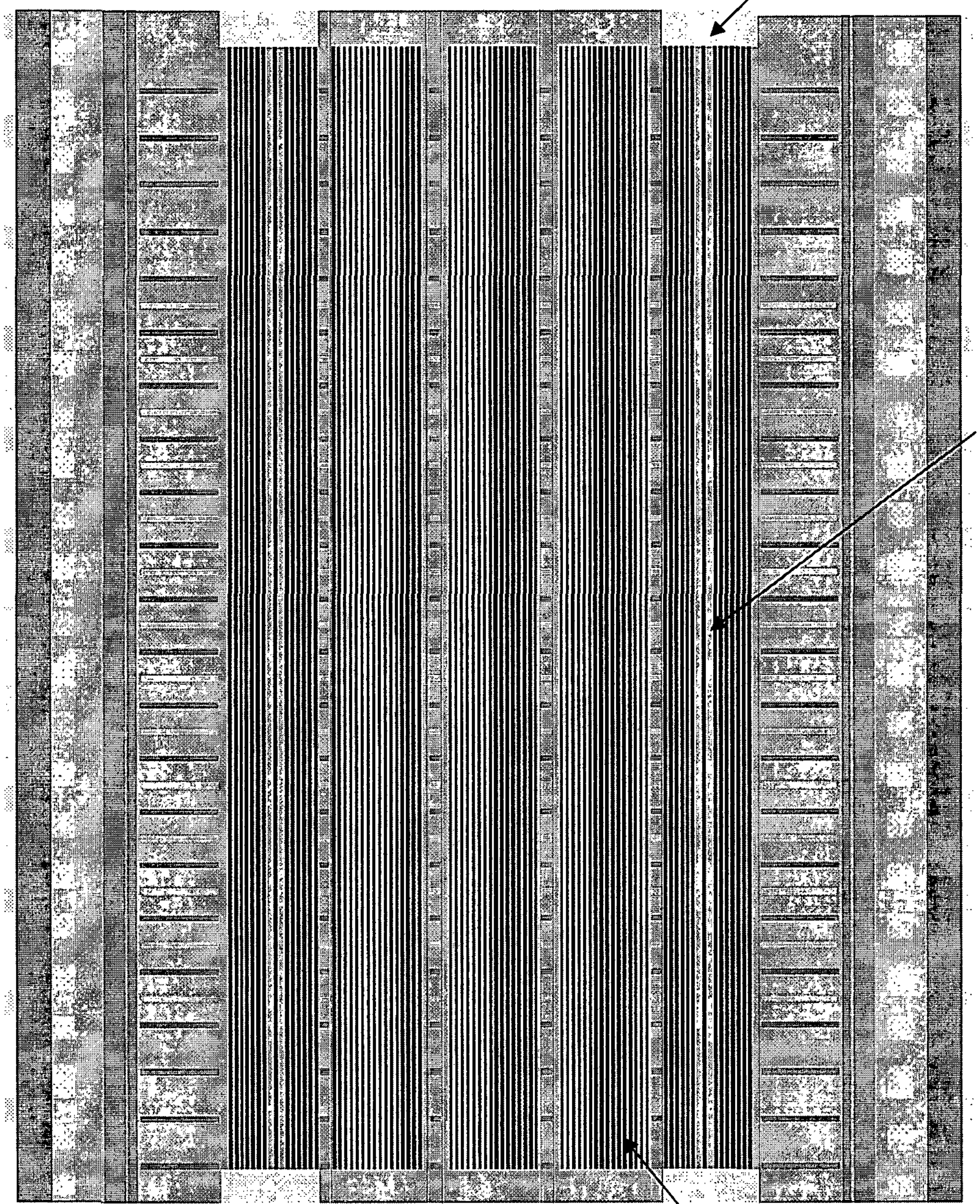

Figure 6.4.3-4 Hypothetical Uneven Drain Down Model

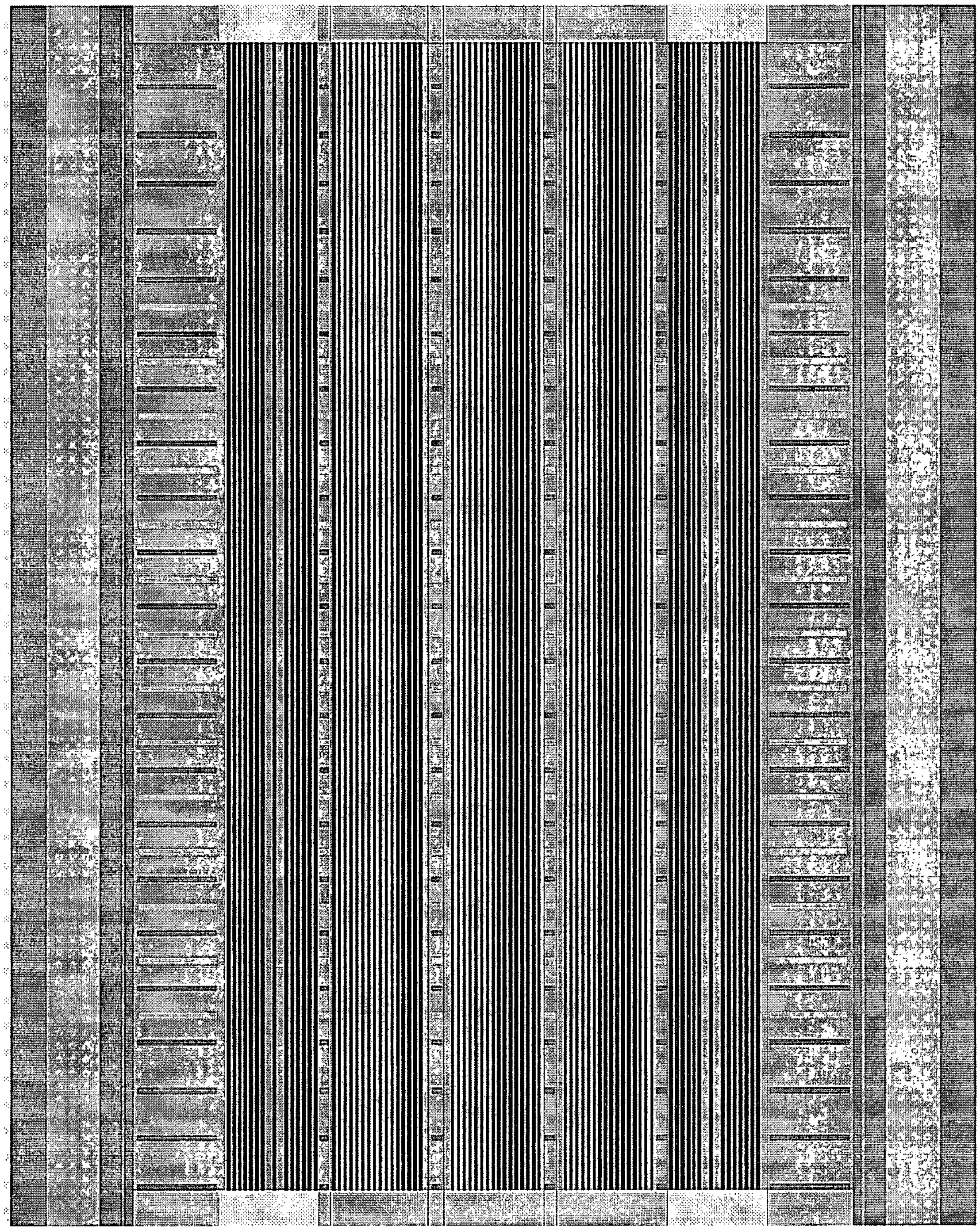

Table 6.4.3-1 Criticality Results for Normal Conditions of Transport of Yankee-MPC Canistered Fuel

Cask Pitch (cm)	H_2O Interior	H_2O Exterior	Neutron Shield	^{10}B	k_{eff}	σ	k_s
250.698	0.0001	1.0	Yes	75.0%	0.4573	0.00067	0.4753
270	0.0001	1.0	Yes	75.0%	0.4557	0.00062	0.4737
300	0.0001	1.0	Yes	75.0%	0.4566	0.00066	0.4746
250.698	0.0001	0.8	Yes	75.0%	0.4569	0.00068	0.4749
270	0.0001	0.8	Yes	75.0%	0.4564	0.00071	0.4744
300	0.0001	0.8	Yes	75.0%	0.4566	0.00064	0.4746
250.698	0.0001	0.6	Yes	75.0%	0.4580	0.00064	0.4760
270	0.0001	0.6	Yes	75.0%	0.4570	0.00069	0.4750
300	0.0001	0.6	Yes	75.0%	0.4579	0.00066	0.4759
250.698	0.0001	0.4	Yes	75.0%	0.4573	0.00046	0.4752
270	0.0001	0.4	Yes	75.0%	0.4575	0.00049	0.4755
300	0.0001	0.4	Yes	75.0%	0.4566	0.0006	0.4746
250.698	0.0001	0.2	Yes	75.0%	0.4557	0.00063	0.4737
270	0.0001	0.2	Yes	75.0%	0.4577	0.00073	0.4758
300	0.0001	0.2	Yes	75.0%	0.4576	0.00067	0.4756
250.698	0.0001	0.1	Yes	75.0%	0.4562	0.00061	0.4742
270	0.0001	0.1	Yes	75.0%	0.4566	0.00068	0.4746
300	0.0001	0.1	Yes	75.0%	0.4572	0.00067	0.4752

Table 6.4.3-2 Criticality Results for Yankee-MPC Canistered Fuel Hypothetical Accident Conditions

Cask Pitch (cm)	H_2O Interior	H_2O Exterior	Neutron Shield	^{10}B	k_{eff}	σ	k_s
250.698	1.0	1.0	No	75.0%	0.8830	0.00074	0.9011
270	1.0	1.0	No	75.0%	0.8819	0.00075	0.8999
300	1.0	1.0	No	75.0%	0.8834	0.00075	0.9014
250.698	0.8	0.8	No	75.0%	0.8328	0.0008	0.8509
270	0.8	0.8	No	75.0%	0.8334	0.00083	0.8514
300	0.8	0.8	No	75.0%	0.8312	0.00084	0.8493
250.698	0.6	0.6	No	75.0%	0.7725	0.00089	0.7906
270	0.6	0.6	No	75.0%	0.7728	0.00089	0.7908
300	0.6	0.6	No	75.0%	0.7742	0.0009	0.7923
250.698	0.4	0.4	No	75.0%	0.6994	0.00094	0.7175
270	0.4	0.4	No	75.0%	0.6997	0.00107	0.7178
300	0.4	0.4	No	75.0%	0.6973	0.00103	0.7154
250.698	0.2	0.2	No	75.0%	0.6086	0.00121	0.6268
270	0.2	0.2	No	75.0%	0.6113	0.00113	0.6295
300	0.2	0.2	No	75.0%	0.6098	0.0005	0.6278
250.698	0.1	0.1	No	75.0%	0.5585	0.0009	0.5766
270	0.1	0.1	No	75.0%	0.5578	0.00097	0.5759
300	0.1	0.1	No	75.0%	0.5580	0.00094	0.5761

Table 6.4.3-3 Assembly Type Reactivity Evaluations

Assembly	Initial Enrichment	k_{eff}	σ
Westinghouse Type A[1]	4.94 wt% ^{235}U	0.8642	0.00105
Westinghouse Type B	4.94 wt% ^{235}U	0.8664	0.00102
United Nuclear Type A	4.00 wt% ^{235}U	0.8974	0.00087
United Nuclear Type B[2]	4.00 wt% ^{235}U	0.8974	0.00106
Exxon - ANF Type A	4.00 wt% ^{235}U	0.8870	0.00111
Exxon - ANF Type B	4.00 wt% ^{235}U	0.8877	0.00111
Combustion Engineering Type A	3.90 wt% ^{235}U	0.8943	0.00060
Combustion Engineering Type B	3.90 wt% ^{235}U	0.8939	0.00163

1. At an enrichment of 4.97 wt % ^{235}U, k_{eff} is 0.8670.
2. At an enrichment of 4.03 wt % ^{235}U, k_{eff} is 0.8992.

Table 6.4.3-4 Most Reactive Fuel Containing Non-solid Fill Rods with Stainless Steel Slugs

Pattern	Slug Diam (in)	k_{eff}	σ	Δk_{eff}	$\Delta k_{eff}/\sigma$
------	------	0.90565	0.00074	-----	-----
a	0.265	0.89351	0.00073	-0.01214	-16.4
a	0.270	0.89382	0.00072	-0.01183	-16.0
a	0.275	0.89284	0.00073	-0.01281	-17.3
a	0.280	0.89099	0.00073	-0.01466	-19.8
a	0.285	0.89071	0.00073	-0.01494	-20.2
a	0.290	0.89009	0.00074	-0.01556	-21.0
a	0.295	0.88806	0.00074	-0.01759	-23.8
a	0.300	0.88741	0.00073	-0.01824	-24.6
a	0.305	0.88796	0.00071	-0.01769	-23.9
a	0.308	0.88555	0.00072	-0.02010	-27.2
b	0.265	0.89278	0.00073	-0.01287	-17.4
b	0.270	0.89141	0.00073	-0.01424	-19.2
b	0.275	0.89197	0.00075	-0.01368	-18.5
b	0.280	0.88887	0.00074	-0.01678	-22.7
b	0.285	0.88824	0.00074	-0.01741	-23.5
b	0.290	0.88790	0.00072	-0.01775	-24.0
b	0.295	0.88712	0.00073	-0.01853	-25.0
b	0.300	0.88452	0.00074	-0.02113	-28.6
b	0.305	0.88358	0.00073	-0.02207	-29.8
b	0.308	0.88588	0.00072	-0.01977	-26.7

Table 6.4.3-5 Most Reactive Fuel Non-solid Fill Rods with Zircaloy Slugs

Pattern	Slug Diam (in)	k_{eff}	σ	Δk_{eff}	$\Delta k_{eff}/\sigma$
------	------	0.90565	0.00074	-----	-----
a	0.290	0.90708	0.00071	0.00143	1.9
a	0.295	0.90692	0.00033	0.00127	1.7
a	0.300	0.90684	0.00074	0.00119	1.6
a	0.305	0.90576	0.00072	0.00011	0.1
a	0.308	0.90542	0.00073	-0.00023	-0.3
b	0.290	0.90662	0.00071	0.00097	1.3
b	0.295	0.90566	0.00076	0.00001	0.0
b	0.300	0.90684	0.00025	0.00119	1.6
b	0.305	0.90524	0.00073	-0.00041	-0.6
b	0.308	0.90455	0.00074	-0.00110	-1.5
c	0.290	0.90646	0.00073	0.00081	1.1
c	0.295	0.90528	0.00033	-0.00037	-0.5
c	0.300	0.90456	0.00077	-0.00109	-1.5
c	0.305	0.90657	0.00072	0.00092	1.2
c	0.308	0.90539	0.00073	-0.00026	-0.4
d	0.290	0.90562	0.00072	-0.00003	0.0
d	0.295	0.90685	0.00033	0.00120	1.6
d	0.300	0.90606	0.00076	0.00041	0.6
d	0.305	0.90493	0.00077	-0.00072	-1.0
d	0.308	0.90522	0.00074	-0.00043	-0.6
e	0.290	0.90711	0.00018	0.00146	1.97
e	0.295	0.90648	0.00033	0.00083	1.1
e	0.300	0.90606	0.00076	0.00041	0.6
e	0.305	0.90493	0.00077	-0.00072	-1.0
e	0.308	0.90522	0.00074	-0.00043	-0.6

Table 6.4.3-6 United Nuclear Type Removed Rod Results

	Type A				Type B			
# of Removed Rods	**k_{eff}**	**σ**	**Δk_{eff}**	**Δk_{eff} /σ**	**k_{eff}**	**σ**	**Δk_{eff}**	**Δk_{eff} /σ**
01	0.90152	0.00123	-0.02747	-23.5	0.90235	0.00121	-0.02593	-20.9
01	0.90069	0.00106	-0.02830	-24.2	0.89816	0.00114	-0.03012	-24.3
02	0.89986	0.00121	-0.02913	-24.9	0.90229	0.00108	-0.02599	-21.0
02	0.89967	0.00115	-0.02932	-25.1	0.90113	0.00113	-0.02715	-21.9
04	0.90466	0.00123	-0.02433	-20.8	0.90507	0.00111	-0.02321	-18.7
04	0.90459	0.00113	-0.02440	-20.9	0.90569	0.00115	-0.02259	-18.2
08	0.91344	0.00119	-0.01555	-13.3	0.91027	0.00118	-0.01801	-14.5
08	0.91342	0.00121	-0.01557	-13.3	0.91210	0.00113	-0.01618	-13.0
12	0.91483	0.00108	-0.01416	-12.1	0.91777	0.00121	-0.01051	-8.5
12	0.91930	0.00117	-0.00969	-8.3	0.91751	0.00125	-0.01077	-8.7
16	0.92239	0.00116	-0.00660	-5.6	0.92272	0.00120	-0.00556	-4.5
16	0.91899	0.00113	-0.01000	-8.5	0.91744	0.00115	-0.01084	-8.7
20	0.92612	0.00111	-0.00287	-2.5	0.92800	0.00118	-0.00028	-0.2
20	0.92833	0.00116	-0.00066	-0.6	0.92603	0.00119	-0.00225	-1.8
20	0.92899	0.00117	-----	-----	0.92626	0.00115	-0.00202	-1.6
20	0.92666	0.00109	-0.00233	-2.0	0.92828	0.00124	-----	-----

Table 6.4.3-7 Combustion Engineering Type Removed Rod Results

	Type A				Type B			
# of Removed Rods	k_{eff}	σ	Δk_{eff}	Δk_{eff} /σ	k_{eff}	σ	Δk_{eff}	Δk_{eff} /σ
01	0.89413	0.00114	-0.02906	-24.6	0.89397	0.00114	-0.02997	-25.8
01	0.89648	0.00109	-0.02671	-22.6	0.89481	0.00118	-0.02913	-25.1
02	0.89594	0.00115	-0.02725	-23.1	0.89584	0.00119	-0.02810	-24.2
02	0.89507	0.00117	-0.02812	-23.8	0.89697	0.00122	-0.02697	-23.2
04	0.90229	0.00109	-0.02090	-17.7	0.90213	0.00120	-0.02181	-18.8
04	0.90108	0.00113	-0.02211	-18.7	0.90048	0.00115	-0.02346	-20.2
08	0.90533	0.00116	-0.01786	-15.1	0.90822	0.00114	-0.01572	-13.6
08	0.90612	0.00108	-0.01707	-14.5	0.90661	0.00121	-0.01733	-14.9
12	0.90941	0.00114	-0.01378	-11.7	0.90993	0.00113	-0.01401	-12.1
12	0.91232	0.00118	-0.01087	-9.2	0.91239	0.00122	-0.01155	-10.0
16	0.91807	0.00114	-0.00512	-4.3	0.9178	0.00116	-0.00614	-5.3
16	0.91282	0.00115	-0.01037	-8.8	0.91421	0.00112	-0.00973	-8.4
20	0.92263	0.00117	-0.00056	-0.5	0.92254	0.00114	-0.00140	-1.2
20	0.92042	0.00114	-0.00277	-2.3	0.91982	0.00119	-0.00412	-3.6
20	0.92212	0.0012	-0.00107	-0.9	0.92394	0.00116	-----	-----
20	0.92319	0.00118	-----	-----	0.9221	0.00116	-0.00184	-1.6

Table 6.4.3-8 Exxon Type Removed Rod Results

	Type A				Type B			
# of Removed Rods	k_{eff}	σ	Δk_{eff}	$\Delta k_{eff}/\sigma$	k_{eff}	σ	Δk_{eff}	$\Delta k_{eff}/\sigma$
01	0.89171	0.00118	-0.02705	-23.9	0.89017	0.00113	-0.02604	-24.8
01	0.88843	0.00119	-0.03033	-26.8	0.89000	0.00112	-0.02621	-25.0
02	0.88992	0.00107	-0.02884	-25.5	0.89067	0.00109	-0.02554	-24.3
02	0.89274	0.00108	-0.02602	-23.0	0.88884	0.00111	-0.02737	-26.1
04	0.89287	0.00115	-0.02589	-22.9	0.89334	0.00119	-0.02287	-21.8
04	0.89416	0.00112	-0.02460	-21.8	0.89293	0.00114	-0.02328	-22.2
08	0.90302	0.00116	-0.01574	-13.9	0.89925	0.00115	-0.01696	-16.2
08	0.89969	0.00116	-0.01907	-16.9	0.90053	0.00110	-0.01568	-14.9
12	0.90492	0.00123	-0.01384	-12.2	0.90562	0.00115	-0.01059	-10.1
12	0.90812	0.00102	-0.01064	-9.4	0.90544	0.00120	-0.01077	-10.3
16	0.91225	0.00125	-0.00651	-5.8	0.90952	0.00121	-0.00669	-6.4
16	0.90747	0.00112	-0.01129	-10.0	0.90679	0.00121	-0.00942	-9.0
20	0.91876	0.00113	-----	-----	0.91433	0.00116	-0.00188	-1.8
20	0.91425	0.00114	-0.00451	-4.0	0.91254	0.00115	-0.00367	-3.5
20	0.91498	0.00116	-0.00378	-3.3	0.91183	0.00118	-0.00438	-4.2
20	0.91687	0.00115	-0.00189	-1.7	0.91621	0.00105	-----	-----

Table 6.4.3-9 Westinghouse Type A Removed Rod Results

	Type A				Type B			
# of Removed Rods	k_{eff}	σ	Δk_{eff}	Δk_{eff} /σ	k_{eff}	σ	Δk_{eff}	Δk_{eff} /σ
01	0.86696	0.00109	-0.02844	-26.8	0.86772	0.00108	-0.02809	-26.8
01	0.86502	0.00112	-0.03038	-28.7	0.86720	0.00108	-0.02861	-27.2
02	0.86736	0.00102	-0.02804	-26.5	0.86832	0.00105	-0.02749	-26.2
02	0.86715	0.00107	-0.02825	-26.7	0.87009	0.00110	-0.02572	-24.5
04	0.87038	0.00105	-0.02502	-23.6	0.87128	0.00107	-0.02453	-23.4
04	0.87110	0.00109	-0.02430	-22.9	0.87058	0.00109	-0.02523	-24.0
08	0.87648	0.00105	-0.01892	-17.8	0.87938	0.00110	-0.01643	-15.6
08	0.87746	0.00107	-0.01794	-16.9	0.87817	0.00109	-0.01764	-16.8
12	0.88039	0.00108	-0.01501	-14.2	0.88366	0.00110	-0.01215	-11.6
12	0.88512	0.00104	-0.01028	-9.7	0.88429	0.00106	-0.01152	-11.0
16	0.88957	0.00113	-0.00583	-5.5	0.88829	0.00099	-0.00752	-7.2
16	0.88917	0.00107	-0.00623	-5.9	0.88933	0.00109	-0.00648	-6.2
20	0.89458	0.00113	-0.00082	-0.8	0.89565	0.00108	-0.00016	-0.2
20	0.89429	0.00109	-0.00111	-1.0	0.89233	0.00106	-0.00348	-3.3
20	0.89540	0.00106	-----	-----	0.89581	0.00105	-----	-----
20	0.89514	0.00108	-0.00026	-0.2	0.89384	0.00109	-0.00197	-1.9

Table 6.4.3-10 Damaged Fuel Can Results of Fuel-Water Mixture between Rods

Volume Fraction of UO_2 in Water	**k_{eff}**	**σ**	**Δk_{eff}**	**Δk_{eff} /σ**
0.0	0.92480	0.00073	-----	-----
0.1	0.91083	0.00072	-0.01397	-19.1
0.2	0.90715	0.00074	-0.01765	-24.2
0.3	0.90313	0.00073	-0.02167	-29.7
0.4	0.89873	0.00074	-0.02607	-35.7
0.5	0.89733	0.00076	-0.02747	-37.6
0.6	0.89611	0.00073	-0.02869	-39.3
0.7	0.89504	0.00073	-0.02976	-40.8
0.8	0.89374	0.00071	-0.03106	-42.5
0.9	0.89411	0.00074	-0.03069	-42.0
1.0	0.89292	0.00074	-0.03188	-43.7

Table 6.4.3-11 Damaged Fuel Can Analysis Results of Fuel-Water Mixture Outside Neutron Absorber Coverage – 30 cm Exposed

Height of Top & Bottom Exposed Regions (cm)	Volume Fraction of UO_2 in Water	k_{eff}	σ	Δk_{eff}	$\Delta k_{eff}/\sigma$
30	0.0	0.91886[1]	0.00074	-----	-----
30	0.1	0.91710	0.00074	-0.00171	-2.4
30	0.2	0.91872	0.00074	-0.00009	-0.1
30	0.3	0.91753	0.00071	-0.00128	-1.8
30	0.4	0.91921	0.00073	0.00040	0.6
30	0.5	0.91811	0.00076	-0.00070	-1.0
30	0.6	0.91826	0.00077	-0.00055	-0.8
30	0.7	0.91984	0.00074	0.00103	1.5
30	0.8	0.91807	0.00074	-0.00074	-1.0
30	0.9	0.91827	0.00074	-0.00054	-0.8
30	1.0	0.91874	0.00076	-0.00007	-0.1

Notes:

1. Lower in reactivity than the 0% volume fraction case in Table 6.4.3-10 due to axial leakage from finite basket height model.

Table 6.4.3-12 Damaged Fuel Can Analysis Results of Fuel-Water Mixture Outside Neutron Absorber Coverage – 15 cm Exposed

Height of Top & Bottom Exposed Regions (cm)	Volume Fraction of UO_2 in Water	k_{eff}	σ	Δk_{eff}	$\Delta k_{eff}/\sigma$
15	0.0	0.91763[1]	0.00073	-----	-----
15	0.1	0.91966	0.00073	0.00203	2.8
15	0.2	0.91791	0.00076	0.00028	0.4
15	0.3	0.91946	0.00073	0.00183	2.5
15	0.4	0.91846	0.00076	0.00083	1.1
15	0.5	0.91828	0.00074	0.00065	0.9
15	0.6	0.91770	0.00072	0.00007	0.1
15	0.7	0.91746	0.00071	-0.00017	-0.2
15	0.8	0.91753	0.00075	-0.00010	-0.1
15	0.9	0.91948	0.00074	0.00185	2.5
15	1.0	0.91881	0.00071	0.00118	1.6

Notes:

1. Lower in reactivity than the 0% volume fraction case in Table 6.4.3-10 due to axial leakage from finite basket height model.

Table 6.4.3-13 Damaged Fuel Can Preferential Flooding Analysis

Moderator Density		k_{eff}	σ	Δk_{eff}	$\Delta k_{eff}/\sigma$
TSC	**Fuel Can**				
1.0	1.0	0.92480[1]	0.00073	-----	-----
0.0	1.0	0.89988	0.00076	-0.02492	-34.1
0.1	1.0	0.85082	0.00064	-0.07398	-101.3
0.2	1.0	0.84184	0.00071	-0.08296	-113.6
0.3	1.0	0.84192	0.00068	-0.08288	-113.5
0.4	1.0	0.84910	0.00073	-0.07570	-103.7
0.5	1.0	0.85830	0.00072	-0.06650	-91.1
0.6	1.0	0.86870	0.00072	-0.05610	-76.8
0.7	1.0	0.88328	0.00073	-0.04152	-56.9
0.8	1.0	0.89573	0.00074	-0.02907	-39.8
0.9	1.0	0.90964	0.00075	-0.01516	-20.8
1.0	0.0	0.88624	0.00071	-0.03856	-52.8
1.0	0.1	0.88708	0.00076	-0.03772	-51.7
1.0	0.2	0.88879	0.00073	-0.03601	-49.3
1.0	0.3	0.89028	0.00070	-0.03452	-47.3
1.0	0.4	0.89134	0.00074	-0.03346	-45.8
1.0	0.5	0.89500	0.00076	-0.02980	-40.8
1.0	0.6	0.89672	0.00075	-0.02808	-38.5
1.0	0.7	0.90249	0.00076	-0.02231	-30.6
1.0	0.8	0.90933	0.00073	-0.01547	-21.2
1.0	0.9	0.91511	0.00074	-0.00969	-13.3

1. Base case from Table 6.4.3-10 with 0.0 UO_2 in H_2O.

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6.4.4 Criticality Results for Canistered Connecticut Yankee Fuel

The criticality evaluation of the CY-MPC is performed using the MONK8a Monte Carlo Program for Nuclear Criticality Safety Analysis. The code employs JEF 2.2 point energy neutron cross-section libraries. Calculations are performed for the normal operating conditions and accident conditions (contingencies) of transport, which include optimum moderation. The evaluation considers the canister loaded with intact fuel assemblies, assemblies with Reactor Control Cluster Assemblies or Flow Mixers, fuel debris within CY reconfigured fuel assemblies and CY damaged fuel cans containing fuel assemblies with damaged cladding. Bounding fuel assembly dimensions, conservative basket dimensions, radial and axial shifting of the fuel within the basket, partial flooding of the canister and optimum moderation are also considered.

The individual MONK8a calculations execute until the standard deviation of the final result is less than or equal to 0.0008 for each of the configurations analyzed. Upon completion of each set of analyses, a reactivity comparison is made to determine the most reactive configuration.

6.4.4.1 Connecticut Yankee Fuel Loading Optimization

The CY-MPC canister has two basket configurations. The 26-assembly basket represents a canister fully loaded with 26-design basis fuel assemblies, except the Westinghouse Vantage 5H. The 24-assembly basket represents a canister and cask loaded with 24 design basis Westinghouse Vantage 5H fuel assemblies. The 24-assembly basket may be loaded with any fuel assemblies, but is evaluated using the Vantage 5H, which is the highest reactivity fuel. The two baskets are identical, except that 2 fuel loading positions of the 26-assembly basket are blocked to create the 24-assembly basket. The blocked fuel positions cannot be loaded. The models use a reflecting boundary condition on the radial surface of the transfer cask and periodic boundary conditions on the top and bottom. These conditions bound an infinite three-dimensional array of casks.

6.4.4.2 Connecticut Yankee Fuel Criticality Results

This section establishes the most reactive CY-MPC contents and the most reactive loading for each CY-MPC basket configuration. These results are used to calculate the effective neutron multiplication factor for the transport cask assuming full moderation.

6.4.4.2.1 Most Reactive Assembly – Connecticut Yankee Fuel

Each of the Connecticut Yankee fuel assembly design groupings shown in Table 6.2-4 is evaluated in the fully flooded 26-assembly basket configuration. The basket is configured assuming centered basket components with nominal dimensions. For each design grouping, the bounding fuel assembly dimensions that serve to increase moderation within the active fuel region are considered. To maximize moderation, the fuel pellet/clad gap is assumed to be flooded, and the maximum fuel rod pitch is used in conjunction with the minimum clad outer diameter and cladding thickness. To maximize the fuel volume, the maximum active fuel length is used for each design grouping. Fuel pellet diameter studies are also performed. Maximizing the fuel pellet diameter is not necessarily conservative, since the increased fuel volume displaces moderator in the flooded pellet/clad gap. In order to standardize the comparison, each assembly is evaluated with the UO_2 at 95% theoretical density.

Table 6.4.4-1 presents the results for each of the fuel assembly design groupings at three different pellet outside diameters. The pellet diameters are labeled minimum, middle and maximum and were established based on the variations of the pellet diameters within each of the design groups. The results of the evaluation demonstrate that the reactivity of the Westinghouse Vantage 5H fuel assemblies at a maximum initial enrichment of 4.61 wt % ^{235}U in the 26-assembly basket configuration is 0.9460, which exceeds the upper subcritical limit of 0.9425 (Section 6.5.2). As a result, Zircaloy-clad fuel enriched over 3.93 wt % ^{235}U may be loaded only in the 24-assembly basket configuration. Disk openings 12 and 15 in Figure 6.3-3 are blocked in the 24-assembly basket configuration because removing the fuel assemblies from these locations minimizes neutron interaction between all fuel assemblies in the system and, thus, provides the largest reactivity penalty (or reduction) from removing only two assemblies. The k_{eff} of the 4.61 wt % Zircaloy-clad Westinghouse Vantage 5H fuel assemblies centered in the 24-assembly basket configuration is 0.9197, compared to 0.9460 in the 26-assembly basket.

For the 26-assembly basket configuration, the Zircaloy-clad fuel enriched to 3.93 wt % ^{235}U bounds all stainless steel-clad fuel and the lower enrichment Zircaloy-clad fuel. The remaining analyses are, therefore, performed with either the 24-assembly basket configuration containing 4.61 wt % ^{235}U Zircaloy-clad fuel assemblies, or the 26-assembly basket configuration containing 3.93 wt % ^{235}U Zircaloy-clad fuel assemblies. As shown in Table 6.4.4-1, no statistically significant differences in reactivity (i.e., greater than 2σ or 0.0016 Δk_{eff}) result from the pellet diameter variations. Therefore, further analyses will use the largest pellet diameter, as this maximizes the fuel within the system.

The CY reconfigured fuel assembly with the most reactive fuel rods is also explicitly modeled in the 26-assembly basket configuration. As shown in Section 6.4.4.2.6, detailed studies are performed demonstrating that the CY reconfigured fuel assembly containing fuel material enriched to 4.61 wt % ^{235}U is lower in reactivity than intact fuel assemblies.

6.4.4.2.2 Most Reactive Mechanical Configuration - Connecticut Yankee Fuel

Evaluations of the effect of basket dimensional perturbations are made using the 26-assembly and 24-assembly basket configurations, along with the design basis 3.93 and 4.61 wt % ^{235}U Zircaloy-clad fuel assemblies, respectively. These criticality analyses determine the most reactive basket mechanical configurations by altering the nominal model dimensional parameters and comparing the perturbed k_{eff} to the nominal result. If Δk_{eff} ($k_{perturbed}$ - $k_{nominal}$) is positive, the tolerance causes an increase in reactivity. Conversely, if Δk_{eff} is negative, the tolerance causes a decrease in reactivity. Two types of perturbations are assessed in these evaluations: fabrication tolerances and radial movement of components within the basket.

Fabrication Tolerances

Five major fabrication tolerances are evaluated: the fuel tube opening size (± 0.03 inch), the disk opening size (± 0.015 inch) and center location within 0.015 inch, and the neutron poison sheet length and width (± 0.06 inch). The tolerances associated with each component are independently analyzed with assemblies centered in the fuel tubes and with the fuel tubes centered in the disk openings. A 26-assembly basket configuration with the design basis Zircaloy-clad fuel enriched to 4.61 wt % ^{235}U is used in these analyses. This fuel assembly was conservatively used, since a more reactive loading will be more sensitive to variations in component dimensions than a less reactive loading. The modeled width of the BORAL sheet is decreased to 7.974 inches, from a minimum toleranced width of 8.17 inches, to account for shifting of the BORAL sheet or off-center placement on the side of the fuel tube. This dimension was calculated by determining the minimum width remaining on half the tube face due to shifting to the opposite side of the tube, then conservatively applying this distance to the entire BORAL sheet width.

Table 6.4.4-2 indicates that the most reactive set of basket tolerances are: maximum fuel tube opening and minimum neutron poison material. Increasing the fuel tube opening brings more moderator into the gap between the assembly and the tube, lowering the efficiency of the BORAL sheets and increasing the reactivity of the system. A case evaluating the combined effect of a BORAL sheet width of 7.974 inches and a tube opening width of 8.75 inches (8.72 + 0.03) is documented in Table 6.4.4-2.

Mechanical Perturbations

In addition to these basket tolerances, possible mechanical perturbations of the system are evaluated. Radial component shifting is analyzed to ensure that the system remains subcritical under shifted conditions. Axial shifting of components of the CY-MPC is evaluated in Section 6.4.4.4. Tolerances on the disk opening size are applied during the mechanical perturbation evaluation since an increased disk opening would provide additional movement space. The disk opening center location variance is applied since shifting the disk opening centers will allow increased interaction for the shifted tube and/or assembly. Disk opening center tolerances are applied in the same direction as the component shift studied.

Shifting analyses are performed for the 26-assembly basket configuration loaded with design basis Zircaloy-clad fuel enriched to 3.93 wt % ^{235}U, and for the 24-assembly basket configuration loaded with design basis Zircaloy-clad fuel enriched to 4.61 wt % ^{235}U. The results of these analyses are provided in Table 6.4.4-3 and Table 6.4.4-4 with the most reactive shifting patterns listed following the base case. The shifting patterns considered were evaluated toward various areas of the basket. The shifting patterns that produce the maximum reactivity for the 26-assembly and 24-assembly basket configurations are shown in Figure 6.4.4-1 and Figure 6.4.4-2, respectively. Each fuel assembly, tube and disk opening are shifted in the direction indicated by the arrow.

Most Reactive Connecticut Yankee Fuel Configuration Summary

Combining the worst-case fabrication tolerances with the worst-case radial shifting pattern produces the most reactivity configuration for the 26-assembly and 24-assembly baskets. The k_{eff} values calculated for these configurations are 0.9219 for the 26-assembly basket and 0.9313 for the 24-assembly basket (See Tables 6.4.4-12 and 6.4.4-5, respectively). It should be noted that these combinations of fabrication tolerances and mechanical perturbations are highly unrealistic, and unlikely to occur during actual operations. However, by combining conservative assumptions, the most reactive credible configuration is bounded.

6.4.4.2.3 Connecticut Yankee Fuel Assemblies with Missing Fuel Rods

Some of the Connecticut Yankee fuel assemblies are missing individual fuel rods. The exact number and location of these missing rods differ from assembly to assembly. To determine a bounding reactivity for these assemblies, an analysis varying the number of rods removed from the 15 x 15 array is performed. This analysis uses the most reactive 24-assembly basket configuration loaded with Zircaloy clad fuel assemblies enriched to 4.61 wt % ^{235}U. The maximum reactivity resulting from loading assemblies with missing rods in this configuration bounds the maximum reactivity resulting from loading assemblies with the same missing rod geometry into other less reactive configurations such as the 26-assembly basket with 3.93 wt % ^{235}U. Tolerances on basket components, as well as the most reactive radial shifting pattern for the 24-assembly basket configuration, are considered. For each case, all 24 assemblies have the same number and location of missing fuel rods. The results presented in Table 6.4.4-5 show that 24 rods missing from the array represents the bounding number of missing fuel rods for the Connecticut Yankee fuel assemblies. Figure 6.4.4-3 shows the locations of the 24 fuel rods that were removed. In effect, this study has optimized the H/U ratio within all 24 undermoderated fuel assemblies and has resulted in a substantial increase in system reactivity. Hence, loading of assemblies with missing rods will be restricted to the four corner fuel tube locations (openings 1, 4, 23 and 26 as seen in Figure 6.3-3). This configuration results in a system reactivity (k_{eff}) of 0.9327 and corresponds to a change in reactivity, $\Delta k_{eff} = 0.0014$, which is within the statistics of the code. Therefore, loading of assemblies with missing fuel rods into the four corner fuel tube locations does not significantly affect the overall reactivity of the CY-MPC system.

6.4.4.2.4 Connecticut Yankee Non-Fuel Hardware and Partial Height Flooding

The inventory of the Connecticut Yankee spent fuel pool contains both Reactor Control Cluster Assemblies and Flow Mixers. Either of these components may be placed within a fuel assembly in the CY-MPC. Adding a Reactor Control Cluster Assembly into a fuel assembly displaces moderator in the guide tubes and slightly modifies the reflection material outside the top of the fuel region. As shown in Section 6.4.4.3, the Connecticut Yankee fuel assemblies are undermoderated. Therefore, removing moderator from the lattice decreases reactivity.

When the canister is flooded, the water level inside the canister varies as a function of time. It is not instantaneously filled with water. An additional analysis is performed to evaluate the reactivity effect on the system for the canister cavity flooded only to the top of the active fuel region. This scenario is analyzed to consider the potential increased neutron scattering in the top end of the canister that may result when water is not present in this region. This scenario is evaluated with the 26-assembly basket configuration, containing the 3.93 wt % ^{235}U, Zircaloy-clad fuel assemblies. A graphical illustration of the partially flooded basket is shown in Figure 6.4.4-9. This case produces a k_{eff} value of 0.9210, and the change in reactivity from the base case ($\Delta k_{eff} = 0.0009$) is statistically insignificant. Similar results would be expected from the 24-assembly basket configuration.

The partial flooding evaluation demonstrates that removing the moderator above the active fuel region has no significant impact on cask reactivity. Therefore, replacing the water in the guide tubes above the active fuel region and a small portion of water above the upper end fitting with stainless steel from the Reactor Control Cluster Assembly or Flow Mixer would also not have an significant effect on the reactivity of the system.

6.4.4.2.5 Damaged Fuel Assembly Can Evaluation

A number of the fuel assemblies in the Connecticut Yankee spent fuel pool inventory may be classified as damaged, i.e., cladding damage greater than pinhole leaks or hairline cracks. These damaged fuel assemblies must be placed in a damaged fuel can prior to being loaded in the canister. This can has a screened opening in the base plate and the top plate to permit drainage, vacuum drying, and inerting of the can without releasing fissile material from the can. Prior to loading the assemblies with damaged fuel rods into the damaged fuel assembly can, all fuel must be within the confines of the fuel rod cladding. Damaged fuel assembly cans are physically restricted to the 4 oversize fuel tubes in the basket. Assemblies with damaged rods may be placed into a damaged fuel assembly can prior to being loaded into a basket. However, if the damaged fuel assembly cans are first installed in the basket, the damaged fuel should be loaded before loading the remaining (intact) fuel assemblies. This ensures that no fuel material is accidentally dispersed into other regions of the basket that already hold fuel assemblies. Loading the remaining fuel tubes is allowed to commence as long as no fuel material has been dispersed into the canister cavity.

This evaluation considers the CY-MPC 24-assembly basket loaded with 20 of the most reactive fuel assemblies and with 4 damaged fuel assembly cans. Connecticut Yankee 15 x 15 assemblies that have up to 204 damaged fuel rods are analyzed within the damaged fuel assembly can, considering 100% dispersal of the fuel from the rods. All loose fuel in each analysis is modeled as a homogeneous mixture of fuel and water in which the volume fractions of the fuel versus the water are varied from 0-1.0 and vice versa. The clad material of the damaged rods is conservatively ignored. The bottom of the can is assumed to be in contact with the canister floor. The top of the can lid assembly support ring is assumed to be in contact with the canister lid. Thus, the can cavity height is conservatively extended. Figures 6.4.4-4 through 6.4.4-7 show the model used for the damaged fuel can evaluation. The base case used for reactivity comparisons of these analyses is that of loading the can with an assembly in the most reactive missing rod array containing no damaged or loose fuel. This base case configuration results in a system reactivity, k_{eff}, of 0.9330 with a standard deviation of 0.0008.

First, loose fuel from the damaged fuel rods is distributed between the remaining rods of the assembly in each can. These remaining rods are conservatively assumed to be in the most reactive missing rod array. The results of this analysis, provided in Table 6.4.4.6, show that this scenario slightly decreases the reactivity of the system compared to just placing the most reactive missing rod array within each can. This is due to the fact that adding fuel to the already optimized H/U ratio of the bounding missing rod array reduces the reactivity of the system as this effectively returns the system to an undermoderated state. Second, loose fuel is considered above and below the active fuel region of the most reactive missing rod array within each can. The results of this study, provided in Table 6.4.4.7, show that any possible mixture combination of fuel and water above and below the active fuel region will not significantly increase the reactivity of the system beyond that of the most reactive missing rod array within the can. Loose fuel is also considered to replace all contents of the Connecticut Yankee damaged fuel assembly can in each oversized fuel tube location. The results of this study, provided in Table 6.4.4.8, show that any mixture of fuel and water within the damaged fuel assembly can cavity will not significantly increase the reactivity of the system beyond that of placing an assembly having the most reactive missing rod array within each can.

The most reactive damaged fuel configuration occurs when the fully flooded 24-assembly basket configuration is loaded with 4 damaged fuel assembly cans, with each fully flooded can containing an assembly having the most reactive missing rod array. This configuration results in a system reactivity of 0.9330. This corresponds to a change in reactivity, $\Delta k_{eff} = 0.0017$, which is considered to be within the statistics of the code when compared to loading the 24-assembly basket configuration with 24 Westinghouse Vantage 5H assemblies. Loading the 26-assembly basket with 4 damaged fuel cans containing Zircaloy-clad fuel assemblies enriched up to 3.93 wt % ^{235}U or stainless steel clad fuel assemblies, either type with up 204 damaged fuel rods, would behave similarly. Therefore, loading the basket with damaged fuel assembly cans containing assemblies with up to 204 damaged rods does not affect the overall reactivity of the CY-MPC system as long as the enrichment of the fuel within each can is limited to that of the basket configuration in which it is loaded.

6.4.4.2.6 CY Reconfigured Fuel Assembly Evaluation

The Connecticut Yankee spent fuel pool inventory includes a number of individual fuel rods that have been removed from their host fuel assemblies and may be intact or damaged. The CY reconfigured fuel assembly is designed to accommodate these individual fuel rods, or other fuel debris. The key physical dimensions and limits on the fuel material to be stored are listed in Table 6.2-5. The CY reconfigured fuel assembly restricts the fuel rods to a 10 x 10 array of tubes that are captured between top and bottom tie-plates. The tie-plates have a smaller drain line at each tube. There is a screened drain reservoir below the bottom tie-plate. The analysis of the CY reconfigured fuel assembly assumes that the fuel rods contain fuel with an initial enrichment of 4.61 wt % ^{235}U. For conservatism, the fuel rod cladding is not modeled within each individual tube. The CY reconfigured fuel assembly is designed to be physically restricted to the four corner fuel tube locations. However, the analysis conservatively evaluates the assemblies in all 26 basket locations to demonstrate that the CY reconfigured fuel assembly design has a lower reactivity than either of the design basis intact fuel assembly configurations.

Four individual studies are performed to demonstrate that the CY reconfigured fuel assembly is bounded by the design basis intact fuel evaluation. The first study evaluates the reactivity of the CY reconfigured fuel assembly as a function of the fuel pellet diameter within the tubes as shown in Table 6.4.4-9. The fuel pellet diameter inside each tube is decreased from the 1.2814 cm maximum. The reported variation in reactivity between diameters of 1.2814 cm and 1.27 cm is statistically insignificant. Therefore, the largest diameter is assumed to be the most reactive, as this maximizes the amount of fissile material in the system. The second study considers variations in water moderator density within the flooded canister, including within the CY reconfigured fuel assembly. Results for this moderator density study are shown in Table 6.4.4-10 and demonstrate that the effective full density moderator condition is the most reactive, and that the reactivity of the CY reconfigured fuel assembly is well below that of the design basis intact fuel assembly. The third study considers a homogeneous volume fraction study of a fuel-water mixture within each reconfigured fuel assembly tube. Results for this evaluation are shown in Table 6.4.4-11. Excluding the statistically insignificant variations in reactivity that occur for water volume fractions below 10%, the most reactive configuration is for the individual tubes completely filled with fuel material. The fourth study considers the reactivity impact of fuel debris in the drain lines and drain reservoir in the bottom end fitting, as depicted in Figure 6.4.4-8. In this figure, the drain lines in the bottom tie-plate are conservatively considered to be the same size as the tube. The results of this case, k_{eff} = 0.9079, show that modeling the drain tubes beneath each of the tubes in the 10 x 10 array and the drain reservoir with solid fuel material surrounded by water, is the most reactive CY reconfigured fuel assembly configuration.

Comparison of the most reactive CY reconfigured fuel assembly case to either of the design basis intact fuel assembly cases demonstrates that the reactivity of the CY reconfigured fuel assembly is bounded by that of the design basis fuel assemblies. As an additional conservative margin, CY reconfigured fuel assemblies can be loaded only in the 4 corner locations of the fuel basket.

6.4.4.3 Normal Conditions – Connecticut Yankee Fuel

Connecticut Yankee fuel assemblies will be sealed inside a canister that is welded shut. Consequently, the canistered fuel is dry under normal conditions of loading and transport. Evaluation of normal conditions, therefore, requires the moderator density to be ~0.0 g/cc (dry). The resulting k_{eff} for normal conditions of transport are 0.3555 ± 0.0008 for the 26-assembly basket configuration and 0.3715 ± 0.0008 for the 24-assembly basket configuration as shown in the last row of Table 6.4.4-12. For conservatism, the transport cask criticality analysis also considers a flooded normal condition. The maximum reactivity for this scenario results in a k_{eff} of 0.9313 ± 0.0008 for the 24-assembly basket configuration and a k_{eff} of 0.9219 ± 0.0008 for the 26-assembly basket configuration.

Including statistical uncertainties, all results for the normal condition are below the 0.9425 upper subcritical limit defined in Section 6.5.2. Thus, compliance with 10 CFR 71.55 (b) and (d) as well as 10 CFR 71.75 (a) is demonstrated.

6.4.4.4 Hypothetical Accident Conditions – Connecticut Yankee Fuel

Criticality analysis of the hypothetical accident conditions includes variations in moderator density from 1.0 g/cc to ~0.0 g/cc (dry). The cask, canister and fuel are considered to be fully moderated as described in Section 6.1.2. The moderator density studies, provided in Tables 6.4.4-12 and 6.4.4-13, show that optimum moderation occurs at full density and results in a system reactivity, $k_{eff} \pm \sigma$, of 0.9313 ± 0.0008 for the 24-assembly basket and a k_{eff} of 0.9219 ± 0.0008 for the 26-assembly basket.

A case discretely modeling a partially flooded canister loaded with four fully flooded damaged fuel cans was also evaluated. The geometry of this case is identical to the most reactive damaged fuel can configuration documented in Section 6.4.4.2.5 with the following exception. The canister cavity is partially flooded with full density moderator to a height approximately equal to the middle of the active fuel. The four damaged fuel cans are hypothetically assumed to remain fully flooded along the entire axial extent of each can. This geometry bounds a postulated uneven drain down condition for a canister containing damaged fuel cans. Comparison of the calculated reactivity of this configuration, $k_{eff} \pm 2\sigma = 0.9259 \pm 0.0008$, to the calculated reactivity of the same basket loading with full density moderator completely filling the canister cavity, $k_{eff} \pm 2\sigma = 0.9330 \pm 0.0008$, demonstrates that the full canister flooding scenario is bounding. Similar results would be expected from the 26-assembly basket configuration.

Axial shifting of the contents of the CY-MPC system is considered as a result of the top end impact accident condition. A bounding hypothetical fuel-shifting scenario is considered. This scenario conservatively shifts all fuel rods to the top of each assembly. The fuel within these rods is assumed to shift into half the height of the plenum, and each assembly is shifted up until it is in contact with the lid. The conservatively toleranced basket is assumed to remain in contact with the canister floor. The MONK8a criticality analysis sequence of the ANSWERS software code evaluated the change in reactivity of the system as a result of this scenario to a statistical uncertainty of 0.0004.

As a result of this shifting scenario, some of the active fuel protrudes beyond the top of the BORAL. The Connecticut Yankee fuel assembly dimensions that are used to determine this height are presented in Table 6.2-4. The height of active fuel that protrudes beyond the top of the BORAL sheets is calculated by taking the maximum possible height from the canister lid to the top of the BORAL and subtracting the minimum distance from the top of the assembly to the top of the active fuel.

Top End Impact Evaluation

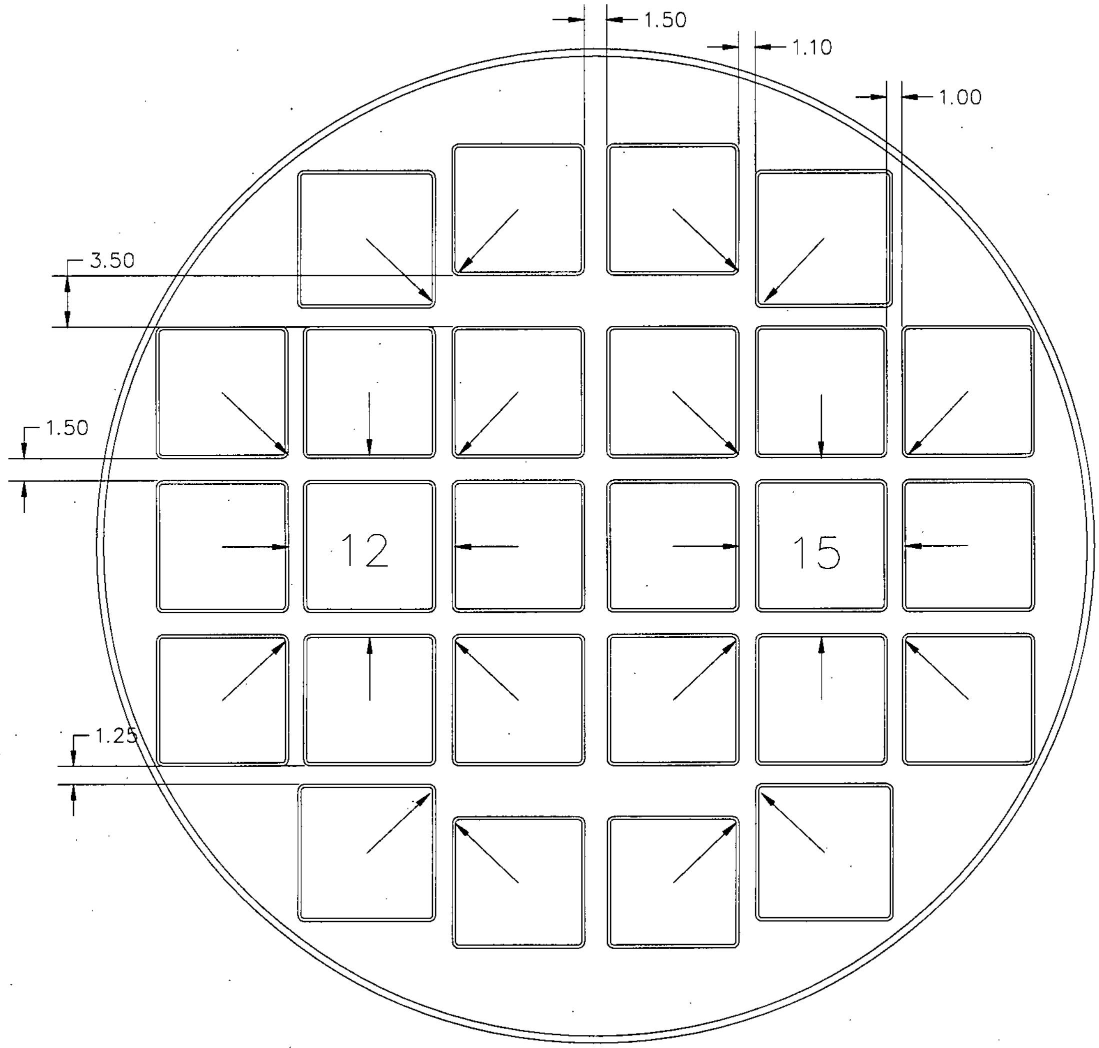
Analysis of the hypothetical top end impact accident condition is performed using the most reactive 24-assembly basket configuration. Structural evaluations show that in the transport cask hypothetical top end impact event, PWR top nozzles do not deform. Therefore, the hypothetical shifting condition of a CY assembly with the axial dimensions presented in Table 6.2-4 results in 1.905 inches of active fuel protruding beyond the top of the BORAL. To provide extra margin, this analysis conservatively considers 4 inches active fuel protruding beyond the top of the BORAL by reducing the BORAL sheet length by 2.095 inches. This condition establishes a transport cask top end impact system reactivity (k_{eff}) of 0.9327 upon exposing 4 inches of active fuel above the BORAL, as shown in Figure 6.4.4-10.

Bottom End Impact Evaluation

The maximum distance from the canister floor to the bottom of the BORAL occurs when the conservatively toleranced basket components are shifted up towards the canister lid. For the CY-MPC, this distance is limited to 5.41 inches. All Connecticut Yankee fuel types to be loaded have rod end caps, tie plates and/or bottom nozzle components that do not deform to a total height of less than 1.41 inches. Therefore, the top end impact event, which exposes 4 inches of PWR fuel, bounds the bottom end impact condition.

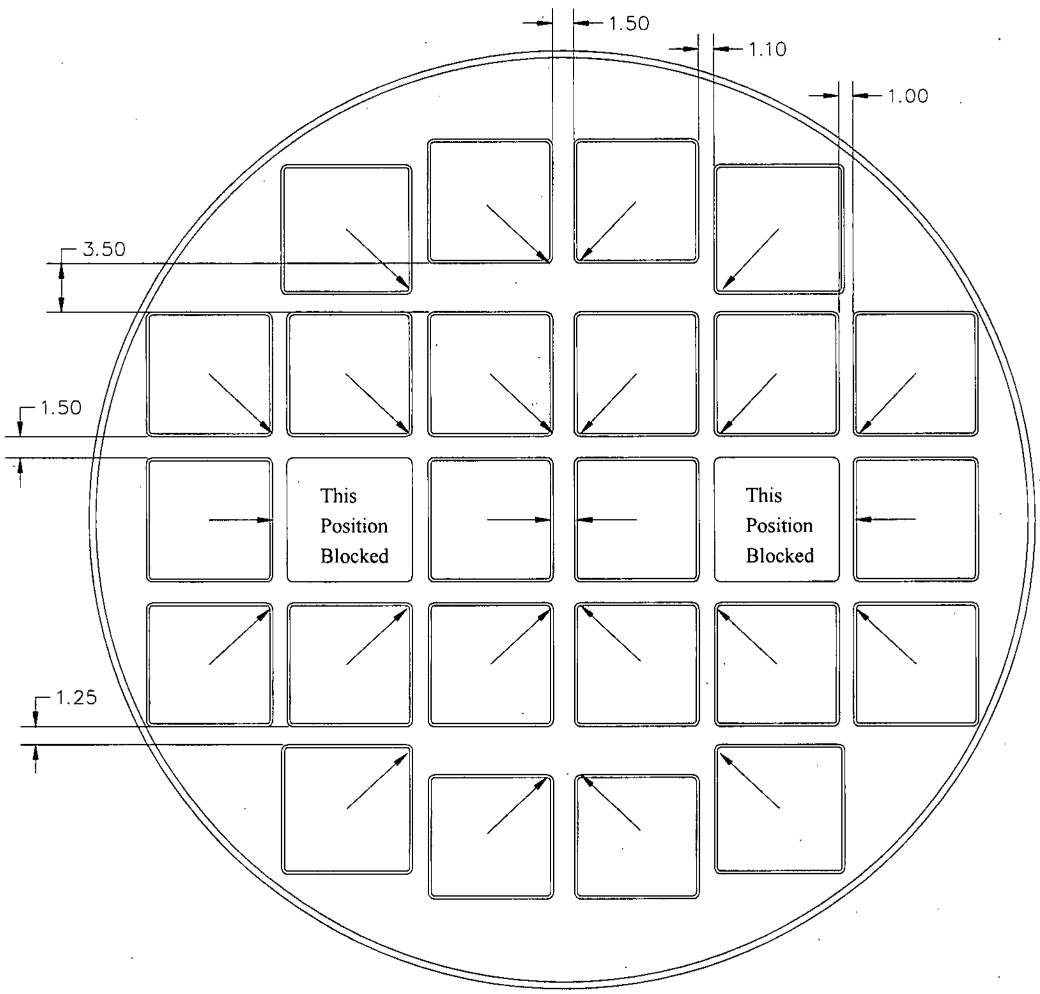
Given that the bounding end impact event does not significantly affect the reactivity of the system, poison sheet coverage is adequate for all allowed contents of the CY-MPC system. The maximum system reactivity, including statistical uncertainties, optimum moderation, mechanical perturbations, tolerances, shifting, and the hypothetical accident conditions is 0.9329. The MONK8a output for this case is shown in Figure 6.7-9. Including statistical uncertainties, all results for the hypothetical accident conditions of transport are well below the 0.9425 upper subcritical limit. Thus, compliance with 10 CFR 71.55 (e) is demonstrated.

Figure 6.4.4-1 CY-MPC Maximum Reactivity Shifting Pattern – 26-Assembly Basket



(Units = inches, Not drawn to scale)

Figure 6.4.4-2 CY-MPC Maximum Reactivity Shifting Pattern – 24-Assembly Basket



(Units = inches, Not drawn to scale)

Figure 6.4.4-3 CY-MPC Most Reactive Missing Fuel Rod Geometry

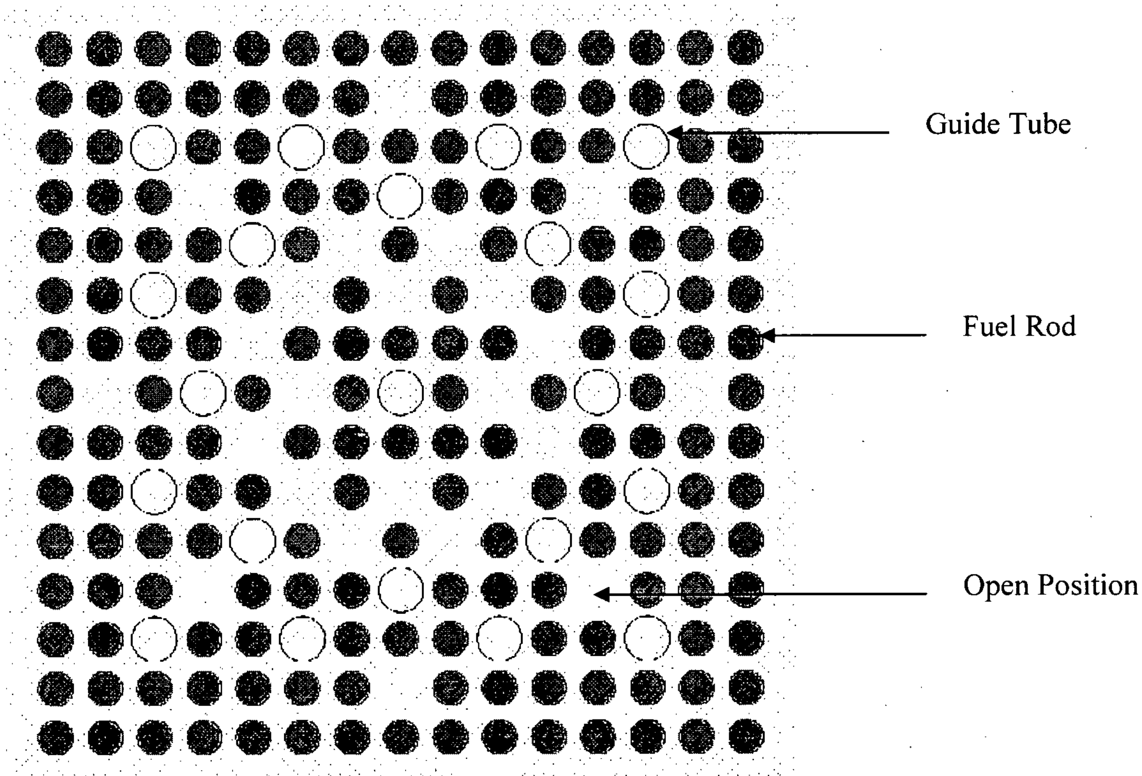


Figure 6.4.4-4 Shifted CY Damaged Fuel Can and Most Reactive Missing Rod Array

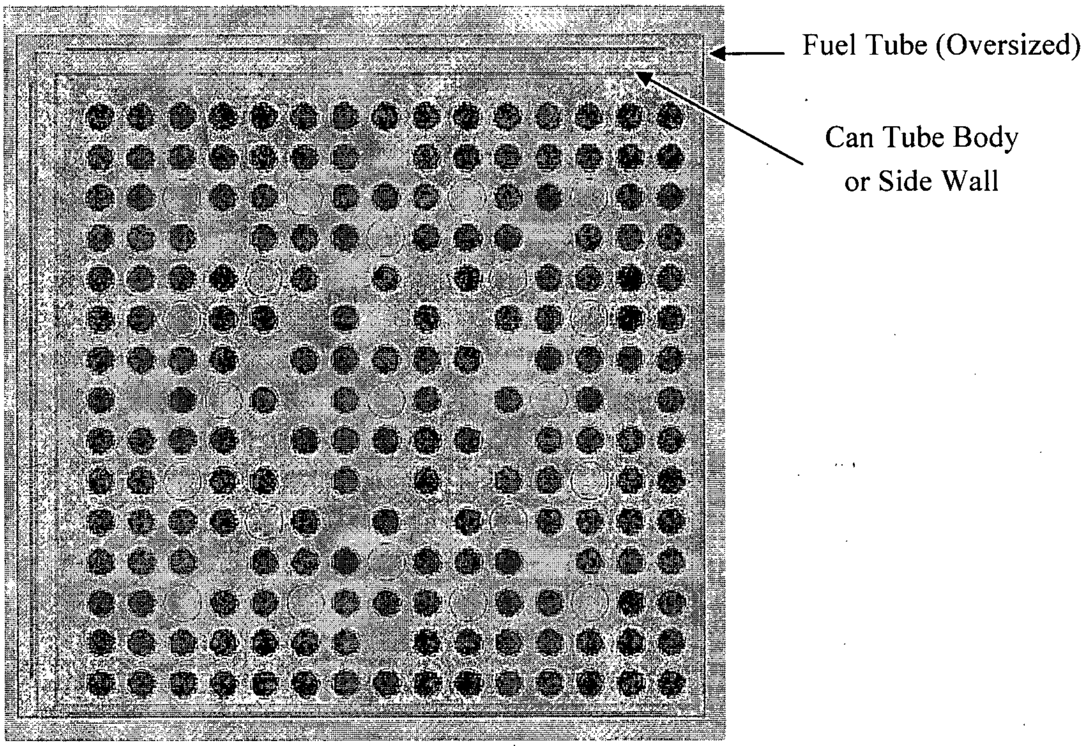


Figure 6.4.4-5 CY-MPC Model Geometry Below Active Fuel

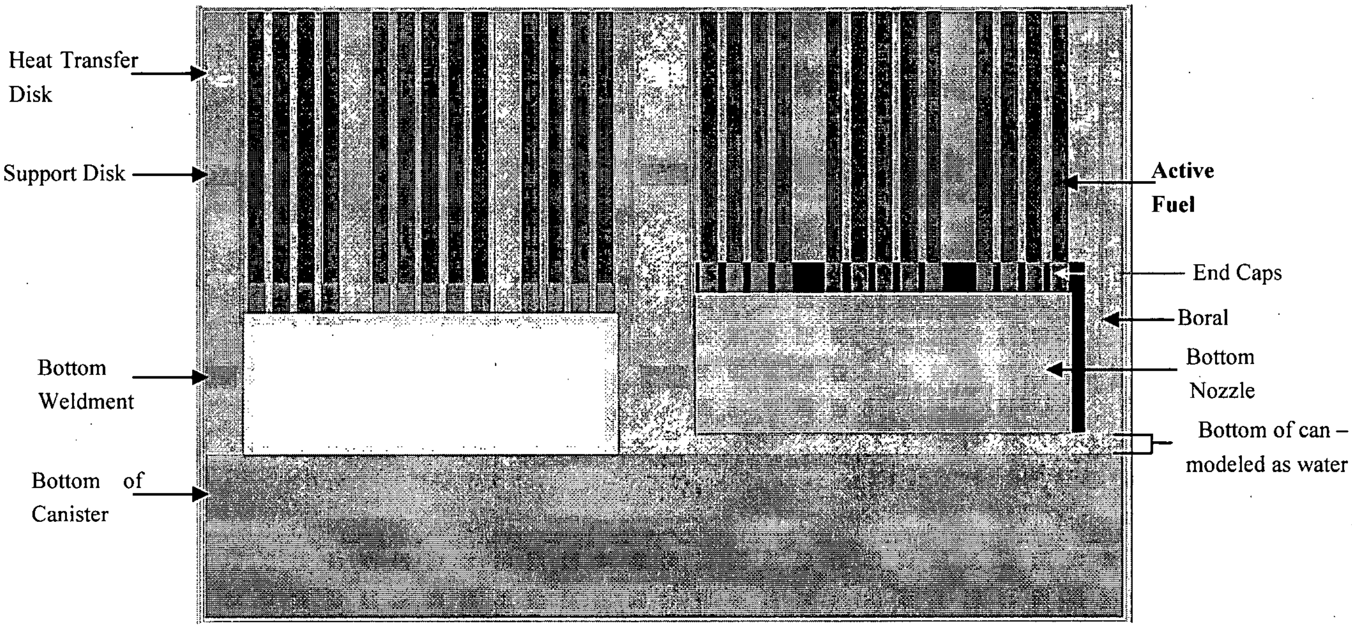


Figure 6.4.4-6 CY-MPC Model Geometry Above Active Fuel

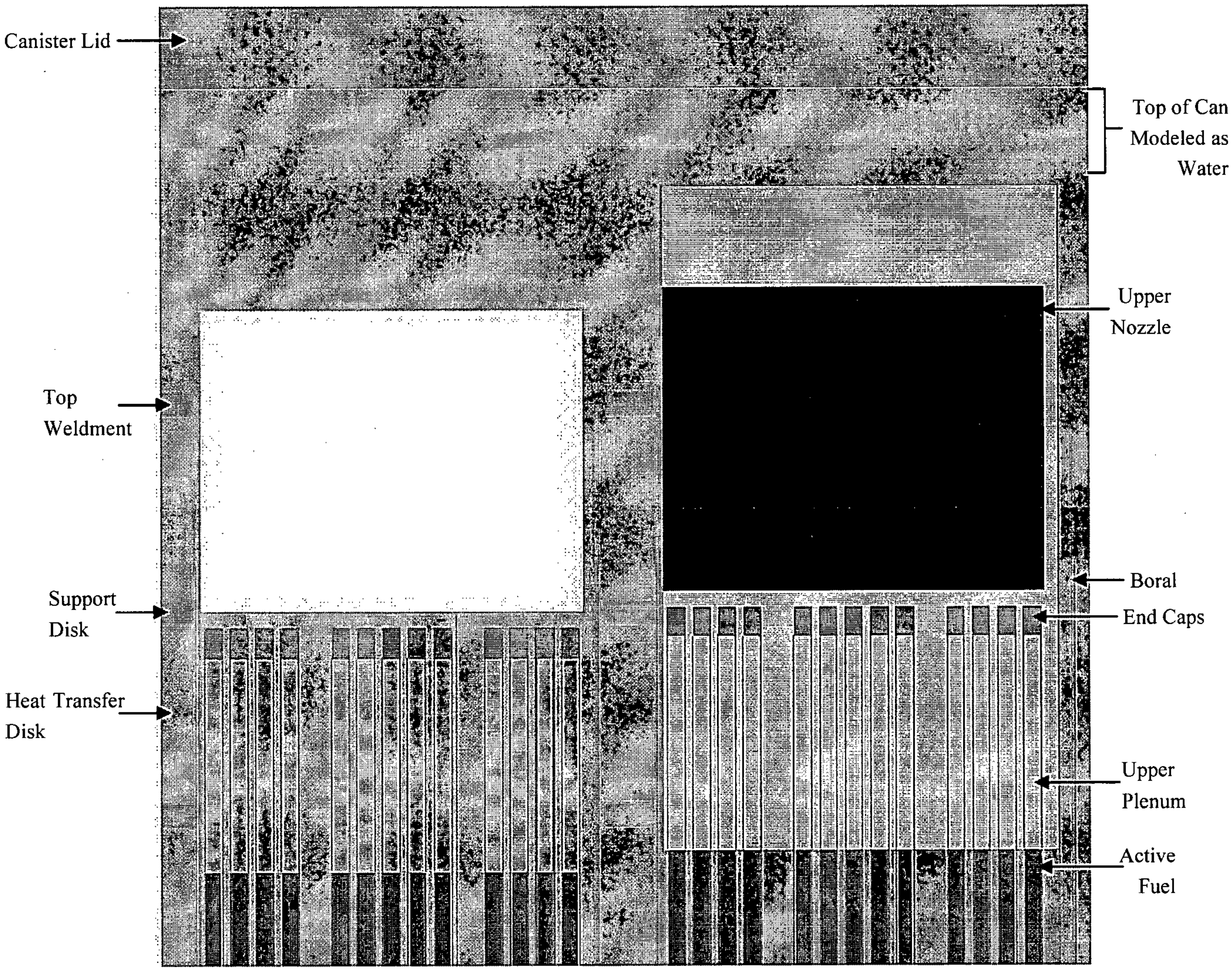


Figure 6.4.4-7 CY-MPC Model Slice of Two Corner Tubes with Damaged Fuel Cans and Two Middle Tubes

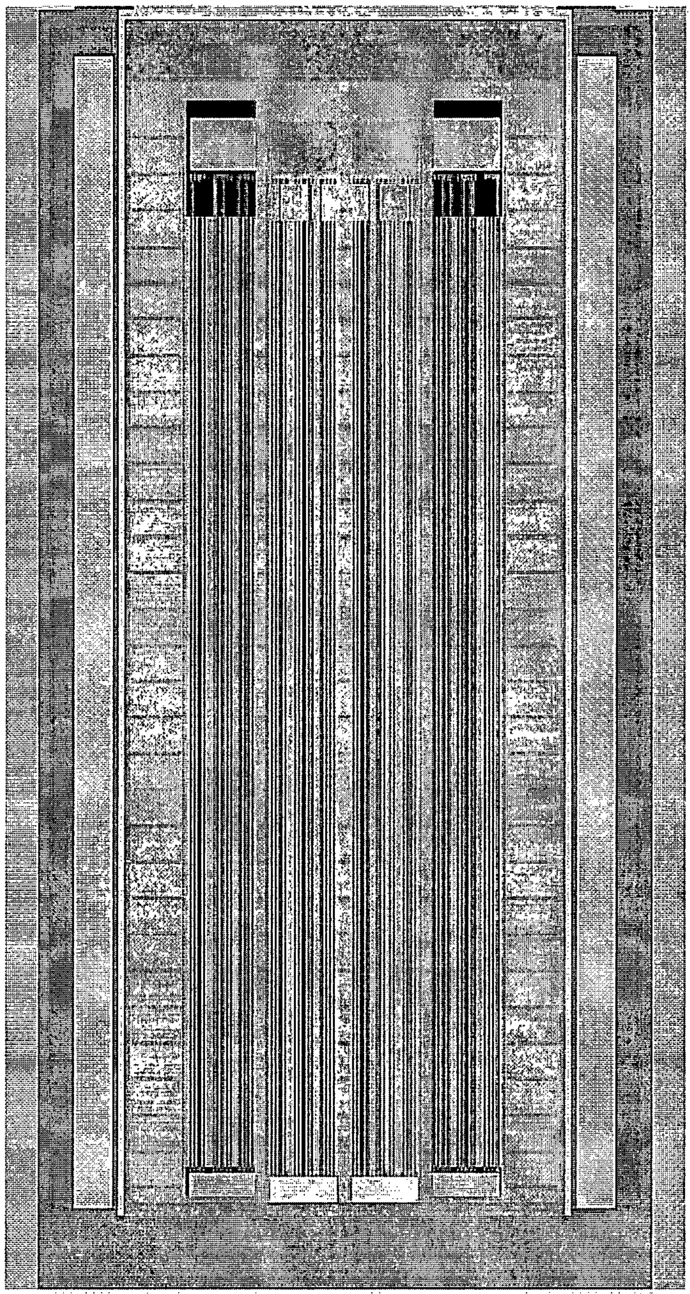


Figure 6.4.4-8 CY Reconfigured Fuel Assembly - Axial Model Configuration with Fuel in Drain Reservoir

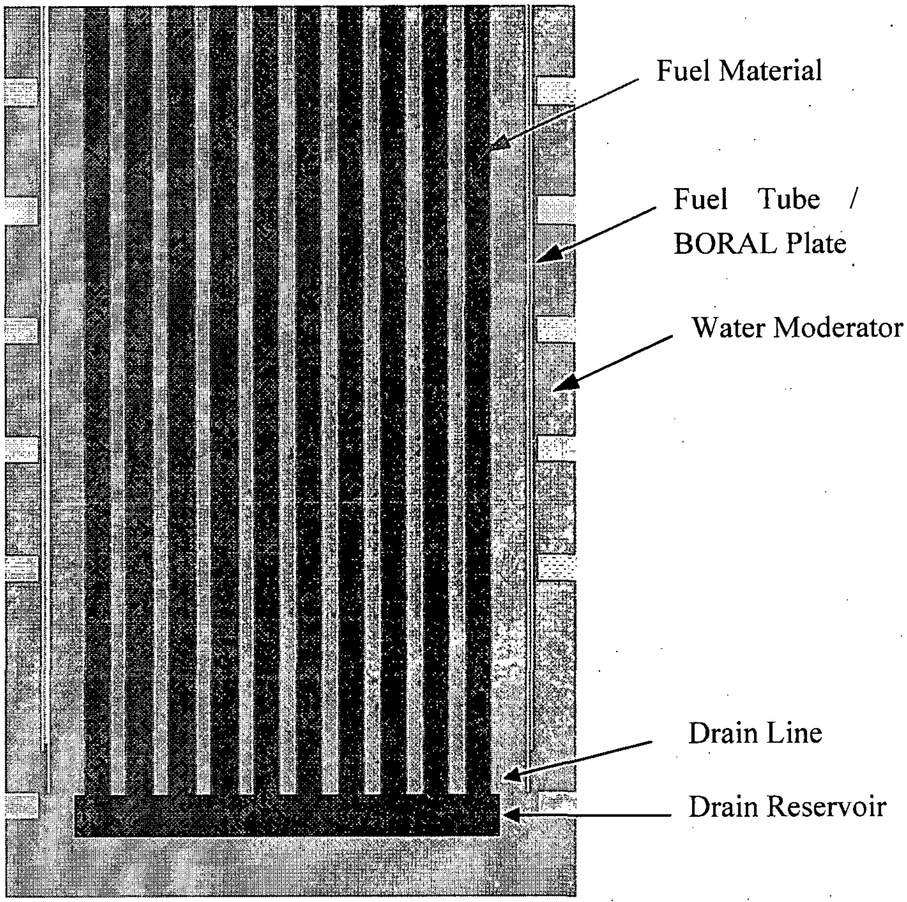


Figure 6.4.4-9 CY-MPC Partial Flooding Model – Top of Active Fuel Region

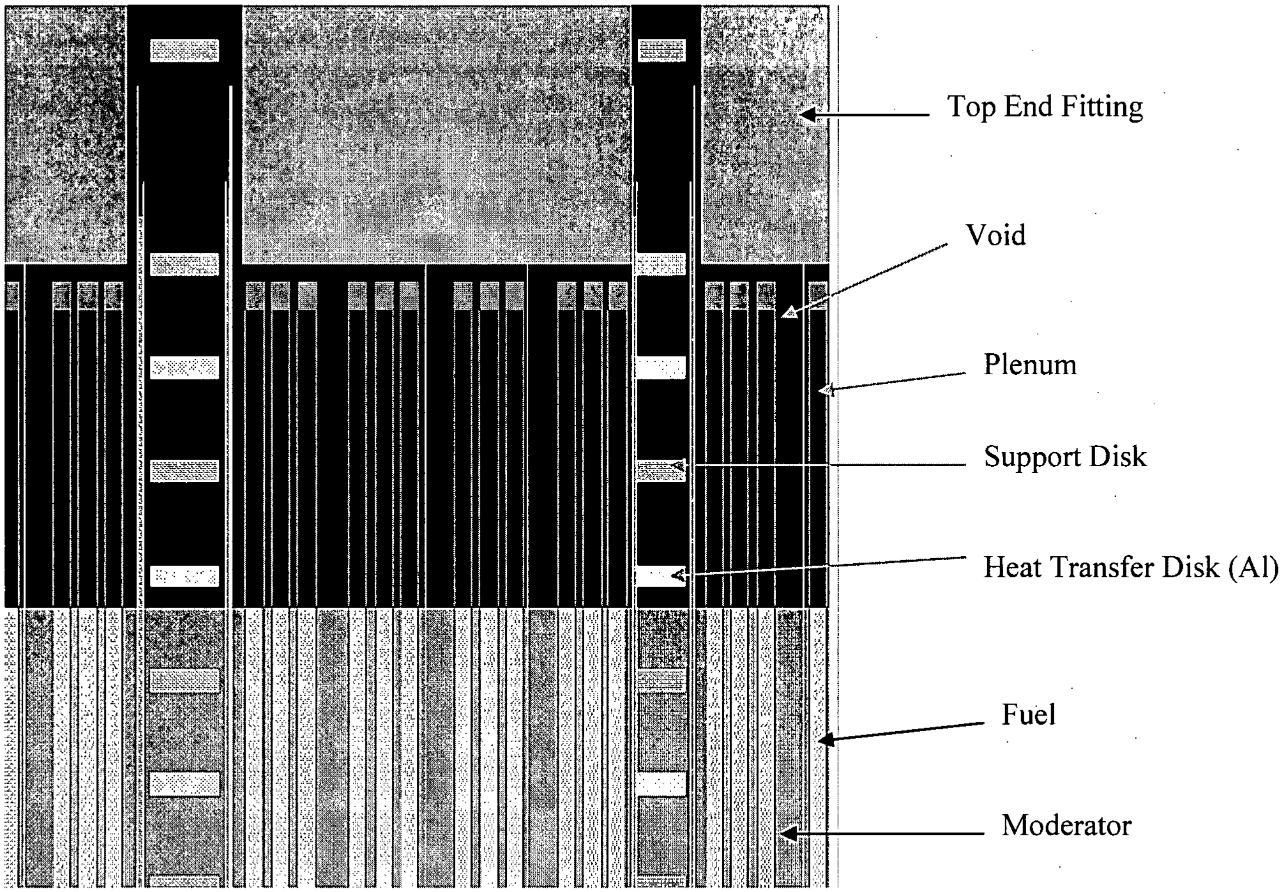


Figure 6.4.4-10 CY-MPC Top Impact Model – Top of the Shifted Active Fuel Region

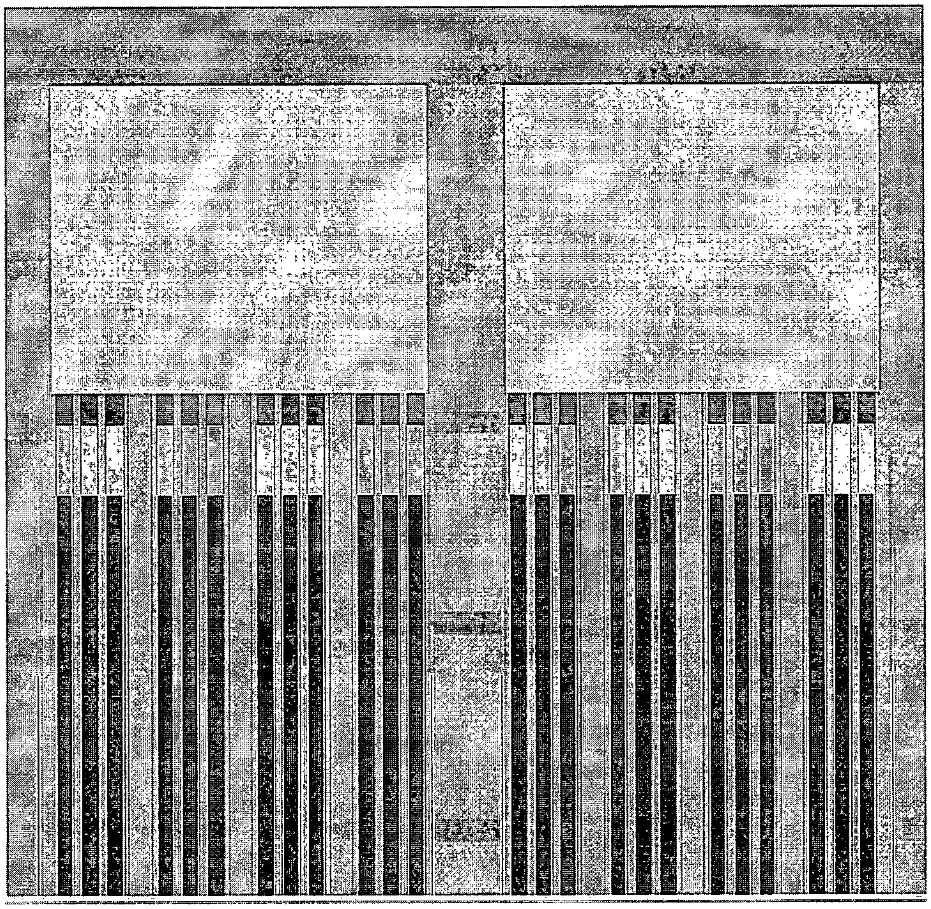


Table 6.4.4-1 Connecticut Yankee Most Reactive Fuel Assembly Evaluation

	Enrichment (wt % ^{235}U)	**k_{eff} - Flooded Gap**		
		Min Pellet OD	**Mid Pellet OD**	**Max Pellet OD**
Stainless Steel	4.03	0.8898	0.8903	0.8904
Zircaloy	3.42	0.8840	0.8834	0.8824
Zircaloy	3.93	0.9073	0.9077	0.9064
Zircaloy	4.61	0.9454	0.9445	0.9460

Table 6.4.4-2 CY-MPC Fabrication Tolerance Evaluation

Model	**k_{eff}**	**Δ k_{eff}**
Base Case	0.9460	n/a
BORAL sheet minus tolerances	0.9479	0.0019
Disk opening center minus tolerance	0.9456	-0.0004
Disk opening center plus tolerance	0.9454	-0.0006
Disk opening minus tolerance	0.9457	-0.0003
Disk opening plus tolerance	0.9434	-0.0026
Tube opening minus tolerance	0.9413	-0.0047
Tube opening plus tolerance	0.9500	0.0040
Combined BORAL sheet and tube opening tolerances	0.9494	0.0034

Note: The Base Case is 26 Zircaloy clad fuel assemblies with 4.61 wt % ^{235}U, maximum pellet diameter, centered in the tube openings.

Table 6.4.4-3 CY-MPC Mechanical Perturbation Evaluation – 26-Assembly Basket

Configuration	k_{eff}	Δk_{eff}
Base Case – No shift	0.9064	NA
Toward Openings 12 and 15	0.9153	0.0089
Toward Openings 13 and 14	0.9136	0.0072
9, 10, 15, 16 towards each other; 11, 12, 17, 18 towards each other; remaining openings towards 13 and 14	0.9129	0.0065
6, 12, 18 towards 11; 9, 15, 21 towards 16; remaining openings towards 13 and 14	0.9120	0.0056
2, 6, 12, 18, 24 towards 11; 3, 9, 15, 21, 25 towards 16; remaining openings towards 13 and 14	0.9119	0.0055
4 peripheral clusters targeting 1.1 inch gaps center row also targeting 1.1 inch gaps	0.9096	0.0032
6 peripheral clusters targeting 1.0 inch gaps; remaining openings (which are adjacent to 1.5 inch gap) towards 13 and 14	0.9089	0.0025
4 peripheral clusters targeting 1.1 inch gaps 3 clusters in center row	0.9081	0.0011

Notes:

1. Fuel position numbers are as shown in Figure 6.3-3.
2. The Base Case is 26 Zircaloy clad fuel assemblies with 3.93 wt % ^{235}U, maximum pellet diameter, maximum disk opening size, with the fuel tubes and disk openings shifted as specified.

Table 6.4.4-4 CY-MPC Mechanical Perturbation Evaluation – 24-Assembly Basket

Configuration	k_{eff}	Δk_{eff}
Base case - No shift	0.9197	NA
Toward Openings 13 and 14	0.9275	0.0078
4 peripheral clusters targeting 1.1 inch gaps; remaining openings towards 13 and 14	0.9261	0.0064
4 peripheral clusters targeting 1.1 inch gaps; remaining openings towards 1.5 inch gap	0.9260	0.0063
4 peripheral clusters targeting 1.0 inch gaps; remaining openings towards 13 and 14	0.9257	0.0060
Openings surrounding 12 or 15 towards 12 or 15, respectively; remaining openings towards 13 and 14	0.9226	0.0029
Openings surrounding 12 or 15 towards 12 or 15, respectively, remaining openings in 4 clusters targeting 1.1 inch gaps	0.9219	0.0022

Note:

1. Fuel position numbers are as shown in Figure 6.3-3.
2. The Base Case is 24 Zircaloy clad fuel assemblies with 4.61 wt % ^{235}U, maximum pellet diameter, maximum disk opening size, with the fuel tubes and disk openings shifted as specified.

Table 6.4.4-5 CY-MPC Missing Fuel Rod Evaluation Results

Number of Missing Rods	k_{eff}	Δk_{eff}
0	0.9313	NA
4	0.9396	0.0083
8	0.9376	0.0063
12	0.9401	0.0088
16	0.9413	0.0100
20	0.9441	0.0128
24	0.9464	0.0151
28	0.9444	0.0131
32	0.9439	0.0126
36	0.9463	0.0150
40	0.9453	0.0140
44	0.9399	0.0086
48	0.9396	0.0083
56	0.9384	0.0071

Note: The 0 missing rods case is 24 Zircaloy clad fuel assemblies with 4.61 wt % ^{235}U, maximum tube opening, minimum BORAL width, maximum disk opening size, with the fuel, tubes and disk openings shifted towards openings 13 and 14.

Table 6.4.4-6 Mixture of Damaged Fuel and Water within the Active Fuel Region of Intact Rods in Each Can

V_f of UO_2	k_{eff}	Δk_{eff}
0.00	0.9330	NA
0.20	0.9300	-0.0030
0.40	0.9276	-0.0054
0.60	0.9257	-0.0073
0.80	0.9284	-0.0046
1.00	0.9263	-0.0067

Table 6.4.4-7 Mixture of Damaged Fuel and Water outside the Active Fuel Region of Intact Rods in Each Can

V_f of UO_2	k_{eff}	Δk_{eff}
0.00	0.9330	NA*
0.20	0.9337	0.0007
0.40	0.9333	0.0003
0.60	0.9320	-0.0010
0.80	0.9310	-0.0020
1.00	0.9328	-0.0002

* Base Case with 0.00 UO_2 in water between rods from Table 6.4.4-6.

Table 6.4.4-8 Mixture of Damaged Fuel and Water Replacing Contents of Each Can

V_f of UO_2	k_{eff}	Δk_{eff}
NA*	0.9330	NA
0.00	0.9258	-0.0072
0.20	0.9336	0.0006
0.40	0.9281	-0.0049
0.60	0.9288	-0.0042
0.80	0.9268	-0.0062
1.00	0.9266	-0.0064

* Base case with 0.00 UO_2 in water between rods from Table 6.4.4-6.

Table 6.4.4-9 CY Reconfigured Fuel Assembly – Reactivity as a Function of Fuel Pellet Diameter

Fuel Diameter (cm)	k_{eff}
1.2814	0.9057
1.270	0.9059
1.250	0.9045
1.245	0.9049
1.240	0.9019
1.235	0.9023
1.230	0.9036
1.225	0.9009
1.200	0.8994
1.100	0.8812
1.000	0.8569

Table 6.4.4-10 CY Reconfigured Fuel Assembly – Reactivity as a Function of Moderator Density Variation

Moderator Density (g/cc)	k_{eff}
0.9982	0.9057
0.975	0.8990
0.95	0.8949
0.90	0.8800
0.85	0.8699
0.80	0.8587
0.60	0.8022
0.40	0.7245
0.20	0.5979
0.000001 (dry cask)	0.3756

Table 6.4.4-11 CY Reconfigured Fuel Assembly – Reactivity as a Function of Variations in Fuel/Water Homogeneous Mixture Volume Fraction

Water Volume Fraction	k_{eff}
0.00	0.9057
0.05	0.9032
0.06	0.9047
0.07	0.9059
0.08	0.9020
0.09	0.9020
0.10	0.9032
0.15	0.8986
0.20	0.8962
0.25	0.8931
0.30	0.8873
0.35	0.8831
0.40	0.8695
0.45	0.8618
0.50	0.8466
0.55	0.8305
0.60	0.8119
0.65	0.7846
0.70	0.7513
0.75	0.7095

Table 6.4.4-12 CY-MPC Transfer Cask Analyses – Reactivity as a Function of Moderator Density Variations

Water Density	26-Assembly Basket Configuration	24-Assembly Basket Configuration
(g/cc)	k_{eff}	k_{eff}
0.9982	0.9219	0.9313
0.95	0.9067	0.9173
0.90	0.8930	0.9006
0.85	0.8769	0.8818
0.80	0.8595	0.8622
0.60	0.7818	0.7767
0.40	0.6832	0.6729
0.20	0.5520	0.5500
0.000001 ~ 0.0	0.3555	0.3715

Table 6.4.4-13 CY Damaged Fuel Can Analyses – Reactivity as a Function of Moderator Density Variation

Moderator Density			
Canister	Can	k_{eff}	Δk_{eff}
1.00	1.00	0.9313	NA
1.00	0.00	0.9253	-0.0060
1.00	0.20	0.9263	-0.0050
1.00	0.40	0.9271	-0.0042
1.00	0.60	0.9264	-0.0049
1.00	0.80	0.9282	-0.0031
0.00	1.00	0.9149	-0.0164
0.20	1.00	0.8744	-0.0569
0.40	1.00	0.8692	-0.0621
0.60	1.00	0.8765	-0.0548
0.80	1.00	0.8892	-0.0421

6.5 Critical Benchmark Experiments

This section provides the validation of the computer codes used in the criticality evaluation of the NAC-STC directly loaded and the Yankee-MPC and CY-MPC canistered fuel systems. This validation is required by the criticality safety standard ANSI/ANS-8.1 [10].

Section 6.5.1 describes the methodology, computer program and cross section libraries used, the experimental data, the areas of applicability and the bias and margins of safety applied in the SCALE 4.3 analysis package used in the evaluation of the NAC-STC directly loaded and Yankee-MPC canistered fuel configurations. Section 6.5.2 describes the MONK8a code applied in the analysis of the CY-MPC canistered fuel configuration.

ANSI/ANS-8.17 prescribes the criteria to establish subcritical safety margins. This criteria is:

$$k_s \leq k_c - \Delta k_s - \Delta k_c - \Delta k_m \quad (1)$$

where,

k_s = the calculated allowable maximum multiplication factor, k_{eff}, of the system being evaluated for all normal or credible abnormal conditions or events.

k_c = the mean k_{eff} that results from the calculation of the benchmark criticality experiments using a particular calculational method. If the calculated k_{eff} for the criticality experiments exhibit a trend with a parameter, then k_c shall be determined by extrapolation on the basis of a best fit to the calculated values. The criticality experiments used as benchmarks in computing k_c should have physical compositions, configurations, and nuclear characteristics (including reflectors) similar to those of the system being evaluated.

Δk_s = an allowance for

(a) statistical or convergence uncertainties, or both, in the computation of k_s,
(b) material and fabrication tolerances, and
(c) geometric or material representations used in the computational method.

Δk_c = a margin for uncertainty in k_c which includes allowance for

(a) uncertainties in the critical experiments,

(b) statistical or convergence uncertainties, or both, in the computation of k_c,

(c) uncertainties due to extrapolation of k_c outside the range of experimental data, and

(d) uncertainties due to limitations in the geometrical or material representations used in the computational method.

Δk_m = an arbitrary margin to ensure the subcriticality of k_s

The various uncertainties are combined statistically if they are independent. Correlated uncertainties are combined additively. The above equation (1) can be rewritten as:

$$k_s \leq 1 - \Delta k_m - \Delta k_s - (1-k_c) - \Delta k_c \qquad (2)$$

Noting that the NRC requires a 5% subcriticality margin ($\Delta k_m = 0.05$) and the definition of the bias ($\beta = 1-k_c$), this equation can then be written as:

$$k_s \leq 0.95 - \Delta k_s - \beta - \Delta\beta \qquad (3)$$

where $\Delta\beta = \Delta k_c$. Thus, k_s (the maximum allowable value for k_{eff}) must be below 0.95 minus the bias, uncertainties in the bias and uncertainties in the system being analyzed (i.e., Monte Carlo, mechanical and modeling). This is an upper safety limit criterion often used in the DOE criticality safety community.

Alternatively, this equation can be rewritten applying the bias and uncertainties to the k_{eff} of the system being analyzed as:

$$k_s \equiv k_{eff} + \Delta k_s + \beta + \Delta\beta \leq 0.95 \qquad (4)$$

In equation 4, k_{eff} replaces k_s, and k_s has been redefined as the effective multiplication factor of the system being analyzed, including the method bias and all uncertainties. This is a maximum calculated k_{eff} criteria often used in LWR spent fuel storage and transport analyses.

β and $\Delta\beta$ are evaluated in Section 6.5.1 for the NAC-STC directly loaded and Yankee-MPC canistered fuel configurations and in Section 6.5.2 for the CY-MPC fuel configuration.

6.5.1 Benchmark Experiments and Applicability for CSAS25

The criticality safety method applied to the NAC-STC directly loaded and Yankee-MPC canistered fuel configurations is CSAS25 embedded in SCALE Version 4.3 for the PC. CSAS25 includes the SCALE Material Information Processor, BONAMI, NITAWL-II, and KENO-Va. The Material Information Processor generates number densities for standard compositions, prepares geometry data for resonance self-shielding, and creates data input files for the cross section processing codes. The BONAMI and NITAWL-II codes are used to prepare a resonance-corrected cross section library in AMPX working format. The KENO-Va code calculates the model k_{eff} using Monte Carlo techniques. The 27-group ENDF/B-IV neutron cross section library is used in this validation.

6.5.1.1 Description of Experiments

Sixty-three critical experiments were selected: nine Babcox and Wilcox 2.46 wt % ^{235}U fuel storage [11]; ten Pacific Northwest Laboratory 4.31 wt % ^{235}U lattice [12]; twenty-one PNL 2.35 and 4.31 wt % ^{235}U with metal reflectors [13, 14]; twelve PNL flux trap [10, 15]; and, eleven Valduc Critical Mass Laboratory 4.74 wt % ^{235}U, some involving moderator density variations [16, 17]. These experiments span a range of fuel enrichments, fuel rod pitches, neutron absorber sheet characteristics, shielding materials and geometries that are typical of LWR fuel in a cask.

6.5.1.2 Applicability of Experiments

All of the experiments chosen in this validation are applicable to either PWR, including Yankee Class fuel, or to BWR fuel. Fuel enrichments have covered a range from 2.35 up to 4.74 wt % ^{235}U typical of the fuels presently used. The experiment fuel rod and pitch characteristics are within the range of standard PWR or BWR fuel rods (i.e., pellet diameters from 0.78 to 1.2 cm, rod diameters from 0.95 to 1.88 cm and pitches from 1.26 to 1.87 cm). This is particularly true of the Valduc Critical Mass Laboratory (PWR rod type) and Babcock and Wilcox experiments (BWR rod type). The H/U volume ratios of the experimental fuel arrays are within the range of PWR fuel assemblies (1.6 to 2.32) and BWR fuel assemblies (1.6 to 1.9).

In the case of the Yankee Class fuel, the majority of the Zircaloy clad fuel has an enrichment below 4.03 wt % ^{235}U, and the stainless steel clad fuel is 4.97 wt % ^{235}U, just outside the experimental range. However, the stainless steel clad fuel is much less reactive than the Zircaloy clad and is not limiting. Also, in the case of the Yankee Class fuel, the pellet diameter varies from 0.747 to 0.789

cm, the rod outside diameter varies from 0.864 to 0.927 cm and the pitch varies from 1.07 to 1.20 cm, and the resultant H/U volume ratio varies from 1.28 to 1.57. These fuel parameters are all slightly outside of the range of experiments, but given the lack of statistically significant trends as demonstrated in Figures 6.5.1-2 through 6.5.1-7, confidence in criticality prediction by extrapolation to the Yankee fuel parameter is still high.

Experiments covered the geometry and neutron absorber sheet arrangements typical of the NAC-STC directly loaded and Yankee-MPC canister basket designs. This included a flux trap gap spacing of 3.81 cm such as in the NAC-STC directly loaded basket, and gap spacing as low as 1.91 cm such as in the canister basket used for the Yankee Class fuel. The ^{10}B neutron absorber loadings are also typical of these basket designs (0.005 to 0.025). The experiments covered the influence of water and metal reflector regions, including steel and lead, which would be present in storage and transport cask shielding.

Confidence in predicting criticality, including bias and uncertainty, has been demonstrated for spent fuel with enrichments up to 4.74 wt % ^{235}U and, based on the lack of a significant trend with enrichment, confidence in extrapolation up to 4.97 wt % ^{235}U is high. Confidence in predicting criticality has been demonstrated for storage and transport arrays using flux trap or single neutron absorber sheet or simple spacing criticality control. Confidence in predicting criticality has been demonstrated for spent fuel storage and transport arrays next to water and metal reflector regions.

6.5.1.3 Results of Benchmark Calculations

The k-effective results for the experiments are shown in Table 6.5.1-1 and a frequency distribution plot is provided in Figure 6.5.1-1. Five sets of cases are presented: Set 1 - B&W, Set 2 - PNL lattice, Set 3 - PNL reflector, Set 4 - PNL flux trap and Set 5 - VCML critical experiments.

The overall average and standard deviation of the sixty-three cases is 0.9948±0.0044. The average Monte Carlo error (statistical convergence) is ±0.0012 for the sixty-three cases. This uncertainty component is statistically subtracted from the uncertainties, because it is previously included in the above standard deviation. The KENO-Va models are three dimensional, fully explicit representations (no homogenization) of the experimental geometry. Therefore, the uncertainty due to limitations of geometrical modeling is taken to be 0.0. The experiments modeled cover the range of fuel types, enrichments, neutron absorber configurations, neutron absorber ^{10}B loading and metal reflector effects, so there are no extrapolations necessary outside of the range of data, and the uncertainty due to this is also taken to be 0.0. Based on the reported experimental error for the B&W cases, the reported error of the critical size number of rods for the PNL cases and the reported error for the critical height in the VCML cases, the experimental error is conservatively taken to be ±0.001. Criticality can then be represented as 1.000±0.001. This uncertainty component is statistically added to the sum of the other uncertainties because the bias is the difference between two random variates (i.e., criticality and code prediction, and the uncertainty in the difference between two random variates is the statistical sum (rms) of their individual uncertainties).

Thus, the bias or average difference between code prediction and critical is β=1-0.9948 = 0.0052. The uncertainty in the bias, accounting for the statistical convergence (Monte Carlo error) and the uncertainty in criticality, is $(0.0044^2 - 0.0012^2 + 0.0010^2)^{1/2} = 0.0043$. For 63 samples of criticality, the 95/95 one side tolerance factor is 2.012 [18]. This results in a 95/95 one-sided uncertainty in the bias of $\Delta\beta$= 2.012x0.0043=0.0087. Equation 4 now becomes:

$$k_{eff} + \Delta k_s + 0.0052 + 0.0087 \leq 0.95 \qquad (5)$$

where Δk_s becomes the uncertainty in k_s due to Monte Carlo error, mechanical and material tolerances, and geometric or material representations. If the nominal representation of the system is evaluated for k_s, then the mechanical and material perturbation can be evaluated independently and can be combined statistically as the root sum of squares. If the worst case mechanical and material tolerances are used in the calculations of k_s (e.g., the most reactive positioning of fuel or basket components and 75% of the specified minimum boron loading), then Δk_s becomes 0.0 and the Monte Carlo error, σ_{mc}, can be combined statistically, since it is independent, with the uncertainty in the bias as:

$$k_{eff} + 0.0052 + \sqrt{0.0087^2 + (2\sigma)^2} \leq 0.95 \qquad (6)$$

6.5.1.4 Trends

Scatter plots of k_{eff} versus wt % ^{235}U, rod pitch, H/U volume ratio, average neutron group causing fission, ^{10}B loading for flux trap cases, and flux trap gap thickness are shown in Figures 6.5.1-2 through 6.5.1-7. Included in these scatter plots are linear regression lines with a corresponding correlation coefficient (R). This statistically indicates any trend, or lack thereof. In particular, the correlation coefficient is a measure of the linear relationship between k_{eff} and a critical experiment parameter. If R is +1, a perfect linear relationship with a positive slope is indicated, and if R is -1, a perfect linear relationship with a negative slope is indicated. When R is 0, no linear relationship is indicated.

The largest correlation coefficient indicated in the plots is +0.3608 (k_{eff} versus enrichment) and the lowest is +0.0693 (k_{eff} versus ^{10}B loading in flux trap experiments). Based on the correlation coefficients, no statistically significant trends exist over the range of variables studied. Most importantly, no significant trends are shown with either flux trap gap spacing or ^{10}B loading. This is the major criticality control feature of both the directly loaded basket and the Yankee-MPC canistered basket for Yankee Class fuel.

6.5.1.5 Comparison of NAC Method to NUREG/CR-6361

NUREG/CR-6361, "Criticality Benchmark Guide for Light-Water-Reactor Fuel in Transportation and Storage Packages," provides a guide to LWR criticality benchmark calculations and the determination of bias and subcritical limits in critical safety evaluations. In Section 2 of NUREG/CR-6361, a series of LWR critical experiments are described in sufficient detail for independent modeling. In Section 3, the critical experiments are modeled, and the results (k_{eff} values) are presented. The method utilized in the NUREG is KENO-Va with the 44 group ENDF/B-V cross section library embedded in the SCALE 4.3 code package. Inputs are provided in NUREG Appendix A. In Section 4, a guide for the determination of bias and subcritical safety limits and statistical analysis of the trending in the bias are provided based on ANSI/ANS-8.17. Finally, in Section 5, guidelines for experiment selection and applicability are presented. In this section, the approach presented in Section 4 of the NUREG is described in detail and is compared to the NAC approach presented in Sections 6.5.1, 6.5.1.1 and 6.5.1.2.

NAC has performed an extensive LWR critical benchmarking effort as documented in Sections 6.5.1.1 and 6.5.1.2. The method used in NAC benchmarking/validation included the CSAS25 (KENO-Va) criticality analysis sequence, with the 27 group ENDF/B-IV library, contained in the SCALE 4.3 package. Trending in k_{eff} was evaluated for the following independent variables: wt % ^{235}U, rod pitch, H/U volume ratio, average neutron group causing fission, ^{10}B loading for flux trap cases, and flux trap gap thickness. No statistically significant trends were found, and a constant bias with associated uncertainty was determined for criticality evaluation.

Both the NUREG/CR-6361 and the NAC approach to criticality evaluation start with ANSI/ANS-8.17 [19] criticality safety criterion:

$$k_s \leq k_c - \Delta k_s - \Delta k_c - \Delta k_m \quad (1)$$

where:

k_s = calculated allowable maximum multiplication factor, k_{eff}, of the system being evaluated for all normal or credible abnormal conditions or events.

k_c = mean k_{eff} that results from a calculation of benchmark criticality experiments using a particular calculation method. If the calculated k_{eff} values for the criticality experiments exhibit a trend with an independent parameter, then k_c shall be determined by extrapolation based on best fit to calculated values. Criticality experiments used as benchmarks in computing k_c should have physical compositions, configurations, and nuclear characteristics (including reflectors) similar to those of the system being evaluated.

Δk_s= allowance for:

a) statistical or convergence uncertainties, or both, in computation of k_s,
b) material and fabrication tolerances, and
c) geometric or material representations used in computational method.

Δk_c= margin for uncertainty in k_c which includes allowance for:

a) uncertainties in critical experiments,
b) statistical or convergence uncertainties, or both, in computation of k_c,
c) uncertainties resulting from extrapolation of k_c outside range of experimental data, and
d) uncertainties resulting from limitations in geometrical or material representations used in computational method.

Δk_m= arbitrary administrative margin to ensure subcriticality of k_s.

The various uncertainties are combined statistically if they are independent. Correlated uncertainties are combined by addition.

Equation 1 can be rewritten as:

$$k_s \leq 1 - \Delta k_m - \Delta k_s - (1-k_c) - \Delta k_c \quad (2)$$

Noting that the definition of the bias is $\beta = 1-k_c$, Equation 2 can be written as:

$$k_s + \Delta k_s \leq 1-\Delta k_m - \beta - \Delta\beta \quad (3)$$

where $\Delta\beta = \Delta k_c$. Thus, the maximum allowable value for k_{eff} plus uncertainties in the system being analyzed must be below 1 minus an administrative margin (typically 0.05), the bias and the uncertainty in the bias. This can also be written as:

$$k_s + \Delta k_s \leq USL \quad (4)$$

where,

$$USL \equiv 1 - \Delta k_m - \beta - \Delta\beta \quad (5)$$

This is the Upper Safety Limit criterion as described in Section 4 of NUREG/CR-6361. Two methods are prescribed for the statistical determination of the USL: Confidence Band with Administrative Margin (USL-1) and Single Sided Uniform with Close Approach (USL-2). In the first method, $\Delta k_m = 0.05$ and a lower confidence band (usually 95%) is specified based on a linear regression of k_{eff} as a function of some system parameter. In the second method, the arbitrary administrative margin is set to zero and a uniform lower tolerance band is determined based on a linear regression. Thus, the second method provides a criticality safety margin that is generally less than 0.05. In cases where there are a limited number of data points, this method may indicate the need for a larger administrative margin. In both cases, all the significant system parameters need to be studied to determine the strongest correlation.

In the Section 6.5.1.1 and 6.5.1.2 analyses, the bias and uncertainties are applied directly to the estimate of the system k_{eff}. Noting that the NRC requires a 5% subcriticality margin (Δk_m = 0.05), Equation 3 can be rewritten applying the bias and uncertainty in the bias to the k_{eff} of the system being analyzed as:

$$k_s + \Delta k_s + \beta + \Delta\beta \leq 0.95 \quad (6)$$

In Equation 6, the method bias and all uncertainties are added to k_s. This is the maximum k_{eff} criterion defined in Section 6.5.1.2.

To this point, both the USL criterion and maximum k_{eff} criterion are equivalent. The effects of trending in the bias or the uncertainty in the bias can be directly incorporated into either equation 5 or equation 6. Trending is established by performing a regression analysis of k_{eff} as a function of the principle system variables such as: enrichment, rod pitch, H to U ratio, average group of fission, ^{10}B absorber loading and flux trap gap spacing. Usually, simple linear regression is performed, and the line with the greatest correlation is used to functionalize β. This is the approach recommended in NUREG/CR-6361. However, if no strong correlation can be determined, then a constant bias adjustment can be made. This is typically done with a one-side tolerance factor that guarantees 95% confidence in the uncertainty in the bias. This is the approach taken in the criticality analysis for the NAC-STC directly loaded and Yankee-MPC canistered fuel configurations.

Both NUREG/CR-6361 and the NAC methodology performed regression analysis on key system parameters. For all the major system parameters, the NAC methodology found no strong correlation. This is based on the observation that the correlation coefficients are all much less than ± 1. Thus, a constant bias with a 95/95 confidence factor is applied to the system k_{eff}. The NAC methodology's statistical analysis of the k_{eff} results produced a bias of 0.0052 and a 95/95 uncertainty of 0.0087. Adding the two together and subtracting from 0.95, yields an effective constant USL of 0.9361.

To assure compliance with NUREG/CR-6361, an upper safety limit is generated using USLSTATS and is compared to the constant NAC methodology bias and bias uncertainty used in Section 6.5.1.2.

To evaluate the relative importance of the trend analysis to the upper safety limits, correlation coefficients are required for all independent parameters. Table 6.5.1.2 contains the correlation coefficients, R, for each linear fit of k_{eff} versus experimental parameter (data is extracted from Figure 6.5.1.2 through Figure 6.5.1.7 by taking the square root of the listed R^2 value). Based on the highest correlation coefficient and the method presented in NUREG/CR-6361, a USL will be established based on the variation of k_{eff} with enrichment. Note that even the enrichment function shows a low statistical correlation coefficient (an $|R|$ equal or near 1 would indicate a good fit). The output generated by USLSTATS is shown in Figure 6.5.1.8.

The NAC methodology applied USL of 0.9361 bounds the calculated upper safety limits for all enrichment values above 3 wt % ^{235}U. Since the maximum reactivities in the NAC-STC cask systems are calculated at enrichments well above this level, the existing bias bounds the NUREG calculated USL. The parameters of the most reactive fuel element analysis are listed in Table 6.5.1-3.

Figure 6.5.1-1 KENO-Va Validation - 27 Group Library Results Frequency Distribution of K_{eff} Values

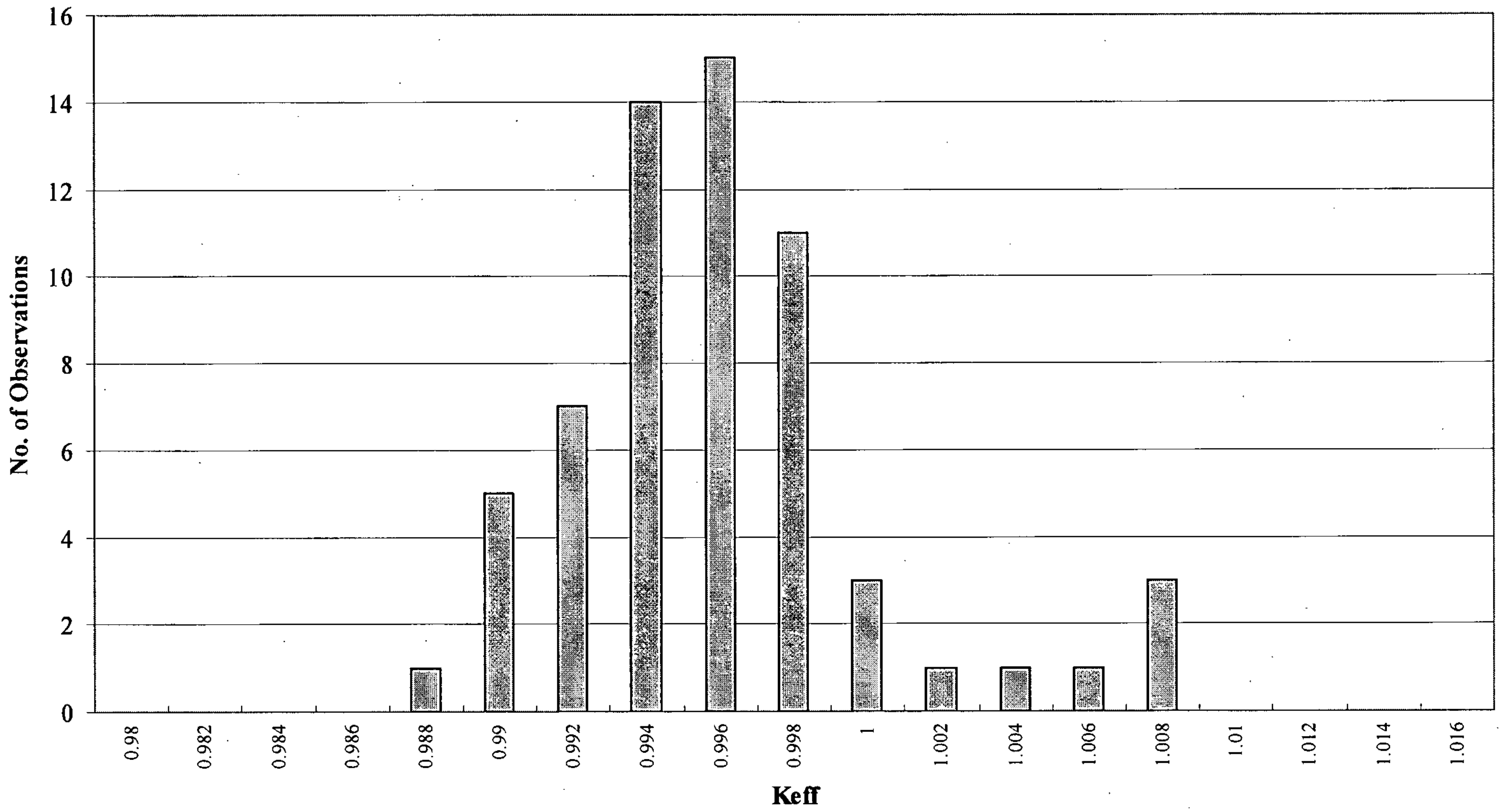


Figure 6.5.1-2 KENO-Va Validation -27 Group Library K_{eff} versus Enrichment

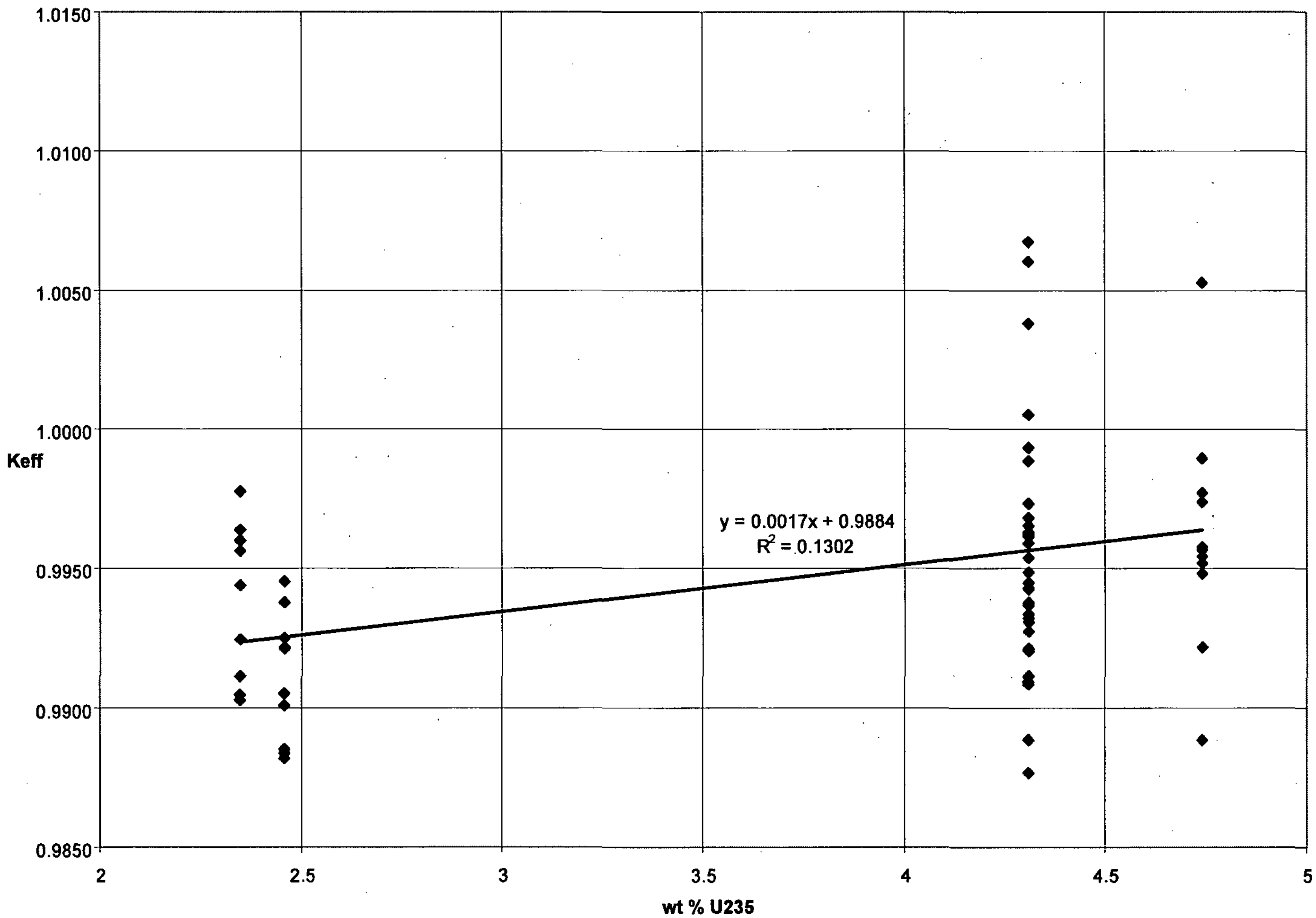


Figure 6.5.1-3 KENO-Va Validation - 27 Group Library K_{eff} versus Rod Pitch

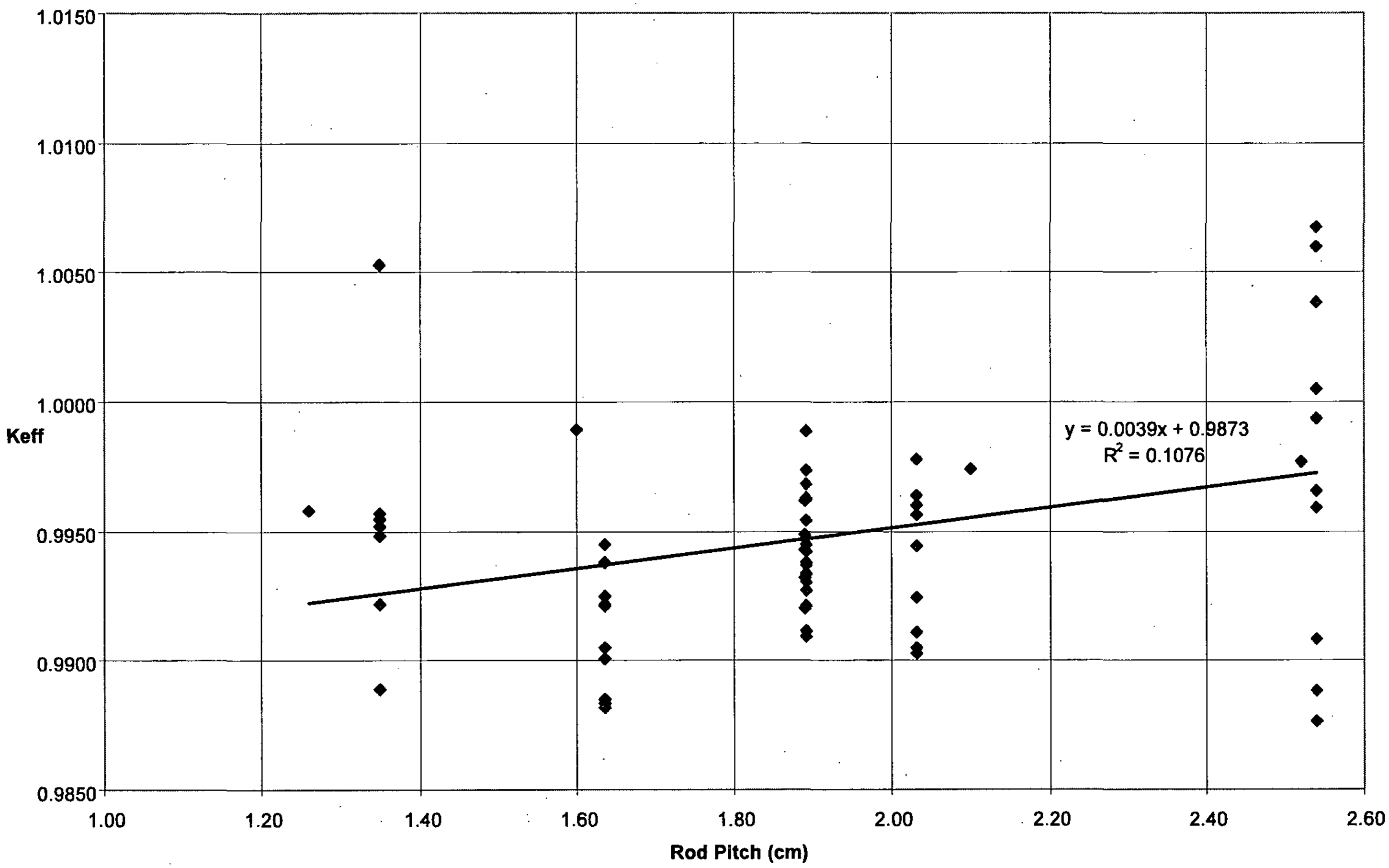


Figure 6.5.1-4 KENO-Va Validation -27 Group Library K_{eff} versus H/U Volume Ratio

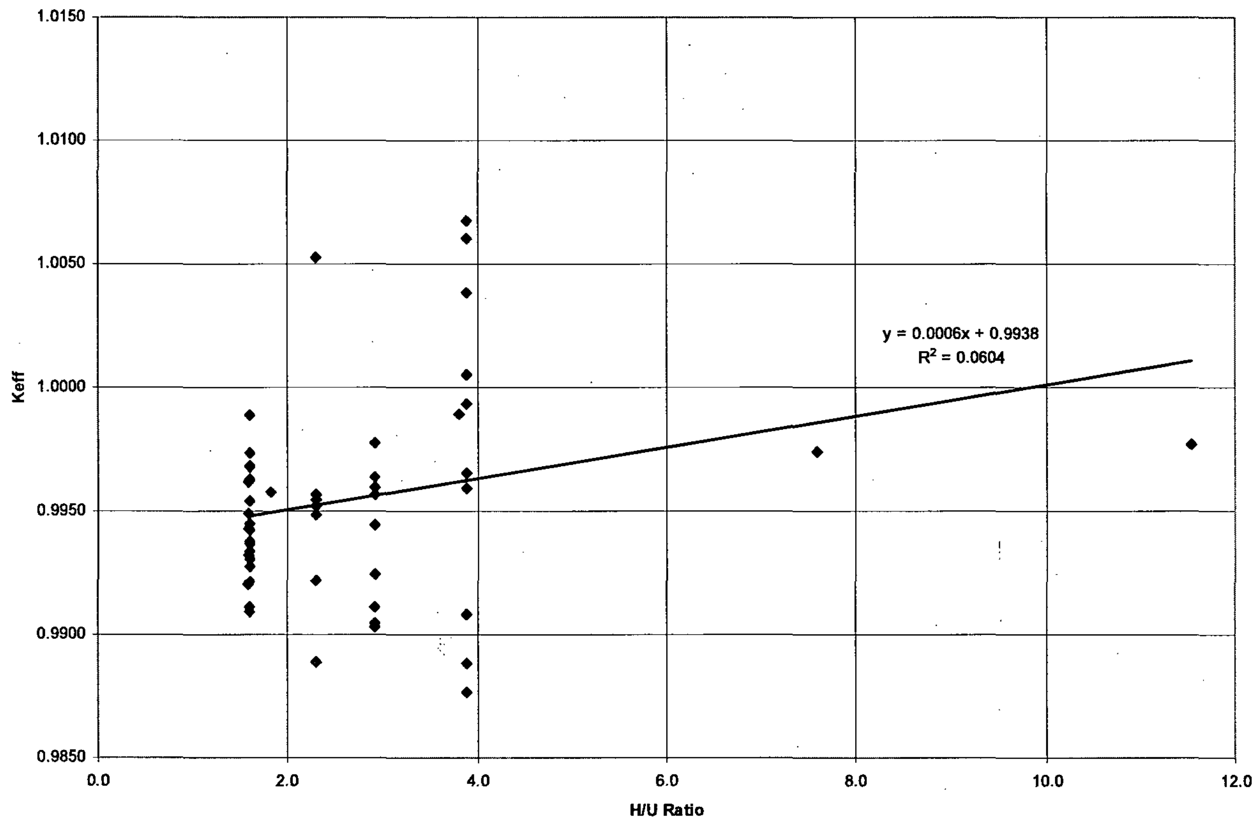


Figure 6.5.1-5 KENO-Va Validation -27 Group Library K_{eff} versus Average Group of Fission

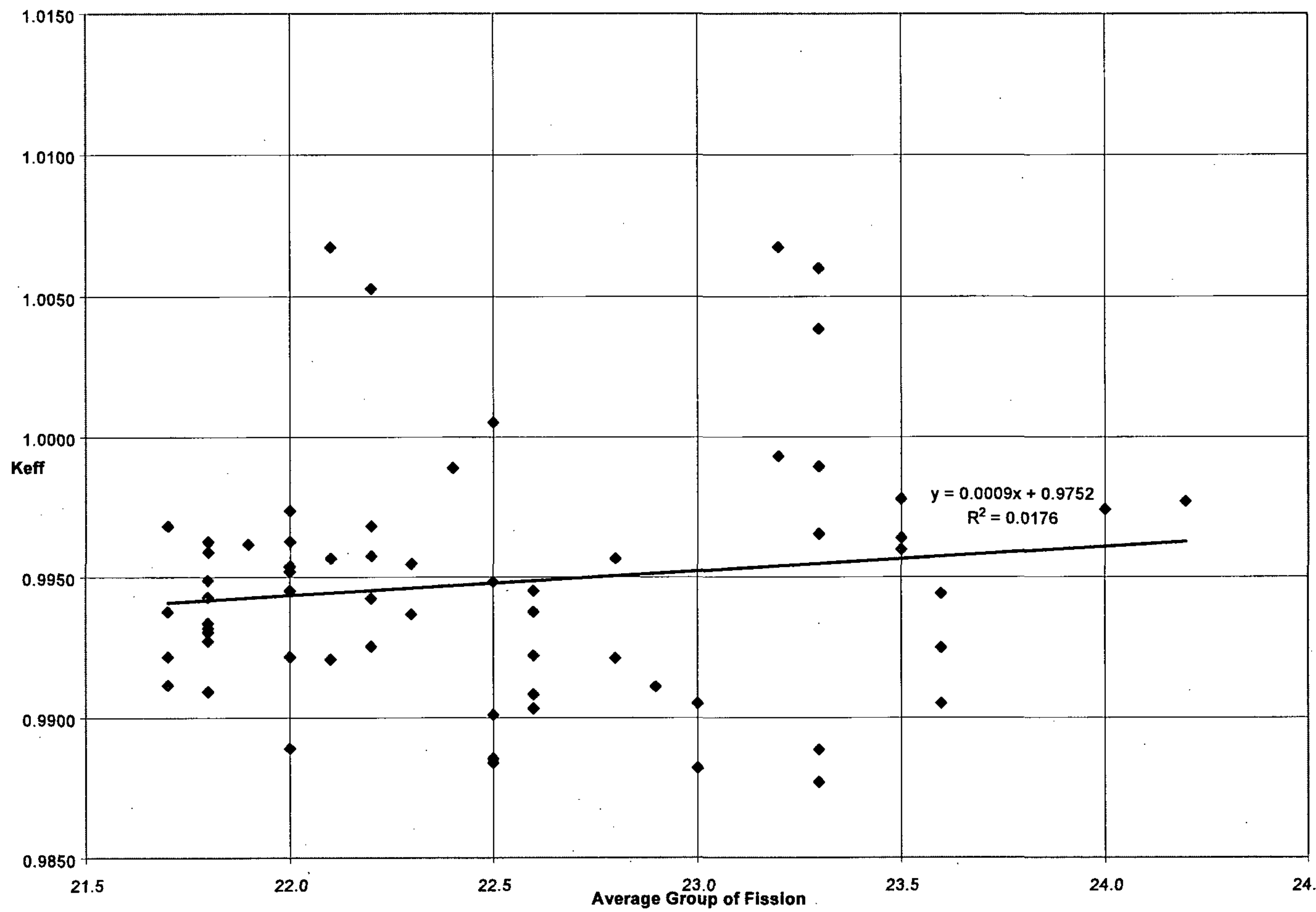


Figure 6.5.1-6 KENO-Va Validation - 27 Group Library K_{eff} versus ^{10}B Loading For Flux Trap Criticals

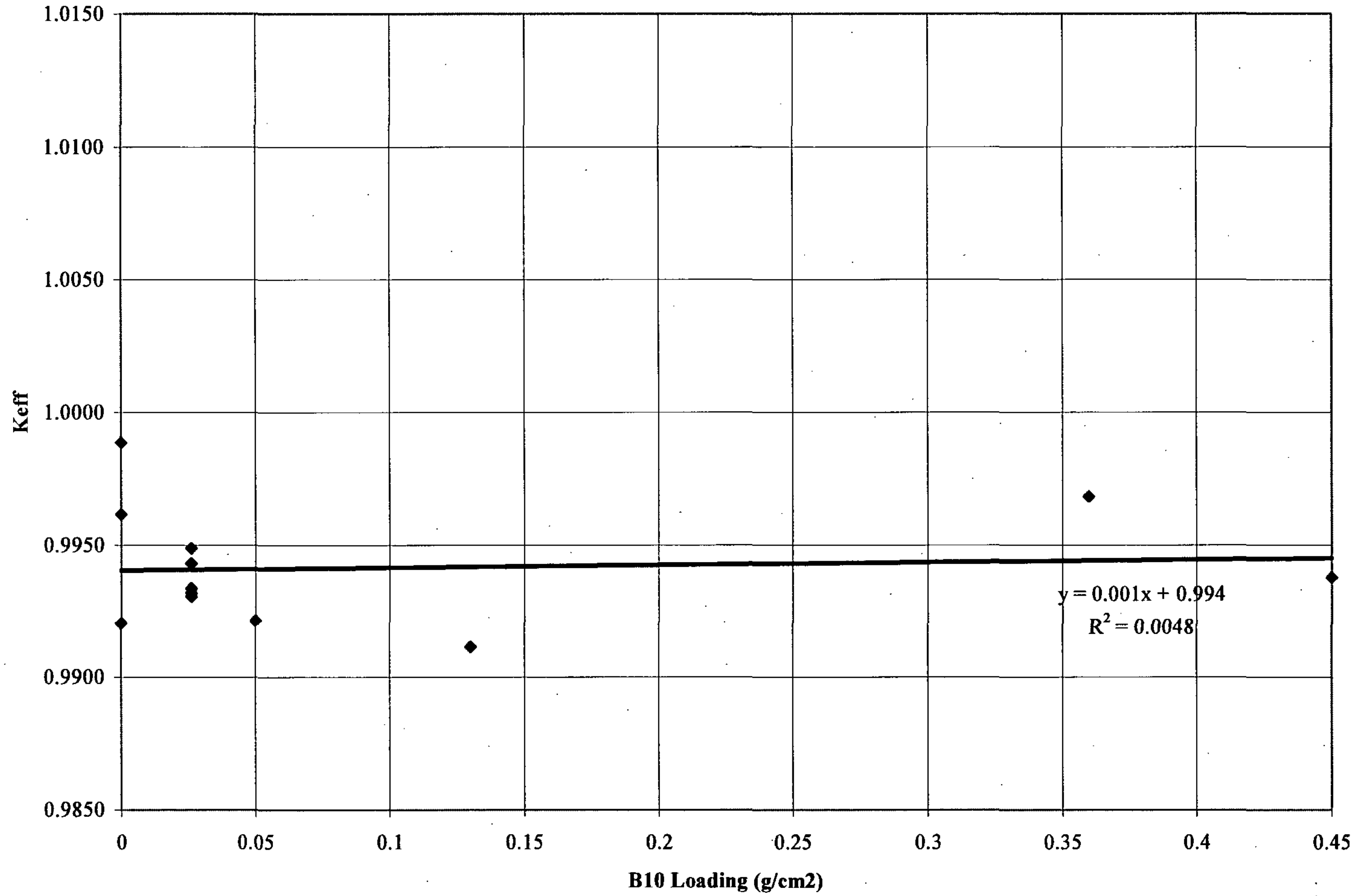


Figure 6.5.1-7 KENO-Va Validation -27 Group Library Results K_{eff} versus Flux Trap Critical Gap Thickness

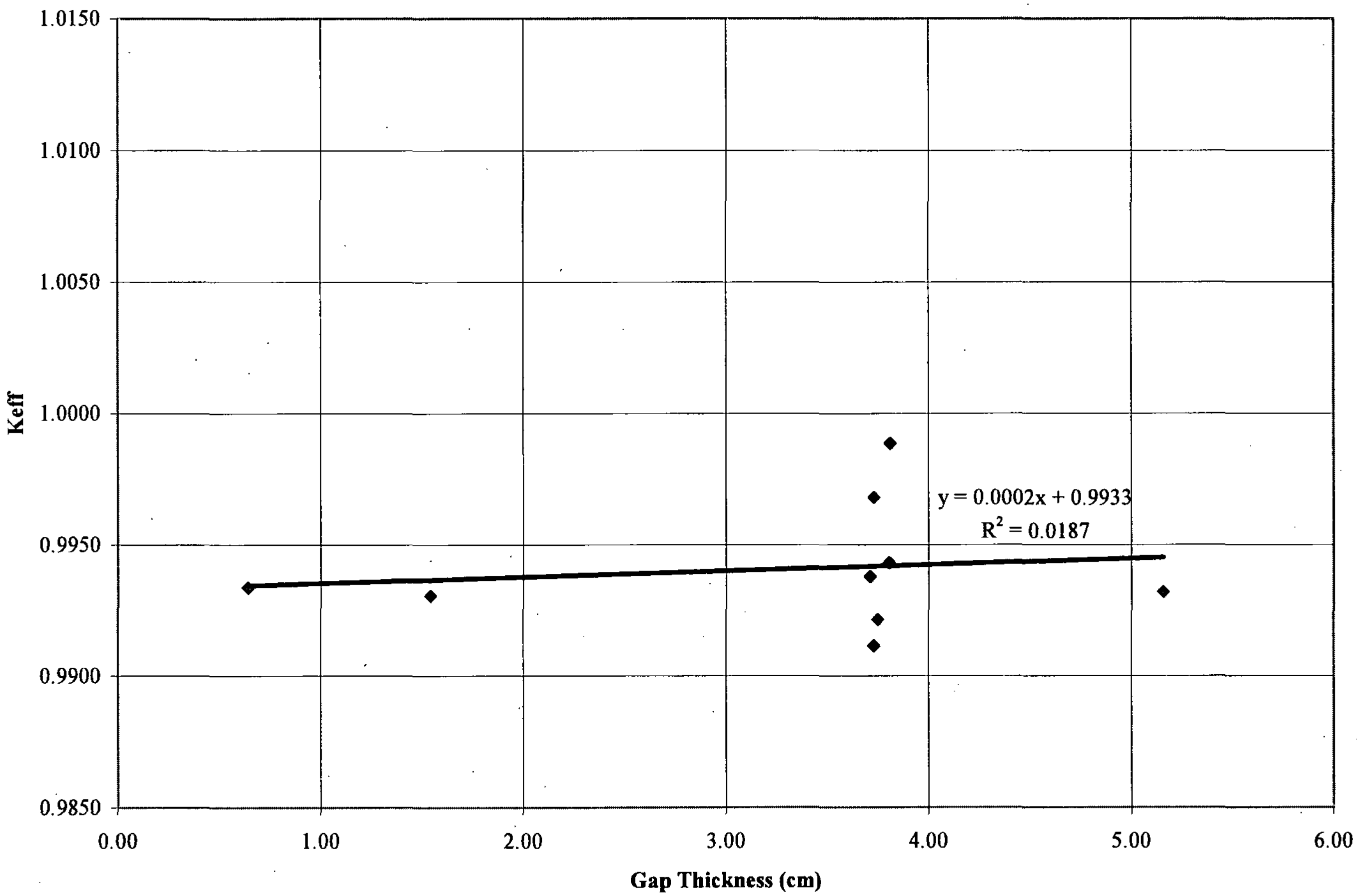


Figure 6.5.1-8 USLSTATS Output for Fuel Enrichment Study

```
uslstats: a utility to calculate upper subcritical
limits for criticality safety applications

*************************************************************************
Version 1.3.4, February 12, 1998
Oak Ridge National Laboratory
*************************************************************************


Input to statistical treatment from file:EN_KEFF.TXT

Title: 63 LWR CRITICAL EXPERIMENT KEFF VS ENRICHMENT

Proportion of the population = .995
Confidence of fit            = .950
Confidence on proportion     = .950
Number of observations       =   63
Minimum value of closed band =    0.00
Maximum value of closed band =    0.00
Administrative margin        =    0.05
```

independent variable - x	dependent variable - y	deviation in y	independent variable - x	dependent variable - y	deviation in y
2.35000E+00	9.96400E-01	1.00000E-03	4.31000E+00	9.96500E-01	1.10000E-03
2.35000E+00	9.94400E-01	1.00000E-03	4.31000E+00	1.00680E+00	2.10000E-03
2.35000E+00	9.90500E-01	1.00000E-03	4.31000E+00	1.00380E+00	1.20000E-03
2.35000E+00	9.96000E-01	1.10000E-03	4.31000E+00	9.88900E-01	1.10000E-03
2.35000E+00	9.97800E-01	1.00000E-03	4.31000E+00	9.95900E-01	1.10000E-03
2.35000E+00	9.92500E-01	1.00000E-03	4.31000E+00	1.00670E+00	1.00000E-03
2.35000E+00	9.90300E-01	9.00000E-04	4.31000E+00	1.00050E+00	1.10000E-03
2.35000E+00	9.95700E-01	1.00000E-03	4.31000E+00	9.90800E-01	1.10000E-03
2.35000E+00	9.91100E-01	1.00000E-03	4.31000E+00	9.98900E-01	1.20000E-03
2.46000E+00	9.92100E-01	1.10000E-03	4.31000E+00	9.92100E-01	1.20000E-03
2.46000E+00	9.92500E-01	9.00000E-04	4.31000E+00	9.91100E-01	1.20000E-03
2.46000E+00	9.93800E-01	9.00000E-04	4.31000E+00	9.96800E-01	1.30000E-03
2.46000E+00	9.90500E-01	1.00000E-03	4.31000E+00	9.93800E-01	1.20000E-03
2.46000E+00	9.88200E-01	1.00000E-03	4.31000E+00	9.93400E-01	1.00000E-03
2.46000E+00	9.94500E-01	1.00000E-03	4.31000E+00	9.93100E-01	1.00000E-03
2.46000E+00	9.92200E-01	1.00000E-03	4.31000E+00	9.94300E-01	1.00000E-03
2.46000E+00	9.88500E-01	1.00000E-03	4.31000E+00	9.93200E-01	1.00000E-03
2.46000E+00	9.88400E-01	1.00000E-03	4.31000E+00	9.94900E-01	1.00000E-03
2.46000E+00	9.90100E-01	9.00000E-04	4.31000E+00	9.92000E-01	1.00000E-03
4.31000E+00	9.95400E-01	1.40000E-03	4.31000E+00	9.96200E-01	1.00000E-03
4.31000E+00	9.94500E-01	1.30000E-03	4.74000E+00	9.92200E-01	1.30000E-03
4.31000E+00	9.97400E-01	1.30000E-03	4.74000E+00	9.88900E-01	1.30000E-03
4.31000E+00	9.96300E-01	1.30000E-03	4.74000E+00	9.95700E-01	1.30000E-03
4.31000E+00	9.92700E-01	1.20000E-03	4.74000E+00	1.00530E+00	1.10000E-03
4.31000E+00	9.90900E-01	1.20000E-03	4.74000E+00	9.95500E-01	1.20000E-03
4.31000E+00	9.96200E-01	1.20000E-03	4.74000E+00	9.94800E-01	1.30000E-03
4.31000E+00	9.93700E-01	1.30000E-03	4.74000E+00	9.95800E-01	1.20000E-03
4.31000E+00	9.94200E-01	1.20000E-03	4.74000E+00	9.95200E-01	1.20000E-03
4.31000E+00	9.96800E-01	1.20000E-03	4.74000E+00	9.98900E-01	1.30000E-03
4.31000E+00	9.87700E-01	2.30000E-03	4.74000E+00	9.97400E-01	1.20000E-03
4.31000E+00	9.99300E-01	1.20000E-03	4.74000E+00	9.97700E-01	1.10000E-03
4.31000E+00	1.00600E+00	2.20000E-03			

```
chi =  2.1587 (upper bound = 9.49). The data tests normal.

Output from statistical treatment
```

Figure 6.5.1-8 USLSTATS Output for Fuel Enrichment Study (Continued)

```
63 LWR CRITICAL EXPERIMENT KEFF VS ENRICHMENT

Number of data points (n)                          63
Linear regression, k(X)                          0.9884 + ( 1.6748E-03)*X
Confidence on fit (1-gamma) [input]               95.0%
Confidence on proportion (alpha) [input]          95.0%
Proportion of population falling above
lower tolerance interval (rho) [input]            99.5%
Minimum value of X                                   2.3500
Maximum value of X                                   4.7400
Average value of X                                   3.81143
Average value of k                                 0.99482
Minimum value of k                                 0.98770
Variance of fit, s(k,X)^2                         1.6973E-05
Within variance, s(w)^2                           1.4306E-06
Pooled variance, s(p)^2                           1.8404E-05
Pooled std. deviation, s(p)                       4.2900E-03
C(alpha,rho)*s(p)                                 1.5488E-02
student-t @ (n-2,1-gamma)                         1.67078E+00
Confidence band width, W                          7.3606E-03
Minimum margin of subcriticality, C*s(p)-W        8.1273E-03

Upper subcritical limits: (  2.35000 <= X <=   4.74000)
***** *********** *******

USL Method 1 (Confidence Band with
Administrative Margin)             USL1 = 0.9311 + ( 1.6748E-03)*X

USL Method 2 (Single-Sided Uniform
Width Closed Interval Approach)    USL2 = 0.9729 + ( 1.6748E-03)*X



USLs Evaluated Over Range of Parameter X:
**** ********* **** ***** ** ********* **

X:    2.35   2.69   3.03   3.37   3.72   4.06   4.40   4.74
---------------------------------------------------------
USL-1:  0.9350 0.9356 0.9362 0.9367 0.9373 0.9379 0.9384 0.9390
USL-2:  0.9769 0.9775 0.9780 0.9786 0.9792 0.9797 0.9803 0.9809
---------------------------------------------------------

****************************************************************************
Thus spake USLSTATS
Finis.
```

Table 6.5.1-1 KENO-Va and 27 Group Library Validation Statistics

Criticals	Configuration	wt % ^{235}U	Pitch (cm)	Clad OD (cm)	Pellet OD (cm)	H/U	Sol. B (ppm)	Poison	g ^{10}B/cm^2	Gap(cm)	Gap Den.	Average FissionGroup	K_{eff}	σ
Set 1														
B&W-I	Cylindrical	2.46	1.636	1.206	1.03	1.6	0	na	na	0		22.8	0.9921	0.0011
B&W-II	3X3-14X14	2.46	1.636	1.206	1.03	1.6	1037	na	na	0		22.2	0.9925	0.0009
B&W-III	3X3-14X14	2.46	1.636	1.206	1.03	1.6	764	na	na	1.636		22.6	0.9938	0.0009
B&W-IX	3X3-14X14	2.46	1.636	1.206	1.03	1.6	0	na	na	6.543		23	0.9905	0.0010
B&W-X	3X3-14X14	2.46	1.636	1.206	1.03	1.6	143	na	na	4.907		23	0.9882	0.0010
B&W-XI	3X3-14X14	2.46	1.636	1.206	1.03	1.6	514	Steel	0	1.636		22.6	0.9945	0.0010
B&W-XIII	3X3-14X14	2.46	1.636	1.206	1.03	1.6	15	B-Al	0.0052	1.636		22.6	0.9922	0.0010
B&W-XIV	3X3-14X14	2.46	1.636	1.206	1.03	1.6	92	B-Al	0.0040	1.636		22.5	0.9885	0.0010
B&W-XVII	3X3-14X14	2.46	1.636	1.206	1.03	1.6	487	B-Al	0.0008	1.636		22.5	0.9884	0.0010
B&W-XIX	3X3-14X14	2.46	1.636	1.206	1.03	1.6	634	B-Al	0.0003	1.636		22.5	0.9901	0.0009
												Average	0.9911	0.0023
Set 2														
PNL-043	17X13 Lattice	4.31	1.892	1.415	1.265	1.6	0	na	na	na	na	22.0	0.9954	0.0014
PNL-044	16X14 Lattice	4.31	1.892	1.415	1.265	1.6	0	na	na	na	na	22.0	0.9945	0.0013
PNL-045	14X16 Lattice	4.31	1.892	1.415	1.265	1.6	0	na	na	na	na	22.0	0.9974	0.0013
PNL-046	12x19 Lattice	4.31	1.892	1.415	1.265	1.6	0	na	na	na	na	22.0	0.9963	0.0013
PNL-087	4 11X14 Arrays	4.31	1.892	1.415	1.265	1.6	0	BORAL	0.066	2.83		21.8	0.9927	0.0012
PNL-079	4 11X14 Arrays	4.31	1.892	1.415	1.265	1.6	0	BORAL	0.030	2.83		21.8	0.9909	0.0012
PNL-093	4 11X14 Arrays	4.31	1.892	1.415	1.265	1.6	0	BORAL	0.026	2.83		21.8	0.9962	0.0012
PNL-115	4 9X12 Arrays	4.31	1.892	1.415	1.265	1.6	0	Aluminum	0	2.83		22.3	0.9937	0.0013
PNL-064	4 9X12 Arrays	4.31	1.892	1.415	1.265	1.6	0	Steel (.302)	0	2.83		22.2	0.9942	0.0012
PNL-071	4 9X12 Arrays	4.31	1.892	1.415	1.265	1.6	0	Steel (.485)	0	2.83		22.2	0.9968	0.0012
												Average	0.9948	0.0020

Table 6.5.1-1 KENO-Va and 27 Group Library Validation Statistics (continued)

Criticals Set 3	Configuration	wt % ^{235}U	Pitch (cm)	Clad OD (cm)	Pellet OD (cm)	H/U	Sol. B (ppm)	Poison	g $^{10}B/cm^2$	Gap(cm) Cluster	Gap Den. Wall/Cluster	Average Fission Group	K_{eff}	σ
PNL-STA	3X1 St Refl.	2.35	2.032	1.27	1.1176	2.9	0	na	na	10.65	0.00	23.5	0.9964	0.0010
PNL-STB	3X1 St Refl.	2.35	2.032	1.27	1.1176	2.9	0	na	na	11.20	1.32	23.6	0.9944	0.0010
PNL-STC	3X1 St Refl.	2.35	2.032	1.27	1.1176	2.9	0	na	na	10.36	2.62	23.6	0.9905	0.0010
PNL-PBA	3X1 Pb Refl.	2.35	2.032	1.27	1.1176	2.9	0	na	na	13.84	0.00	23.5	0.9960	0.0011
PNL-PBB	3X1 Pb Refl.	2.35	2.032	1.27	1.1176	2.9	0	na	na	13.72	0.66	23.5	0.9978	0.0010
PNL_PBC	3X1 Pb Refl.	2.35	2.032	1.27	1.1176	2.9	0	na	na	11.25	2.62	23.6	0.9925	0.0010
PNL-DUA	3X1 DU Refl.	2.35	2.032	1.27	1.1176	2.9	0	na	na	11.83	0.00	22.6	0.9903	0.0009
PNL-DUB	3X1 DU Refl.	2.35	2.032	1.27	1.1176	2.9	0	na	na	14.11	1.96	22.8	0.9957	0.0010
PNL-DUC	3X1 DU Refl.	2.35	2.032	1.27	1.1176	2.9	0	na	na	13.70	2.62	22.9	0.9911	0.0010
PNL-H20	3X1 H2O Refl	4.31	2.54	1.415	1.265	3.9	0	na	na	8.24	inf	23.3	0.9877	0.0023
PNL-ST0	3X1 St Refl.	4.31	2.54	1.415	1.265	3.9	0	na	na	12.89	0	23.2	0.9993	0.0012
PNL-ST1	3X1 St Refl.	4.31	2.54	1.415	1.265	3.9	0	na	na	14.12	1.32	23.3	1.0060	0.0022
PNL-ST26	3X1 St Refl.	4.31	2.54	1.415	1.265	3.9	0	na	na	12.44	2.62	23.3	0.9965	0.0011
PNL-PB0	3X1 Pb Refl.	4.31	2.54	1.415	1.265	3.9	0	na	na	20.62	0	23.2	1.0068	0.0021
PNL-PB13	3X1 Pb Refl.	4.31	2.54	1.415	1.265	3.9	0	na	na	19.04	1.32	23.3	1.0038	0.0012
PNL-PB5	3X1 Pb Refl.	4.31	2.54	1.415	1.265	3.9	0	na	na	10.3	5.41	23.3	0.9889	0.0011
PNL-DU0	3X1 DU Refl.	4.31	2.54	1.415	1.265	3.9	0	na	na	15.38	0	21.8	0.9959	0.0011
PNL-DU13	3X1 DU Refl.	4.31	2.54	1.415	1.265	3.9	0	na	na	19.04	1.32	22.1	1.0067	0.0010
PNL-DU39	3X1 DU Refl.	4.31	2.54	1.415	1.265	3.9	0	na	na	18.05	3.91	22.5	1.0005	0.0011
PNL-DU54	3X1 DU Refl.	4.31	2.54	1.415	1.265	3.9	0	na	na	13.49	5.41	22.6	0.9908	0.0011
												Average	0.9964	0.0060

Table 6.5.1-1 KENO-Va and 27 Group Library Validation Statistics (continued)

Criticals	Configuration	wt % ^{235}U	Pitch (cm)	Clad OD (cm)	Pellet OD (cm)	H/U	Sol. B (ppm)	Poison	g $^{10}B/cm^2$	Gap(cm)	Gap Den.	Average Fission Group	K_{eff}	σ
Set 4														
PNL-229	2x2 Flux Trap	4.31	1.89	1.415	1.265	1.6	0	Aluminum	0	3.81	0.9982	22.4	0.9989	0.0012
PNL-230	2x2 Flux Trap	4.31	1.89	1.415	1.265	1.6	0	BORAL	0.05	3.75	0.9982	21.7	0.9921	0.0012
PNL-228	2x2 Flux Trap	4.31	1.89	1.415	1.265	1.6	0	BORAL	0.13	3.73	0.9982	21.7	0.9911	0.0012
PNL-214	2x2 Flux Trap	4.31	1.89	1.415	1.265	1.6	0	BORAL	0.36	3.73	0.9982	21.7	0.9968	0.0013
PNL-231	2x2 Flux Trap	4.31	1.89	1.415	1.265	1.6	0	BORAL	0.45	3.71	0.9982	21.7	0.9938	0.0012
PNL-127	2x1 Flux Trap	4.31	1.89	1.415	1.265	1.6	0	BORAL	0.026	0.64	0.9982	21.8	0.9934	0.0010
PNL-126	2x1 Flux Trap	4.31	1.89	1.415	1.265	1.6	0	BORAL	0.026	1.54	0.9982	21.8	0.9931	0.0010
PNL-123	2x1 Flux Trap	4.31	1.89	1.415	1.265	1.6	0	BORAL	0.026	3.80	0.9982	21.8	0.9943	0.0010
PNL-125	2x1 Flux Trap	4.31	1.89	1.415	1.265	1.6	0	BORAL	0.026	5.16	0.9982	21.8	0.9932	0.0010
PNL-124	2x1 Flux Trap	4.31	1.89	1.415	1.265	1.6	0	BORAL	0.026	INF	0.9982	21.8	0.9949	0.0010
PNL-123-S	2x1 Flux Trap	4.31	1.89	1.415	1.265	1.6	0	Steel	0	3.80	0.9982	22.1	0.9920	0.0010
PNL-124-S	2x1 Flux Trap	4.31	1.89	1.415	1.265	1.6	0	Steel	0	INF	0.9982	21.9	0.9962	0.0010
												Average	0.9941	0.0022
Set 5														
VCML	2x2 Water Gap	4.74	1.35	0.94	0.79	2.3	0	na	na	1.90	0	22.0	0.9922	0.0013
VCML	2x2 Water Gap	4.74	1.35	0.94	0.79	2.3	0	na	na	1.90	0.0323	22.0	0.9889	0.0013
VCML	2x2 Water Gap	4.74	1.35	0.94	0.79	2.3	0	na	na	1.90	0.2879	22.1	0.9957	0.0013
VCML	2x2 Water Gap	4.74	1.35	0.94	0.79	2.3	0	na	na	1.90	0.5540	22.2	1.0053	0.0011
VCML	2x2 Water Gap	4.74	1.35	0.94	0.79	2.3	0	na	na	2.50	0.9982	22.3	0.9955	0.0012
VCML	2x2 Water Gap	4.74	1.35	0.94	0.79	2.3	0	na	na	5.00	0.9982	22.5	0.9948	0.0013
VCML	Square Lattice	4.74	1.26	0.94	0.79	1.8	0	na	na	na	na	22.2	0.9958	0.0012
VCML	Square Lattice	4.74	1.35	0.94	0.79	2.3	0	na	na	na	na	22.0	0.9952	0.0012
VCML	Square Lattice	4.74	1.60	0.94	0.79	3.8	0	na	na	na	na	23.3	0.9989	0.0013
VCML	Square Lattice	4.74	2.10	0.94	0.79	7.6	0	na	na	na	na	24.0	0.9974	0.0012
VCML	Square Lattice	4.74	2.52	0.94	0.79	11.5	0	na	na	na	na	24.2	0.9977	0.0011
												Average	0.9961	0.0041

Table 6.5.1-2 Correlation Coefficient for Linear Curve-Fit of Critical Benchmarks

Correlation Studied	Correlation Coefficient (R)
k_{eff} versus enrichment	0.361
k_{eff} versus rod pitch	0.328
k_{eff} versus H/U volume ratio	0.246
k_{eff} versus ^{10}B loading	0.069
k_{eff} versus average group causing fission	0.133
k_{eff} versus flux gap thickness	0.137

Table 6.5.1-3 Most Reactive Configuration System Parameters

Parameters	Value
Enrichment (wt % ^{235}U)[1]	4.0
Rod pitch (cm)	1.1887
H/U volume ratio	1.52
^{10}B loading (g/cm^2)	0.01
Average group causing fission	21.6
Flux gap thickness (cm)	1.9 to 2.25

1.) Minor variations in the maximum enrichment due to fuel fabrication tolerances are considered in Section 6.4.2.1.

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6.5.2 MONK8a Validation in Accordance with NUREG/CR-6361

NUREG/CR-6361, "Criticality Benchmark Guide for Light-Water-Reactor Fuel in Transportation and Storage Packages" (NUREG), provides the guide to criticality benchmark calculations and the determination of bias and subcritical limits in critical safety evaluations. This section implements the ULSTATS method for the MONK8a application with JEF 2.2 point energy libraries.

Benchmarking of MONK8a has been performed by AEA Technologies. Critical benchmarks relevant to light water reactor spent fuel evaluations were extracted from the total benchmark set and listed in Table 6.5.2-1. Trending in k_{eff} was evaluated for the independent variables of enrichment, rod pitch, fuel pellet diameter, fuel rod diameter, H/U ratio, average neutron group causing fission, ^{10}B loading for flux trap cases, and flux trap gap thickness. Plots depicting the trend in k_{eff} as a function of each independent parameter are provided in Figures 6.5.2-1 through 6.5.2-8. The minimum and maximum values of each parameter define the area of applicability of the validation as summarized in Table 6.5.2-2.

To evaluate the relative importance of the trend analysis to the upper safety limit (USL), correlation coefficients are required for all independent parameters. Table 6.5.2-3 contains the correlation coefficient, R, for each linear fit of k_{eff} versus the experimental parameter (data is extracted from Figures 6.5.2-1 through 6.5.2-8 by taking the square root of the R^2 value). The USL is established based on the highest correlation coefficient, which occurs for the variation of k_{eff} with flux trap thickess, and the method presented in NUREG/CR-6361. Note that even the flux trap function shows a low statistical correlation coefficient (an $|R|$ equal or near 1 would indicate a good fit). The output generated by USLSTATS is shown in Figure 6.5.2-9.

The NAC applied USL is 0.9425, which bounds the calculated upper safety limits for the typical flux trap spacing found in multi-purpose casks. As demonstrated in Table 6.5.2-2, the parameters of the most reactive Connecticut Yankee fuel fall within the area of applicablility of this validation.

Figure 6.5.2-1 MONK8a – JEF 2.2 Library Validation Statistics – k_{eff} versus Fuel Enrichment

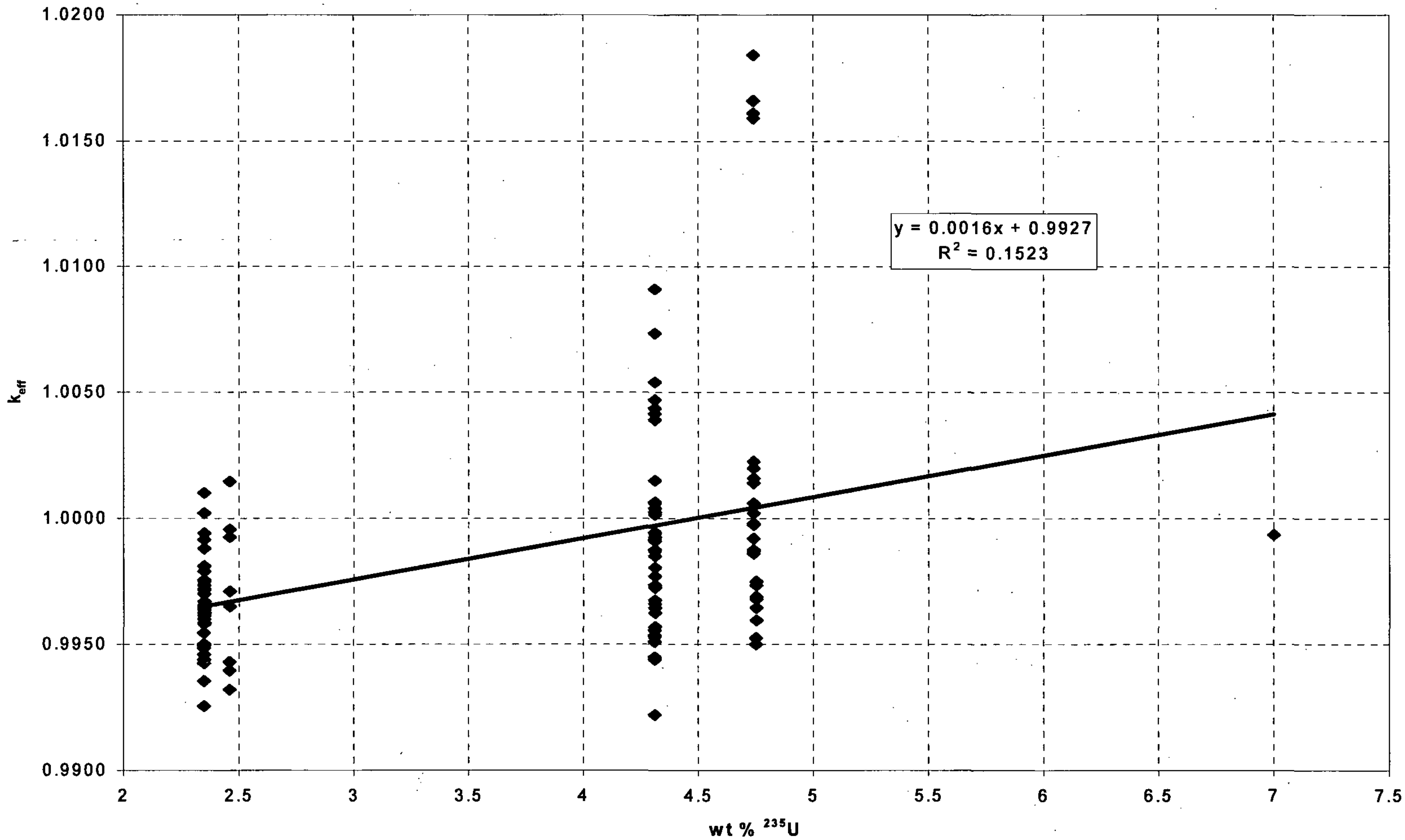

Figure 6.5.2-2 MONK8a – JEF 2.2 Library – k_{eff} versus Rod Pitch

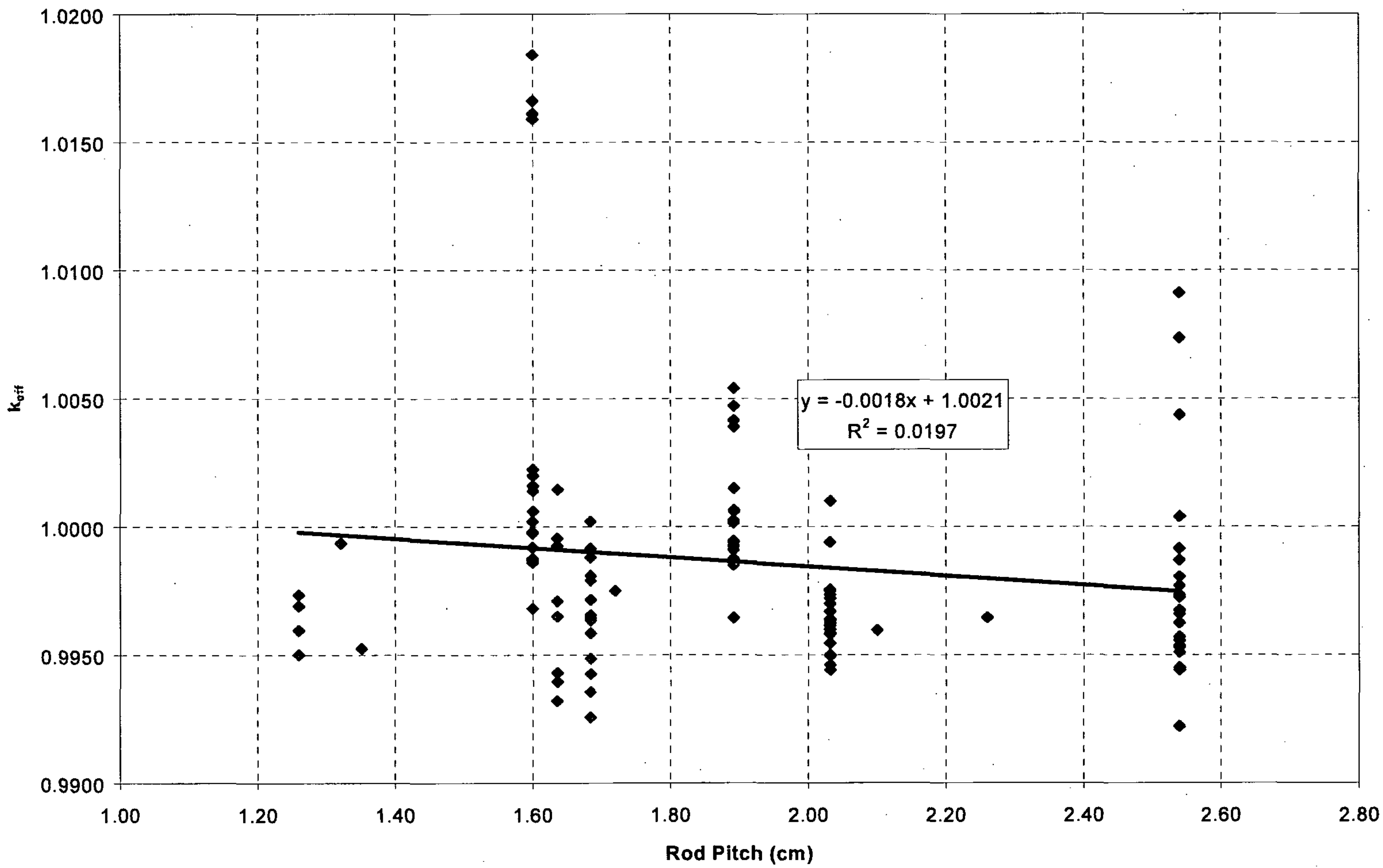

Figure 6.5.2-3 MONK8a – JEF 2.2 Library - k_{eff} versus H/U (fissile) Atom Ratio

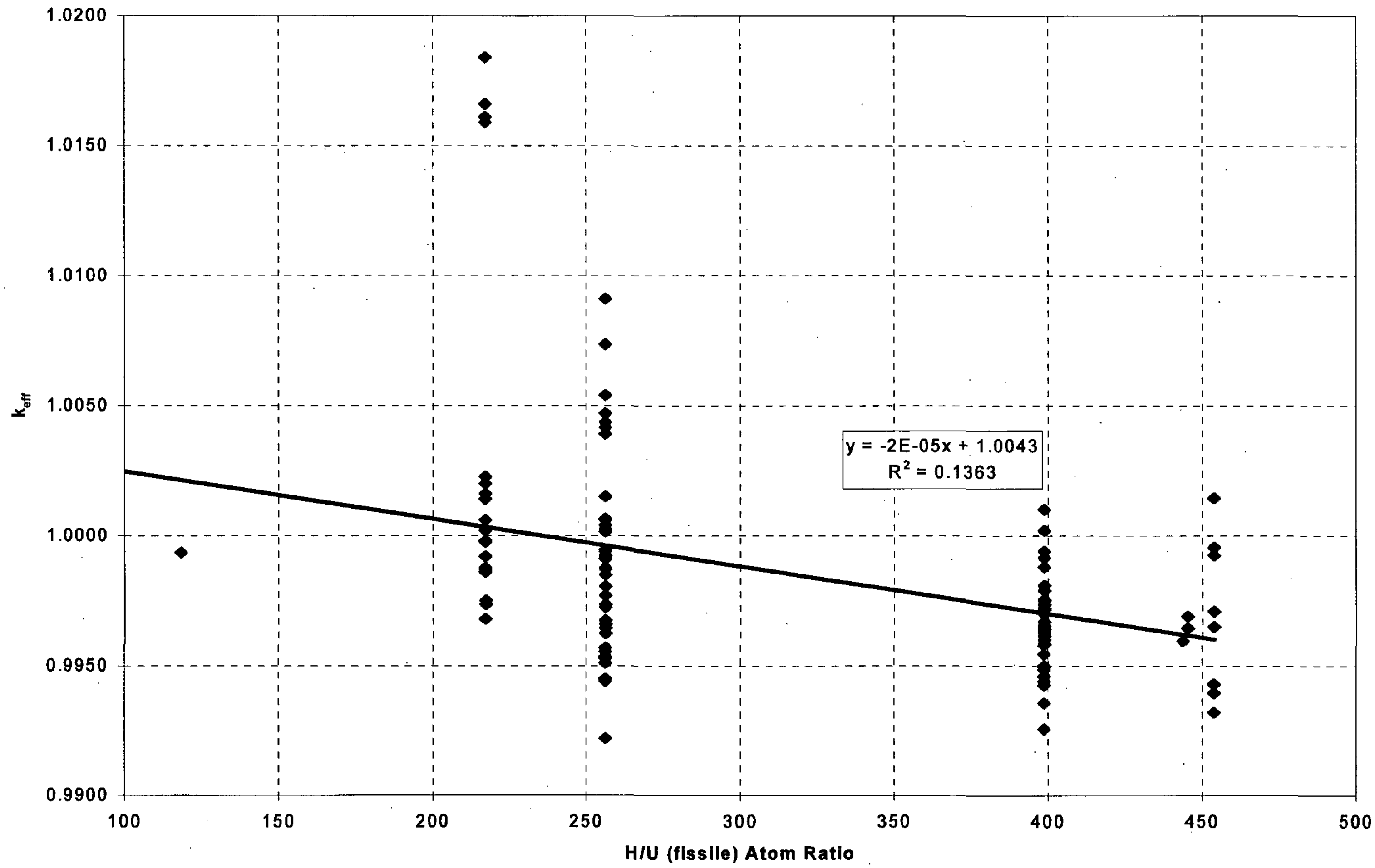

Figure 6.5.2-4 *MONK8a – JEF 2.2 Library - k_{eff} versus ^{10}B Loading*

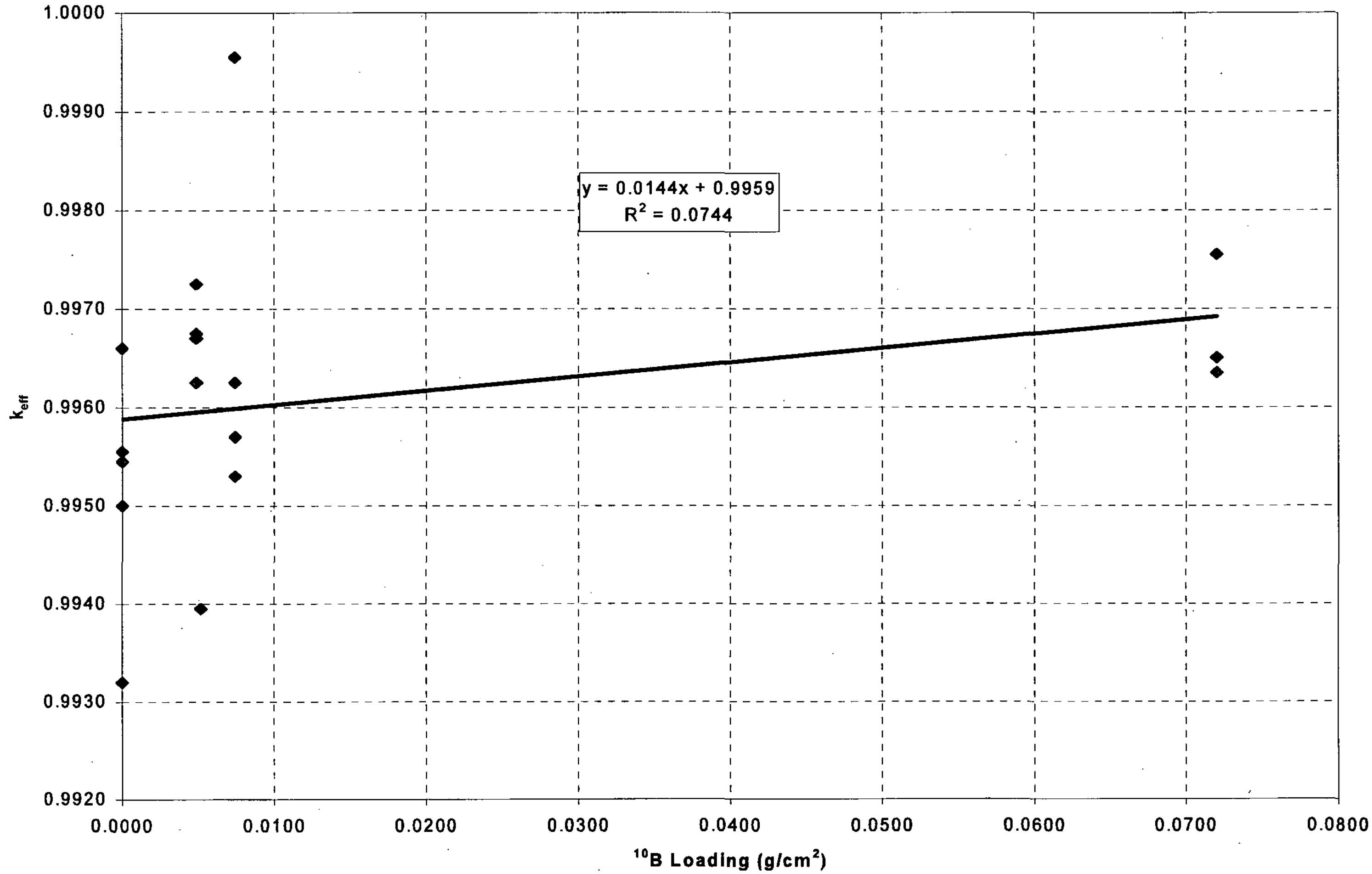

Figure 6.5.2-5 MONK8a – JEF 2.2 Library - k_{eff} versus Mean Neutron Log(e) Causing Fission

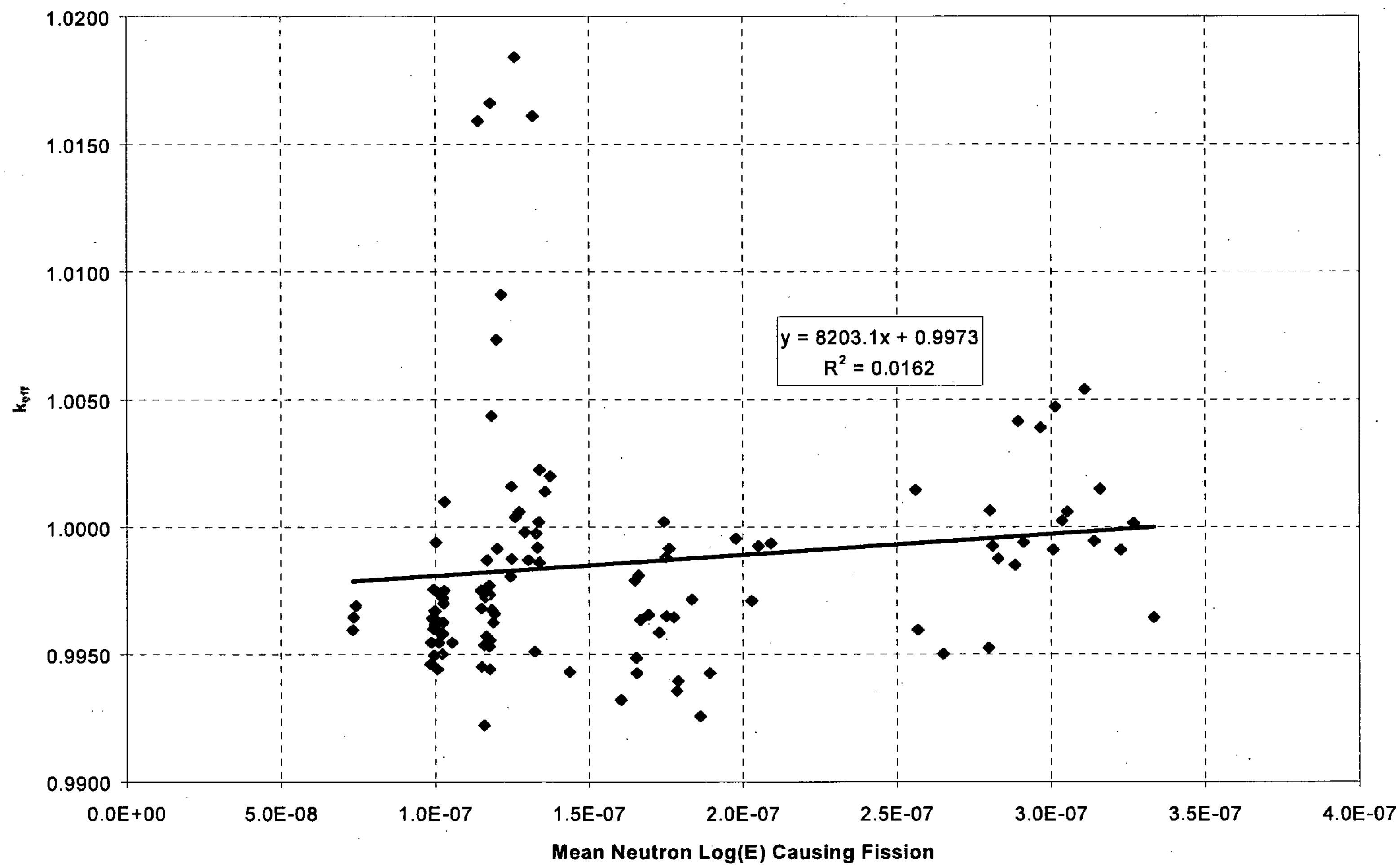

Figure 6.5.2-6 MONK8a – JEF 2.2 Library - k_{eff} versus Cluster Gap Thickness

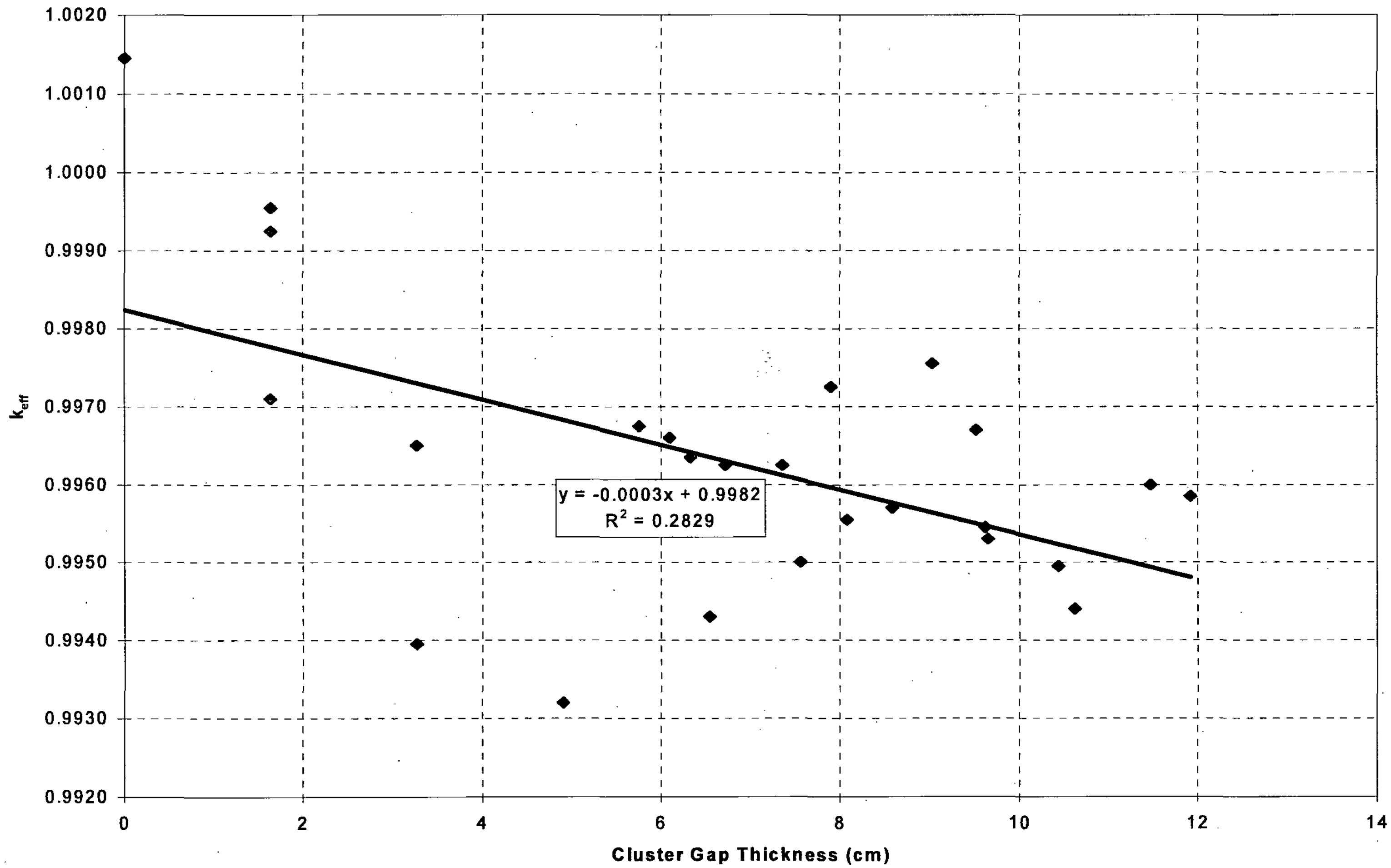

Figure 6.5.2-7 MONK8a – JEF 2.2 Library - k_{eff} versus Fuel Pellet Outside Diameter

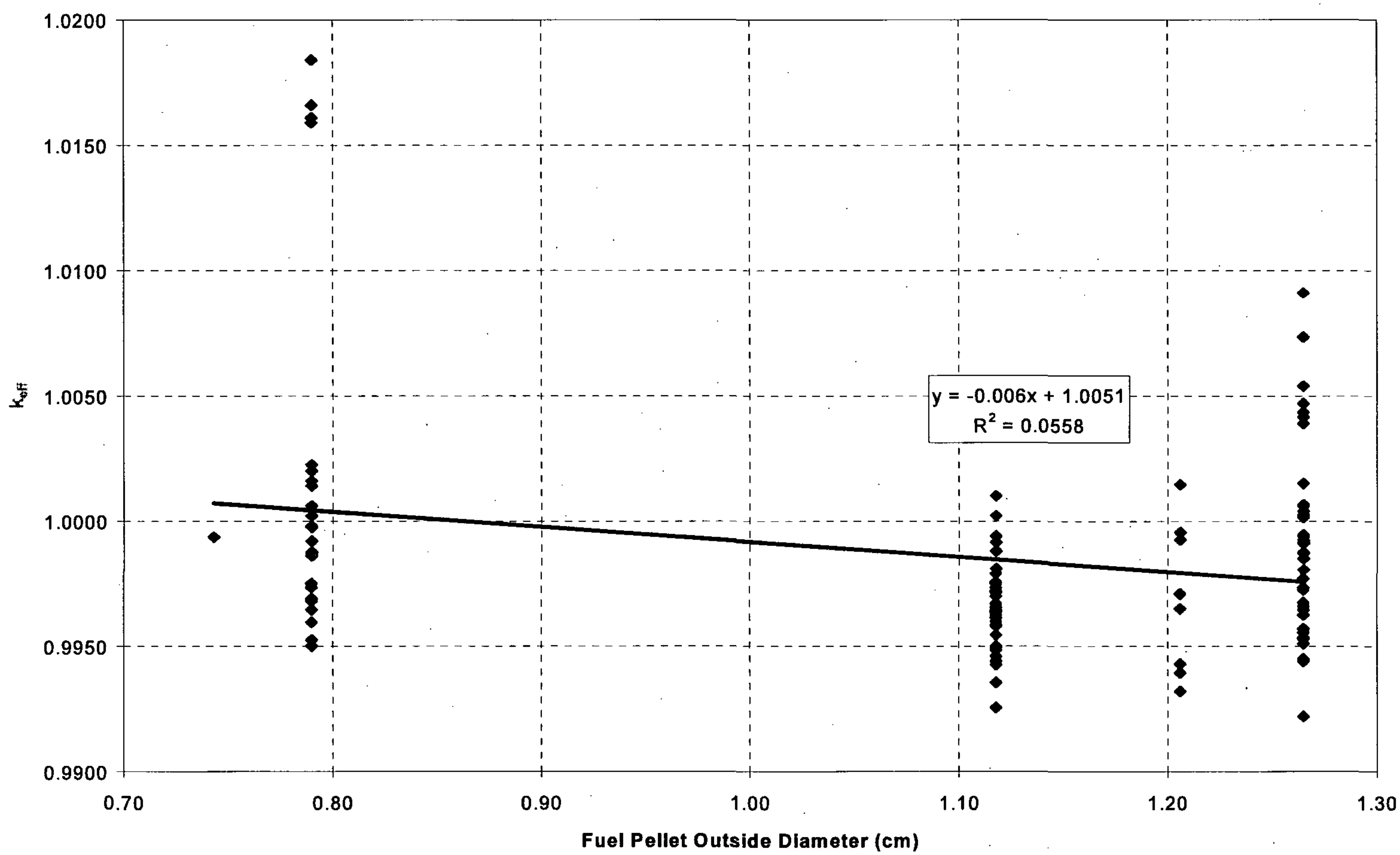

Figure 6.5.2-8 MONK8a – JEF 2.2 Library - k_{eff} versus Fuel Rod Outside Diameter

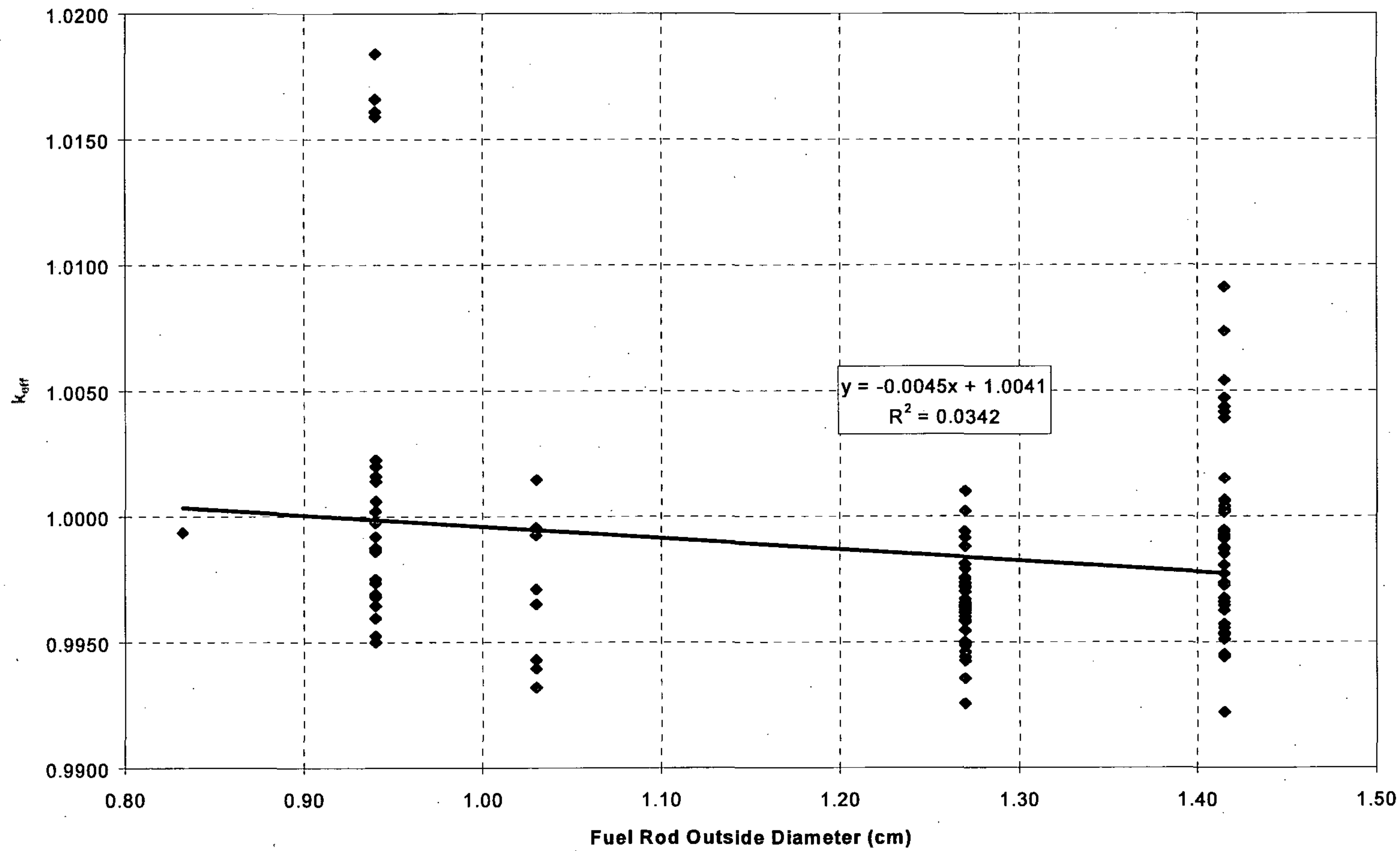

Figure 6.5.2-9 USLSTATS Output - k_{eff} versus Gap Thickness

```
 uslstats: a utility to calculate upper subcritical
limits for criticality safety applications

***************************************************************************
Version 1.3.4, February 12, 1998
Oak Ridge National Laboratory
*****

Input to statistical treatment from file:gap_keff.txt

Title: 110 LWR CRITICAL EXPERIMENT KEFF VS GAP THICKNESS

Proportion of the population = .995
Confidence of fit            = .950
Confidence on proportion     = .950
Number of observations       =   54
Minimum value of closed band =    0.00
Maximum value of closed band =    0.00
Administrative margin        =    0.05
```

independent variable - x	dependent variable - y	deviation in y	independent variable - x	dependent variable - y	deviation in y
6.33000E+00	9.96400E-01	1.00000E-03	1.05100E+01	9.96200E-01	1.00000E-03
9.03000E+00	9.97600E-01	1.00000E-03	1.10900E+01	9.95500E-01	1.00000E-03
1.04400E+01	9.95000E-01	1.00000E-03	1.31900E+01	9.97200E-01	1.00000E-03
1.14700E+01	9.96000E-01	1.00000E-03	1.33700E+01	9.97400E-01	1.00000E-03
7.56000E+00	9.95000E-01	1.00000E-03	1.29600E+01	9.96700E-01	1.00000E-03
9.62000E+00	9.95500E-01	1.00000E-03	9.95000E+00	9.94400E-01	1.00000E-03
7.36000E+00	9.96300E-01	1.00000E-03	7.82000E+00	9.94600E-01	1.00000E-03
9.52000E+00	9.96700E-01	1.00000E-03	9.88800E+00	9.97500E-01	1.00000E-03
1.19200E+01	9.95900E-01	1.00000E-03	1.04380E+01	9.97000E-01	1.00000E-03
1.06200E+01	9.94400E-01	1.00000E-03	1.04380E+01	9.95800E-01	1.00000E-03
8.58000E+00	9.95700E-01	1.00000E-03	9.59800E+00	9.96400E-01	1.00000E-03
9.65000E+00	9.95300E-01	1.00000E-03	8.74800E+00	9.95500E-01	1.00000E-03
6.10000E+00	9.96600E-01	1.00000E-03	8.56600E+00	9.94300E-01	1.00000E-03
8.08000E+00	9.95600E-01	1.00000E-03	9.16600E+00	9.97200E-01	1.00000E-03
5.76000E+00	9.96800E-01	1.00000E-03	9.09600E+00	9.98800E-01	1.00000E-03
7.90000E+00	9.97300E-01	1.00000E-03	9.24600E+00	9.96500E-01	1.00000E-03
6.72000E+00	9.96300E-01	1.00000E-03	8.86600E+00	9.96600E-01	1.00000E-03
0.00000E+00	1.00150E+00	1.00000E-03	8.64600E+00	9.95900E-01	1.00000E-03
1.64000E+00	9.99300E-01	1.00000E-03	8.12600E+00	9.94300E-01	1.00000E-03
1.64000E+00	9.97100E-01	1.00000E-03	7.25600E+00	9.94900E-01	1.00000E-03
1.64000E+00	9.99600E-01	1.00000E-03	9.64600E+00	9.99200E-01	1.00000E-03
3.27000E+00	9.96500E-01	1.00000E-03	9.69600E+00	1.00020E+00	1.00000E-03
3.27000E+00	9.94000E-01	1.00000E-03	8.08600E+00	9.97900E-01	1.00000E-03
4.91000E+00	9.93200E-01	1.00000E-03	7.64600E+00	9.92600E-01	1.00000E-03
6.54000E+00	9.94300E-01	1.00000E-03	9.08600E+00	9.93600E-01	1.00000E-03
1.31000E+01	1.00100E+00	1.00000E-03	9.41600E+00	9.98100E-01	1.00000E-03
1.29800E+01	9.99400E-01	1.00000E-03	9.77600E+00	9.96400E-01	1.00000E-03

```
chi =  1.7407 (upper bound = 9.49). The data tests normal.
```

Figure 6.5.2-9 USLSTATS Output - k_{eff} versus Gap Thickness (continued)

```
Output from statistical treatment

110 LWR CRITICAL EXPERIMENT KEFF VS GAP THICKNESS

Number of data points (n)                          54
Linear regression, k(X)                           0.9968 + (-3.5885E-05)*X
Confidence on fit (1-gamma) [input]                95.0%
Confidence on proportion (alpha) [input]           95.0%
Proportion of population falling above
lower tolerance interval (rho) [input]             99.5%
Minimum value of X                                    0.0000
Maximum value of X                                   13.3700
Average value of X                                    8.44389
Average value of k                                 0.99646
Minimum value of k                                 0.99260
Variance of fit, s(k,X)^2                          3.6340E-06
Within variance, s(w)^2                            1.0000E-06
Pooled variance, s(p)^2                            4.6340E-06
Pooled std. deviation, s(p)                        2.1527E-03
C(alpha,rho)*s(p)                                  8.6255E-03
student-t @ (n-2,1-gamma)                          1.67620E+00
Confidence band width, W                           3.8972E-03
Minimum margin of subcriticality, C*s(p)-W         4.7283E-03

Upper subcritical limits: (  0.00000 <= X <=  13.37000)
***** *********** *******

USL Method 1 (Confidence Band with
Administrative Margin)            USL1 = 0.9429 + (-3.5885E-05)*X

USL Method 2 (Single-Sided Uniform
Width Closed Interval Approach)   USL2 = 0.9881 + (-3.5885E-05)*X


USLs Evaluated Over Range of Parameter X:
**** ********* **** ***** ** ********* **

X:    0.00   1.91   3.82   5.73   7.64   9.55  11.46  13.37
---------------------------------------------------------
USL-1:  0.9429 0.9428 0.9427 0.9427 0.9426 0.9425 0.9425 0.9424
USL-2:  0.9881 0.9881 0.9880 0.9879 0.9879 0.9878 0.9877 0.9877
---------------------------------------------------------

*****************************************************************************
Thus spake USLSTATS
Finis.
```

Table 6.5.2-1 MONK8a – JEF 2.2 Library Validation Statistics

Case	Configuration	wt % ^{235}U	Pitch (cm)	Fuel OD (cm)	Clad OD (cm)	Clad Mat'l.	H/U (fissile)	Sol. B (ppm)	Poison Type/Absorber	G $^{10}B/cm^2$	Cluster Gap (cm)	Wall/ Cluster (cm)	Reflector	Mean Log(E) Neutrons Causing Fission	k_{eff} (JEF2.2)	σ
1.01	3 clusters; 20x17 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Boral	0.0720	6.33	Inf	Water	1.00E-07	0.9964	0.0010
1.02	3 clusters; 20x17 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Boral	0.0720	9.03	Inf	Water	9.95E-08	0.9976	0.0010
1.03	3 clusters; 20x17 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	304L Steel (no boron)	0	10.44	Inf	Water	9.97E-08	0.9950	0.0010
1.04	3 clusters; 20x17 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	304L Steel (no boron)	0	11.47	Inf	Water	9.95E-08	0.9960	0.0010
1.05	3 clusters; 20x17 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	304L Steel (1.05% boron)	0.0049	7.56	Inf	Water	1.02E-07	0.9950	0.0010
1.06	3 clusters; 20x17 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	304L Steel (1.05% boron)	0.0049	9.62	Inf	Water	1.01E-07	0.9955	0.0010
1.07	3 clusters; 20x17 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	304L Steel (1.62% boron)	0.0074	7.36	Inf	Water	1.02E-07	0.9963	0.0010
1.08	3 clusters; 20x17 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	304L Steel (1.62% boron)	0.0074	9.52	Inf	Water	9.99E-08	0.9967	0.0010
1.09	3 clusters; 20x17 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	None	Na	11.92	Inf	Water	1.01E-07	0.9959	0.0010
2.01	1.26 (square)	4.75	1.26	0.79	0.94	Al	98.21	0	Na	Na	Na	Na	Water	2.57E-07	0.9960	0.0010
2.02	1.60 (square)	4.75	1.60	0.79	0.94	Al	217.26	0	Na	Na	Na	Na	Water	1.15E-07	0.9968	0.0010
2.03	2.10 (square)	4.75	2.10	0.79	0.94	Al	443.75	0	Na	Na	Na	Na	Water	7.31E-08	0.9960	0.0010
2.04	1.35 (triangular)	4.75	1.35	0.79	0.94	Al	97.08	0	Na	Na	Na	Na	Water	2.80E-07	0.9953	0.0010
2.05	1.72 (triangular)	4.75	1.72	0.79	0.94	Al	217.51	0	Na	Na	Na	Na	Water	1.15E-07	0.9975	0.0010
2.06	2.26 (triangular)	4.75	2.26	0.79	0.94	Al	445.38	0	Na	Na	Na	Na	Water	7.34E-08	0.9965	0.0010

Table 6.5.2-1 MONK8a – JEF 2.2 Library Validation Statistics (Continued)

Case	Configuration	wt % ^{235}U	Pitch (cm)	Fuel OD (cm)	Clad OD (cm)	Clad Mat'l.	H/U (fissile)	Sol. B (ppm)	Poison Type/Absorber	G $^{10}B/cm^2$	Cluster Gap (cm)	Wall/ Cluster (cm)	Reflector	Mean Log(E) Neutrons Causing Fission	k_{eff} (JEF2.2)	σ
2.07	1.26 (square-1 in 5 missing)	4.75	1.26	0.79	0.94	Al	97.08	0	Na	Na	Na	Na	Water	2.65E-07	0.9950	0.0010
2.08	1.26 (square-1 in 2 missing)	4.75	1.26	0.79	0.94	Al	217.51	0	Na	Na	Na	Na	Water	1.16E-07	0.9974	0.0010
2.09	1.26 (square-1 in 3 missing)	4.75	1.26	0.79	0.94	Al	445.38	0	Na	Na	Na	Na	Water	7.42E-08	0.9969	0.0010
3.01	3 clusters; 8x15 rods	4.31	2.54	1.265	1.415	Al	256.38	0	None	Na	10.62	Inf	Water	1.18E-07	0.9944	0.0010
3.02	3 clusters; 8x15 rods	4.31	2.54	1.265	1.415	Al	256.38	0	304L Steel (no boron)	0	8.58	Inf	Water	1.17E-07	0.9957	0.0010
3.03	3 clusters; 8x15 rods	4.31	2.54	1.265	1.415	Al	256.38	0	304L Steel (no boron)	0	9.65	Inf	Water	1.18E-07	0.9953	0.0010
3.04	3 clusters; 8x15 rods	4.31	2.54	1.265	1.415	Al	256.38	0	304L Steel (1.05% boron)	0.0049	6.10	Inf	Water	1.19E-07	0.9966	0.0010
3.05	3 clusters; 8x15 rods	4.31	2.54	1.265	1.415	Al	256.38	0	304L Steel (1.05% boron)	0.0049	8.08	Inf	Water	1.18E-07	0.9956	0.0010
3.06	3 clusters; 8x15 rods	4.31	2.54	1.265	1.415	Al	256.38	0	304L Steel (1.62% boron)	0.0074	5.76	Inf	Water	1.18E-07	0.9968	0.0010
3.07	3 clusters; 8x15 rods	4.31	2.54	1.265	1.415	Al	256.38	0	304L Steel (1.62% boron)	0.0074	7.90	Inf	Water	1.16E-07	0.9973	0.0010
3.08	3 clusters; 8x15 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Boral	0.0720	6.72	Inf	Water	1.19E-07	0.9963	0.0010
7.01	3x3 clusters; 14x14 rods	2.46	1.6358	1.206	1.03	Al	453.84	1037	None	Na	0	Inf	Water	2.56E-07	1.0015	0.0010

Table 6.5.2-1 MONK8a – JEF 2.2 Library Validation Statistics (Continued)

Case	Configuration	wt % ^{235}U	Pitch (cm)	Fuel OD (cm)	Clad OD (cm)	Clad Mat'l.	H/U (fissile)	Sol. B (ppm)	Poison Type/Absorber	G $^{10}B/cm^2$	Cluster Gap (cm)	Wall/ Cluster (cm)	Reflector	Mean Log(E) Neutrons Causing Fission	k_{eff} (JEF2.2)	σ
7.02	3x3 clusters; 14x14 rods	2.46	1.6358	1.206	1.03	Al	453.84	769	None	Na	1.64	Inf	Water	2.05E-07	0.9993	0.0010
7.03	3x3 clusters; 14x14 rods	2.46	1.6358	1.206	1.03	Al	453.84	0	B_4C Pins	Na	1.64	Inf	Water	2.03E-07	0.9971	0.0010
7.04	3x3 clusters; 14x14 rods	2.46	1.6358	1.206	1.03	Al	453.84	15	B/Al (1.61wt% B)	0.0052	1.64	Inf	Water	1.98E-07	0.9996	0.0010
7.05	3x3 clusters; 14x14 rods	2.46	1.6358	1.206	1.03	Al	453.84	217	Stainless Steel	0	3.27	Inf	Water	1.75E-07	0.9965	0.0010
7.06	3x3 clusters; 14x14 rods	2.46	1.6358	1.206	1.03	Al	453.84	320	B/Al (0.1wt% B)	0.0003	3.27	Inf	Water	1.79E-07	0.9940	0.0010
7.07	3x3 clusters; 14x14 rods	2.46	1.6358	1.206	1.03	Al	453.84	72	B/Al (0.1wt% B)	0.0003	4.91	Inf	Water	1.61E-07	0.9932	0.0010
7.08	3x3 clusters; 14x14 rods	2.46	1.6358	1.206	1.03	Al	453.84	0	None	Na	6.54	Inf	Water	1.44E-07	0.9943	0.0010
27.01	Cylindrical	7.00	1.32	0.743	0.8324	SS	118.39	0	Na	Na	Na	Na	Water	2.09E-07	0.9994	0.0010
32.01	14x14 array	4.74	1.60	0.79	0.94	Al	217.31	0	Na	Na	Na	0.0	Lead and light water	1.32E-07	1.0161	0.0010
32.02	14x14 array	4.74	1.60	0.79	0.94	Al	217.31	0	Na	Na	Na	0.5	Lead and light water	1.26E-07	1.0184	0.0010
32.03	14x14 array	4.74	1.60	0.79	0.94	Al	217.31	0	Na	Na	Na	1.0	Lead and light water	1.18E-07	1.0166	0.0010

Table 6.5.2-1 MONK8a – JEF 2.2 Library Validation Statistics (Continued)

Case	Configuration	wt % ^{235}U	Pitch (cm)	Fuel OD (cm)	Clad OD (cm)	Clad Mat'l.	H/U (fissile)	Sol. B (ppm)	Poison Type/Absorber	G $^{10}B/cm^2$	Cluster Gap (cm)	Wall/ Cluster (cm)	Reflector	Mean Log(E) Neutrons Causing Fission	k_{eff} (JEF2.2)	σ
32.04	14x14 array	4.74	1.60	0.79	0.94	Al		0	Na	Na	Na	1.5	Lead and light water	1.14E-07	1.0159	0.0010
40.01	22x22	4.74	1.60	0.79	0.94	Al	217.31	0	Hafnium plate	Na	0.0978	Na	Water	1.33E-07	0.9992	0.0010
40.02	22x22	4.74	1.60	0.79	0.94	Al	217.31	0	Hafnium plate	Na	0.1956	Na	Water	1.34E-07	1.0002	0.0010
40.03	22x22	4.74	1.60	0.79	0.94	Al	217.31	0	Hafnium plate	Na	0.2934	Na	Water	1.33E-07	0.9998	0.0010
40.04	22x22	4.74	1.60	0.79	0.94	Al	217.31	0	Hafnium plate	Na	0.3912	Na	Water	1.34E-07	0.9986	0.0010
40.05	22x22	4.74	1.60	0.79	0.94	Al	217.31	0	Hafnium plate	Na	0.489	Na	Water	1.37E-07	1.0020	0.0010
40.06	21x21	4.74	1.60	0.79	0.94	Al	217.31	0	Hafnium plate	Na	0.0978	Na	Water	1.36E-07	1.0014	0.0010
40.07	20x21	4.74	1.60	0.79	0.94	Al	217.31	0	Hafnium plate	Na	0.0978	Na	Water	1.34E-07	1.0023	0.0010
40.08	20x20	4.74	1.60	0.79	0.94	Al	217.31	0	Hafnium plate	Na	0.0978	Na	Water	1.30E-07	0.9987	0.0010
40.09	22x22	4.74	1.60	0.79	0.94	Al	217.31	0	None	Na	-	Na	Water	1.29E-07	0.9998	0.0010
40.10	21x21	4.74	1.60	0.79	0.94	Al	217.31	0	None	Na	-	Na	Water	1.27E-07	1.0006	0.0010
40.11	21x20	4.74	1.60	0.79	0.94	Al	217.31	0	None	Na	-	Na	Water	1.25E-07	1.0016	0.0010
40.12	20x20	4.74	1.60	0.79	0.94	Al	217.31	0	None	Na	-	Na	Water	1.25E-07	0.9988	0.0010
17.01	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	13.100	0.000	Lead	1.03E-07	1.0010	0.0010
17.02	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	12.980	0.660	Lead	1.00E-07	0.9994	0.0010
17.03	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	10.510	2.616	Lead	1.00E-07	0.9962	0.0010
17.04	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	11.090	0.000	Uranium	1.05E-07	0.9955	0.0010

Table 6.5.2-1 MONK8a – JEF 2.2 Library Validation Statistics (Continued)

Case	Configuration	wt % ^{235}U	Pitch (cm)	Fuel OD (cm)	Clad OD (cm)	Clad Mat'l.	H/U (fissile)	Sol. B (ppm)	Poison Type/Absorber	G $^{10}B/cm^2$	Cluster Gap (cm)	Wall/ Cluster (cm)	Reflector	Mean Log(E) Neutrons Causing Fission	k_{eff} (JEF2.2)	σ
17.05	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	13.190	1.321	Uranium	1.02E-07	0.9972	0.0010
17.06	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	13.370	1.956	Uranium	1.02E-07	0.9974	0.0010
17.07	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	12.960	2.616	Uranium	1.00E-07	0.9967	0.0010
17.08	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	9.950	5.405	Uranium	1.01E-07	0.9944	0.0010
17.09	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	7.820	10.676	Uranium	9.86E-08	0.9946	0.0010
17.10	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	9.888	0.000	Steel	1.03E-07	0.9975	0.0010
17.11	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	10.438	0.660	Steel	1.03E-07	0.9970	0.0010
17.12	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	10.438	1.321	Steel	1.02E-07	0.9958	0.0010
17.13	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	9.598	2.616	Steel	9.91E-08	0.9964	0.0010
17.14	3 clusters; 16x19 rods	2.35	2.032	1.1176	1.27	Al	398.80	0	Na	Na	8.748	3.912	Steel	9.88E-08	0.9955	0.0010
17.15	18x25(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	8.566	0.000	Steel	1.89E-07	0.9943	0.0010
17.16	18x25(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	9.166	0.660	Steel	1.83E-07	0.9972	0.0010
17.17	18x25(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	9.096	1.321	Steel	1.75E-07	0.9988	0.0010

Table 6.5.2-1 MONK8a – JEF 2.2 Library Validation Statistics (Continued)

Case	Configuration	wt % ^{235}U	Pitch (cm)	Fuel OD (cm)	Clad OD (cm)	Clad Mat'l.	H/U (fissile)	Sol. B (ppm)	Poison Type/Absorber	G $^{10}B/cm^2$	Cluster Gap (cm)	Wall/ Cluster (cm)	Reflector	Mean Log(E) Neutrons Causing Fission	k_{eff} (JEF2.2)	σ
17.18	18x25(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	9.246	1.684	Steel	1.77E-07	0.9965	0.0010
17.19	18x25(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	8.866	2.344	Steel	1.69E-07	0.9966	0.0010
17.20	18x25(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	8.646	3.005	Steel	1.73E-07	0.9959	0.0010
17.21	18x25(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	8.126	3.912	Steel	1.66E-07	0.9943	0.0010
17.22	18x25(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	7.256	6.726	Steel	1.65E-07	0.9949	0.0010
17.23	18x23(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	9.646	0.000	Lead	1.76E-07	0.9992	0.0010
17.24	18x23(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	9.696	0.660	Lead	1.74E-07	1.0002	0.0010
17.25	18x23(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	8.086	3.276	Lead	1.65E-07	0.9979	0.0010
17.26	18x23(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	7.646	0.000	Uranium	1.86E-07	0.9926	0.0010
17.27	18x23(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	9.086	1.321	Uranium	1.78E-07	0.9936	0.0010
17.28	18x23(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	9.416	2.616	Uranium	1.66E-07	0.9981	0.0010
17.29	18x23(center), 18x20(two outer)	2.35	1.684	1.1176	1.27	Al	398.80	0	Na	Na	9.776	3.912	Uranium	1.67E-07	0.9964	0.0010
10.01	3 clusters; 8x13 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Na	Na	19.495	0.000	Lead	1.22E-07	1.0091	0.0010
10.02	3 clusters; 8x13 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Na	Na	19.655	0.660	Lead	1.20E-07	1.0074	0.0010

Table 6.5.2-1 MONK8a – JEF 2.2 Library Validation Statistics (Continued)

Case	Configuration	wt % ^{235}U	Pitch (cm)	Fuel OD (cm)	Clad OD (cm)	Clad Mat'l.	H/U (fissile)	Sol. B (ppm)	Poison Type/Absorber	G $^{10}B/cm^2$	Cluster Gap (cm)	Wall/ Cluster (cm)	Reflector	Mean Log(E) Neutrons Causing Fission	k_{eff} (JEF2.2)	σ
10.03	3 clusters; 8x13 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Na	Na	17.915	1.321	Lead	1.18E-07	1.0044	0.0010
10.04	3 clusters; 8x13 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Na	Na	9.175	5.405	Lead	1.15E-07	0.9945	0.0010
10.05	3 clusters; 8x13 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Na	Na	14.255	0.000	Uranium	1.32E-07	0.9951	0.0010
10.06	3 clusters; 8x12 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Na	Na	14.195	1.956	Uranium	1.18E-07	0.9974	0.0010
10.07	3 clusters; 8x13 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Na	Na	16.925	3.912	Uranium	1.18E-07	0.9977	0.0010
10.08	3 clusters; 8x13 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Na	Na	12.365	5.405	Uranium	1.16E-07	0.9922	0.0010
10.09	3 clusters; 8x13 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Na	Na	11.765	0.000	Steel	1.26E-07	1.0004	0.0010
10.10	3 clusters; 8x13 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Na	Na	13.125	0.660	Steel	1.25E-07	0.9981	0.0010
10.11	3 clusters; 8x13 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Na	Na	12.995	1.321	Steel	1.20E-07	0.9992	0.0010
10.12	3 clusters; 8x13 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Na	Na	11.315	2.616	Steel	1.17E-07	0.9987	0.0010
10.13	3 clusters; 8x13 rods	4.31	2.54	1.265	1.415	Al	256.38	0	Na	Na	8.675	5.405	Steel	1.16E-07	0.9954	0.0010
10.14	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	14.393	0.000	Steel	3.27E-07	1.0002	0.0010
10.15	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	15.263	0.660	Steel	3.16E-07	1.0015	0.0010
10.16	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	15.393	1.321	Steel	3.04E-07	1.0003	0.0010

Table 6.5.2-1 MONK8a – *JEF 2.2 Library Validation Statistics (Continued)*

Case	Configuration	wt % ^{235}U	Pitch (cm)	Fuel OD (cm)	Clad OD (cm)	Clad Mat'l.	H/U (fissile)	Sol. B (ppm)	Poison Type/Absorber	G $^{10}B/cm^2$	Cluster Gap (cm)	Wall/ Cluster (cm)	Reflector	Mean Log(E) Neutrons Causing Fission	k_{eff} (JEF2.2)	σ
10.17	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	15.363	1.956	Steel	2.97E-07	1.0039	0.0010
10.18	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	14.973	2.616	Steel	2.91E-07	0.9994	0.0010
10.19	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	13.343	5.405	Steel	2.80E-07	1.0007	0.0010
10.20	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	17.263	0.000	Lead	3.11E-07	1.0054	0.0010
10.21	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	17.703	0.660	Lead	3.01E-07	1.0047	0.0010
10.22	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	16.953	1.956	Lead	2.89E-07	1.0042	0.0010
10.23	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	13.873	5.001	Lead	2.81E-07	0.9993	0.0010
10.24	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	14.853	0.000	Uranium	3.33E-07	0.9965	0.0010
10.25	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	16.233	0.660	Uranium	3.23E-07	0.9991	0.0010
10.26	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	17.793	1.321	Uranium	3.14E-07	0.9995	0.0010
10.27	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	18.763	1.956	Uranium	3.05E-07	1.0006	0.0010
10.28	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	18.893	2.616	Uranium	3.01E-07	0.9991	0.0010
10.29	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	18.303	3.276	Uranium	2.88E-07	0.9985	0.0010
10.30	3 clusters; 12x16 rods	4.31	1.892	1.265	1.415	Al	256.38	0	Na	Na	15.923	5.405	Uranium	2.83E-07	0.9988	0.0010

Table 6.5.2-2 Range of Correlated Parameters for Connecticut Yankee Fuel

Parameter	Benchmark Minimum Value	Benchmark Maximum Value	CY-MPC
Enrichment (wt % ^{235}U)	2.35	7.00	4.61
Rod pitch (cm)	1.26	2.54	1.429
H/U (fissile) atomic ratio	97.08	453.84	130.17
^{10}B loading (g/cm^2)	0.000	0.072	0.02
Log energy causing fission	7.31E-08	3.33E-07	2.88E-07
Cluster gap thickness (cm)	0.0	11.92	2.54 to 8.89
Fuel diameter (cm)	0.743	1.265	0.975
Clad diameter (cm)	0.8324	1.4150	1.076

Table 6.5.2-3 MONK8a – Correlation Coefficient for Linear Curve-Fit of Critical Benchmarks

Correlation Studied	Correlation Coefficient (R)
k_{eff} versus enrichment	0.390
k_{eff} versus rod pitch	0.140
k_{eff} versus H/U (fissile) atomic ratio	0.369
k_{eff} versus ^{10}B loading	0.273
k_{eff} versus log energy causing fission	0.127
k_{eff} versus cluster gap thickness	0.532
k_{eff} versus fuel diameter	0.236
k_{eff} versus clad diameter	0.185

6.6 References

1. Code of Federal Regulations, "Packaging and Transportation of Radioactive Materials," Part 71, Title 10.

2. Not used.

3. Landers, N.F. and Petrie, L.M., "SCALE 4.3: Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation for Workstations and Personal Computers," ORNL CC-545, ORNL, September 1995.

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6.7 Supplemental Data

This section presents the input and/or output files for the NAC-STC directly loaded fuel configuration, and for the Yankee-MPC and CY-MPC canistered fuel configurations.

Figures 6.7-1 and 6.7-2 present the CSAS25 input/output files for the criticality analysis of the directly loaded fuel.

Figures 6.7-3 through 6.7-8 present the CSAS25 input/output files for the Yankee Class fuel in the NAC-MPC canistered configuration, including reconfigured Yankee Class fuel and the enlarged fuel tube configuration.

Figure 6.7-9 presents the MONK8a input and output file for the maximum reactivity CY-MPC canistered fuel configuration.

Figure 6.7-10 presents a typical CSAS25 input and output file for the Framatome-Cogema fuel.

Figure 6.7-11 presents a typical CSAS input/output summary for the Damaged Fuel Can configuration for normal conditions.

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis

```
PRIMARY MODULE ACCESS AND INPUT RECORD ( SCALE DRIVER - 95/03/29 - 09:06:37 )
   MODULE CSAS25   WILL BE CALLED
     NAC-STC 26 DIRECTLY LOADED, WEST 17x17 OFA, NORMAL LOAD 1.0 1.0, PITCH 250 CM
     27GROUPNDF4 LATTICECELL
     'FUEL
     UO2  1  0.95 293.0 92235 4.20 92238 95.80 END
     'CLAD
     ZIRCALLOY   2  1.0  293.0  END
     'H2O CASK INTERIOR
     H2O  3  1.0  293.0  END
     'AL DISK
     AL   4  1.0  293.0  END
     'CASK / DISK STEEL
     SS304 5 1.0  293.0  END
     'BORAL SHEETS
     AL     6 DEN=2.6226 0.5738 293.0 END
     B-10   6 DEN=2.6226 0.0450 293.0 END
     B-11   6 DEN=2.6226 0.2735 293.0 END
     C      6 DEN=2.6226 0.0926 293.0 END
     'LEAD SHIELD
     PB     7 1.0 293.0  END
     'NS4FR SHIELD
     B-10   8 0.0 8.553-5 293.0 END
     B-11   8 0.0 3.422-4 293.0 END
     AL     8 0.0 7.763-3 293.0 END
     H      8 0.0 5.854-2 293.0 END
     O      8 0.0 2.609-2 293.0 END
     C      8 0.0 2.264-2 293.0 END
     N      8 0.0 1.394-3 293.0 END
     'CASK EXTERIOR WATER
     H2O    9 1.0 293.0 END
     'PELLET CLAD GAP WATER
     H2O  10 1.0 293.0 END
     END COMP
     SQUAREPITCH  1.2598 0.7844 1 3 0.9144 2 0.8002 0 END
     NAC-STC 26 DIRECTLY LOADED, WEST 17x17 OFA, NORMAL LOAD 1.0 1.0, PITCH 250 CM
     READ PARAM RUN=YES PLT=NO TME=5000 GEN=803 NPG=1000 END PARAM
     READ GEOM
     UNIT  1
     COM='FUEL PIN CELL - FOR WATER ELEVATION'
     CYLINDER  1 1  0.3922   2P2.3749
     CYLINDER  0 1  0.4001   2P2.3749
     CYLINDER  2 1  0.4572   2P2.3749
     CUBOID    3 1  4P0.6299 2P2.3749
     UNIT  2
     COM='GUIDE/INSTRUMENT TUBE CELL - FOR WATER ELEVATION'
     CYLINDER  3 1  0.5715   2P2.3749
     CYLINDER  2 1  0.6121   2P2.3749
     CUBOID    3 1  4P0.6299 2P2.3749
     UNIT  3
     COM='FUEL PIN CELL - FOR STEEL DISK ELEVATION'
     CYLINDER  1 1  0.3922   2P0.6350
     CYLINDER  0 1  0.4001   2P0.6350
     CYLINDER  2 1  0.4572   2P0.6350
     CUBOID    3 1  4P0.6299 2P0.6350
     UNIT  4
     COM='GUIDE/INSTRUMENT TUBE CELL - FOR STEEL DISK ELEVATION'
     CYLINDER  3 1  0.5715   2P0.6350
     CYLINDER  2 1  0.6121   2P0.6350
     CUBOID    3 1  4P0.6299 2P0.6350
     UNIT  5
     COM='FUEL PIN CELL - FOR AL DISK ELEVATION'
     CYLINDER  1 1  0.3922   2P0.7938
     CYLINDER  0 1  0.4001   2P0.7938
     CYLINDER  2 1  0.4572   2P0.7938
     CUBOID    3 1  4P0.6299 2P0.7938
     UNIT  6
     COM='GUIDE/INSTRUMENT TUBE CELL - FOR AL DISK ELEVATION'
     CYLINDER  3 1  0.5715   2P0.7938
     CYLINDER  2 1  0.6121   2P0.7938
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
CUBOID    3 1  4P0.6299 2P0.7938
UNIT 21
COM='ASSEMBLY - FOR WATER ELEVATION'
ARRAY  1 -10.7083 -10.7083 -2.3749
UNIT 22
COM='ASSEMBLY - FOR STEEL DISK ELEVATION
ARRAY  2 -10.7083 -10.7083 -0.6350
UNIT 23
COM='ASSEMBLY - FOR AL DISK ELEVATION'
ARRAY  3 -10.7083 -10.7083 -0.7938
UNIT 31
COM='X-X BORAL SHEET - FOR WATER ELEVATION'
CUBOID 6 1 2P10.3886 2P0.0635 2P2.3749
CUBOID 4 1 2P10.3886 2P0.0951 2P2.3749
UNIT 32
COM='Y-Y BORAL SHEET - FOR WATER ELEVATION'
CUBOID 6 1 2P0.0635 2P10.3886 2P2.3749
CUBOID 4 1 2P0.0951 2P10.3886 2P2.3749
UNIT 33
COM='X-X BORAL SHEET - FOR STEEL DISK ELEVATION'
CUBOID 6 1 2P10.3886 2P0.0635 2P0.6350
CUBOID 4 1 2P10.3886 2P0.0951 2P0.6350
UNIT 34
COM='Y-Y BORAL SHEET - FOR STEEL DISK ELEVATION'
CUBOID 6 1 2P0.0635 2P10.3886 2P0.6350
CUBOID 4 1 2P0.0951 2P10.3886 2P0.6350
UNIT 35
COM='X-X BORAL SHEET - FOR AL DISK ELEVATION'
CUBOID 6 1 2P10.3886 2P0.0635 2P0.7938
CUBOID 4 1 2P10.3886 2P0.0951 2P0.7938
UNIT 36
COM='Y-Y BORAL SHEET - FOR AL DISK ELEVATION'
CUBOID 6 1 2P0.0635 2P10.3886 2P0.7938
CUBOID 4 1 2P0.0951 2P10.3886 2P0.7938
UNIT 40
COM='FUEL TUBE - FOR WATER ELEVATION (B)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE   21 0.0 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0.0 +11.4054 0.0
HOLE 31 0.0 -11.4054 0.0
HOLE 32 +11.4054 0.0 0.0
HOLE 32 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 41
COM='FUEL TUBE - FOR WATER ELEVATION (T)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE   21 0.0 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0.0 +11.4054 0.0
HOLE 31 0.0 -11.4054 0.0
HOLE 32 +11.4054 0.0 0.0
HOLE 32 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 42
COM='FUEL TUBE - FOR WATER ELEVATION (BL)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE   21 -0.4803 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0.0 +11.4054 0.0
HOLE 31 0.0 -11.4054 0.0
HOLE 32 +11.4054 0.0 0.0
HOLE 32 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 43
COM='FUEL TUBE - FOR WATER ELEVATION (BR)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE   21 +0.4803 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0.0 +11.4054 0.0
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
HOLE 31 0.0 -11.4054 0.0
HOLE 32 +11.4054 0.0 0.0
HOLE 32 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 44
COM='FUEL TUBE - FOR WATER ELEVATION (TL)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE   21 -0.4803 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0.0 +11.4054 0.0
HOLE 31 0.0 -11.4054 0.0
HOLE 32 +11.4054 0.0 0.0
HOLE 32 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 45
COM='FUEL TUBE - FOR WATER ELEVATION (TR)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE   21 +0.4803 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0.0 +11.4054 0.0
HOLE 31 0.0 -11.4054 0.0
HOLE 32 +11.4054 0.0 0.0
HOLE 32 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 50
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (B)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE   22 0.0 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0.0 +11.4054 0.0
HOLE 33 0.0 -11.4054 0.0
HOLE 34 +11.4054 0.0 0.0
HOLE 34 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 51
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (T)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE   22 0.0 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0.0 +11.4054 0.0
HOLE 33 0.0 -11.4054 0.0
HOLE 34 +11.4054 0.0 0.0
HOLE 34 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 52
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (BL)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE   22 -0.4803 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0.0 +11.4054 0.0
HOLE 33 0.0 -11.4054 0.0
HOLE 34 +11.4054 0.0 0.0
HOLE 34 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 53
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (BR)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE   22 +0.4803 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0.0 +11.4054 0.0
HOLE 33 0.0 -11.4054 0.0
HOLE 34 +11.4054 0.0 0.0
HOLE 34 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 54
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (TL)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE   22 -0.4803 +0.4803 0.0
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0.0 +11.4054 0.0
HOLE 33 0.0 -11.4054 0.0
HOLE 34 +11.4054 0.0 0.0
HOLE 34 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 55
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (TR)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE   22 +0.4803 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0.0 +11.4054 0.0
HOLE 33 0.0 -11.4054 0.0
HOLE 34 +11.4054 0.0 0.0
HOLE 34 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 60
COM='FUEL TUBE - FOR AL DISK ELEVATION (B)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE   23 0.0 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0.0 +11.4054 0.0
HOLE 35 0.0 -11.4054 0.0
HOLE 36 +11.4054 0.0 0.0
HOLE 36 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 61
COM='FUEL TUBE - FOR AL DISK ELEVATION (T)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE   23 0.0 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0.0 +11.4054 0.0
HOLE 35 0.0 -11.4054 0.0
HOLE 36 +11.4054 0.0 0.0
HOLE 36 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 62
COM='FUEL TUBE - FOR AL DISK ELEVATION (BL)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE   23 -0.4803 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0.0 +11.4054 0.0
HOLE 35 0.0 -11.4054 0.0
HOLE 36 +11.4054 0.0 0.0
HOLE 36 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 63
COM='FUEL TUBE - FOR AL DISK ELEVATION (BR)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE   23 +0.4803 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0.0 +11.4054 0.0
HOLE 35 0.0 -11.4054 0.0
HOLE 36 +11.4054 0.0 0.0
HOLE 36 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 64
COM='FUEL TUBE - FOR AL DISK ELEVATION (TL)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE   23 -0.4803 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0.0 +11.4054 0.0
HOLE 35 0.0 -11.4054 0.0
HOLE 36 +11.4054 0.0 0.0
HOLE 36 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 65
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
COM='FUEL TUBE - FOR AL DISK ELEVATION (TR)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE   23 +0.4803 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0.0 +11.4054 0.0
HOLE 35 0.0 -11.4054 0.0
HOLE 36 +11.4054 0.0 0.0
HOLE 36 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 70
COM='DISK OPENING - FOR WATER ELEVATION (B)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 40 0.0 -0.1810 0.0
UNIT 71
COM='DISK OPENING - FOR WATER ELEVATION (T)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 41 0.0 +0.1810 0.0
UNIT 72
COM='DISK OPENING - FOR WATER ELEVATION (BL)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 42 -0.1810 -0.1810 0.0
UNIT 73
COM='DISK OPENING - FOR WATER ELEVATION (BR)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 43 +0.1810 -0.1810 0.0
UNIT 74
COM='DISK OPENING - FOR WATER ELEVATION (TL)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 44 -0.1810 +0.1810 0.0
UNIT 75
COM='DISK OPENING - FOR WATER ELEVATION (TR)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 45 +0.1810 +0.1810 0.0
UNIT 80
COM='DISK OPENING - FOR STEEL DISK ELEVATION (B)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 50 0.0 -0.1810 0.0
UNIT 81
COM='DISK OPENING - FOR STEEL DISK ELEVATION (T)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 51 0.0 +0.1810 0.0
UNIT 82
COM='DISK OPENING - FOR STEEL DISK ELEVATION (BL)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 52 -0.1810 -0.1810 0.0
UNIT 83
COM='DISK OPENING - FOR STEEL DISK ELEVATION (BR)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 53 +0.1810 -0.1810 0.0
UNIT 84
COM='DISK OPENING - FOR STEEL DISK ELEVATION (TL)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 54 -0.1810 +0.1810 0.0
UNIT 85
COM='DISK OPENING - FOR STEEL DISK ELEVATION (TR)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 55 +0.1810 +0.1810 0.0
UNIT 90
COM='DISK OPENING - FOR AL DISK ELEVATION (B)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 60 0.0 -0.1810 0.0
UNIT 91
COM='DISK OPENING - FOR AL DISK ELEVATION (T)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 61 0.0 +0.1810 0.0
UNIT 92
COM='DISK OPENING - FOR AL DISK ELEVATION (BL)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 62 -0.1810 -0.1810 0.0
UNIT 93
COM='DISK OPENING - FOR AL DISK ELEVATION (BR)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 63 +0.1810 -0.1810 0.0
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
UNIT 94
COM='DISK OPENING - FOR AL DISK ELEVATION (TL)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 64 -0.1810 +0.1810 0.0
UNIT 95
COM='DISK OPENING - FOR AL DISK ELEVATION (TR)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 65 +0.1810 +0.1810 0.0
UNIT 101
COM='BASKET STRUCTURE IN TRANPORT CASK - WATER ELEVATION'
CYLINDER 3 1 +90.17 2P2.3749
HOLE 75 -58.9864 -40.7822 0.0
HOLE 75 -58.9864 -13.5941 0.0
HOLE 73 -58.9864 +13.5941 0.0
HOLE 73 -58.9864 +40.7822 0.0
HOLE 75 -27.1882 -67.9704 0.0
HOLE 75 -27.1882 -40.7822 0.0
HOLE 75 -27.1882 -13.5941 0.0
HOLE 73 -27.1882 +13.5941 0.0
HOLE 73 -27.1882 +40.7822 0.0
HOLE 73 -27.1882 +67.9704 0.0
HOLE 71   0.0    -67.9704 0.0
HOLE 71   0.0    -40.7822 0.0
HOLE 71   0.0    -13.5941 0.0
HOLE 70   0.0    +13.5941 0.0
HOLE 70   0.0    +40.7822 0.0
HOLE 70   0.0    +67.9704 0.0
HOLE 74 +27.1882 -67.9704 0.0
HOLE 74 +27.1882 -40.7822 0.0
HOLE 74 +27.1882 -13.5941 0.0
HOLE 72 +27.1882 +13.5941 0.0
HOLE 72 +27.1882 +40.7822 0.0
HOLE 72 +27.1882 +67.9704 0.0
HOLE 74 +58.9864 -40.7822 0.0
HOLE 74 +58.9864 -13.5941 0.0
HOLE 72 +58.9864 +13.5941 0.0
HOLE 72 +58.9864 +40.7822 0.0
CYLINDER  5 1  +93.98 2P2.3749
CYLINDER  7 1 +103.43 2P2.3749
CYLINDER  5 1 +110.11 2P2.3749
CYLINDER  8 1 +124.12 2P2.3749
CYLINDER  0 1 +124.44 2P2.3749
CYLINDER  5 1 +125.07 2P2.3749
CUBOID    9 1 4P125.07 2P2.3749
UNIT 102
COM='BASKET STRUCTURE IN TRANPORT CASK - ST DISK ELEVATION'
CYLINDER  5 1 +89.99 2P0.6350
HOLE 85 -58.9864 -40.7822 0.0
HOLE 85 -58.9864 -13.5941 0.0
HOLE 83 -58.9864 +13.5941 0.0
HOLE 83 -58.9864 +40.7822 0.0
HOLE 85 -27.1882 -67.9704 0.0
HOLE 85 -27.1882 -40.7822 0.0
HOLE 85 -27.1882 -13.5941 0.0
HOLE 83 -27.1882 +13.5941 0.0
HOLE 83 -27.1882 +40.7822 0.0
HOLE 83 -27.1882 +67.9704 0.0
HOLE 81   0.0    -67.9704 0.0
HOLE 81   0.0    -40.7822 0.0
HOLE 81   0.0    -13.5941 0.0
HOLE 80   0.0    +13.5941 0.0
HOLE 80   0.0    +40.7822 0.0
HOLE 80   0.0    +67.9704 0.0
HOLE 84 +27.1882 -67.9704 0.0
HOLE 84 +27.1882 -40.7822 0.0
HOLE 84 +27.1882 -13.5941 0.0
HOLE 82 +27.1882 +13.5941 0.0
HOLE 82 +27.1882 +40.7822 0.0
HOLE 82 +27.1882 +67.9704 0.0
HOLE 84 +58.9864 -40.7822 0.0
HOLE 84 +58.9864 -13.5941 0.0
HOLE 82 +58.9864 +13.5941 0.0
HOLE 82 +58.9864 +40.7822 0.0
CYLINDER  3 1  +90.17 2P0.6350
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
CYLINDER  5 1  +93.98 2P0.6350
CYLINDER  7 1 +103.43 2P0.6350
CYLINDER  5 1 +110.11 2P0.6350
CYLINDER  8 1 +124.12 2P0.6350
CYLINDER  0 1 +124.44 2P0.6350
CYLINDER  5 1 +125.07 2P0.6350
CUBOID    9 1 4P125.07 2P0.6350
UNIT 103
COM='BASKET STRUCTURE IN TRANPORT CASK - AL DISK ELEVATION'
CYLINDER  4 1 +89.73 2P0.7938
HOLE 95 -58.9864 -40.7822 0.0
HOLE 95 -58.9864 -13.5941 0.0
HOLE 93 -58.9864 +13.5941 0.0
HOLE 93 -58.9864 +40.7822 0.0
HOLE 95 -27.1882 -67.9704 0.0
HOLE 95 -27.1882 -40.7822 0.0
HOLE 95 -27.1882 -13.5941 0.0
HOLE 93 -27.1882 +13.5941 0.0
HOLE 93 -27.1882 +40.7822 0.0
HOLE 93 -27.1882 +67.9704 0.0
HOLE 91   0.0    -67.9704 0.0
HOLE 91   0.0    -40.7822 0.0
HOLE 91   0.0    -13.5941 0.0
HOLE 90   0.0    +13.5941 0.0
HOLE 90   0.0    +40.7822 0.0
HOLE 90   0.0    +67.9704 0.0
HOLE 94 +27.1882 -67.9704 0.0
HOLE 94 +27.1882 -40.7822 0.0
HOLE 94 +27.1882 -13.5941 0.0
HOLE 92 +27.1882 +13.5941 0.0
HOLE 92 +27.1882 +40.7822 0.0
HOLE 92 +27.1882 +67.9704 0.0
HOLE 94 +58.9864 -40.7822 0.0
HOLE 94 +58.9864 -13.5941 0.0
HOLE 92 +58.9864 +13.5941 0.0
HOLE 92 +58.9864 +40.7822 0.0
CYLINDER  3 1  +90.17 2P0.7938
CYLINDER  5 1  +93.98 2P0.7938
CYLINDER  7 1 +103.43 2P0.7938
CYLINDER  5 1 +110.11 2P0.7938
CYLINDER  8 1 +124.12 2P0.7938
CYLINDER  0 1 +124.44 2P0.7938
CYLINDER  5 1 +125.07 2P0.7938
CUBOID    9 1 4P125.07 2P0.7938
GLOBAL UNIT 104
COM='DISK SLICE STACK'
ARRAY  4 -125.07 -125.07 0.0
CUBOID 9 1 4P125.08 12.3573 0.0
END GEOM
READ ARRAY
ARA=1   NUX=17 NUY=17 NUZ=1  FILL
                        34R1
          5R1   2   2R1   2   2R1   2   5R1
               3R1   2   9R1   2   3R1
                        17R1
2R1   2   2R1   2   2R1   2   2R1   2   2R1   2   2R1
                        34R1
2R1   2   2R1   2   2R1   2   2R1   2   2R1   2   2R1
                        34R1
2R1   2   2R1   2   2R1   2   2R1   2   2R1   2   2R1
                        17R1
               3R1   2   9R1   2   3R1
          5R1   2   2R1   2   2R1   2   5R1
                        34R1
END FILL
ARA=2  NUX=17 NUY=17 NUZ=1  FILL
                        34R3
          5R3   4   2R3   4   2R3   4   5R3
               3R3   4   9R3   4   3R3
                        17R3
2R3   4   2R3   4   2R3   4   2R3   4   2R3   4   2R3
                        34R3
2R3   4   2R3   4   2R3   4   2R3   4   2R3   4   2R3
                        34R3
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
2R3   4   2R3   4   2R3   4   2R3   4   2R3   4   2R3
                         17R3
               3R3   4   9R3   4   3R3
          5R3   4   2R3   4   2R3   4   5R3
                         34R3
END FILL
ARA=3  NUX=17 NUY=17 NUZ=1  FILL
                         34R5
          5R5   6   2R5   6   2R5   6   5R5
               3R5   6   9R5   6   3R5
                         17R5
2R5   6   2R5   6   2R5   6   2R5   6   2R5   6   2R5
                         34R5
2R5   6   2R5   6   2R5   6   2R5   6   2R5   6   2R5
                         34R5
2R5   6   2R5   6   2R5   6   2R5   6   2R5   6   2R5
                         17R5
               3R5   6   9R5   6   3R5
          5R5   6   2R5   6   2R5   6   5R5
                         34R5
END FILL
ARA=4 NUX=1 NUY=1 NUZ=4 FILL 101 102 101 103 END FILL
END ARRAY
READ BOUNDS ZFC=PER YXF=MIRROR END BOUNDS
READ PLOT
TTL='XY SLICE OF CASK - ST DISK ELEVATION'
SCR=YES PIC=MAT LPI=10
XUL=-120.0 YUL=120.0 ZUL=5.5 XLR=120.0 YLR=-120.0 ZLR=5.5
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='XY SLICE CASK CENTER AREA ST DISK ELEVATION'
SCR=YES PIC=MAT LPI=10
XUL=-27.0 YUL=27.0 ZUL=5.5 XLR=27.0 YLR=-27.0 ZLR=5.5
UAX=1.0 VDN=-1.0 NAX=1500 END
END PLOT
END DATA
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
*****************************************************************************
*****************************************************************************
*****************************************************************************
*****                                                                   *****
*****                 PROGRAM VERIFICATION INFORMATION                  *****
*****                                                                   *****
*****                CODE SYSTEM:  SCALE-PC VERSION:  4.3               *****
*****                                                                   *****
*****************************************************************************
*****************************************************************************
*****                                                                   *****
*****                                                                   *****
*****              PROGRAM:  CSAS                                       *****
*****                                                                   *****
*****        CREATION DATE:  03-08-96                                   *****
*****                                                                   *****
*****              VOLUME:   ENG                                        *****
*****                                                                   *****
*****              LIBRARY:  G:\SCALE43\EXE                             *****
*****                                                                   *****
*****                                                                   *****
*****      PRODUCTION CODE:  CSAS                                       *****
*****                                                                   *****
*****              VERSION:  3.1                                        *****
*****                                                                   *****
*****              JOBNAME:  SCALE-PC                                   *****
*****                                                                   *****
*****    DATE OF EXECUTION:  01/27/98                                   *****
*****                                                                   *****
*****    TIME OF EXECUTION:  03:55:50                                   *****
*****                                                                   *****
*****                                                                   *****
*****************************************************************************
*****************************************************************************
*****************************************************************************


NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, NORMAL LOAD 1.0 1.0, PITCH 250 CM


**** PROBLEM PARAMETERS ****

LIB 27GROUPNDF4  LIBRARY
MXX           10 MIXTURES
MSC           19 COMPOSITION SPECIFICATIONS
IZM            4 MATERIAL ZONES
GE  LATTICECELL  GEOMETRY
MORE           0 0/1 DO NOT READ/READ OPTIONAL PARAMETER DATA
MSLN           0 FUEL SOLUTIONS


**** PROBLEM COMPOSITION DESCRIPTION ****

SC  UO2          STANDARD COMPOSITION
MX             1 MIXTURE NO.
VF        0.9500 VOLUME FRACTION
ROTH     10.9600 THEORETICAL DENSITY
NEL            2 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           92000      1.00 ATOM/MOLECULE
                           92235     4.200 WT%
                           92238    95.800 WT%
            8016      2.00 ATOMS/MOLECULE

'CLAD
 END

SC  ZIRCALLOY    STANDARD COMPOSITION
MX             2 MIXTURE NO.
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
    VF          1.0000 VOLUME FRACTION
    ROTH        6.5600 THEORETICAL DENSITY
    NEL              1 NO. ELEMENTS
    ICP              1 0/1 MIXTURE/COMPOUND
    TEMP         293.0 DEG KELVIN
                 40302       1.00 ATOM/MOLECULE

'H2O CASK INTERIOR
    END

    SC  H2O            STANDARD COMPOSITION
    MX               3 MIXTURE NO.
    VF          1.0000 VOLUME FRACTION
    ROTH        0.9982 THEORETICAL DENSITY
    NEL              2 NO. ELEMENTS
    ICP              1 0/1 MIXTURE/COMPOUND
    TEMP         293.0 DEG KELVIN
                  1001       2.00 ATOMS/MOLECULE
                  8016       1.00 ATOM/MOLECULE

'AL DISK
    END

    SC  AL             STANDARD COMPOSITION
    MX               4 MIXTURE NO.
    VF          1.0000 VOLUME FRACTION
    ROTH        2.7020 THEORETICAL DENSITY
    NEL              1 NO. ELEMENTS
    ICP              1 0/1 MIXTURE/COMPOUND
    TEMP         293.0 DEG KELVIN
                 13027       1.00 ATOM/MOLECULE

'CASK / DISK STEEL
    END

    SC  SS304          STANDARD COMPOSITION
    MX               5 MIXTURE NO.
    VF          1.0000 VOLUME FRACTION
    ROTH        7.9200 THEORETICAL DENSITY
    NEL              4 NO. ELEMENTS
    ICP              0 0/1 MIXTURE/COMPOUND
    TEMP         293.0 DEG KELVIN
                 24304     19.000 WT%
                 25055      2.000 WT%
                 26304     69.500 WT%
                 28304      9.500 WT%

'BORAL SHEETS
    END

    SC  AL             STANDARD COMPOSITION
    MX               6 MIXTURE NO.
    VF          0.5738 VOLUME FRACTION
    ROTH        2.6226 SPECIFIED DENSITY
    NEL              1 NO. ELEMENTS
    ICP              1 0/1 MIXTURE/COMPOUND
    TEMP         293.0 DEG KELVIN
                 13027       1.00 ATOM/MOLECULE
    END

    SC  B-10           STANDARD COMPOSITION
    MX               6 MIXTURE NO.
    VF          0.0450 VOLUME FRACTION
    ROTH        2.6226 SPECIFIED DENSITY
    NEL              1 NO. ELEMENTS
    ICP              1 0/1 MIXTURE/COMPOUND
    TEMP         293.0 DEG KELVIN
                  5010       1.00 ATOM/MOLECULE
    END

    SC  B-11           STANDARD COMPOSITION
    MX               6 MIXTURE NO.
    VF          0.2735 VOLUME FRACTION
    ROTH        2.6226 SPECIFIED DENSITY
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                5011       1.00 ATOM/MOLECULE
    END

    SC  C            STANDARD COMPOSITION
    MX             6 MIXTURE NO.
    VF        0.0926 VOLUME FRACTION
    ROTH      2.6226 SPECIFIED DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                6012       1.00 ATOM/MOLECULE

'LEAD SHIELD
    END

    SC  PB           STANDARD COMPOSITION
    MX             7 MIXTURE NO.
    VF        1.0000 VOLUME FRACTION
    ROTH     11.3440 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
               82000       1.00 ATOM/MOLECULE

'NS4FR SHIELD
    END

    SC  B-10         STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   8.5530E-05 ATOMIC DENSITY
    ROTH      1.0000 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                5010       1.00 ATOM/MOLECULE
    END

    SC  B-11         STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   3.4220E-04 ATOMIC DENSITY
    ROTH      1.0000 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                5011       1.00 ATOM/MOLECULE
    END

    SC  AL           STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   7.7630E-03 ATOMIC DENSITY
    ROTH      2.7020 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
               13027       1.00 ATOM/MOLECULE
    END

    SC  H            STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   5.8540E-02 ATOMIC DENSITY
    ROTH      1.0000 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                1001       1.00 ATOM/MOLECULE
    END

    SC  O            STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   2.6090E-02 ATOMIC DENSITY
    ROTH      1.0000 THEORETICAL DENSITY
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
   NEL             1 NO. ELEMENTS
   ICP             1 0/1 MIXTURE/COMPOUND
   TEMP        293.0 DEG KELVIN
                8016      1.00 ATOM/MOLECULE
   END

   SC  C             STANDARD COMPOSITION
   MX              8 MIXTURE NO.
   DEN    2.2640E-02 ATOMIC DENSITY
   ROTH       2.1000 THEORETICAL DENSITY
   NEL             1 NO. ELEMENTS
   ICP             1 0/1 MIXTURE/COMPOUND
   TEMP        293.0 DEG KELVIN
                6012      1.00 ATOM/MOLECULE
   END

   SC  N             STANDARD COMPOSITION
   MX              8 MIXTURE NO.
   DEN    1.3940E-03 ATOMIC DENSITY
   ROTH       1.0000 THEORETICAL DENSITY
   NEL             1 NO. ELEMENTS
   ICP             1 0/1 MIXTURE/COMPOUND
   TEMP        293.0 DEG KELVIN
                7014      1.00 ATOM/MOLECULE

'CASK EXTERIOR WATER
   END

   SC  H2O           STANDARD COMPOSITION
   MX              9 MIXTURE NO.
   VF         1.0000 VOLUME FRACTION
   ROTH       0.9982 THEORETICAL DENSITY
   NEL             2 NO. ELEMENTS
   ICP             1 0/1 MIXTURE/COMPOUND
   TEMP        293.0 DEG KELVIN
                1001      2.00 ATOMS/MOLECULE
                8016      1.00 ATOM/MOLECULE

'PELLET CLAD GAP WATER
   END

   SC  H2O           STANDARD COMPOSITION
   MX             10 MIXTURE NO.
   VF         1.0000 VOLUME FRACTION
   ROTH       0.9982 THEORETICAL DENSITY
   NEL             2 NO. ELEMENTS
   ICP             1 0/1 MIXTURE/COMPOUND
   TEMP        293.0 DEG KELVIN
                1001      2.00 ATOMS/MOLECULE
                8016      1.00 ATOM/MOLECULE
   END


   **** PROBLEM GEOMETRY ****

   CTP SQUAREPITCH  CELL TYPE
   PITCH      1.2598 CM CENTER TO CENTER SPACING
   FUELOD     0.7844 CM FUEL DIAMETER OR SLAB THICKNESS
   MFUEL           1 MIXTURE NO. OF FUEL
   MMOD            3 MIXTURE NO. OF MODERATOR
   CLADOD     0.9144 CM CLAD OUTER DIAMETER
   MCLAD           2 MIXTURE NO. OF CLAD
   GAPOD      0.8002 CM GAP OUTER DIAMETER
   MGAP            0 MIXTURE NO. OF GAP


   ZONE SPECIFICATIONS FOR LATTICECELL GEOMETRY

                  ZONE  1 IS FUEL
                  ZONE  2 IS GAP
                  ZONE  3 IS CLAD
                  ZONE  4 IS MOD
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
********************************************************************************
********************************************************************************
********************************************************************************
*****                                                                      *****
*****                  PROGRAM VERIFICATION INFORMATION                    *****
*****                                                                      *****
*****              CODE SYSTEM:   SCALE-PC VERSION:   4.3                  *****
*****                                                                      *****
********************************************************************************
********************************************************************************
*****                                                                      *****
*****                                                                      *****
*****                     PROGRAM:  000002                                 *****
*****                                                                      *****
*****               CREATION DATE:  09-28-95                               *****
*****                                                                      *****
*****                      VOLUME:  ENG                                    *****
*****                                                                      *****
*****                     LIBRARY:  G:\SCALE43\EXE                         *****
*****                                                                      *****
*****                                                                      *****
*****             PRODUCTION CODE:  NITAWL                                 *****
*****                                                                      *****
*****                     VERSION:  3.0                                    *****
*****                                                                      *****
*****                     JOBNAME:  SCALE-PC                               *****
*****                                                                      *****
*****           DATE OF EXECUTION:  01/27/98                               *****
*****                                                                      *****
*****           TIME OF EXECUTION:  03:55:53                               *****
*****                                                                      *****
*****                                                                      *****
********************************************************************************
********************************************************************************
********************************************************************************

       -1Q ARRAY HAS      1 ENTRIES.

        0Q ARRAY HAS      9 ENTRIES.

        1Q ARRAY HAS     12 ENTRIES.

SELECT 27 NUCLIDES FROM THE MASTER  LIBRARY ON LOGICAL  1
        0 NUCLIDES FROM THE WORKING LIBRARY ON LOGICAL  2
        0 NUCLIDES FROM THE WORKING LIBRARY ON LOGICAL  3
          TO CREATE THE NEW WORKING LIBRARY ON LOGICAL  4

        4 RESONANCE CALCULATIONS HAVE BEEN REQUESTED
       -1 OUTPUT OPTION FOR AMPX FORMATTED CROSS SECTION DATA
     2001 MAXIMUM NUMBER OF RESONANCE MESH INTERVALS
        2 ORDER OF RESONANCE LEVEL PROCESSING

THE STORAGE ALLOCATED FOR THIS CASE IS    100000 WORDS

        2Q ARRAY HAS     27 ENTRIES.

        3Q ARRAY HAS     60 ENTRIES.

        4Q ARRAY HAS     27 ENTRIES.

 GENERAL INFORMATION CONCERNING CROSS SECTION LIBRARY
   TAPE IDENTIFICATION NUMBER                 4321
   NUMBER OF NUCLIDES ON TAPE                   28
   NUMBER OF NEUTRON ENERGY GROUPS              27
   FIRST THERMAL NEUTRON ENERGY GROUP           15
   NUMBER OF GAMMA ENERGY GROUPS                 0

   DIRECT ACCESS UNIT NUMBER  9 REQUIRES 117 BLOCKS OF LENGTH  1680 WORDS
 XSDRN TAPE    4321
                          SCALE 4.2 - 27 GROUP NEUTRON GROUP LIBRARY
                             BASED ON ENDF-B VERSION 4 DATA
                                COMPILED FOR NRC      1/27/89
                                   LAST UPDATED                                      08/12/94
                                      L.M.PETRIE   -   ORNL
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
NUCLIDES FROM XSDRN TAPE
   1     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94     3001001
   2     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94     8001001
   3     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94     9001001
   4     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94    10001001
   5    B-10 1273 218NGP 042375 P-3 293K                        UPDATED 08/12/94     6005010
   6    B-10 1273 218NGP 042375 P-3 293K                        UPDATED 08/12/94     8005010
   7     BORON-11       ENDF/B-IV MAT 1160                      UPDATED 08/12/94     6005011
   8     BORON-11       ENDF/B-IV MAT 1160                      UPDATED 08/12/94     8005011
   9     CARBON-12      ENDF/B-IV MAT 1274/THRM1065             UPDATED 08/12/94     6006012
  10     CARBON-12      ENDF/B-IV MAT 1274/THRM1065             UPDATED 08/12/94     8006012
  11     NITROGEN-14    ENDF/B-IV MAT 1275                      UPDATED 08/12/94     8007014
  12     OXYGEN-16      ENDF/B-IV MAT 1276                      UPDATED 08/12/94     1008016
  13     OXYGEN-16      ENDF/B-IV MAT 1276                      UPDATED 08/12/94     3008016
  14     OXYGEN-16      ENDF/B-IV MAT 1276                      UPDATED 08/12/94     8008016
  15     OXYGEN-16      ENDF/B-IV MAT 1276                      UPDATED 08/12/94     9008016
  16     OXYGEN-16      ENDF/B-IV MAT 1276                      UPDATED 08/12/94    10008016
  17    AL-27 1193 218 GP 040375(5)                             UPDATED 08/12/94     4013027
  18    AL-27 1193 218 GP 040375(5)                             UPDATED 08/12/94     6013027
  19    AL-27 1193 218 GP 040375(5)                             UPDATED 08/12/94     8013027
  20    CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'        UPDATED 08/12/94     5024304
  21     MANGANESE-55   ENDF/B-IV MAT 1197                      UPDATED 08/12/94     5025055
  22    FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'        UPDATED 08/12/94     5026304
  23    NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'        UPDATED 08/12/94     5028304
  24     ZIRCALLOY      ENDF/B-IV MAT 1284                      UPDATED 08/12/94     2040302
  25    PB   1288 218NGP 042375 P-3 293K                        UPDATED 08/12/94     7082000
  26     URANIUM-235    ENDF/B-IV MAT 1261                      UPDATED 08/12/94     1092235
  27     URANIUM-238    ENDF/B-IV MAT 1262                      UPDATED 08/12/94     1092238

 HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94   3001001     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94   8001001     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94   9001001     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94  10001001     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

B-10 1273 218NGP 042375 P-3 293K                     UPDATED 08/12/94   6005010     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

B-10 1273 218NGP 042375 P-3 293K                     UPDATED 08/12/94   8005010     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 BORON-11       ENDF/B-IV MAT 1160                   UPDATED 08/12/94   6005011     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 BORON-11       ENDF/B-IV MAT 1160                   UPDATED 08/12/94   8005011     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 CARBON-12      ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94   6006012     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 CARBON-12      ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94   8006012     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 NITROGEN-14    ENDF/B-IV MAT 1275                   UPDATED 08/12/94   8007014     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94   1008016     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94   3008016     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94   8008016     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94   9008016     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
 OXYGEN-16       ENDF/B-IV MAT 1276                           UPDATED 08/12/94  10008016      TEMPERATURE=   293.00
                                                                   PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

AL-27 1193 218 GP 040375(5)                                   UPDATED 08/12/94   4013027      TEMPERATURE=   293.00
                                                                   PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

AL-27 1193 218 GP 040375(5)                                   UPDATED 08/12/94   6013027      TEMPERATURE=   293.00
                                                                   PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

AL-27 1193 218 GP 040375(5)                                   UPDATED 08/12/94   8013027      TEMPERATURE=   293.00
                                                                   PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'              UPDATED 08/12/94   5024304      TEMPERATURE=   293.00
                                                                   PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 MANGANESE-55    ENDF/B-IV MAT 1197                           UPDATED 08/12/94   5025055      TEMPERATURE=   293.00

GEOMETRY HAS BEEN SET TO HOMOGENEOUS AS LBAR IS  0.0000E+00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =    54.466            TEMPERATURE(KELVIN)         =   293.000

POTENTIAL SCATTER SIGMA  =     2.590            LUMPED NUCLEAR DENSITY      = 1.7363295E-03

SPIN FACTOR (G)          =    14.448            LUMP DIMENSION (A-BAR)      = 0.0000000E+00

INNER RADIUS             = 0.0000000E+00        DANCOFF CORRECTION (C)      = 0.0000000E+00

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1    =    55.845            SIGMA(PER ABSORBER ATOM)= 3.4663022E+02

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2    =    55.925            SIGMA(PER ABSORBER ATOM)= 1.2557598E+02

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 0-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP        RES ABS          RES FISS         RES SCAT
  8       -5.518788E-04    0.000000E+00   -3.944190E-01
  9       -2.797993E-03    0.000000E+00   -2.293471E+00
 10       -3.291452E-01    0.000000E+00   -3.820862E+01
 11       -2.680562E+00    0.000000E+00   -1.159996E+02

EXCESS RESONANCE INTEGRALS

                  RESOLVED

ABSORPTION       3.33719E+00
FISSION          0.00000E+00
                                                                   PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'              UPDATED 08/12/94   5026304      TEMPERATURE=   293.00
                                                                   PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'              UPDATED 08/12/94   5028304      TEMPERATURE=   293.00
                                                                   PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 ZIRCALLOY       ENDF/B-IV MAT 1284                           UPDATED 08/12/94   2040302      TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =    90.436            TEMPERATURE(KELVIN)         =   293.000

POTENTIAL SCATTER SIGMA  =     6.385            LUMPED NUCLEAR DENSITY      = 4.3307818E-02

SPIN FACTOR (G)          =     1.079            LUMP DIMENSION (A-BAR)      = 4.5719999E-01
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
INNER RADIUS            = 4.0009999E-01         DANCOFF CORRECTION (C)     = 4.5673078E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP        RES ABS         RES FISS         RES SCAT
  8      -3.353624E-04    0.000000E+00    -2.667271E-01
  9      -2.345404E-02    0.000000E+00    -9.666542E-01
 10      -2.364268E-02    0.000000E+00    -5.427781E-01
 11      -8.133699E-02    0.000000E+00    -3.886799E-01

EXCESS RESONANCE INTEGRALS

                 RESOLVED

ABSORPTION       5.59244E-01
FISSION          0.00000E+00
                                                  PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

PB   1288 218NGP 042375 P-3 293K                  UPDATED 08/12/94   7082000     TEMPERATURE=   293.00
                                                  PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 URANIUM-235    ENDF/B-IV MAT 1261                UPDATED 08/12/94   1092235     TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)         =   233.025             TEMPERATURE(KELVIN)        =   293.000

POTENTIAL SCATTER SIGMA =    11.500             LUMPED NUCLEAR DENSITY     = 9.8766887E-04

SPIN FACTOR (G)         = 15171.100             LUMP DIMENSION (A-BAR)     = 3.9219999E-01

INNER RADIUS            = 0.0000000E+00         DANCOFF CORRECTION (C)     = 2.3525730E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1     =    15.991           SIGMA(PER ABSORBER ATOM)= 1.8285364E+02

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2     =   238.051           SIGMA(PER ABSORBER ATOM)= 2.7760712E+02

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP        RES ABS         RES FISS         RES SCAT
 12      -3.904891E+00   -2.400683E+00    -9.365656E-02
 13      -1.223861E+01   -5.975270E+00    -2.623999E-01
 14      -9.154386E+00   -5.417213E+00    -6.158343E-02
 15      -5.171851E-04   -3.930799E-04     4.654119E-06

EXCESS RESONANCE INTEGRALS

                 RESOLVED

ABSORPTION       1.98617E+02
FISSION          1.19162E+02
                                                  PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 URANIUM-238    ENDF/B-IV MAT 1262                UPDATED 08/12/94   1092238     TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)         =   236.006             TEMPERATURE(KELVIN)        =   293.000

POTENTIAL SCATTER SIGMA =    10.599             LUMPED NUCLEAR DENSITY     = 2.2243705E-02

SPIN FACTOR (G)         =   656.527             LUMP DIMENSION (A-BAR)     = 3.9219999E-01
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
INNER RADIUS            = 0.0000000E+00          DANCOFF CORRECTION (C)     = 2.3525730E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1     =    15.991              SIGMA(PER ABSORBER ATOM)= 8.1190996E+00

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2     =   235.044              SIGMA(PER ABSORBER ATOM)= 5.2849644E-01

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP        RES ABS          RES FISS         RES SCAT
  9      -4.655258E-02    0.000000E+00    -4.609913E-01
 10      -1.139702E+00   -2.338724E-05    -6.895151E+00
 11      -9.892670E+00    0.000000E+00    -2.712805E+01
 12      -4.299526E+01    0.000000E+00    -4.994605E+01
 13      -5.378721E+01    0.000000E+00    -1.765308E+01
 14      -1.041276E+02    0.000000E+00    -6.054823E+00
 15      -8.495994E-07    0.000000E+00     1.647857E-06

EXCESS RESONANCE INTEGRALS

                  RESOLVED

ABSORPTION       1.88041E+01
FISSION          4.93936E-04
                                                   PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
*******************************************************************************
*******************************************************************************
*******************************************************************************
*****                                                                     *****
*****                  PROGRAM VERIFICATION INFORMATION                   *****
*****                                                                     *****
*****                CODE SYSTEM:  SCALE-PC VERSION:  4.3                 *****
*****                                                                     *****
*******************************************************************************
*******************************************************************************
*****                                                                     *****
*****                                                                     *****
*****              PROGRAM:  000009                                       *****
*****                                                                     *****
*****        CREATION DATE:  03-08-96                                     *****
*****                                                                     *****
*****               VOLUME:  ENG                                          *****
*****                                                                     *****
*****              LIBRARY:  G:\SCALE43\EXE                               *****
*****                                                                     *****
*****                                                                     *****
*****      PRODUCTION CODE:  KENOVA                                       *****
*****                                                                     *****
*****              VERSION:  3.1                                          *****
*****                                                                     *****
*****              JOBNAME:  SCALE-PC                                     *****
*****                                                                     *****
*****    DATE OF EXECUTION:  01/27/98                                     *****
*****                                                                     *****
*****    TIME OF EXECUTION:  03:56:05                                     *****
*****                                                                     *****
*****                                                                     *****
*******************************************************************************
*******************************************************************************
*******************************************************************************


***************************************************************************************************************
***                                                                                                         ***
***                          NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, NORMAL LOAD 1.0 1.0, PITCH 250 CM  ***
***                                                                                                         ***
***************************************************************************************************************
***                              ******        NUMERIC PARAMETERS        ******                             ***
***                                                                                                         ***
***                                                                                                         ***
***               TME        MAXIMUM PROBLEM TIME (MIN)                          ******                     ***
***                                                                                                         ***
***               TBA        TIME PER GENERATION (MIN)                             0.50                     ***
***                                                                                                         ***
***               GEN        NUMBER OF GENERATIONS                                  803                     ***
***                                                                                                         ***
***               NPG        NUMBER PER GENERATION                                 1000                     ***
***                                                                                                         ***
***               NSK        NUMBER OF GENERATIONS TO BE SKIPPED                      3                     ***
***                                                                                                         ***
***               BEG        BEGINNING GENERATION NUMBER                              1                     ***
***                                                                                                         ***
***               RES        GENERATIONS BETWEEN CHECKPOINTS                          0                     ***
***                                                                                                         ***
***               X1D        NUMBER OF EXTRA 1-D CROSS SECTIONS                       1                     ***
***                                                                                                         ***
***               NBK        NEUTRON BANK SIZE                                     1025                     ***
***                                                                                                         ***
***               XNB        EXTRA POSITIONS IN NEUTRON BANK                          0                     ***
***                                                                                                         ***
***               NFB        FISSION BANK SIZE                                     1000                     ***
***                                                                                                         ***
***               XFB        EXTRA POSITIONS IN FISSION BANK                          0                     ***
***                                                                                                         ***
***               WTA        DEFAULT VALUE OF WEIGHT AVERAGE                     0.5000                     ***
***                                                                                                         ***
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
***                WTH        WEIGHT HIGH FOR SPLITTING                         3.0000           ***
***                                                                                              ***
***                WTL        WEIGHT LOW FOR RUSSIAN ROULETTE                   0.3333           ***
***                                                                                              ***
***                RND        STARTING RANDOM NUMBER                       BB827100001           ***
***                                                                                              ***
***                NB8        NUMBER OF D.A. BLOCKS ON UNIT  8                     200           ***
***                                                                                              ***
***                NL8        LENGTH OF D.A. BLOCKS ON UNIT  8                     512           ***
***                                                                                              ***
***                ADJ        MODE OF CALCULATION                              FORWARD           ***
***                                                                                              ***
***                           INPUT DATA WRITTEN ON RESTART UNIT                    NO           ***
***                                                                                              ***
***                           BINARY DATA INTERFACE                                YES           ***
***                                                                                              ***
***                                                                                              ***
**************************************************************************************************

**************************************************************************************************
***                                                                                              ***
***                     NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, NORMAL LOAD 1.0 1.0, PITCH 250 CM  ***
***                                                                                              ***
**************************************************************************************************
***                        ******   LOGICAL PARAMETERS       ******                              ***
***                                                                                              ***
*** RUN  EXECUTE PROBLEM AFTER CHECKING DATA    YES        PLT  PLOT PICTURE MAP(S)                    NO ***
***                                                                                              ***
*** FLX  COMPUTE FLUX                            NO        FDN  COMPUTE FISSION DENSITIES              NO ***
***                                                                                              ***
*** SMU  COMPUTE AVG UNIT SELF-MULTIPLICATION    NO        NUB  COMPUTE NU-BAR & AVG FISSION GROUP    YES ***
***                                                                                              ***
*** MKU  COMPUTE MATRIX K-EFF BY UNIT NUMBER     NO        MKP  COMPUTE MATRIX K-EFF BY UNIT LOCATION   NO ***
***                                                                                              ***
*** CKU  COMPUTE COFACTOR K-EFF BY UNIT NUMBER   NO        CKP  COMPUTE COFACTOR K-EFF BY UNIT LOCATION NO ***
***                                                                                              ***
*** FMU  PRINT FISS PROD MATRIX BY UNIT NUMBER   NO        FMP  PRINT FISS PROD MATRIX BY UNIT LOCATION NO ***
***                                                                                              ***
*** MKH  COMPUTE MATRIX K-EFF BY HOLE NUMBER     NO        MKA  COMPUTE MATRIX K-EFF BY ARRAY NUMBER    NO ***
***                                                                                              ***
*** CKH  COMPUTE COFACTOR K-EFF BY HOLE NUMBER   NO        CKA  COMPUTE COFACTOR K-EFF BY ARRAY NUMBER  NO ***
***                                                                                              ***
*** FMH  PRINT FISS PROD MATRIX BY HOLE NUMBER   NO        FMA  PRINT FISS PROD MATRIX BY ARRAY NUMBER  NO ***
***                                                                                              ***
*** HHL  COLLECT MATRIX BY HIGHEST HOLE LEVEL    NO        HAL  COLLECT MATRIX BY HIGHEST ARRAY LEVEL   NO ***
***                                                                                              ***
*** AMX  PRINT ALL MIXED CROSS SECTIONS          NO        FAR  PRINT FIS. AND ABS. BY REGION           NO ***
***                                                                                              ***
*** XS1  PRINT 1-D MIXTURE X-SECTIONS            NO        GAS  PRINT FAR BY GROUP                      NO ***
***                                                                                              ***
*** XS2  PRINT 2-D MIXTURE X-SECTIONS            NO        PAX  PRINT XSEC-ALBEDO CORRELATION TABLES    NO ***
***                                                                                              ***
*** XAP  PRINT MIXTURE ANGLES & PROBABILITIES    NO        PWT  PRINT WEIGHT AVERAGE ARRAY              NO ***
***                                                                                              ***
*** PKI  PRINT FISSION SPECTRUM                  NO        PGM  PRINT INPUT GEOMETRY                    NO ***
***                                                                                              ***
*** P1D  PRINT EXTRA 1-D CROSS SECTIONS          NO        BUG  PRINT DEBUG INFORMATION                 NO ***
***                                                                                              ***
***                                                        TRK  PRINT TRACKING INFORMATION              NO ***
***                                                                                              ***
***                                                                                              ***
**************************************************************************************************
**************************************************************************************************
**************************************************************************************************
                              PARAMETER INPUT COMPLETED
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
          NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, NORMAL LOAD 1.0 1.0, PITCH 250 CM

                                   MIXING TABLE

                          NUMBER OF SCATTERING ANGLES =  2
                       CROSS SECTION MESSAGE THRESHOLD =3.0E-05


MIXTURE =     1          DENSITY(G/CC) =  10.412
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA       AWT            NUCLIDE TITLE
   1008016  4.64627E-02  1.18489E-01   8016    15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                          UPDATED
08/12/94
   1092235  9.87669E-04  3.70234E-02   92235   235.0441     URANIUM-235     ENDF/B-IV MAT 1261                          UPDATED
08/12/94
   1092238  2.22437E-02  8.44487E-01   92238   238.0510     URANIUM-238     ENDF/B-IV MAT 1262                          UPDATED
08/12/94

MIXTURE =     2          DENSITY(G/CC) =  6.5600
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA       AWT            NUCLIDE TITLE
   2040302  4.33078E-02  1.00000E+00   40000    91.2196     ZIRCALLOY       ENDF/B-IV MAT 1284                          UPDATED
08/12/94

MIXTURE =     3          DENSITY(G/CC) = 0.99817
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA       AWT            NUCLIDE TITLE
   3001001  6.67692E-02  1.11927E-01   1001     1.0077      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002                 UPDATED
08/12/94
   3008016  3.33846E-02  8.88074E-01   8016    15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                          UPDATED
08/12/94

MIXTURE =     4          DENSITY(G/CC) =  2.7020
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA       AWT            NUCLIDE TITLE
   4013027  6.03066E-02  1.00000E+00   13027    26.9818     AL-27 1193 218 GP 040375(5)                                 UPDATED
08/12/94

MIXTURE =     5          DENSITY(G/CC) =  7.9200
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA       AWT            NUCLIDE TITLE
   5024304  1.74286E-02  1.90000E-01   24000    51.9957     CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'            UPDATED
08/12/94
   5025055  1.73633E-03  1.99999E-02   25055    54.9379     MANGANESE-55    ENDF/B-IV MAT 1197                          UPDATED
08/12/94
   5026304  5.93579E-02  6.95000E-01   26000    55.8447     FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'            UPDATED
08/12/94
   5028304  7.72070E-03  9.50001E-02   28000    58.6872     NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'            UPDATED
08/12/94

MIXTURE =     6          DENSITY(G/CC) =  2.5830
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA       AWT            NUCLIDE TITLE
   6005010  7.09799E-03  4.56901E-02   5010     10.0130     B-10 1273 218NGP 042375 P-3 293K                            UPDATED
08/12/94
   6005011  3.92356E-02  2.77698E-01   5011     11.0096     BORON-11        ENDF/B-IV MAT 1160                          UPDATED
08/12/94
   6006012  1.21874E-02  9.40196E-02   6000     12.0001     CARBON-12       ENDF/B-IV MAT 1274/THRM1065                 UPDATED
08/12/94
   6013027  3.35871E-02  5.82592E-01   13027    26.9818     AL-27 1193 218 GP 040375(5)                                 UPDATED
08/12/94

MIXTURE =     7          DENSITY(G/CC) =  11.344
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA       AWT            NUCLIDE TITLE
   7082000  3.29690E-02  1.00000E+00   82000   207.2100     PB   1288 218NGP 042375 P-3 293K                            UPDATED
08/12/94

MIXTURE =     8          DENSITY(G/CC) =  1.6298
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA       AWT            NUCLIDE TITLE
   8001001  5.85400E-02  6.01023E-02   1001     1.0077      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002                 UPDATED
08/12/94
   8005010  8.55300E-05  8.72589E-04   5010     10.0130     B-10 1273 218NGP 042375 P-3 293K                            UPDATED
08/12/94
   8005011  3.42200E-04  3.83863E-03   5011     11.0096     BORON-11        ENDF/B-IV MAT 1160                          UPDATED
08/12/94
   8006012  2.26400E-02  2.76813E-01   6000     12.0001     CARBON-12       ENDF/B-IV MAT 1274/THRM1065                 UPDATED
08/12/94
   8007014  1.39400E-03  1.98893E-02   7014     14.0033     NITROGEN-14     ENDF/B-IV MAT 1275                          UPDATED
08/12/94
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
   8008016  2.60900E-02  4.25068E-01    8016    15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                     UPDATED
08/12/94
   8013027  7.76300E-03  2.13416E-01   13027    26.9818     AL-27 1193 218 GP 040375(5)                             UPDATED
08/12/94

MIXTURE =     9         DENSITY(G/CC) = 0.99817
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA      AWT           NUCLIDE TITLE
   9001001  6.67692E-02  1.11927E-01    1001      1.0077     HYDROGEN        ENDF/B-IV MAT 1269/THRM1002            UPDATED
08/12/94
   9008016  3.33846E-02  8.88074E-01    8016    15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                     UPDATED
08/12/94

MIXTURE =    10         DENSITY(G/CC) = 0.99817
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA      AWT           NUCLIDE TITLE
  10001001  6.67692E-02  1.11927E-01    1001      1.0077     HYDROGEN        ENDF/B-IV MAT 1269/THRM1002            UPDATED
08/12/94
  10008016  3.33846E-02  8.88074E-01    8016    15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                     UPDATED
08/12/94


                             3001001     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94
                             8001001     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94
                             9001001     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94
                            10001001     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94
                             6005010    B-10 1273 218NGP 042375 P-3 293K                     UPDATED 08/12/94
                             8005010    B-10 1273 218NGP 042375 P-3 293K                     UPDATED 08/12/94
                             6005011     BORON-11       ENDF/B-IV MAT 1160                   UPDATED 08/12/94
                             8005011     BORON-11       ENDF/B-IV MAT 1160                   UPDATED 08/12/94
                             6006012     CARBON-12      ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94
                             8006012     CARBON-12      ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94
                             8007014     NITROGEN-14    ENDF/B-IV MAT 1275                   UPDATED 08/12/94
                             1008016     OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94
                             3008016     OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94
                             8008016     OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94
                             9008016     OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94
                            10008016     OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94
                             4013027    AL-27 1193 218 GP 040375(5)                          UPDATED 08/12/94
                             6013027    AL-27 1193 218 GP 040375(5)                          UPDATED 08/12/94
                             8013027    AL-27 1193 218 GP 040375(5)                          UPDATED 08/12/94
                             5024304    CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'     UPDATED 08/12/94
                             5025055     MANGANESE-55   ENDF/B-IV MAT 1197                   UPDATED 08/12/94
                             5026304    FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'     UPDATED 08/12/94
                             5028304    NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'     UPDATED 08/12/94
                             2040302     ZIRCALLOY      ENDF/B-IV MAT 1284                   UPDATED 08/12/94
                             7082000    PB   1288 218NGP 042375 P-3 293K                     UPDATED 08/12/94
                             1092235     URANIUM-235    ENDF/B-IV MAT 1261                   UPDATED 08/12/94
                             1092238     URANIUM-238    ENDF/B-IV MAT 1262                   UPDATED 08/12/94

KENO MESSAGE NUMBER K5-222       1 TRANSFERS FOR MIXTURE     3 WERE CORRECTED FOR BAD MOMENTS.

KENO MESSAGE NUMBER K5-222       1 TRANSFERS FOR MIXTURE     9 WERE CORRECTED FOR BAD MOMENTS.

KENO MESSAGE NUMBER K5-222       1 TRANSFERS FOR MIXTURE    10 WERE CORRECTED FOR BAD MOMENTS.

                             ........   0 IO'S WERE USED MIXING CROSS-SECTIONS       ........

                              1-D CROSS SECTION ARRAY ID NUMBERS
                                 1  2002  1452    27    18  1018

                             ........   0 IO'S WERE USED PREPARING THE CROSS SECTIONS    ........

****************************************************************************************************
             ***                                                                                   ***
             ***         NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, NORMAL LOAD 1.0 1.0, PITCH 250 CM      ***
             ***                                                                                   ***
             *************************************************************************************************
             *************************************************************************************************
             ***                                                                                   ***
             ***                            ****** ADDITIONAL INFORMATION ******                   ***
             ***                                                                                   ***
             ***  NUMBER OF ENERGY GROUPS             27       USE LATTICE GEOMETRY            YES ***
             ***                                                                                   ***
             ***  NO. OF FISSION SPECTRUM SOURCE GROUP  1      GLOBAL ARRAY NUMBER               4 ***
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

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***                                                                                             ***
***  NO. OF SCATTERING ANGLES IN XSECS      2        NUMBER OF UNITS IN THE GLOBAL X DIR.     1  ***
***                                                                                             ***
***  ENTRIES/NEUTRON IN THE NEUTRON BANK   25        NUMBER OF UNITS IN THE GLOBAL Y DIR.     1  ***
***                                                                                             ***
***  ENTRIES/NEUTRON IN THE FISSION BANK   18        NUMBER OF UNITS IN THE GLOBAL Z DIR.     4  ***
***                                                                                             ***
***  NUMBER OF MIXTURES USED                9        USE A GLOBAL REFLECTOR                 YES  ***
***                                                                                             ***
***  NUMBER OF BIAS ID'S USED               1        USE NESTED HOLES                       YES  ***
***                                                                                             ***
***  NUMBER OF DIFFERENTIAL ALBEDOS USED    0        NUMBER OF HOLES                        186  ***
***                                                                                             ***
***  TOTAL INPUT GEOMETRY REGIONS         154        MAXIMUM HOLE NESTING LEVEL               3  ***
***                                                                                             ***
***  NUMBER OF GEOMETRY REGIONS USED      154        USE NESTED ARRAYS                      YES  ***
***                                                                                             ***
***  LARGEST GEOMETRY UNIT NUMBER         104        NUMBER OF ARRAYS USED                    4  ***
***                                                                                             ***
***  LARGEST ARRAY NUMBER                   4        MAXIMUM ARRAY NESTING LEVEL              2  ***
***                                                                                             ***
***                                                                                             ***
***  +X BOUNDARY CONDITION             MIRROR        -X BOUNDARY CONDITION               MIRROR  ***
***                                                                                             ***
***  +Y BOUNDARY CONDITION             MIRROR        -Y BOUNDARY CONDITION               MIRROR  ***
***                                                                                             ***
***  +Z BOUNDARY CONDITION                PER        -Z BOUNDARY CONDITION                  PER  ***
***                                                                                             ***
```

NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, NORMAL LOAD 1.0 1.0, PITCH 250 CM

GENERATION	GENERATION K-EFFECTIVE	ELAPSED TIME MINUTES	AVERAGE K-EFFECTIVE	AVG K-EFF DEVIATION	MATRIX K-EFFECTIVE	MATRIX K-EFF DEVIATION
KENO MESSAGE NUMBER K5-132		WARNING....ONLY	974 INDEPENDENT FISSION POINTS WERE GENERATED			
1	8.44990E-01	1.12667E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
KENO MESSAGE NUMBER K5-132		WARNING....ONLY	980 INDEPENDENT FISSION POINTS WERE GENERATED			
2	8.68154E-01	1.69333E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	8.96286E-01	2.23333E-01	8.96286E-01	0.00000E+00	0.00000E+00	0.00000E+00
4	8.65434E-01	2.76500E-01	8.80860E-01	1.54261E-02	0.00000E+00	0.00000E+00
5	8.97554E-01	3.30500E-01	8.86425E-01	1.05018E-02	0.00000E+00	0.00000E+00
6	9.14550E-01	3.81667E-01	8.93456E-01	1.02267E-02	0.00000E+00	0.00000E+00
7	9.00364E-01	4.35667E-01	8.94838E-01	8.04113E-03	0.00000E+00	0.00000E+00
8	8.85585E-01	4.88833E-01	8.93296E-01	6.74422E-03	0.00000E+00	0.00000E+00
9	9.20117E-01	5.42000E-01	8.97127E-01	6.86807E-03	0.00000E+00	0.00000E+00
10	8.88359E-01	5.97833E-01	8.96031E-01	6.04807E-03	0.00000E+00	0.00000E+00
11	9.24954E-01	6.49000E-01	8.99245E-01	6.22722E-03	0.00000E+00	0.00000E+00
12	9.12174E-01	7.01167E-01	9.00538E-01	5.71788E-03	0.00000E+00	0.00000E+00
13	9.33608E-01	7.52500E-01	9.03544E-01	5.98230E-03	0.00000E+00	0.00000E+00
14	9.18353E-01	8.03667E-01	9.04778E-01	5.59876E-03	0.00000E+00	0.00000E+00
15	9.05712E-01	8.55000E-01	9.04850E-01	5.15061E-03	0.00000E+00	0.00000E+00
16	9.05532E-01	9.09000E-01	9.04899E-01	4.76879E-03	0.00000E+00	0.00000E+00
17	8.83233E-01	9.59333E-01	9.03454E-01	4.66855E-03	0.00000E+00	0.00000E+00
18	8.73386E-01	1.01333E+00	9.01575E-01	4.75421E-03	0.00000E+00	0.00000E+00
19	9.11353E-01	1.06283E+00	9.02150E-01	4.50269E-03	0.00000E+00	0.00000E+00
20	9.15656E-01	1.11317E+00	9.02901E-01	4.31097E-03	0.00000E+00	0.00000E+00
21	9.23252E-01	1.16433E+00	9.03972E-01	4.21610E-03	0.00000E+00	0.00000E+00
22	9.08404E-01	1.21667E+00	9.04193E-01	4.00588E-03	0.00000E+00	0.00000E+00
23	8.74029E-01	1.26883E+00	9.02757E-01	4.07210E-03	0.00000E+00	0.00000E+00
24	8.99533E-01	1.31817E+00	9.02610E-01	3.88536E-03	0.00000E+00	0.00000E+00
25	8.96263E-01	1.37217E+00	9.02334E-01	3.72283E-03	0.00000E+00	0.00000E+00
26	8.99279E-01	1.42250E+00	9.02207E-01	3.56661E-03	0.00000E+00	0.00000E+00
27	9.10017E-01	1.47467E+00	9.02520E-01	3.43521E-03	0.00000E+00	0.00000E+00
28	8.95336E-01	1.52417E+00	9.02243E-01	3.31199E-03	0.00000E+00	0.00000E+00
29	9.74939E-01	1.57450E+00	9.04936E-01	4.17204E-03	0.00000E+00	0.00000E+00
30	9.31477E-01	1.62483E+00	9.05884E-01	4.13052E-03	0.00000E+00	0.00000E+00
31	9.36373E-01	1.67617E+00	9.06935E-01	4.12189E-03	0.00000E+00	0.00000E+00
32	9.52017E-01	1.72833E+00	9.08438E-01	4.25623E-03	0.00000E+00	0.00000E+00
33	9.06217E-01	1.77867E+00	9.08366E-01	4.11726E-03	0.00000E+00	0.00000E+00
34	9.17878E-01	1.82817E+00	9.08663E-01	3.99759E-03	0.00000E+00	0.00000E+00
35	9.35463E-01	1.87567E+00	9.09475E-01	3.95875E-03	0.00000E+00	0.00000E+00
36	9.12519E-01	1.92600E+00	9.09565E-01	3.84160E-03	0.00000E+00	0.00000E+00
37	8.86443E-01	1.97733E+00	9.08904E-01	3.78827E-03	0.00000E+00	0.00000E+00
38	8.67201E-01	2.02667E+00	9.07746E-01	3.85949E-03	0.00000E+00	0.00000E+00
39	9.14923E-01	2.07800E+00	9.07940E-01	3.75874E-03	0.00000E+00	0.00000E+00

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

40	9.27898E-01	2.12833E+00	9.08465E-01	3.69599E-03	0.00000E+00	0.00000E+00
41	8.98449E-01	2.17867E+00	9.08208E-01	3.60912E-03	0.00000E+00	0.00000E+00
42	9.41256E-01	2.22900E+00	9.09034E-01	3.61346E-03	0.00000E+00	0.00000E+00
43	9.26125E-01	2.27750E+00	9.09451E-01	3.54879E-03	0.00000E+00	0.00000E+00
44	9.48744E-01	2.32700E+00	9.10387E-01	3.58740E-03	0.00000E+00	0.00000E+00

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•
•

766	8.52062E-01	3.88853E+01	9.12782E-01	8.87278E-04	0.00000E+00	0.00000E+00
767	8.89113E-01	3.89367E+01	9.12751E-01	8.86658E-04	0.00000E+00	0.00000E+00
768	9.32841E-01	3.89862E+01	9.12777E-01	8.85888E-04	0.00000E+00	0.00000E+00
769	9.25239E-01	3.90355E+01	9.12794E-01	8.84881E-04	0.00000E+00	0.00000E+00
770	9.17486E-01	3.90858E+01	9.12800E-01	8.83749E-04	0.00000E+00	0.00000E+00
771	9.12554E-01	3.91380E+01	9.12799E-01	8.82599E-04	0.00000E+00	0.00000E+00
772	8.92045E-01	3.91875E+01	9.12772E-01	8.81864E-04	0.00000E+00	0.00000E+00
773	9.13794E-01	3.92378E+01	9.12774E-01	8.80721E-04	0.00000E+00	0.00000E+00
774	9.21233E-01	3.92882E+01	9.12785E-01	8.79648E-04	0.00000E+00	0.00000E+00
775	8.96880E-01	3.93367E+01	9.12764E-01	8.78750E-04	0.00000E+00	0.00000E+00
776	9.37107E-01	3.93880E+01	9.12796E-01	8.78177E-04	0.00000E+00	0.00000E+00
777	9.23805E-01	3.94383E+01	9.12810E-01	8.77158E-04	0.00000E+00	0.00000E+00
778	9.05338E-01	3.94897E+01	9.12800E-01	8.76080E-04	0.00000E+00	0.00000E+00
779	8.91731E-01	3.95382E+01	9.12773E-01	8.75372E-04	0.00000E+00	0.00000E+00
780	9.06924E-01	3.95893E+01	9.12766E-01	8.74278E-04	0.00000E+00	0.00000E+00
781	9.62034E-01	3.96407E+01	9.12829E-01	8.75443E-04	0.00000E+00	0.00000E+00
782	9.16989E-01	3.96892E+01	9.12834E-01	8.74336E-04	0.00000E+00	0.00000E+00
783	9.11415E-01	3.97395E+01	9.12832E-01	8.73218E-04	0.00000E+00	0.00000E+00
784	9.05594E-01	3.97890E+01	9.12823E-01	8.72149E-04	0.00000E+00	0.00000E+00
785	9.14512E-01	3.98393E+01	9.12825E-01	8.71038E-04	0.00000E+00	0.00000E+00
786	9.03778E-01	3.98897E+01	9.12814E-01	8.70002E-04	0.00000E+00	0.00000E+00
787	9.37944E-01	3.99372E+01	9.12846E-01	8.69483E-04	0.00000E+00	0.00000E+00
788	9.56264E-01	3.99875E+01	9.12901E-01	8.70131E-04	0.00000E+00	0.00000E+00
789	9.16645E-01	4.00380E+01	9.12906E-01	8.69038E-04	0.00000E+00	0.00000E+00
790	8.75757E-01	4.00883E+01	9.12859E-01	8.69214E-04	0.00000E+00	0.00000E+00
791	9.29604E-01	4.01423E+01	9.12880E-01	8.68371E-04	0.00000E+00	0.00000E+00
792	9.27283E-01	4.01917E+01	9.12898E-01	8.67462E-04	0.00000E+00	0.00000E+00
793	8.74477E-01	4.02420E+01	9.12849E-01	8.67726E-04	0.00000E+00	0.00000E+00
794	9.09629E-01	4.02923E+01	9.12845E-01	8.66639E-04	0.00000E+00	0.00000E+00
795	9.17668E-01	4.03428E+01	9.12851E-01	8.65567E-04	0.00000E+00	0.00000E+00
796	9.24591E-01	4.03932E+01	9.12866E-01	8.64602E-04	0.00000E+00	0.00000E+00
797	9.03978E-01	4.04443E+01	9.12855E-01	8.63586E-04	0.00000E+00	0.00000E+00
798	9.13778E-01	4.04947E+01	9.12856E-01	8.62502E-04	0.00000E+00	0.00000E+00
799	8.96251E-01	4.05468E+01	9.12835E-01	8.61671E-04	0.00000E+00	0.00000E+00
800	8.95363E-01	4.05963E+01	9.12813E-01	8.60869E-04	0.00000E+00	0.00000E+00
801	9.32395E-01	4.06467E+01	9.12838E-01	8.60140E-04	0.00000E+00	0.00000E+00
802	9.35120E-01	4.06970E+01	9.12866E-01	8.59515E-04	0.00000E+00	0.00000E+00
803	9.34006E-01	4.07473E+01	9.12892E-01	8.58847E-04	0.00000E+00	0.00000E+00

```
KENO MESSAGE NUMBER K5-123          EXECUTION TERMINATED DUE TO COMPLETION OF THE SPECIFIED NUMBER OF GENERATIONS.
 NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, NORMAL LOAD 1.0 1.0, PITCH 250 CM

LIFETIME =  4.01972E-05 + OR -  7.69258E-08             GENERATION TIME =  3.01354E-05 + OR -  4.55607E-08
NU BAR   =  2.43862E+00 + OR -  6.74971E-05        AVERAGE FISSION GROUP =  2.22216E+01 + OR -  3.83639E-03
                   ENERGY(EV) OF THE AVERAGE LETHARGY CAUSING FISSION =  1.94425E-01 + OR -  6.19504E-04
```

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
3	0.91291	+ OR - 0.00086	0.91205 TO 0.91377	0.91119 TO 0.91463	0.91033 TO 0.91549	800000
4	0.91297	+ OR - 0.00086	0.91211 TO 0.91383	0.91126 TO 0.91469	0.91040 TO 0.91555	799000
5	0.91299	+ OR - 0.00086	0.91213 TO 0.91385	0.91127 TO 0.91471	0.91041 TO 0.91557	798000
6	0.91299	+ OR - 0.00086	0.91213 TO 0.91385	0.91127 TO 0.91471	0.91041 TO 0.91557	797000
7	0.91301	+ OR - 0.00086	0.91214 TO 0.91387	0.91128 TO 0.91473	0.91042 TO 0.91559	796000
8	0.91304	+ OR - 0.00086	0.91218 TO 0.91390	0.91132 TO 0.91476	0.91045 TO 0.91563	795000
9	0.91303	+ OR - 0.00086	0.91217 TO 0.91389	0.91131 TO 0.91476	0.91044 TO 0.91562	794000
10	0.91306	+ OR - 0.00086	0.91220 TO 0.91393	0.91134 TO 0.91479	0.91047 TO 0.91565	793000

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

11	0.91305	+ OR - 0.00086	0.91218 TO 0.91391	0.91132 TO 0.91478	0.91045 TO 0.91564	792000
12	0.91305	+ OR - 0.00087	0.91218 TO 0.91391	0.91132 TO 0.91478	0.91045 TO 0.91565	791000
17	0.91307	+ OR - 0.00087	0.91220 TO 0.91394	0.91133 TO 0.91481	0.91046 TO 0.91568	786000
22	0.91311	+ OR - 0.00087	0.91224 TO 0.91399	0.91137 TO 0.91486	0.91049 TO 0.91574	781000
27	0.91323	+ OR - 0.00088	0.91235 TO 0.91410	0.91147 TO 0.91498	0.91059 TO 0.91586	776000
32	0.91307	+ OR - 0.00088	0.91219 TO 0.91394	0.91131 TO 0.91482	0.91044 TO 0.91570	771000
37	0.91307	+ OR - 0.00088	0.91219 TO 0.91396	0.91131 TO 0.91484	0.91043 TO 0.91572	766000
42	0.91309	+ OR - 0.00088	0.91221 TO 0.91398	0.91133 TO 0.91486	0.91044 TO 0.91575	761000
47	0.91293	+ OR - 0.00088	0.91204 TO 0.91381	0.91116 TO 0.91470	0.91027 TO 0.91558	756000
52	0.91280	+ OR - 0.00089	0.91191 TO 0.91369	0.91103 TO 0.91458	0.91014 TO 0.91546	751000
57	0.91276	+ OR - 0.00089	0.91187 TO 0.91365	0.91098 TO 0.91454	0.91008 TO 0.91543	746000
			• • •			
692	0.91252	+ OR - 0.00225	0.91027 TO 0.91476	0.90803 TO 0.91701	0.90578 TO 0.91925	111000
697	0.91267	+ OR - 0.00232	0.91035 TO 0.91498	0.90803 TO 0.91730	0.90571 TO 0.91962	106000
702	0.91140	+ OR - 0.00235	0.90905 TO 0.91374	0.90670 TO 0.91609	0.90435 TO 0.91844	101000
707	0.91289	+ OR - 0.00234	0.91055 TO 0.91522	0.90822 TO 0.91756	0.90588 TO 0.91989	96000
712	0.91244	+ OR - 0.00242	0.91003 TO 0.91486	0.90761 TO 0.91728	0.90519 TO 0.91970	91000
717	0.91205	+ OR - 0.00253	0.90952 TO 0.91457	0.90700 TO 0.91710	0.90447 TO 0.91962	86000
722	0.91162	+ OR - 0.00257	0.90905 TO 0.91419	0.90648 TO 0.91676	0.90391 TO 0.91933	81000
727	0.91275	+ OR - 0.00257	0.91018 TO 0.91532	0.90761 TO 0.91789	0.90504 TO 0.92046	76000
732	0.91330	+ OR - 0.00263	0.91067 TO 0.91594	0.90804 TO 0.91857	0.90541 TO 0.92120	71000
737	0.91244	+ OR - 0.00261	0.90984 TO 0.91505	0.90723 TO 0.91765	0.90463 TO 0.92026	66000
742	0.91297	+ OR - 0.00276	0.91020 TO 0.91573	0.90744 TO 0.91850	0.90467 TO 0.92126	61000
747	0.91369	+ OR - 0.00287	0.91082 TO 0.91656	0.90795 TO 0.91943	0.90508 TO 0.92230	56000
752	0.91364	+ OR - 0.00314	0.91050 TO 0.91677	0.90737 TO 0.91991	0.90423 TO 0.92304	51000
757	0.91452	+ OR - 0.00317	0.91135 TO 0.91770	0.90817 TO 0.92087	0.90500 TO 0.92404	46000
762	0.91332	+ OR - 0.00336	0.90996 TO 0.91667	0.90661 TO 0.92003	0.90325 TO 0.92338	41000
767	0.91589	+ OR - 0.00319	0.91270 TO 0.91908	0.90950 TO 0.92228	0.90631 TO 0.92547	36000
772	0.91587	+ OR - 0.00358	0.91229 TO 0.91944	0.90872 TO 0.92302	0.90514 TO 0.92659	31000
777	0.91535	+ OR - 0.00411	0.91124 TO 0.91946	0.90713 TO 0.92357	0.90302 TO 0.92768	26000
782	0.91505	+ OR - 0.00438	0.91067 TO 0.91943	0.90629 TO 0.92381	0.90191 TO 0.92819	21000
787	0.91518	+ OR - 0.00552	0.90966 TO 0.92069	0.90414 TO 0.92621	0.89862 TO 0.93173	16000
792	0.91248	+ OR - 0.00574	0.90673 TO 0.91822	0.90099 TO 0.92397	0.89525 TO 0.92971	11000
797	0.91782	+ OR - 0.00766	0.91016 TO 0.92548	0.90250 TO 0.93314	0.89484 TO 0.94079	6000

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, NORMAL LOAD 1.0 1.0, PITCH 250 CM

                              FREQUENCY FOR GENERATIONS    4 TO  803
0.8449 TO 0.8500     **
0.8500 TO 0.8552     *****
0.8552 TO 0.8603     **
0.8603 TO 0.8654     *******
0.8654 TO 0.8705     **************
0.8705 TO 0.8756     *****************
0.8756 TO 0.8808     **************************
0.8808 TO 0.8859     *********************************
0.8859 TO 0.8910     *********************************************
0.8910 TO 0.8961     ***********************************************************
0.8961 TO 0.9013     *************************************************************
0.9013 TO 0.9064     *************************************************
0.9064 TO 0.9115     ***********************************************************************
0.9115 TO 0.9166     *******************************************************
0.9166 TO 0.9218     ************************************************************
0.9218 TO 0.9269     *********************************************************************
0.9269 TO 0.9320     *****************************************
0.9320 TO 0.9371     *************************************************************
0.9371 TO 0.9422     **********************************
0.9422 TO 0.9474     ***********************
0.9474 TO 0.9525     *******************
0.9525 TO 0.9576     ***********************
0.9576 TO 0.9627     ********
0.9627 TO 0.9679     ********
0.9679 TO 0.9730     **
0.9730 TO 0.9781     ***
0.9781 TO 0.9832     **
0.9832 TO 0.9884     *

                              FREQUENCY FOR GENERATIONS  204 TO  803
0.8449 TO 0.8500     **
0.8500 TO 0.8552     ****
0.8552 TO 0.8603     **
0.8603 TO 0.8654     ***
0.8654 TO 0.8705     ***********
0.8705 TO 0.8756     ***********
0.8756 TO 0.8808     **********************
0.8808 TO 0.8859     *************************
0.8859 TO 0.8910     *********************************
0.8910 TO 0.8961     **********************************************
0.8961 TO 0.9013     ******************************************
0.9013 TO 0.9064     ******************************************
0.9064 TO 0.9115     *******************************************************
0.9115 TO 0.9166     ***********************************
0.9166 TO 0.9218     ***********************************************
0.9218 TO 0.9269     ************************************************
0.9269 TO 0.9320     ***********************************
0.9320 TO 0.9371     **********************************************
0.9371 TO 0.9422     ****************************
0.9422 TO 0.9474     ****************
0.9474 TO 0.9525     ***************
0.9525 TO 0.9576     ****************
0.9576 TO 0.9627     *****
0.9627 TO 0.9679     *****
0.9679 TO 0.9730     **
0.9730 TO 0.9781     *
0.9781 TO 0.9832     **
0.9832 TO 0.9884     *
```

Figure 6.7-1 CSAS25 Input/Output for Directly Loaded Fuel Normal Conditions Criticality Analysis (continued)

```
NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, NORMAL LOAD 1.0 1.0, PITCH 250 CM

                                   FREQUENCY FOR GENERATIONS  404 TO  803
0.8449 TO 0.8500     **
0.8500 TO 0.8552     ***
0.8552 TO 0.8603     *
0.8603 TO 0.8654     ***
0.8654 TO 0.8705     ******
0.8705 TO 0.8756     ********
0.8756 TO 0.8808     *******************
0.8808 TO 0.8859     *************
0.8859 TO 0.8910     ******************
0.8910 TO 0.8961     **********************************
0.8961 TO 0.9013     ****************************
0.9013 TO 0.9064     ***************************
0.9064 TO 0.9115     ************************************
0.9115 TO 0.9166     ***************************
0.9166 TO 0.9218     *****************************
0.9218 TO 0.9269     *************************************
0.9269 TO 0.9320     ********************
0.9320 TO 0.9371     ******************************
0.9371 TO 0.9422     ********************
0.9422 TO 0.9474     **********
0.9474 TO 0.9525     *********
0.9525 TO 0.9576     **********
0.9576 TO 0.9627     ***
0.9627 TO 0.9679     ***
0.9679 TO 0.9730
0.9730 TO 0.9781     *
0.9781 TO 0.9832     **
0.9832 TO 0.9884     *

                                   FREQUENCY FOR GENERATIONS  604 TO  803
0.8449 TO 0.8500     *
0.8500 TO 0.8552     **
0.8552 TO 0.8603     *
0.8603 TO 0.8654     **
0.8654 TO 0.8705     ***
0.8705 TO 0.8756     **
0.8756 TO 0.8808     ********
0.8808 TO 0.8859     *******
0.8859 TO 0.8910     *********
0.8910 TO 0.8961     **************
0.8961 TO 0.9013     ******************
0.9013 TO 0.9064     ***********
0.9064 TO 0.9115     ***************
0.9115 TO 0.9166     *******************
0.9166 TO 0.9218     ************
0.9218 TO 0.9269     *************
0.9269 TO 0.9320     ***************
0.9320 TO 0.9371     *******************
0.9371 TO 0.9422     ***********
0.9422 TO 0.9474     ***
0.9474 TO 0.9525     *****
0.9525 TO 0.9576     ******
0.9576 TO 0.9627     ***
0.9627 TO 0.9679
0.9679 TO 0.9730
0.9730 TO 0.9781     *
0.9781 TO 0.9832
0.9832 TO 0.9884
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis

```
PRIMARY MODULE ACCESS AND INPUT RECORD ( SCALE DRIVER - 95/03/29 - 09:06:37 )
  MODULE CSAS25   WILL BE CALLED
    NAC-STC 26 DIRECTLY LOADED, WEST 17x17 OFA, ACCIDENT TRANSPORT 1.0 1.0, PITCH 25
    27GROUPNDF4 LATTICECELL
    'FUEL
    UO2  1  0.95 293.0 92235 4.20 92238 95.80 END
    'CLAD
    ZIRCALLOY   2  1.0  293.0  END
    'H2O CASK INTERIOR
    H2O  3  1.0  293.0  END
    'AL DISK
    AL   4  1.0  293.0  END
    'CASK / DISK STEEL
    SS304 5 1.0  293.0  END
    'BORAL SHEETS
    AL    6 DEN=2.6226 0.5738 293.0 END
    B-10  6 DEN=2.6226 0.0450 293.0 END
    B-11  6 DEN=2.6226 0.2735 293.0 END
    C     6 DEN=2.6226 0.0926 293.0 END
    'LEAD SHIELD
    PB    7 1.0 293.0  END
    'NS4FR SHIELD
    B-10  8 0.0 8.553-5 293.0 END
    B-11  8 0.0 3.422-4 293.0 END
    AL    8 0.0 7.763-3 293.0 END
    H     8 0.0 5.854-2 293.0 END
    O     8 0.0 2.609-2 293.0 END
    C     8 0.0 2.264-2 293.0 END
    N     8 0.0 1.394-3 293.0 END
    'CASK EXTERIOR WATER
    H2O   9 1.0 293.0 END
    'PELLET CLAD GAP WATER
    H2O  10 1.0 293.0 END
    END COMP
    SQUAREPITCH  1.2598 0.7844 1 3 0.9144 2 0.8002 10 END
    NAC-STC 26 DIRECTLY LOADED, WEST 17x17 OFA, ACCIDENT TRANSPORT 1.0 1.0, PITCH 25
    READ PARAM RUN=YES PLT=NO TME=5000 GEN=803 NPG=1000 END PARAM
    READ GEOM
    UNIT  1
    COM='FUEL PIN CELL - FOR WATER ELEVATION'
    CYLINDER  1 1  0.3922   2P2.3749
    CYLINDER 10 1  0.4001   2P2.3749
    CYLINDER  2 1  0.4572   2P2.3749
    CUBOID    3 1  4P0.6299 2P2.3749
    UNIT  2
    COM='GUIDE/INSTRUMENT TUBE CELL - FOR WATER ELEVATION'
    CYLINDER  3 1  0.5715   2P2.3749
    CYLINDER  2 1  0.6121   2P2.3749
    CUBOID    3 1  4P0.6299 2P2.3749
    UNIT  3
    COM='FUEL PIN CELL - FOR STEEL DISK ELEVATION'
    CYLINDER  1 1  0.3922   2P0.6350
    CYLINDER 10 1  0.4001   2P0.6350
    CYLINDER  2 1  0.4572   2P0.6350
    CUBOID    3 1  4P0.6299 2P0.6350
    UNIT  4
    COM='GUIDE/INSTRUMENT TUBE CELL - FOR STEEL DISK ELEVATION'
    CYLINDER  3 1  0.5715   2P0.6350
    CYLINDER  2 1  0.6121   2P0.6350
    CUBOID    3 1  4P0.6299 2P0.6350
    UNIT  5
    COM='FUEL PIN CELL - FOR AL DISK ELEVATION'
    CYLINDER  1 1  0.3922   2P0.7938
    CYLINDER 10 1  0.4001   2P0.7938
    CYLINDER  2 1  0.4572   2P0.7938
    CUBOID    3 1  4P0.6299 2P0.7938
    UNIT  6
    COM='GUIDE/INSTRUMENT TUBE CELL - FOR AL DISK ELEVATION'
    CYLINDER  3 1  0.5715   2P0.7938
    CYLINDER  2 1  0.6121   2P0.7938
    CUBOID    3 1  4P0.6299 2P0.7938
    UNIT 21
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
COM='ASSEMBLY - FOR WATER ELEVATION'
ARRAY  1 -10.7083 -10.7083 -2.3749
UNIT 22
COM='ASSEMBLY - FOR STEEL DISK ELEVATION'
ARRAY  2 -10.7083 -10.7083 -0.6350
UNIT 23
COM='ASSEMBLY - FOR AL DISK ELEVATION'
ARRAY  3 -10.7083 -10.7083 -0.7938
UNIT 31
COM='X-X BORAL SHEET - FOR WATER ELEVATION'
CUBOID 6 1 2P10.3886 2P0.0635 2P2.3749
CUBOID 4 1 2P10.3886 2P0.0951 2P2.3749
UNIT 32
COM='Y-Y BORAL SHEET - FOR WATER ELEVATION'
CUBOID 6 1 2P0.0635 2P10.3886 2P2.3749
CUBOID 4 1 2P0.0951 2P10.3886 2P2.3749
UNIT 33
COM='X-X BORAL SHEET - FOR STEEL DISK ELEVATION'
CUBOID 6 1 2P10.3886 2P0.0635 2P0.6350
CUBOID 4 1 2P10.3886 2P0.0951 2P0.6350
UNIT 34
COM='Y-Y BORAL SHEET - FOR STEEL DISK ELEVATION'
CUBOID 6 1 2P0.0635 2P10.3886 2P0.6350
CUBOID 4 1 2P0.0951 2P10.3886 2P0.6350
UNIT 35
COM='X-X BORAL SHEET - FOR AL DISK ELEVATION'
CUBOID 6 1 2P10.3886 2P0.0635 2P0.7938
CUBOID 4 1 2P10.3886 2P0.0951 2P0.7938
UNIT 36
COM='Y-Y BORAL SHEET - FOR AL DISK ELEVATION'
CUBOID 6 1 2P0.0635 2P10.3886 2P0.7938
CUBOID 4 1 2P0.0951 2P10.3886 2P0.7938
UNIT 40
COM='FUEL TUBE - FOR WATER ELEVATION (B)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE   21 0.0 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0.0 +11.4054 0.0
HOLE 31 0.0 -11.4054 0.0
HOLE 32 +11.4054 0.0 0.0
HOLE 32 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 41
COM='FUEL TUBE - FOR WATER ELEVATION (T)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE   21 0.0 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0.0 +11.4054 0.0
HOLE 31 0.0 -11.4054 0.0
HOLE 32 +11.4054 0.0 0.0
HOLE 32 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 42
COM='FUEL TUBE - FOR WATER ELEVATION (BL)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE   21 -0.4803 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0.0 +11.4054 0.0
HOLE 31 0.0 -11.4054 0.0
HOLE 32 +11.4054 0.0 0.0
HOLE 32 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 43
COM='FUEL TUBE - FOR WATER ELEVATION (BR)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE   21 +0.4803 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0.0 +11.4054 0.0
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
HOLE 31 0.0 -11.4054 0.0
HOLE 32 +11.4054 0.0 0.0
HOLE 32 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 44
COM='FUEL TUBE - FOR WATER ELEVATION (TL)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE   21 -0.4803 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0.0 +11.4054 0.0
HOLE 31 0.0 -11.4054 0.0
HOLE 32 +11.4054 0.0 0.0
HOLE 32 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 45
COM='FUEL TUBE - FOR WATER ELEVATION (TR)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE   21 +0.4803 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0.0 +11.4054 0.0
HOLE 31 0.0 -11.4054 0.0
HOLE 32 +11.4054 0.0 0.0
HOLE 32 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 50
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (B)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE   22 0.0 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0.0 +11.4054 0.0
HOLE 33 0.0 -11.4054 0.0
HOLE 34 +11.4054 0.0 0.0
HOLE 34 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 51
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (T)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE   22 0.0 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0.0 +11.4054 0.0
HOLE 33 0.0 -11.4054 0.0
HOLE 34 +11.4054 0.0 0.0
HOLE 34 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 52
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (BL)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE   22 -0.4803 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0.0 +11.4054 0.0
HOLE 33 0.0 -11.4054 0.0
HOLE 34 +11.4054 0.0 0.0
HOLE 34 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 53
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (BR)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE   22 +0.4803 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0.0 +11.4054 0.0
HOLE 33 0.0 -11.4054 0.0
HOLE 34 +11.4054 0.0 0.0
HOLE 34 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 54
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (TL)'
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
CUBOID 3 1 4P11.1887 2P0.6350
HOLE   22 -0.4803 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0.0 +11.4054 0.0
HOLE 33 0.0 -11.4054 0.0
HOLE 34 +11.4054 0.0 0.0
HOLE 34 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 55
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (TR)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE   22 +0.4803 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0.0 +11.4054 0.0
HOLE 33 0.0 -11.4054 0.0
HOLE 34 +11.4054 0.0 0.0
HOLE 34 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 60
COM='FUEL TUBE - FOR AL DISK ELEVATION (B)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE   23 0.0 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0.0 +11.4054 0.0
HOLE 35 0.0 -11.4054 0.0
HOLE 36 +11.4054 0.0 0.0
HOLE 36 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 61
COM='FUEL TUBE - FOR AL DISK ELEVATION (T)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE   23 0.0 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0.0 +11.4054 0.0
HOLE 35 0.0 -11.4054 0.0
HOLE 36 +11.4054 0.0 0.0
HOLE 36 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 62
COM='FUEL TUBE - FOR AL DISK ELEVATION (BL)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE   23 -0.4803 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0.0 +11.4054 0.0
HOLE 35 0.0 -11.4054 0.0
HOLE 36 +11.4054 0.0 0.0
HOLE 36 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 63
COM='FUEL TUBE - FOR AL DISK ELEVATION (BR)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE   23 +0.4803 -0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0.0 +11.4054 0.0
HOLE 35 0.0 -11.4054 0.0
HOLE 36 +11.4054 0.0 0.0
HOLE 36 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 64
COM='FUEL TUBE - FOR AL DISK ELEVATION (TL)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE   23 -0.4803 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0.0 +11.4054 0.0
HOLE 35 0.0 -11.4054 0.0
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
HOLE 36 +11.4054 0.0 0.0
HOLE 36 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 65
COM='FUEL TUBE - FOR AL DISK ELEVATION (TR)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE   23 +0.4803 +0.4803 0.0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0.0 +11.4054 0.0
HOLE 35 0.0 -11.4054 0.0
HOLE 36 +11.4054 0.0 0.0
HOLE 36 -11.4054 0.0 0.0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 70
COM='DISK OPENING - FOR WATER ELEVATION (B)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 40 0.0 -0.1810 0.0
UNIT 71
COM='DISK OPENING - FOR WATER ELEVATION (T)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 41 0.0 +0.1810 0.0
UNIT 72
COM='DISK OPENING - FOR WATER ELEVATION (BL)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 42 -0.1810 -0.1810 0.0
UNIT 73
COM='DISK OPENING - FOR WATER ELEVATION (BR)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 43 +0.1810 -0.1810 0.0
UNIT 74
COM='DISK OPENING - FOR WATER ELEVATION (TL)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 44 -0.1810 +0.1810 0.0
UNIT 75
COM='DISK OPENING - FOR WATER ELEVATION (TR)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 45 +0.1810 +0.1810 0.0
UNIT 80
COM='DISK OPENING - FOR STEEL DISK ELEVATION (B)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 50 0.0 -0.1810 0.0
UNIT 81
COM='DISK OPENING - FOR STEEL DISK ELEVATION (T)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 51 0.0 +0.1810 0.0
UNIT 82
COM='DISK OPENING - FOR STEEL DISK ELEVATION (BL)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 52 -0.1810 -0.1810 0.0
UNIT 83
COM='DISK OPENING - FOR STEEL DISK ELEVATION (BR)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 53 +0.1810 -0.1810 0.0
UNIT 84
COM='DISK OPENING - FOR STEEL DISK ELEVATION (TL)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 54 -0.1810 +0.1810 0.0
UNIT 85
COM='DISK OPENING - FOR STEEL DISK ELEVATION (TR)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 55 +0.1810 +0.1810 0.0
UNIT 90
COM='DISK OPENING - FOR AL DISK ELEVATION (B)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 60 0.0 -0.1810 0.0
UNIT 91
COM='DISK OPENING - FOR AL DISK ELEVATION (T)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 61 0.0 +0.1810 0.0
UNIT 92
COM='DISK OPENING - FOR AL DISK ELEVATION (BL)'
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 62 -0.1810 -0.1810 0.0
UNIT 93
COM='DISK OPENING - FOR AL DISK ELEVATION (BR)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 63 +0.1810 -0.1810 0.0
UNIT 94
COM='DISK OPENING - FOR AL DISK ELEVATION (TL)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 64 -0.1810 +0.1810 0.0
UNIT 95
COM='DISK OPENING - FOR AL DISK ELEVATION (TR)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 65 +0.1810 +0.1810 0.0
UNIT 101
COM='BASKET STRUCTURE IN TRANPORT CASK - WATER ELEVATION'
CYLINDER 3 1 +90.17 2P2.3749
HOLE 75 -58.9864 -40.7822 0.0
HOLE 75 -58.9864 -13.5941 0.0
HOLE 73 -58.9864 +13.5941 0.0
HOLE 73 -58.9864 +40.7822 0.0
HOLE 75 -27.1882 -67.9704 0.0
HOLE 75 -27.1882 -40.7822 0.0
HOLE 75 -27.1882 -13.5941 0.0
HOLE 73 -27.1882 +13.5941 0.0
HOLE 73 -27.1882 +40.7822 0.0
HOLE 73 -27.1882 +67.9704 0.0
HOLE 71   0.0    -67.9704 0.0
HOLE 71   0.0    -40.7822 0.0
HOLE 71   0.0    -13.5941 0.0
HOLE 70   0.0    +13.5941 0.0
HOLE 70   0.0    +40.7822 0.0
HOLE 70   0.0    +67.9704 0.0
HOLE 74 +27.1882 -67.9704 0.0
HOLE 74 +27.1882 -40.7822 0.0
HOLE 74 +27.1882 -13.5941 0.0
HOLE 72 +27.1882 +13.5941 0.0
HOLE 72 +27.1882 +40.7822 0.0
HOLE 72 +27.1882 +67.9704 0.0
HOLE 74 +58.9864 -40.7822 0.0
HOLE 74 +58.9864 -13.5941 0.0
HOLE 72 +58.9864 +13.5941 0.0
HOLE 72 +58.9864 +40.7822 0.0
CYLINDER  5 1  +93.98 2P2.3749
CYLINDER  7 1 +103.43 2P2.3749
CYLINDER  5 1 +110.11 2P2.3749
CYLINDER  9 1 +124.12 2P2.3749
CYLINDER  9 1 +124.44 2P2.3749
CYLINDER  5 1 +125.07 2P2.3749
CUBOID    9 1 4P125.07 2P2.3749
UNIT 102
COM='BASKET STRUCTURE IN TRANPORT CASK - ST DISK ELEVATION'
CYLINDER  5 1 +89.99 2P0.6350
HOLE 85 -58.9864 -40.7822 0.0
HOLE 85 -58.9864 -13.5941 0.0
HOLE 83 -58.9864 +13.5941 0.0
HOLE 83 -58.9864 +40.7822 0.0
HOLE 85 -27.1882 -67.9704 0.0
HOLE 85 -27.1882 -40.7822 0.0
HOLE 85 -27.1882 -13.5941 0.0
HOLE 83 -27.1882 +13.5941 0.0
HOLE 83 -27.1882 +40.7822 0.0
HOLE 83 -27.1882 +67.9704 0.0
HOLE 81   0.0    -67.9704 0.0
HOLE 81   0.0    -40.7822 0.0
HOLE 81   0.0    -13.5941 0.0
HOLE 80   0.0    +13.5941 0.0
HOLE 80   0.0    +40.7822 0.0
HOLE 80   0.0    +67.9704 0.0
HOLE 84 +27.1882 -67.9704 0.0
HOLE 84 +27.1882 -40.7822 0.0
HOLE 84 +27.1882 -13.5941 0.0
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
HOLE 82 +27.1882 +13.5941 0.0
HOLE 82 +27.1882 +40.7822 0.0
HOLE 82 +27.1882 +67.9704 0.0
HOLE 84 +58.9864 -40.7822 0.0
HOLE 84 +58.9864 -13.5941 0.0
HOLE 82 +58.9864 +13.5941 0.0
HOLE 82 +58.9864 +40.7822 0.0
CYLINDER  3 1  +90.17 2P0.6350
CYLINDER  5 1  +93.98 2P0.6350
CYLINDER  7 1 +103.43 2P0.6350
CYLINDER  5 1 +110.11 2P0.6350
CYLINDER  9 1 +124.12 2P0.6350
CYLINDER  9 1 +124.44 2P0.6350
CYLINDER  5 1 +125.07 2P0.6350
CUBOID    9 1 4P125.07 2P0.6350
UNIT 103
COM='BASKET STRUCTURE IN TRANPORT CASK - AL DISK ELEVATION'
CYLINDER  4 1 +89.73 2P0.7938
HOLE 95 -58.9864 -40.7822 0.0
HOLE 95 -58.9864 -13.5941 0.0
HOLE 93 -58.9864 +13.5941 0.0
HOLE 93 -58.9864 +40.7822 0.0
HOLE 95 -27.1882 -67.9704 0.0
HOLE 95 -27.1882 -40.7822 0.0
HOLE 95 -27.1882 -13.5941 0.0
HOLE 93 -27.1882 +13.5941 0.0
HOLE 93 -27.1882 +40.7822 0.0
HOLE 93 -27.1882 +67.9704 0.0
HOLE 91   0.0    -67.9704 0.0
HOLE 91   0.0    -40.7822 0.0
HOLE 91   0.0    -13.5941 0.0
HOLE 90   0.0    +13.5941 0.0
HOLE 90   0.0    +40.7822 0.0
HOLE 90   0.0    +67.9704 0.0
HOLE 94 +27.1882 -67.9704 0.0
HOLE 94 +27.1882 -40.7822 0.0
HOLE 94 +27.1882 -13.5941 0.0
HOLE 92 +27.1882 +13.5941 0.0
HOLE 92 +27.1882 +40.7822 0.0
HOLE 92 +27.1882 +67.9704 0.0
HOLE 94 +58.9864 -40.7822 0.0
HOLE 94 +58.9864 -13.5941 0.0
HOLE 92 +58.9864 +13.5941 0.0
HOLE 92 +58.9864 +40.7822 0.0
CYLINDER  3 1  +90.17 2P0.7938
CYLINDER  5 1  +93.98 2P0.7938
CYLINDER  7 1 +103.43 2P0.7938
CYLINDER  5 1 +110.11 2P0.7938
CYLINDER  9 1 +124.12 2P0.7938
CYLINDER  9 1 +124.44 2P0.7938
CYLINDER  5 1 +125.07 2P0.7938
CUBOID    9 1 4P125.07 2P0.7938
GLOBAL UNIT 104
COM='DISK SLICE STACK'
ARRAY  4 -125.07 -125.07 0.0
CUBOID 9 1 4P125.08 12.3573 0.0
END GEOM
READ ARRAY
ARA=1   NUX=17 NUY=17 NUZ=1  FILL
                          34R1
          5R1   2   2R1   2   2R1   2   5R1
                3R1   2   9R1   2   3R1
                          17R1
2R1   2   2R1   2   2R1   2   2R1   2   2R1   2   2R1
                          34R1
2R1   2   2R1   2   2R1   2   2R1   2   2R1   2   2R1
                          34R1
2R1   2   2R1   2   2R1   2   2R1   2   2R1   2   2R1
                          17R1
                3R1   2   9R1   2   3R1
          5R1   2   2R1   2   2R1   2   5R1
                          34R1
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
END FILL
ARA=2  NUX=17 NUY=17 NUZ=1  FILL
                         34R3
          5R3   4   2R3   4   2R3   4   5R3
               3R3   4   9R3   4   3R3
                         17R3
2R3   4   2R3   4   2R3   4   2R3   4   2R3   4   2R3
                         34R3
2R3   4   2R3   4   2R3   4   2R3   4   2R3   4   2R3
                         34R3
2R3   4   2R3   4   2R3   4   2R3   4   2R3   4   2R3
                         17R3
               3R3   4   9R3   4   3R3
          5R3   4   2R3   4   2R3   4   5R3
                         34R3
END FILL
ARA=3  NUX=17 NUY=17 NUZ=1  FILL
                         34R5
          5R5   6   2R5   6   2R5   6   5R5
               3R5   6   9R5   6   3R5
                         17R5
2R5   6   2R5   6   2R5   6   2R5   6   2R5   6   2R5
                         34R5
2R5   6   2R5   6   2R5   6   2R5   6   2R5   6   2R5
                         34R5
2R5   6   2R5   6   2R5   6   2R5   6   2R5   6   2R5
                         17R5
               3R5   6   9R5   6   3R5
          5R5   6   2R5   6   2R5   6   5R5
                         34R5
END FILL
ARA=4 NUX=1 NUY=1 NUZ=4 FILL 101 102 101 103 END FILL
END ARRAY
READ BOUNDS ZFC=PER YXF=MIRROR END BOUNDS
READ PLOT
TTL='XY SLICE OF CASK - ST DISK ELEVATION'
SCR=YES PIC=MAT LPI=10
XUL=-120.0 YUL=120.0 ZUL=5.5 XLR=120.0 YLR=-120.0 ZLR=5.5
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='XY SLICE CASK CENTER AREA ST DISK ELEVATION'
SCR=YES PIC=MAT LPI=10
XUL=-27.0 YUL=27.0 ZUL=5.5 XLR=27.0 YLR=-27.0 ZLR=5.5
UAX=1.0 VDN=-1.0 NAX=1500 END
END PLOT
END DATA
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
******************************************************************************
******************************************************************************
******************************************************************************
*****                                                                    *****
*****                 PROGRAM VERIFICATION INFORMATION                   *****
*****                                                                    *****
*****              CODE SYSTEM:   SCALE-PC VERSION:   4.3                *****
*****                                                                    *****
******************************************************************************
******************************************************************************
*****                                                                    *****
*****                                                                    *****
*****                   PROGRAM:  CSAS                                   *****
*****                                                                    *****
*****             CREATION DATE:  03-08-96                               *****
*****                                                                    *****
*****                    VOLUME:  ENG                                    *****
*****                                                                    *****
*****                   LIBRARY:  G:\SCALE43\EXE                         *****
*****                                                                    *****
*****                                                                    *****
*****           PRODUCTION CODE:  CSAS                                   *****
*****                                                                    *****
*****                   VERSION:  3.1                                    *****
*****                                                                    *****
*****                   JOBNAME:  SCALE-PC                               *****
*****                                                                    *****
*****         DATE OF EXECUTION:  02/03/98                               *****
*****                                                                    *****
*****         TIME OF EXECUTION:  07:42:48                               *****
*****                                                                    *****
*****                                                                    *****
******************************************************************************
******************************************************************************
******************************************************************************

NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, ACCIDENT TRANSPORT 1.0 1.0, PITCH 25


**** PROBLEM PARAMETERS ****

LIB 27GROUPNDF4  LIBRARY
MXX           10 MIXTURES
MSC           19 COMPOSITION SPECIFICATIONS
IZM            4 MATERIAL ZONES
GE  LATTICECELL  GEOMETRY
MORE           0 0/1 DO NOT READ/READ OPTIONAL PARAMETER DATA
MSLN           0 FUEL SOLUTIONS


**** PROBLEM COMPOSITION DESCRIPTION ****

SC  UO2          STANDARD COMPOSITION
MX             1 MIXTURE NO.
VF        0.9500 VOLUME FRACTION
ROTH     10.9600 THEORETICAL DENSITY
NEL            2 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           92000      1.00 ATOM/MOLECULE
                           92235     4.200 WT%
                           92238    95.800 WT%
            8016      2.00 ATOMS/MOLECULE

'CLAD
END

SC  ZIRCALLOY    STANDARD COMPOSITION
MX             2 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      6.5600 THEORETICAL DENSITY
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
    NEL           1 NO. ELEMENTS
    ICP           1 0/1 MIXTURE/COMPOUND
    TEMP      293.0 DEG KELVIN
              40302       1.00 ATOM/MOLECULE

'H2O CASK INTERIOR
    END

    SC  H2O         STANDARD COMPOSITION
    MX            3 MIXTURE NO.
    VF       1.0000 VOLUME FRACTION
    ROTH     0.9982 THEORETICAL DENSITY
    NEL           2 NO. ELEMENTS
    ICP           1 0/1 MIXTURE/COMPOUND
    TEMP      293.0 DEG KELVIN
               1001       2.00 ATOMS/MOLECULE
               8016       1.00 ATOM/MOLECULE

'AL DISK
    END

    SC  AL          STANDARD COMPOSITION
    MX            4 MIXTURE NO.
    VF       1.0000 VOLUME FRACTION
    ROTH     2.7020 THEORETICAL DENSITY
    NEL           1 NO. ELEMENTS
    ICP           1 0/1 MIXTURE/COMPOUND
    TEMP      293.0 DEG KELVIN
              13027       1.00 ATOM/MOLECULE

'CASK / DISK STEEL
    END

    SC  SS304       STANDARD COMPOSITION
    MX            5 MIXTURE NO.
    VF       1.0000 VOLUME FRACTION
    ROTH     7.9200 THEORETICAL DENSITY
    NEL           4 NO. ELEMENTS
    ICP           0 0/1 MIXTURE/COMPOUND
    TEMP      293.0 DEG KELVIN
              24304    19.000 WT%
              25055     2.000 WT%
              26304    69.500 WT%
              28304     9.500 WT%

'BORAL SHEETS
    END

    SC  AL          STANDARD COMPOSITION
    MX            6 MIXTURE NO.
    VF       0.5738 VOLUME FRACTION
    ROTH     2.6226 SPECIFIED DENSITY
    NEL           1 NO. ELEMENTS
    ICP           1 0/1 MIXTURE/COMPOUND
    TEMP      293.0 DEG KELVIN
              13027       1.00 ATOM/MOLECULE
    END

    SC  B-10        STANDARD COMPOSITION
    MX            6 MIXTURE NO.
    VF       0.0450 VOLUME FRACTION
    ROTH     2.6226 SPECIFIED DENSITY
    NEL           1 NO. ELEMENTS
    ICP           1 0/1 MIXTURE/COMPOUND
    TEMP      293.0 DEG KELVIN
               5010       1.00 ATOM/MOLECULE
    END

    SC  B-11        STANDARD COMPOSITION
    MX            6 MIXTURE NO.
    VF       0.2735 VOLUME FRACTION
    ROTH     2.6226 SPECIFIED DENSITY
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                5011       1.00 ATOM/MOLECULE
    END

    SC  C            STANDARD COMPOSITION
    MX             6 MIXTURE NO.
    VF        0.0926 VOLUME FRACTION
    ROTH      2.6226 SPECIFIED DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                6012       1.00 ATOM/MOLECULE

'LEAD SHIELD
    END

    SC  PB           STANDARD COMPOSITION
    MX             7 MIXTURE NO.
    VF        1.0000 VOLUME FRACTION
    ROTH     11.3440 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
               82000       1.00 ATOM/MOLECULE

'NS4FR SHIELD
    END

    SC  B-10         STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   8.5530E-05 ATOMIC DENSITY
    ROTH      1.0000 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                5010       1.00 ATOM/MOLECULE
    END

    SC  B-11         STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   3.4220E-04 ATOMIC DENSITY
    ROTH      1.0000 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                5011       1.00 ATOM/MOLECULE
    END

    SC  AL           STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   7.7630E-03 ATOMIC DENSITY
    ROTH      2.7020 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
               13027       1.00 ATOM/MOLECULE
    END

    SC  H            STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   5.8540E-02 ATOMIC DENSITY
    ROTH      1.0000 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                1001       1.00 ATOM/MOLECULE
    END

    SC  O            STANDARD COMPOSITION
    MX             8 MIXTURE NO.
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
    DEN    2.6090E-02 ATOMIC DENSITY
    ROTH       1.0000 THEORETICAL DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
                 8016       1.00 ATOM/MOLECULE
    END

    SC  C             STANDARD COMPOSITION
    MX              8 MIXTURE NO.
    DEN    2.2640E-02 ATOMIC DENSITY
    ROTH       2.1000 THEORETICAL DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
                 6012       1.00 ATOM/MOLECULE
    END

    SC  N             STANDARD COMPOSITION
    MX              8 MIXTURE NO.
    DEN    1.3940E-03 ATOMIC DENSITY
    ROTH       1.0000 THEORETICAL DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
                 7014       1.00 ATOM/MOLECULE

'CASK EXTERIOR WATER
    END

    SC  H2O           STANDARD COMPOSITION
    MX              9 MIXTURE NO.
    VF         1.0000 VOLUME FRACTION
    ROTH       0.9982 THEORETICAL DENSITY
    NEL             2 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
                 1001       2.00 ATOMS/MOLECULE
                 8016       1.00 ATOM/MOLECULE

'PELLET CLAD GAP WATER
    END

    SC  H2O           STANDARD COMPOSITION
    MX             10 MIXTURE NO.
    VF         1.0000 VOLUME FRACTION
    ROTH       0.9982 THEORETICAL DENSITY
    NEL             2 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
                 1001       2.00 ATOMS/MOLECULE
                 8016       1.00 ATOM/MOLECULE
    END

    **** PROBLEM GEOMETRY ****

    CTP SQUAREPITCH  CELL TYPE
    PITCH      1.2598 CM CENTER TO CENTER SPACING
    FUELOD     0.7844 CM FUEL DIAMETER OR SLAB THICKNESS
    MFUEL           1 MIXTURE NO. OF FUEL
    MMOD            3 MIXTURE NO. OF MODERATOR
    CLADOD     0.9144 CM CLAD OUTER DIAMETER
    MCLAD           2 MIXTURE NO. OF CLAD
    GAPOD      0.8002 CM GAP OUTER DIAMETER
    MGAP           10 MIXTURE NO. OF GAP

    ZONE SPECIFICATIONS FOR LATTICECELL GEOMETRY

                   ZONE  1 IS FUEL
                   ZONE  2 IS GAP
                   ZONE  3 IS CLAD
                   ZONE  4 IS MOD
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
******************************************************************************
******************************************************************************
******************************************************************************
*****                                                                    *****
*****                  PROGRAM VERIFICATION INFORMATION                  *****
*****                                                                    *****
*****              CODE SYSTEM:  SCALE-PC VERSION:  4.3                  *****
*****                                                                    *****
******************************************************************************
******************************************************************************
*****                                                                    *****
*****                                                                    *****
*****                  PROGRAM:  000002                                  *****
*****                                                                    *****
*****            CREATION DATE:  09-28-95                                *****
*****                                                                    *****
*****                   VOLUME:  ENG                                     *****
*****                                                                    *****
*****                  LIBRARY:  G:\SCALE43\EXE                          *****
*****                                                                    *****
*****                                                                    *****
*****          PRODUCTION CODE:  NITAWL                                  *****
*****                                                                    *****
*****                  VERSION:  3.0                                     *****
*****                                                                    *****
*****                  JOBNAME:  SCALE-PC                                *****
*****                                                                    *****
*****        DATE OF EXECUTION:  02/03/98                                *****
*****                                                                    *****
*****        TIME OF EXECUTION:  07:42:53                                *****
*****                                                                    *****
*****                                                                    *****
******************************************************************************
******************************************************************************
******************************************************************************

       -1Q ARRAY HAS      1 ENTRIES.

        0Q ARRAY HAS      9 ENTRIES.

        1Q ARRAY HAS     12 ENTRIES.

SELECT 27 NUCLIDES FROM THE MASTER  LIBRARY ON LOGICAL  1
        0 NUCLIDES FROM THE WORKING LIBRARY ON LOGICAL  2
        0 NUCLIDES FROM THE WORKING LIBRARY ON LOGICAL  3
          TO CREATE THE NEW WORKING LIBRARY ON LOGICAL  4

        4 RESONANCE CALCULATIONS HAVE BEEN REQUESTED
       -1 OUTPUT OPTION FOR AMPX FORMATTED CROSS SECTION DATA
     2001 MAXIMUM NUMBER OF RESONANCE MESH INTERVALS
        2 ORDER OF RESONANCE LEVEL PROCESSING

THE STORAGE ALLOCATED FOR THIS CASE IS    100000 WORDS

        2Q ARRAY HAS     27 ENTRIES.

        3Q ARRAY HAS     60 ENTRIES.

        4Q ARRAY HAS     27 ENTRIES.

 GENERAL INFORMATION CONCERNING CROSS SECTION LIBRARY
   TAPE IDENTIFICATION NUMBER                   4321
   NUMBER OF NUCLIDES ON TAPE                     27
   NUMBER OF NEUTRON ENERGY GROUPS                27
   FIRST THERMAL NEUTRON ENERGY GROUP             15
   NUMBER OF GAMMA ENERGY GROUPS                   0

   DIRECT ACCESS UNIT NUMBER  9 REQUIRES 117 BLOCKS OF LENGTH  1680 WORDS
 XSDRN TAPE   4321
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
                          SCALE 4.2 - 27 GROUP NEUTRON GROUP LIBRARY
                             BASED ON ENDF-B VERSION 4 DATA
                                COMPILED FOR NRC     1/27/89
                                   LAST UPDATED                                                   08/12/94
                                      L.M.PETRIE   -   ORNL

NUCLIDES FROM XSDRN TAPE
   1     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002              UPDATED 08/12/94     3001001
   2     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002              UPDATED 08/12/94     8001001
   3     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002              UPDATED 08/12/94     9001001
   4     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002              UPDATED 08/12/94    10001001
   5    B-10 1273 218NGP 042375 P-3 293K                         UPDATED 08/12/94     6005010
   6    B-10 1273 218NGP 042375 P-3 293K                         UPDATED 08/12/94     8005010
   7     BORON-11       ENDF/B-IV MAT 1160                       UPDATED 08/12/94     6005011
   8     BORON-11       ENDF/B-IV MAT 1160                       UPDATED 08/12/94     8005011
   9     CARBON-12      ENDF/B-IV MAT 1274/THRM1065              UPDATED 08/12/94     6006012
  10     CARBON-12      ENDF/B-IV MAT 1274/THRM1065              UPDATED 08/12/94     8006012
  11     NITROGEN-14    ENDF/B-IV MAT 1275                       UPDATED 08/12/94     8007014
  12     OXYGEN-16      ENDF/B-IV MAT 1276                       UPDATED 08/12/94     1008016
  13     OXYGEN-16      ENDF/B-IV MAT 1276                       UPDATED 08/12/94     3008016
  14     OXYGEN-16      ENDF/B-IV MAT 1276                       UPDATED 08/12/94     8008016
  15     OXYGEN-16      ENDF/B-IV MAT 1276                       UPDATED 08/12/94     9008016
  16     OXYGEN-16      ENDF/B-IV MAT 1276                       UPDATED 08/12/94    10008016
  17    AL-27 1193 218 GP 040375(5)                              UPDATED 08/12/94     4013027
  18    AL-27 1193 218 GP 040375(5)                              UPDATED 08/12/94     6013027
  19    AL-27 1193 218 GP 040375(5)                              UPDATED 08/12/94     8013027
  20    CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94     5024304
  21     MANGANESE-55   ENDF/B-IV MAT 1197                       UPDATED 08/12/94     5025055
  22    FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94     5026304
  23    NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94     5028304
  24     ZIRCALLOY      ENDF/B-IV MAT 1284                       UPDATED 08/12/94     2040302
  25    PB   1288 218NGP 042375 P-3 293K                         UPDATED 08/12/94     7082000
  26     URANIUM-235    ENDF/B-IV MAT 1261                       UPDATED 08/12/94     1092235
  27     URANIUM-238    ENDF/B-IV MAT 1262                       UPDATED 08/12/94     1092238

HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94   3001001     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94   8001001     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94   9001001     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94  10001001     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

B-10 1273 218NGP 042375 P-3 293K                    UPDATED 08/12/94   6005010     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

B-10 1273 218NGP 042375 P-3 293K                    UPDATED 08/12/94   8005010     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

BORON-11       ENDF/B-IV MAT 1160                   UPDATED 08/12/94   6005011     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

BORON-11       ENDF/B-IV MAT 1160                   UPDATED 08/12/94   8005011     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

CARBON-12      ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94   6006012     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

CARBON-12      ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94   8006012     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

NITROGEN-14    ENDF/B-IV MAT 1275                   UPDATED 08/12/94   8007014     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94   1008016     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
 OXYGEN-16      ENDF/B-IV MAT 1276                  UPDATED 08/12/94   3008016      TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                  UPDATED 08/12/94   8008016      TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                  UPDATED 08/12/94   9008016      TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                  UPDATED 08/12/94  10008016      TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

AL-27 1193 218 GP 040375(5)                         UPDATED 08/12/94   4013027      TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

AL-27 1193 218 GP 040375(5)                         UPDATED 08/12/94   6013027      TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

AL-27 1193 218 GP 040375(5)                         UPDATED 08/12/94   8013027      TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'    UPDATED 08/12/94   5024304      TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 MANGANESE-55   ENDF/B-IV MAT 1197                  UPDATED 08/12/94   5025055      TEMPERATURE=   293.00

GEOMETRY HAS BEEN SET TO HOMOGENEOUS AS LBAR IS  0.0000E+00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)            =    54.466           TEMPERATURE(KELVIN)       =   293.000

POTENTIAL SCATTER SIGMA   =     2.590            LUMPED NUCLEAR DENSITY    = 1.7363295E-03

SPIN FACTOR (G)            =    14.448           LUMP DIMENSION (A-BAR)    = 0.0000000E+00

INNER RADIUS               = 0.0000000E+00       DANCOFF CORRECTION (C)    = 0.0000000E+00

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1    =     55.845             SIGMA(PER ABSORBER ATOM)= 3.4663022E+02

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2    =     55.925             SIGMA(PER ABSORBER ATOM)= 1.2557598E+02

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 0-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP        RES ABS         RES FISS        RES SCAT
  8       -5.518788E-04    0.000000E+00   -3.944190E-01
  9       -2.797993E-03    0.000000E+00   -2.293471E+00
 10       -3.291452E-01    0.000000E+00   -3.820862E+01
 11       -2.680562E+00    0.000000E+00   -1.159996E+02

EXCESS RESONANCE INTEGRALS

                  RESOLVED

ABSORPTION       3.33719E+00
FISSION          0.00000E+00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'    UPDATED 08/12/94   5026304      TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'    UPDATED 08/12/94   5028304      TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
 ZIRCALLOY      ENDF/B-IV MAT 1284                     UPDATED 08/12/94   2040302     TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =     90.436            TEMPERATURE(KELVIN)        =   293.000

POTENTIAL SCATTER SIGMA  =      6.385            LUMPED NUCLEAR DENSITY     = 4.3307818E-02

SPIN FACTOR (G)          =      1.079            LUMP DIMENSION (A-BAR)     = 4.5719999E-01

INNER RADIUS             = 4.0009999E-01         DANCOFF CORRECTION (C)     = 4.4366416E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP       RES ABS         RES FISS         RES SCAT
  8      -3.284353E-04    0.000000E+00   -2.612845E-01
  9      -2.311753E-02    0.000000E+00   -9.524279E-01
 10      -2.325708E-02    0.000000E+00   -5.342349E-01
 11      -8.027643E-02    0.000000E+00   -3.840209E-01

EXCESS RESONANCE INTEGRALS

                     RESOLVED

ABSORPTION        5.62305E-01
FISSION           0.00000E+00
                                                             PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

PB   1288 218NGP 042375 P-3 293K                       UPDATED 08/12/94   7082000     TEMPERATURE=   293.00
                                                             PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 URANIUM-235    ENDF/B-IV MAT 1261                     UPDATED 08/12/94   1092235     TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =    233.025            TEMPERATURE(KELVIN)        =   293.000

POTENTIAL SCATTER SIGMA  =     11.500            LUMPED NUCLEAR DENSITY     = 9.8766887E-04

SPIN FACTOR (G)          = 15171.100             LUMP DIMENSION (A-BAR)     = 3.9219999E-01

INNER RADIUS             = 0.0000000E+00         DANCOFF CORRECTION (C)     = 2.3525730E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1    =     15.991            SIGMA(PER ABSORBER ATOM)= 1.8285364E+02

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2    =    238.051            SIGMA(PER ABSORBER ATOM)= 2.7760712E+02

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP       RES ABS         RES FISS         RES SCAT
 12      -3.904891E+00   -2.400683E+00   -9.365656E-02
 13      -1.223861E+01   -5.975270E+00   -2.623999E-01
 14      -9.154386E+00   -5.417213E+00   -6.158343E-02
 15      -5.171851E-04   -3.930799E-04    4.654119E-06

EXCESS RESONANCE INTEGRALS

                     RESOLVED

ABSORPTION        1.98617E+02
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
FISSION          1.19162E+02
                                                      PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 URANIUM-238    ENDF/B-IV MAT 1262                 UPDATED 08/12/94   1092238     TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =   236.006           TEMPERATURE(KELVIN)        =   293.000

POTENTIAL SCATTER SIGMA  =    10.599           LUMPED NUCLEAR DENSITY     = 2.2243705E-02

SPIN FACTOR (G)          =   656.527           LUMP DIMENSION (A-BAR)     = 3.9219999E-01

INNER RADIUS             = 0.0000000E+00       DANCOFF CORRECTION (C)     = 2.3525730E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1    =    15.991            SIGMA(PER ABSORBER ATOM)= 8.1190996E+00

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2    =   235.044            SIGMA(PER ABSORBER ATOM)= 5.2849644E-01

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP        RES ABS         RES FISS        RES SCAT
  9      -4.655258E-02    0.000000E+00   -4.609913E-01
 10      -1.139702E+00   -2.338724E-05   -6.895151E+00
 11      -9.892670E+00    0.000000E+00   -2.712805E+01
 12      -4.299526E+01    0.000000E+00   -4.994605E+01
 13      -5.378721E+01    0.000000E+00   -1.765308E+01
 14      -1.041276E+02    0.000000E+00   -6.054823E+00
 15      -8.495994E-07    0.000000E+00    1.647857E-06

EXCESS RESONANCE INTEGRALS

                  RESOLVED

ABSORPTION       1.88041E+01
FISSION          4.93936E-04
                                                      PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00
THIS XSDRN WORKING TAPE WAS CREATED 02/03/98 AT 07:42:53
     THE TITLE OF THE PARENT CASE IS AS FOLLOWS
     SCALE 4.2 - 27 GROUP NEUTRON GROUP LIBRARY
        BASED ON ENDF-B VERSION 4 DATA
           COMPILED FOR NRC      1/27/89
         TAPE ID                            4321         NUMBER OF NUCLIDES                    27
         NUMBER OF NEUTRON GROUPS             27         NUMBER OF GAMMA GROUPS                 0
         FIRST THERMAL GROUP                  15         LOGICAL UNIT                           4
                                    TABLE OF CONTENTS
        HYDROGEN       ENDF/B-IV MAT 1269/THRM1002           UPDATED 08/12/94        ID   3001001
        HYDROGEN       ENDF/B-IV MAT 1269/THRM1002           UPDATED 08/12/94        ID   8001001
        HYDROGEN       ENDF/B-IV MAT 1269/THRM1002           UPDATED 08/12/94        ID   9001001
        HYDROGEN       ENDF/B-IV MAT 1269/THRM1002           UPDATED 08/12/94        ID  10001001
       B-10 1273 218NGP 042375 P-3 293K                      UPDATED 08/12/94        ID   6005010
       B-10 1273 218NGP 042375 P-3 293K                      UPDATED 08/12/94        ID   8005010
        BORON-11       ENDF/B-IV MAT 1160                    UPDATED 08/12/94        ID   6005011
        BORON-11       ENDF/B-IV MAT 1160                    UPDATED 08/12/94        ID   8005011
        CARBON-12      ENDF/B-IV MAT 1274/THRM1065           UPDATED 08/12/94        ID   6006012
        CARBON-12      ENDF/B-IV MAT 1274/THRM1065           UPDATED 08/12/94        ID   8006012
        NITROGEN-14    ENDF/B-IV MAT 1275                    UPDATED 08/12/94        ID   8007014
        OXYGEN-16      ENDF/B-IV MAT 1276                    UPDATED 08/12/94        ID   1008016
        OXYGEN-16      ENDF/B-IV MAT 1276                    UPDATED 08/12/94        ID   3008016
        OXYGEN-16      ENDF/B-IV MAT 1276                    UPDATED 08/12/94        ID   8008016
        OXYGEN-16      ENDF/B-IV MAT 1276                    UPDATED 08/12/94        ID   9008016
        OXYGEN-16      ENDF/B-IV MAT 1276                    UPDATED 08/12/94        ID  10008016
       AL-27 1193 218 GP 040375(5)                           UPDATED 08/12/94        ID   4013027
       AL-27 1193 218 GP 040375(5)                           UPDATED 08/12/94        ID   6013027
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
AL-27 1193 218 GP 040375(5)                              UPDATED 08/12/94       ID    8013027
CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94       ID    5024304
 MANGANESE-55    ENDF/B-IV MAT 1197                      UPDATED 08/12/94       ID    5025055
FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94       ID    5026304
NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94       ID    5028304
 ZIRCALLOY       ENDF/B-IV MAT 1284                      UPDATED 08/12/94       ID    2040302
PB   1288 218NGP 042375 P-3 293K                         UPDATED 08/12/94       ID    7082000
 URANIUM-235     ENDF/B-IV MAT 1261                      UPDATED 08/12/94       ID    1092235
 URANIUM-238     ENDF/B-IV MAT 1262                      UPDATED 08/12/94       ID    1092238

                 ********************************************************************************
                 ********************************************************************************
                 ********************************************************************************
                 *****                                                                      *****
                 *****                  PROGRAM VERIFICATION INFORMATION                    *****
                 *****                                                                      *****
                 *****                 CODE SYSTEM:  SCALE-PC VERSION:  4.3                 *****
                 *****                                                                      *****
                 ********************************************************************************
                 ********************************************************************************
                 *****                                                                      *****
                 *****                                                                      *****
                 *****              PROGRAM:  000009                                        *****
                 *****                                                                      *****
                 *****        CREATION DATE:  03-08-96                                      *****
                 *****                                                                      *****
                 *****               VOLUME:  ENG                                           *****
                 *****                                                                      *****
                 *****              LIBRARY:  G:\SCALE43\EXE                                *****
                 *****                                                                      *****
                 *****                                                                      *****
                 *****      PRODUCTION CODE:  KENOVA                                        *****
                 *****                                                                      *****
                 *****              VERSION:  3.1                                           *****
                 *****                                                                      *****
                 *****              JOBNAME:  SCALE-PC                                      *****
                 *****                                                                      *****
                 *****    DATE OF EXECUTION:  02/03/98                                      *****
                 *****                                                                      *****
                 *****    TIME OF EXECUTION:  07:43:08                                      *****
                 *****                                                                      *****
                 *****                                                                      *****
                 ********************************************************************************
                 ********************************************************************************
                 ********************************************************************************
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
*****************************************************************************************************************
***                                                                                                           ***
***                         NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, ACCIDENT TRANSPORT 1.0 1.0, PITCH 25***
***                                                                                                           ***
*****************************************************************************************************************
***                         ******     NUMERIC PARAMETERS      ******                                         ***
***                                                                                                           ***
***                                                                                                           ***
***           TME      MAXIMUM PROBLEM TIME (MIN)                         ******                              ***
***                                                                                                           ***
***           TBA      TIME PER GENERATION (MIN)                            0.50                              ***
***                                                                                                           ***
***           GEN      NUMBER OF GENERATIONS                                 803                              ***
***                                                                                                           ***
***           NPG      NUMBER PER GENERATION                                1000                              ***
***                                                                                                           ***
***           NSK      NUMBER OF GENERATIONS TO BE SKIPPED                     3                              ***
***                                                                                                           ***
***           BEG      BEGINNING GENERATION NUMBER                             1                              ***
***                                                                                                           ***
***           RES      GENERATIONS BETWEEN CHECKPOINTS                         0                              ***
***                                                                                                           ***
***           X1D      NUMBER OF EXTRA 1-D CROSS SECTIONS                      1                              ***
***                                                                                                           ***
***           NBK      NEUTRON BANK SIZE                                    1025                              ***
***                                                                                                           ***
***           XNB      EXTRA POSITIONS IN NEUTRON BANK                         0                              ***
***                                                                                                           ***
***           NFB      FISSION BANK SIZE                                    1000                              ***
***                                                                                                           ***
***           XFB      EXTRA POSITIONS IN FISSION BANK                         0                              ***
***                                                                                                           ***
***           WTA      DEFAULT VALUE OF WEIGHT AVERAGE                    0.5000                              ***
***                                                                                                           ***
***           WTH      WEIGHT HIGH FOR SPLITTING                          3.0000                              ***
***                                                                                                           ***
***           WTL      WEIGHT LOW FOR RUSSIAN ROULETTE                    0.3333                              ***
***                                                                                                           ***
***           RND      STARTING RANDOM NUMBER                         BB827100001                             ***
***                                                                                                           ***
***           NB8      NUMBER OF D.A. BLOCKS ON UNIT  8                      200                              ***
***                                                                                                           ***
***           NL8      LENGTH OF D.A. BLOCKS ON UNIT  8                      512                              ***
***                                                                                                           ***
***           ADJ      MODE OF CALCULATION                               FORWARD                              ***
***                                                                                                           ***
***                    INPUT DATA WRITTEN ON RESTART UNIT                     NO                              ***
***                                                                                                           ***
***                    BINARY DATA INTERFACE                                 YES                              ***
***                                                                                                           ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
*****************************************************************************************************
*****************************************************************************************************
***                                                                                               ***
***                        NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, ACCIDENT TRANSPORT 1.0 1.0, PITCH 25***
***                                                                                               ***
*****************************************************************************************************
***                       ******      LOGICAL PARAMETERS       ******                             ***
***                                                                                               ***
***  RUN  EXECUTE PROBLEM AFTER CHECKING DATA   YES         PLT  PLOT PICTURE MAP(S)            NO ***
***                                                                                               ***
***  FLX  COMPUTE FLUX                          NO          FDN  COMPUTE FISSION DENSITIES      NO ***
***                                                                                               ***
***  SMU  COMPUTE AVG UNIT SELF-MULTIPLICATION  NO          NUB  COMPUTE NU-BAR & AVG FISSION GROUP  YES ***
***                                                                                               ***
***  MKU  COMPUTE MATRIX K-EFF BY UNIT NUMBER   NO          MKP  COMPUTE MATRIX K-EFF BY UNIT LOCATION   NO ***
***                                                                                               ***
***  CKU  COMPUTE COFACTOR K-EFF BY UNIT NUMBER NO          CKP  COMPUTE COFACTOR K-EFF BY UNIT LOCATION NO ***
***                                                                                               ***
***  FMU  PRINT FISS PROD MATRIX BY UNIT NUMBER NO          FMP  PRINT FISS PROD MATRIX BY UNIT LOCATION NO ***
***                                                                                               ***
***  MKH  COMPUTE MATRIX K-EFF BY HOLE NUMBER   NO          MKA  COMPUTE MATRIX K-EFF BY ARRAY NUMBER    NO ***
***                                                                                               ***
***  CKH  COMPUTE COFACTOR K-EFF BY HOLE NUMBER NO          CKA  COMPUTE COFACTOR K-EFF BY ARRAY NUMBER  NO ***
***                                                                                               ***
***  FMH  PRINT FISS PROD MATRIX BY HOLE NUMBER NO          FMA  PRINT FISS PROD MATRIX BY ARRAY NUMBER  NO ***
***                                                                                               ***
***  HHL  COLLECT MATRIX BY HIGHEST HOLE LEVEL  NO          HAL  COLLECT MATRIX BY HIGHEST ARRAY LEVEL   NO ***
***                                                                                               ***
***  AMX  PRINT ALL MIXED CROSS SECTIONS        NO          FAR  PRINT FIS. AND ABS. BY REGION      NO ***
***                                                                                               ***
***  XS1  PRINT 1-D MIXTURE X-SECTIONS          NO          GAS  PRINT FAR BY GROUP                 NO ***
***                                                                                               ***
***  XS2  PRINT 2-D MIXTURE X-SECTIONS          NO          PAX  PRINT XSEC-ALBEDO CORRELATION TABLES   NO ***
***                                                                                               ***
***  XAP  PRINT MIXTURE ANGLES & PROBABILITIES  NO          PWT  PRINT WEIGHT AVERAGE ARRAY         NO ***
***                                                                                               ***
***  PKI  PRINT FISSION SPECTRUM                NO          PGM  PRINT INPUT GEOMETRY               NO ***
***                                                                                               ***
***  P1D  PRINT EXTRA 1-D CROSS SECTIONS        NO          BUG  PRINT DEBUG INFORMATION            NO ***
***                                                                                               ***
***                                                         TRK  PRINT TRACKING INFORMATION         NO ***
***                                                                                               ***
***                                                                                               ***
*****************************************************************************************************
*****************************************************************************************************
*****************************************************************************************************
                              PARAMETER INPUT COMPLETED


                     NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, ACCIDENT TRANSPORT 1.0 1.0, PITCH 25

                                   MIXING TABLE

                          NUMBER OF SCATTERING ANGLES =  2
                        CROSS SECTION MESSAGE THRESHOLD =3.0E-05


MIXTURE =      1         DENSITY(G/CC) =  10.412
   NUCLIDE  ATOM-DENS.  WGT. FRAC.    ZA     AWT            NUCLIDE TITLE
   1008016  4.64627E-02  1.18489E-01   8016    15.9904     OXYGEN-16     ENDF/B-IV MAT 1276                        UPDATED
08/12/94
   1092235  9.87669E-04  3.70234E-02   92235   235.0441    URANIUM-235   ENDF/B-IV MAT 1261                        UPDATED
08/12/94
   1092238  2.22437E-02  8.44487E-01   92238   238.0510    URANIUM-238   ENDF/B-IV MAT 1262                        UPDATED
08/12/94

MIXTURE =      2         DENSITY(G/CC) =  6.5600
   NUCLIDE  ATOM-DENS.  WGT. FRAC.    ZA     AWT            NUCLIDE TITLE
   2040302  4.33078E-02  1.00000E+00   40000   91.2196     ZIRCALLOY     ENDF/B-IV MAT 1284                        UPDATED
08/12/94
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
MIXTURE =      3          DENSITY(G/CC) = 0.99817
    NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA        AWT                NUCLIDE TITLE
    3001001   6.67692E-02  1.11927E-01    1001       1.0077         HYDROGEN          ENDF/B-IV MAT 1269/THRM1002             UPDATED
08/12/94
    3008016   3.33846E-02  8.88074E-01    8016      15.9904        OXYGEN-16          ENDF/B-IV MAT 1276                      UPDATED
08/12/94

MIXTURE =      4          DENSITY(G/CC) =  2.7020
    NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA        AWT                NUCLIDE TITLE
    4013027   6.03066E-02  1.00000E+00   13027      26.9818       AL-27 1193 218 GP 040375(5)                                 UPDATED
08/12/94

MIXTURE =      5          DENSITY(G/CC) =  7.9200
    NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA        AWT                NUCLIDE TITLE
    5024304   1.74286E-02  1.90000E-01   24000      51.9957        CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'           UPDATED
08/12/94
    5025055   1.73633E-03  1.99999E-02   25055      54.9379        MANGANESE-55     ENDF/B-IV MAT 1197                        UPDATED
08/12/94
    5026304   5.93579E-02  6.95000E-01   26000      55.8447        FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'           UPDATED
08/12/94
    5028304   7.72070E-03  9.50001E-02   28000      58.6872        NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'           UPDATED
08/12/94

MIXTURE =      6          DENSITY(G/CC) =  2.5830
    NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA        AWT                NUCLIDE TITLE
    6005010   7.09799E-03  4.56901E-02    5010      10.0130       B-10 1273 218NGP 042375 P-3 293K                            UPDATED
08/12/94
    6005011   3.92356E-02  2.77698E-01    5011      11.0096        BORON-11         ENDF/B-IV MAT 1160                        UPDATED
08/12/94
    6006012   1.21874E-02  9.40196E-02    6000      12.0001         CARBON-12        ENDF/B-IV MAT 1274/THRM1065              UPDATED
08/12/94
    6013027   3.35871E-02  5.82592E-01   13027      26.9818       AL-27 1193 218 GP 040375(5)                                 UPDATED
08/12/94

MIXTURE =      7          DENSITY(G/CC) =  11.344
    NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA        AWT                NUCLIDE TITLE
    7082000   3.29690E-02  1.00000E+00   82000     207.2100       PB   1288 218NGP 042375 P-3 293K                            UPDATED
08/12/94

MIXTURE =      8          DENSITY(G/CC) =  1.6298
    NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA        AWT                NUCLIDE TITLE
    8001001   5.85400E-02  6.01023E-02    1001       1.0077         HYDROGEN          ENDF/B-IV MAT 1269/THRM1002             UPDATED
08/12/94
    8005010   8.55300E-05  8.72589E-04    5010      10.0130       B-10 1273 218NGP 042375 P-3 293K                            UPDATED
08/12/94
    8005011   3.42200E-04  3.83863E-03    5011      11.0096        BORON-11         ENDF/B-IV MAT 1160                        UPDATED
08/12/94
    8006012   2.26400E-02  2.76813E-01    6000      12.0001         CARBON-12        ENDF/B-IV MAT 1274/THRM1065              UPDATED
08/12/94
    8007014   1.39400E-03  1.98893E-02    7014      14.0033        NITROGEN-14      ENDF/B-IV MAT 1275                        UPDATED
08/12/94
    8008016   2.60900E-02  4.25068E-01    8016      15.9904        OXYGEN-16        ENDF/B-IV MAT 1276                        UPDATED
08/12/94
    8013027   7.76300E-03  2.13416E-01   13027      26.9818       AL-27 1193 218 GP 040375(5)                                 UPDATED
08/12/94

MIXTURE =      9          DENSITY(G/CC) = 0.99817
    NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA        AWT                NUCLIDE TITLE
    9001001   6.67692E-02  1.11927E-01    1001       1.0077         HYDROGEN          ENDF/B-IV MAT 1269/THRM1002             UPDATED
08/12/94
    9008016   3.33846E-02  8.88074E-01    8016      15.9904        OXYGEN-16        ENDF/B-IV MAT 1276                        UPDATED
08/12/94

MIXTURE =      10         DENSITY(G/CC) = 0.99817
    NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA        AWT                NUCLIDE TITLE
   10001001   6.67692E-02  1.11927E-01    1001       1.0077         HYDROGEN          ENDF/B-IV MAT 1269/THRM1002             UPDATED
08/12/94
   10008016   3.33846E-02  8.88074E-01    8016      15.9904        OXYGEN-16        ENDF/B-IV MAT 1276                        UPDATED
08/12/94
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Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
   3001001    HYDROGEN      ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94
   8001001    HYDROGEN      ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94
   9001001    HYDROGEN      ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94
  10001001    HYDROGEN      ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94
   6005010   B-10 1273 218NGP 042375 P-3 293K                    UPDATED 08/12/94
   8005010   B-10 1273 218NGP 042375 P-3 293K                    UPDATED 08/12/94
   6005011    BORON-11      ENDF/B-IV MAT 1160                   UPDATED 08/12/94
   8005011    BORON-11      ENDF/B-IV MAT 1160                   UPDATED 08/12/94
   6006012    CARBON-12     ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94
   8006012    CARBON-12     ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94
   8007014    NITROGEN-14   ENDF/B-IV MAT 1275                   UPDATED 08/12/94
   1008016    OXYGEN-16     ENDF/B-IV MAT 1276                   UPDATED 08/12/94
   3008016    OXYGEN-16     ENDF/B-IV MAT 1276                   UPDATED 08/12/94
   8008016    OXYGEN-16     ENDF/B-IV MAT 1276                   UPDATED 08/12/94
   9008016    OXYGEN-16     ENDF/B-IV MAT 1276                   UPDATED 08/12/94
  10008016    OXYGEN-16     ENDF/B-IV MAT 1276                   UPDATED 08/12/94
   4013027   AL-27 1193 218 GP 040375(5)                         UPDATED 08/12/94
   6013027   AL-27 1193 218 GP 040375(5)                         UPDATED 08/12/94
   8013027   AL-27 1193 218 GP 040375(5)                         UPDATED 08/12/94
   5024304   CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'    UPDATED 08/12/94
   5025055    MANGANESE-55  ENDF/B-IV MAT 1197                   UPDATED 08/12/94
   5026304   FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'    UPDATED 08/12/94
   5028304   NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'    UPDATED 08/12/94
   2040302    ZIRCALLOY     ENDF/B-IV MAT 1284                   UPDATED 08/12/94
   7082000   PB  1288 218NGP 042375 P-3 293K                     UPDATED 08/12/94
   1092235    URANIUM-235   ENDF/B-IV MAT 1261                   UPDATED 08/12/94
   1092238    URANIUM-238   ENDF/B-IV MAT 1262                   UPDATED 08/12/94

KENO MESSAGE NUMBER K5-222     1 TRANSFERS FOR MIXTURE    3 WERE CORRECTED FOR BAD MOMENTS.

KENO MESSAGE NUMBER K5-222     1 TRANSFERS FOR MIXTURE    9 WERE CORRECTED FOR BAD MOMENTS.

KENO MESSAGE NUMBER K5-222     1 TRANSFERS FOR MIXTURE   10 WERE CORRECTED FOR BAD MOMENTS.

          ........   0 IO'S WERE USED MIXING CROSS-SECTIONS      ........

           1-D CROSS SECTION ARRAY ID NUMBERS
              1  2002  1452    27    18  1018

          ........   0 IO'S WERE USED PREPARING THE CROSS SECTIONS    ........
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
****************************************************************************************************
***                                                                                              ***
***        NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, ACCIDENT TRANSPORT 1.0 1.0, PITCH 25      ***
***                                                                                              ***
****************************************************************************************************
****************************************************************************************************
***                                                                                              ***
***                              ****** ADDITIONAL INFORMATION ******                            ***
***                                                                                              ***
***  NUMBER OF ENERGY GROUPS                 27       USE LATTICE GEOMETRY                  YES  ***
***                                                                                              ***
***  NO. OF FISSION SPECTRUM SOURCE GROUP  1          GLOBAL ARRAY NUMBER                     4  ***
***                                                                                              ***
***  NO. OF SCATTERING ANGLES IN XSECS       2        NUMBER OF UNITS IN THE GLOBAL X DIR.    1  ***
***                                                                                              ***
***  ENTRIES/NEUTRON IN THE NEUTRON BANK  25          NUMBER OF UNITS IN THE GLOBAL Y DIR.    1  ***
***                                                                                              ***
***  ENTRIES/NEUTRON IN THE FISSION BANK  18          NUMBER OF UNITS IN THE GLOBAL Z DIR.    4  ***
***                                                                                              ***
***  NUMBER OF MIXTURES USED                 9        USE A GLOBAL REFLECTOR                YES  ***
***                                                                                              ***
***  NUMBER OF BIAS ID'S USED                1        USE NESTED HOLES                      YES  ***
***                                                                                              ***
***  NUMBER OF DIFFERENTIAL ALBEDOS USED   0          NUMBER OF HOLES                       186  ***
***                                                                                              ***
***  TOTAL INPUT GEOMETRY REGIONS          154        MAXIMUM HOLE NESTING LEVEL              3  ***
***                                                                                              ***
***  NUMBER OF GEOMETRY REGIONS USED       154        USE NESTED ARRAYS                     YES  ***
***                                                                                              ***
***  LARGEST GEOMETRY UNIT NUMBER          104        NUMBER OF ARRAYS USED                   4  ***
***                                                                                              ***
***  LARGEST ARRAY NUMBER                    4        MAXIMUM ARRAY NESTING LEVEL             2  ***
***                                                                                              ***
***                                                                                              ***
***  +X BOUNDARY CONDITION              MIRROR        -X BOUNDARY CONDITION              MIRROR  ***
***                                                                                              ***
***  +Y BOUNDARY CONDITION              MIRROR        -Y BOUNDARY CONDITION              MIRROR  ***
***                                                                                              ***
***  +Z BOUNDARY CONDITION                 PER        -Z BOUNDARY CONDITION                 PER  ***
***                                                                                              ***
****************************************************************************************************

NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, ACCIDENT TRANSPORT 1.0 1.0, PITCH 25

                 GENERATION     ELAPSED TIME       AVERAGE        AVG K-EFF        MATRIX       MATRIX K-EFF
   GENERATION   K-EFFECTIVE       MINUTES        K-EFFECTIVE      DEVIATION      K-EFFECTIVE      DEVIATION
KENO MESSAGE NUMBER K5-132     WARNING....ONLY  915 INDEPENDENT FISSION POINTS WERE GENERATED
        1       8.45028E-01    1.85000E-01    1.00000E+00    0.00000E+00    0.00000E+00    0.00000E+00
KENO MESSAGE NUMBER K5-132     WARNING....ONLY  954 INDEPENDENT FISSION POINTS WERE GENERATED
        2       8.60486E-01    2.54500E-01    1.00000E+00    0.00000E+00    0.00000E+00    0.00000E+00
KENO MESSAGE NUMBER K5-132     WARNING....ONLY  962 INDEPENDENT FISSION POINTS WERE GENERATED
        3       8.78953E-01    3.14000E-01    8.78953E-01    0.00000E+00    0.00000E+00    0.00000E+00
        4       8.80614E-01    3.97333E-01    8.79784E-01    8.30412E-04    0.00000E+00    0.00000E+00
        5       9.02418E-01    4.62333E-01    8.87328E-01    7.55995E-03    0.00000E+00    0.00000E+00
        6       8.56431E-01    5.31000E-01    8.79604E-01    9.39371E-03    0.00000E+00    0.00000E+00
        7       9.04664E-01    5.96000E-01    8.84616E-01    8.83544E-03    0.00000E+00    0.00000E+00
        8       8.52169E-01    6.58167E-01    8.79208E-01    9.01598E-03    0.00000E+00    0.00000E+00
        9       8.93579E-01    7.48833E-01    8.81261E-01    7.89162E-03    0.00000E+00    0.00000E+00
       10       9.14812E-01    8.08333E-01    8.85455E-01    8.01854E-03    0.00000E+00    0.00000E+00
       11       8.85195E-01    8.77833E-01    8.85426E-01    7.07174E-03    0.00000E+00    0.00000E+00
       12       8.74378E-01    9.50167E-01    8.84321E-01    6.42092E-03    0.00000E+00    0.00000E+00
       13       9.20378E-01    1.03900E+00    8.87599E-01    6.66906E-03    0.00000E+00    0.00000E+00
       14       9.05397E-01    1.11050E+00    8.89082E-01    6.26605E-03    0.00000E+00    0.00000E+00
       15       9.37424E-01    1.17900E+00    8.92801E-01    6.85936E-03    0.00000E+00    0.00000E+00
       16       9.19052E-01    1.28717E+00    8.94676E-01    6.62157E-03    0.00000E+00    0.00000E+00
       17       9.02743E-01    1.36583E+00    8.95214E-01    6.18776E-03    0.00000E+00    0.00000E+00
       18       8.71399E-01    1.43533E+00    8.93725E-01    5.97643E-03    0.00000E+00    0.00000E+00
       19       9.15408E-01    1.51050E+00    8.95001E-01    5.75693E-03    0.00000E+00    0.00000E+00
       20       8.69583E-01    1.61200E+00    8.93589E-01    5.60837E-03    0.00000E+00    0.00000E+00
       21       9.08974E-01    1.75400E+00    8.94398E-01    5.36643E-03    0.00000E+00    0.00000E+00
       22       9.43581E-01    1.88217E+00    8.96858E-01    5.65385E-03    0.00000E+00    0.00000E+00
       23       8.98740E-01    1.95083E+00    8.96947E-01    5.37863E-03    0.00000E+00    0.00000E+00
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

24	9.41417E-01	2.00750E+00	8.98969E-01	5.51232E-03	0.00000E+00	0.00000E+00
25	8.95500E-01	2.09183E+00	8.98818E-01	5.26936E-03	0.00000E+00	0.00000E+00
26	9.25465E-01	2.20167E+00	8.99928E-01	5.16576E-03	0.00000E+00	0.00000E+00
27	8.96219E-01	2.39483E+00	8.99780E-01	4.95704E-03	0.00000E+00	0.00000E+00
28	8.98023E-01	2.44700E+00	8.99712E-01	4.76305E-03	0.00000E+00	0.00000E+00
29	9.22820E-01	2.75917E+00	9.00568E-01	4.66247E-03	0.00000E+00	0.00000E+00
30	9.04949E-01	3.02733E+00	9.00725E-01	4.49559E-03	0.00000E+00	0.00000E+00
31	8.82567E-01	3.26983E+00	9.00098E-01	4.38276E-03	0.00000E+00	0.00000E+00
32	9.24196E-01	3.50617E+00	9.00902E-01	4.30966E-03	0.00000E+00	0.00000E+00
33	8.99021E-01	3.60033E+00	9.00841E-01	4.16877E-03	0.00000E+00	0.00000E+00
34	9.05256E-01	3.76517E+00	9.00979E-01	4.03875E-03	0.00000E+00	0.00000E+00
35	9.11266E-01	3.81733E+00	9.01291E-01	3.92684E-03	0.00000E+00	0.00000E+00
36	8.90096E-01	3.86867E+00	9.00961E-01	3.82380E-03	0.00000E+00	0.00000E+00
37	9.34055E-01	3.97483E+00	9.01907E-01	3.83144E-03	0.00000E+00	0.00000E+00
38	9.09443E-01	4.16800E+00	9.02116E-01	3.72937E-03	0.00000E+00	0.00000E+00
39	9.20308E-01	4.29067E+00	9.02608E-01	3.66035E-03	0.00000E+00	0.00000E+00
40	9.60828E-01	4.34467E+00	9.04140E-01	3.87818E-03	0.00000E+00	0.00000E+00
41	8.92753E-01	4.40050E+00	9.03848E-01	3.78870E-03	0.00000E+00	0.00000E+00
42	9.30630E-01	4.46083E+00	9.04518E-01	3.75298E-03	0.00000E+00	0.00000E+00
43	9.30950E-01	4.51667E+00	9.05162E-01	3.71664E-03	0.00000E+00	0.00000E+00
44	8.89295E-01	4.57067E+00	9.04784E-01	3.64669E-03	0.00000E+00	0.00000E+00
			•			
			•			
			•			
766	9.07771E-01	5.74732E+01	9.18980E-01	8.71601E-04	0.00000E+00	0.00000E+00
767	9.00615E-01	5.75510E+01	9.18956E-01	8.70792E-04	0.00000E+00	0.00000E+00
768	9.62929E-01	5.77148E+01	9.19013E-01	8.71547E-04	0.00000E+00	0.00000E+00
769	9.27617E-01	5.78750E+01	9.19025E-01	8.70483E-04	0.00000E+00	0.00000E+00
770	8.98795E-01	5.79968E+01	9.18998E-01	8.69747E-04	0.00000E+00	0.00000E+00
771	9.26927E-01	5.80892E+01	9.19008E-01	8.68677E-04	0.00000E+00	0.00000E+00
772	9.08778E-01	5.82338E+01	9.18995E-01	8.67650E-04	0.00000E+00	0.00000E+00
773	9.32480E-01	5.82852E+01	9.19013E-01	8.66700E-04	0.00000E+00	0.00000E+00
774	9.13695E-01	5.83363E+01	9.19006E-01	8.65604E-04	0.00000E+00	0.00000E+00
775	9.59137E-01	5.83858E+01	9.19058E-01	8.66041E-04	0.00000E+00	0.00000E+00
776	9.24788E-01	5.84362E+01	9.19065E-01	8.64953E-04	0.00000E+00	0.00000E+00
777	8.53001E-01	5.84875E+01	9.18980E-01	8.68032E-04	0.00000E+00	0.00000E+00
778	9.37161E-01	5.85360E+01	9.19003E-01	8.67229E-04	0.00000E+00	0.00000E+00
779	9.24118E-01	5.85845E+01	9.19010E-01	8.66138E-04	0.00000E+00	0.00000E+00
780	8.84378E-01	5.86367E+01	9.18965E-01	8.66168E-04	0.00000E+00	0.00000E+00
781	9.13175E-01	5.86852E+01	9.18958E-01	8.65087E-04	0.00000E+00	0.00000E+00
782	9.33630E-01	5.87382E+01	9.18977E-01	8.64182E-04	0.00000E+00	0.00000E+00
783	9.44099E-01	5.87977E+01	9.19009E-01	8.63674E-04	0.00000E+00	0.00000E+00
784	9.75015E-01	5.88692E+01	9.19081E-01	8.65537E-04	0.00000E+00	0.00000E+00
785	9.23788E-01	5.89185E+01	9.19087E-01	8.64452E-04	0.00000E+00	0.00000E+00
786	8.91437E-01	5.89698E+01	9.19051E-01	8.64069E-04	0.00000E+00	0.00000E+00
787	8.86729E-01	5.90230E+01	9.19010E-01	8.63949E-04	0.00000E+00	0.00000E+00
788	8.94312E-01	5.90770E+01	9.18979E-01	8.63421E-04	0.00000E+00	0.00000E+00
789	9.30979E-01	5.91263E+01	9.18994E-01	8.62458E-04	0.00000E+00	0.00000E+00
790	8.91876E-01	5.92070E+01	9.18960E-01	8.62050E-04	0.00000E+00	0.00000E+00
791	9.45892E-01	5.92582E+01	9.18994E-01	8.61634E-04	0.00000E+00	0.00000E+00
792	8.77510E-01	5.93077E+01	9.18941E-01	8.62143E-04	0.00000E+00	0.00000E+00
793	9.00762E-01	5.93580E+01	9.18918E-01	8.61359E-04	0.00000E+00	0.00000E+00
794	9.33553E-01	5.94093E+01	9.18937E-01	8.60469E-04	0.00000E+00	0.00000E+00
795	9.40924E-01	5.94597E+01	9.18964E-01	8.59830E-04	0.00000E+00	0.00000E+00
796	9.59407E-01	5.95337E+01	9.19015E-01	8.60256E-04	0.00000E+00	0.00000E+00
797	9.00746E-01	5.95850E+01	9.18992E-01	8.59481E-04	0.00000E+00	0.00000E+00
798	9.08014E-01	5.96573E+01	9.18979E-01	8.58511E-04	0.00000E+00	0.00000E+00
799	9.49942E-01	5.97160E+01	9.19017E-01	8.58313E-04	0.00000E+00	0.00000E+00
800	9.20550E-01	5.97690E+01	9.19019E-01	8.57239E-04	0.00000E+00	0.00000E+00
801	9.01510E-01	5.98387E+01	9.18997E-01	8.56445E-04	0.00000E+00	0.00000E+00
802	9.21593E-01	5.98880E+01	9.19001E-01	8.55380E-04	0.00000E+00	0.00000E+00
803	8.95358E-01	5.99375E+01	9.18971E-01	8.54822E-04	0.00000E+00	0.00000E+00

```
KENO MESSAGE NUMBER K5-123          EXECUTION TERMINATED DUE TO COMPLETION OF THE SPECIFIED NUMBER OF GENERATIONS.
 NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, ACCIDENT TRANSPORT 1.0 1.0, PITCH 25

LIFETIME =  4.03233E-05 + OR -  8.15400E-08             GENERATION TIME =  3.02951E-05 + OR -  4.54570E-08
NU BAR   =  2.43825E+00 + OR -  6.68329E-05         AVERAGE FISSION GROUP =  2.22583E+01 + OR -  3.88626E-03
                     ENERGY(EV) OF THE AVERAGE LETHARGY CAUSING FISSION =  1.89263E-01 + OR -  6.21076E-04

NO. OF INITIAL
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
3	0.91902	+ OR - 0.00085	0.91817 TO 0.91988	0.91731 TO 0.92073	0.91646 TO 0.92158	800000
4	0.91907	+ OR - 0.00085	0.91822 TO 0.91992	0.91736 TO 0.92078	0.91651 TO 0.92163	799000
5	0.91909	+ OR - 0.00085	0.91824 TO 0.91995	0.91738 TO 0.92080	0.91653 TO 0.92165	798000
6	0.91917	+ OR - 0.00085	0.91832 TO 0.92002	0.91746 TO 0.92087	0.91661 TO 0.92173	797000
7	0.91919	+ OR - 0.00085	0.91833 TO 0.92004	0.91748 TO 0.92089	0.91663 TO 0.92175	796000
8	0.91927	+ OR - 0.00085	0.91842 TO 0.92012	0.91757 TO 0.92097	0.91672 TO 0.92182	795000
9	0.91930	+ OR - 0.00085	0.91845 TO 0.92015	0.91760 TO 0.92100	0.91675 TO 0.92186	794000
10	0.91931	+ OR - 0.00085	0.91846 TO 0.92016	0.91761 TO 0.92101	0.91675 TO 0.92186	793000
11	0.91935	+ OR - 0.00085	0.91850 TO 0.92020	0.91765 TO 0.92106	0.91680 TO 0.92191	792000
12	0.91941	+ OR - 0.00085	0.91856 TO 0.92026	0.91771 TO 0.92111	0.91686 TO 0.92196	791000
17	0.91942	+ OR - 0.00086	0.91857 TO 0.92028	0.91771 TO 0.92114	0.91686 TO 0.92199	786000
22	0.91954	+ OR - 0.00086	0.91868 TO 0.92039	0.91783 TO 0.92125	0.91697 TO 0.92210	781000
27	0.91959	+ OR - 0.00086	0.91873 TO 0.92045	0.91787 TO 0.92131	0.91701 TO 0.92217	776000
32	0.91967	+ OR - 0.00086	0.91881 TO 0.92054	0.91795 TO 0.92140	0.91709 TO 0.92226	771000
37	0.91975	+ OR - 0.00087	0.91888 TO 0.92062	0.91802 TO 0.92148	0.91715 TO 0.92235	766000
42	0.91973	+ OR - 0.00087	0.91886 TO 0.92060	0.91799 TO 0.92147	0.91712 TO 0.92234	761000
47	0.91988	+ OR - 0.00087	0.91900 TO 0.92075	0.91813 TO 0.92162	0.91726 TO 0.92249	756000
52	0.91982	+ OR - 0.00087	0.91894 TO 0.92069	0.91807 TO 0.92156	0.91720 TO 0.92243	751000
57	0.91973	+ OR - 0.00088	0.91885 TO 0.92060	0.91798 TO 0.92148	0.91710 TO 0.92235	746000
			• • •			
692	0.91879	+ OR - 0.00241	0.91637 TO 0.92120	0.91396 TO 0.92362	0.91154 TO 0.92603	111000
697	0.91958	+ OR - 0.00249	0.91709 TO 0.92207	0.91459 TO 0.92457	0.91210 TO 0.92706	106000
702	0.92013	+ OR - 0.00256	0.91757 TO 0.92269	0.91501 TO 0.92525	0.91245 TO 0.92781	101000
707	0.91941	+ OR - 0.00265	0.91675 TO 0.92206	0.91410 TO 0.92471	0.91145 TO 0.92736	96000
712	0.92037	+ OR - 0.00266	0.91772 TO 0.92303	0.91506 TO 0.92569	0.91240 TO 0.92834	91000
717	0.91955	+ OR - 0.00276	0.91679 TO 0.92230	0.91403 TO 0.92506	0.91128 TO 0.92782	86000
722	0.91973	+ OR - 0.00280	0.91692 TO 0.92253	0.91412 TO 0.92533	0.91131 TO 0.92814	81000
727	0.91983	+ OR - 0.00295	0.91687 TO 0.92278	0.91392 TO 0.92574	0.91097 TO 0.92869	76000
732	0.91969	+ OR - 0.00292	0.91677 TO 0.92262	0.91385 TO 0.92554	0.91093 TO 0.92846	71000
737	0.91957	+ OR - 0.00305	0.91652 TO 0.92262	0.91346 TO 0.92568	0.91041 TO 0.92873	66000
742	0.91911	+ OR - 0.00327	0.91584 TO 0.92239	0.91257 TO 0.92566	0.90930 TO 0.92893	61000
747	0.91832	+ OR - 0.00349	0.91482 TO 0.92181	0.91133 TO 0.92531	0.90783 TO 0.92880	56000
752	0.91721	+ OR - 0.00371	0.91349 TO 0.92092	0.90978 TO 0.92464	0.90607 TO 0.92835	51000

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
   757         0.91752   + OR - 0.00396    0.91357 TO 0.92148   0.90961 TO 0.92543   0.90566 TO 0.92939    46000

   762         0.91920   + OR - 0.00432    0.91488 TO 0.92352   0.91056 TO 0.92784   0.90623 TO 0.93216    41000

   767         0.91929   + OR - 0.00446    0.91484 TO 0.92375   0.91038 TO 0.92821   0.90592 TO 0.93267    36000

   772         0.91837   + OR - 0.00492    0.91346 TO 0.92329   0.90854 TO 0.92820   0.90363 TO 0.93312    31000

   777         0.91871   + OR - 0.00500    0.91371 TO 0.92371   0.90870 TO 0.92872   0.90370 TO 0.93372    26000

   782         0.91876   + OR - 0.00587    0.91289 TO 0.92463   0.90702 TO 0.93050   0.90115 TO 0.93637    21000

   787         0.91706   + OR - 0.00606    0.91100 TO 0.92312   0.90494 TO 0.92918   0.89888 TO 0.93524    16000

   792         0.92112   + OR - 0.00667    0.91445 TO 0.92779   0.90778 TO 0.93446   0.90111 TO 0.94113    11000

   797         0.91616   + OR - 0.00797    0.90820 TO 0.92413   0.90023 TO 0.93209   0.89226 TO 0.94006     6000NAC-STC 26
DIRECTLY LOADED, WEST 17X17 OFA, ACCIDENT TRANSPORT 1.0 1.0, PITCH 25

                              FREQUENCY FOR GENERATIONS    4 TO  803
0.8442 TO 0.8483     *
0.8483 TO 0.8525     ***
0.8525 TO 0.8566     *****
0.8566 TO 0.8608
0.8608 TO 0.8649     *****
0.8649 TO 0.8691     ***
0.8691 TO 0.8732     ********
0.8732 TO 0.8774     ************
0.8774 TO 0.8815     *******************
0.8815 TO 0.8857     **************
0.8857 TO 0.8898     ********************
0.8898 TO 0.8940     ************************
0.8940 TO 0.8981     *********************************
0.8981 TO 0.9023     *******************************************
0.9023 TO 0.9064     *******************************************
0.9064 TO 0.9105     ************************************************
0.9105 TO 0.9147     ******************************************************
0.9147 TO 0.9188     *****************************************************
0.9188 TO 0.9230     *********************************************************************
0.9230 TO 0.9271     ****************************************************
0.9271 TO 0.9313     *******************************************
0.9313 TO 0.9354     **********************************************
0.9354 TO 0.9396     ***********************************************
0.9396 TO 0.9437     *******************************
0.9437 TO 0.9479     *****************************
0.9479 TO 0.9520     ***********************
0.9520 TO 0.9562     **************************
0.9562 TO 0.9603     *****************
0.9603 TO 0.9645     ********
0.9645 TO 0.9686     *****
0.9686 TO 0.9728     *******
0.9728 TO 0.9769     ****
0.9769 TO 0.9811     ***
0.9811 TO 0.9852
0.9852 TO 0.9894
0.9894 TO 0.9935     *
0.9935 TO 0.9977     *
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, ACCIDENT TRANSPORT 1.0 1.0, PITCH 25

                                FREQUENCY FOR GENERATIONS  204 TO  803
0.8442 TO 0.8483     *
0.8483 TO 0.8525     *
0.8525 TO 0.8566     ***
0.8566 TO 0.8608
0.8608 TO 0.8649     **
0.8649 TO 0.8691     *
0.8691 TO 0.8732     **
0.8732 TO 0.8774     *********
0.8774 TO 0.8815     *************
0.8815 TO 0.8857     *******
0.8857 TO 0.8898     ****************
0.8898 TO 0.8940     *************
0.8940 TO 0.8981     *********************
0.8981 TO 0.9023     *********************************
0.9023 TO 0.9064     ******************************
0.9064 TO 0.9105     *************************************
0.9105 TO 0.9147     ************************************************
0.9147 TO 0.9188     *****************************************
0.9188 TO 0.9230     ****************************************************
0.9230 TO 0.9271     ********************************************
0.9271 TO 0.9313     ********************************
0.9313 TO 0.9354     ***************************************
0.9354 TO 0.9396     **************************************
0.9396 TO 0.9437     ************************
0.9437 TO 0.9479     *******************
0.9479 TO 0.9520     *********************
0.9520 TO 0.9562     ******************
0.9562 TO 0.9603     *************
0.9603 TO 0.9645     ****
0.9645 TO 0.9686     ***
0.9686 TO 0.9728     *******
0.9728 TO 0.9769     ***
0.9769 TO 0.9811     ***
0.9811 TO 0.9852
0.9852 TO 0.9894
0.9894 TO 0.9935     *
0.9935 TO 0.9977     *
NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, ACCIDENT TRANSPORT 1.0 1.0, PITCH 25
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
                              FREQUENCY FOR GENERATIONS  404 TO  803
0.8442 TO 0.8483      *
0.8483 TO 0.8525      *
0.8525 TO 0.8566      **
0.8566 TO 0.8608
0.8608 TO 0.8649      *
0.8649 TO 0.8691      *
0.8691 TO 0.8732      **
0.8732 TO 0.8774      *****
0.8774 TO 0.8815      ********
0.8815 TO 0.8857      *****
0.8857 TO 0.8898      ********
0.8898 TO 0.8940      *********
0.8940 TO 0.8981      ***************
0.8981 TO 0.9023      **************************
0.9023 TO 0.9064      ******************
0.9064 TO 0.9105      *************************
0.9105 TO 0.9147      ********************************
0.9147 TO 0.9188      *********************
0.9188 TO 0.9230      **********************************
0.9230 TO 0.9271      **********************************
0.9271 TO 0.9313      *********************
0.9313 TO 0.9354      **************************
0.9354 TO 0.9396      ***********************
0.9396 TO 0.9437      ***********
0.9437 TO 0.9479      *************
0.9479 TO 0.9520      ***************
0.9520 TO 0.9562      *************
0.9562 TO 0.9603      ***********
0.9603 TO 0.9645      ****
0.9645 TO 0.9686      **
0.9686 TO 0.9728      ******
0.9728 TO 0.9769      ***
0.9769 TO 0.9811      **
0.9811 TO 0.9852
0.9852 TO 0.9894
0.9894 TO 0.9935      *
0.9935 TO 0.9977      *
```

Figure 6.7-2 CSAS25 Input/Output for Directly Loaded Fuel Accident Conditions Criticality Analysis (continued)

```
NAC-STC 26 DIRECTLY LOADED, WEST 17X17 OFA, ACCIDENT TRANSPORT 1.0 1.0, PITCH 25

                                FREQUENCY FOR GENERATIONS  604 TO  803
0.8442 TO 0.8483     *
0.8483 TO 0.8525
0.8525 TO 0.8566     **
0.8566 TO 0.8608
0.8608 TO 0.8649     *
0.8649 TO 0.8691     *
0.8691 TO 0.8732     *
0.8732 TO 0.8774     ***
0.8774 TO 0.8815     ***
0.8815 TO 0.8857     ****
0.8857 TO 0.8898     ****
0.8898 TO 0.8940     ******
0.8940 TO 0.8981     *********
0.8981 TO 0.9023     *************
0.9023 TO 0.9064     *********
0.9064 TO 0.9105     ****************
0.9105 TO 0.9147     ***************
0.9147 TO 0.9188     *********
0.9188 TO 0.9230     ****************
0.9230 TO 0.9271     ******************
0.9271 TO 0.9313     *******
0.9313 TO 0.9354     ************
0.9354 TO 0.9396     ********
0.9396 TO 0.9437     *********
0.9437 TO 0.9479     *********
0.9479 TO 0.9520     *********
0.9520 TO 0.9562     ******
0.9562 TO 0.9603     *****
0.9603 TO 0.9645     **
0.9645 TO 0.9686     *
0.9686 TO 0.9728
0.9728 TO 0.9769     *
0.9769 TO 0.9811
0.9811 TO 0.9852
0.9852 TO 0.9894
0.9894 TO 0.9935
0.9935 TO 0.9977
```

Figure 6.7-3 CSAS25 Input for Canistered Yankee Class Fuel - Normal Conditions

```
=CSAS25
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 250.698 cm) (EXT. MOD. VF = 0.6)
'       THIS IS A MODEL OF THE NAC-MPC BASKET
'   LOADED WITH 36 UNITED NUCLEAR TYPE A ASSEMBLIES
'       INTERIOR MODERATOR VOLUME FRACTION = 0.0001
'       EXTERIOR MODERATOR VOLUME FRACTION = 0.6
'           CASK TO CASK PITCH = 250.698 cm
27GROUPNDF4 LATTICECELL
UO2         1             0.95    293.0 92235 4.0 92238 96.0 END
ZIRCALLOY   2             1.0     293.0                      END
H2O         3             0.0001  293.0                      END
AL          4             1.0     293.0                      END
SS304       5             1.0     293.0                      END
B-10        6  DEN=2.6226 0.0450  293.0                      END
B-11        6  DEN=2.6226 0.2736  293.0                      END
C           6  DEN=2.6226 0.0927  293.0                      END
AL          6  DEN=2.6226 0.5737  293.0                      END
PB          7             1.0     293.0                      END
H           8  DEN=1.6291 0.060   293.0                      END
O           8  DEN=1.6291 0.425   293.0                      END
C           8  DEN=1.6291 0.277   293.0                      END
N           8  DEN=1.6291 0.020   293.0                      END
AL          8  DEN=1.6291 0.214   293.0                      END
B-10        8  DEN=1.6291 0.001   293.0                      END
B-11        8  DEN=1.6291 0.004   293.0                      END
H2O         9             0.6     293.0                      END
END COMP
SQUAREPITCH  1.1887 0.7887 1 3 0.9271 2 0.8052 0 END
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 250.698 cm) (EXT. MOD. VF = 0.6)
READ PARAM RUN=YES PLT=NO GEN=203 NPG=1000 TME=500 END PARAM
READ GEOM
'
'  WATER LEVEL UNIT CELLS
'
UNIT  1
COM='FUEL PIN CELL - BETWEEN DISKS'
CYLINDER  1 1  0.3943    2P2.1400
CYLINDER  0 1  0.4026    2P2.1400
CYLINDER  2 1  0.4635    2P2.1400
CUBOID    3 1  4P0.5944  2P2.1400
UNIT  2
COM='WATER CELL - BETWEEN DISKS'
CUBOID    3 1  4P0.5944  2P2.1400
UNIT  3
COM='DISPLACEMENT CELL - BETWEEN DISKS'
CYLINDER  2 1  0.4635    2P2.1400
CUBOID    3 1  4P0.5944  2P2.1400
UNIT  4
COM='INSTRUMENT TUBE CELL - BETWEEN DISKS'
CYLINDER  3 1  0.4998    2P2.1400

CYLINDER  5 1  0.5442    2P2.1400
CUBOID    3 1  4P0.5944  2P2.1400
'
'  DISK LEVEL UNIT CELLS (BOTH SS AND AL)
'
UNIT  5
COM='FUEL PIN CELL - WITH SS DISK'
CYLINDER  1 1  0.3943   2P0.6604
CYLINDER  0 1  0.4026   2P0.6604
CYLINDER  2 1  0.4635   2P0.6604
CUBOID    3 1  4P0.5944 2P0.6604
UNIT  6
COM='WATER CELL - WITH SS DISK'
CUBOID    3 1  4P0.5944 2P0.6604
UNIT  7
COM='DISPLACEMENT CELL - WITH SS DISK'
CYLINDER  2 1  0.4635   2P0.6604
CUBOID    3 1  4P0.5944 2P0.6604
UNIT  8
COM='INSTRUMENT TUBE CELL - WITH SS DISK'
CYLINDER  3 1  0.4998   2P0.6604
CYLINDER  5 1  0.5442   2P0.6604
CUBOID    3 1  4P0.5944 2P0.6604
'
'  WATER LEVEL BORAL SHEETS
UNIT 14
COM='X-X BORAL SHEET BETWEEN DISKS'
CUBOID 6 1 2P9.144 2P0.0318 2P2.1400
```

Figure 6.7-3 CSAS25 Input for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
CUBOID 4 1 2P9.144 2P0.0953 2P2.1400
UNIT 15
COM='Y-Y BORAL SHEET BETWEEN DISKS'
CUBOID 6 1 2P0.0318 2P9.144 2P2.1400
CUBOID 4 1 2P0.0953 2P9.144 2P2.1400
'  DISK LEVEL BORAL SHEETS (AL AND SS)
UNIT 16
COM='X-X BORAL SHEET WITH SS DISK'
CUBOID 6 1 2P9.144 2P0.0318 2P0.6604
CUBOID 4 1 2P9.144 2P0.0953 2P0.6604
UNIT 17
COM='Y-Y BORAL SHEET WITH SS DISK'
CUBOID 6 1 2P0.0318 2P9.144 2P0.6604
CUBOID 4 1 2P0.0953 2P9.144 2P0.6604
' WATER LEVEL WEB MATERIAL
UNIT 20
COM='WATER LEVEL WEB MATERIAL (SMALL) X-X'
CUBOID    3 1 2P10.4635 2P0.9716 2P2.1400
UNIT 21
COM='WATER LEVEL WEB MATERIAL (MEDIUM) X-X'
CUBOID    3 1 2P10.4635 2P1.0478 2P2.1400
UNIT 22
COM='WATER LEVEL WEB MATERIAL (LARGE) X-X'
CUBOID    3 1 2P10.4635 2P1.1208 2P2.1400
UNIT 23
COM='WATER LEVEL WEB MATERIAL (LONG) Y-Y'
CUBOID    3 1 2P1.1208 2P79.5249 2P2.1400
'  SUPPORT DISK WEB MATERIAL
'
UNIT 30
COM='SUPPORT DISK WEB MATERIAL (SMALL) X-X'
CUBOID    5 1 2P10.4635 2P0.9716 2P0.6604
UNIT 31
COM='SUPPORT DISK WEB MATERIAL (MEDIUM) X-X'
CUBOID    5 1 2P10.4635 2P1.0478 2P0.6604
UNIT 32
COM='SUPPORT DISK WEB MATERIAL (LARGE) X-X'
CUBOID    5 1 2P10.4635 2P1.1208 2P0.6604
UNIT 33
COM='SUPPORT DISK WEB MATERIAL (LONG) Y-Y'
CUBOID    5 1 2P1.1208 2P79.5249 2P0.6604
'
'  HEAT TRANSFER DISK WEB MATERIAL
'
UNIT 40
COM='HEAT TRANSFER DISK WEB MATERIAL (SMALL) X-X'
CUBOID    4 1 2P10.4635 2P0.9716 2P0.6604
UNIT 41
COM='HEAT TRANSFER DISK WEB MATERIAL (MEDIUM) X-X'
CUBOID    4 1 2P10.4635 2P1.0478 2P0.6604
UNIT 42
COM='HEAT TRANSFER DISK WEB MATERIAL (LARGE) X-X'
CUBOID    4 1 2P10.4635 2P1.1208 2P0.6604
UNIT 43
COM='HEAT TRANSFER DISK WEB MATERIAL (LONG) Y-Y'
CUBOID    4 1 2P1.1208 2P79.5249 2P0.6604
'  WATER LEVEL ASSEMBLY ARRAYS
UNIT 50
COM='FUEL TUBE AND ASSEMBLY - WATER LEVEL'
ARRAY  1  -9.5104 -9.5104 -2.1400
CUBOID 3 1 4P9.9441                         2P2.1400
CUBOID 5 1 4P10.0661                        2P2.1400
CUBOID 3 1 4P10.25681                       2P2.1400
HOLE  14   0.0       10.1615  0.0
HOLE  14   0.0      -10.1615  0.0
HOLE  15   10.1615  0.0       0.0
HOLE  15   -10.1615 0.0       0.0
CUBOID 5 1 4P10.3051                        2P2.1400
UNIT 51
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -Y'
CUBOID 3 1 4P10.4635                        2P2.1400
HOLE  50   0.0       -0.1584       0.0
UNIT 52
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS Y'
```

Figure 6.7-3 CSAS25 Input for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
CUBOID 3 1 4P10.4635                               2P2.1400
HOLE  50   0.0      0.1584        0.0
UNIT 53
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X'
CUBOID 3 1 4P10.4635                               2P2.1400
HOLE  50   -0.1584   0.0           0.0
UNIT 54
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X'
CUBOID 3 1 4P10.4635                               2P2.1400
HOLE  50   0.1584   0.0           0.0
UNIT 55
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X Y'
CUBOID 3 1 4P10.4635                               2P2.1400
HOLE  50   0.1584   0.1584        0.0
UNIT 56
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X Y'
CUBOID 3 1 4P10.4635                               2P2.1400
HOLE  50   -0.1584   0.1584        0.0
UNIT 57
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X -Y'
CUBOID 3 1 4P10.4635                               2P2.1400
HOLE  50   0.1584   -0.1584        0.0
UNIT 58
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X -Y'
CUBOID 3 1 4P10.4635                               2P2.1400
HOLE  50   -0.1584   -0.1584        0.0
UNIT 59
COM='CENTRAL HOLE'
CUBOID 3 1 4P10.4636                               2P2.1400
'
'   SUPPORT DISK LEVEL ASSEMBLY ARRAYS
'
UNIT 60
COM='FUEL TUBE AND ASSEMBLY - SUPPORT DISK LEVEL'
ARRAY  2  -9.5104 -9.5104 -0.6604
CUBOID 3 1 4P9.9441                                2P0.6604
CUBOID 5 1 4P10.0661                               2P0.6604
CUBOID 3 1 4P10.25681                              2P0.6604
HOLE  16   0.0       10.1615  0.0
HOLE  16   0.0       -10.1615 0.0
HOLE  17   10.1615  0.0       0.0
HOLE  17   -10.1615 0.0       0.0
CUBOID 5 1 4P10.3051                               2P0.6604
UNIT 61
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -Y'
CUBOID 3 1 4P10.4635                               2P0.6604
HOLE  60   0.0      -0.1584       0.0
UNIT 62
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS Y'
CUBOID 3 1 4P10.4635                               2P0.6604
HOLE  60   0.0      0.1584        0.0
UNIT 63
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X'
CUBOID 3 1 4P10.4635                               2P0.6604
HOLE  60   -0.1584   0.0           0.0
UNIT 64
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X'
CUBOID 3 1 4P10.4635                               2P0.6604
HOLE  60   0.1584   0.0           0.0
UNIT 65
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X Y'
CUBOID 3 1 4P10.4635                               2P0.6604
HOLE  60   0.1584   0.1584        0.0
UNIT 66
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X Y'
CUBOID 3 1 4P10.4635                               2P0.6604
HOLE  60   -0.1584   0.1584        0.0
UNIT 67
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X -Y'
CUBOID 3 1 4P10.4635                               2P0.6604
HOLE  60   0.1584   -0.1584        0.0
UNIT 68
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X -Y'
CUBOID 3 1 4P10.4635                               2P0.6604
HOLE  60   -0.1584   -0.1584        0.0
UNIT 69
COM='CENTRAL HOLE'
```

Figure 6.7-3 CSAS25 Input for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
CUBOID 3 1 4P10.4636   2P0.6604
'
'   HEAT TRANSFER DISK LEVEL ASSEMBLY ARRAYS
'
UNIT 70
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS'
ARRAY  2  -9.5104 -9.5104 -0.6604
CUBOID 3 1 4P9.9441                             2P0.6604
CUBOID 5 1 4P10.0661                            2P0.6604
CUBOID 3 1 4P10.25681                           2P0.6604
HOLE  16   0.0       10.1615  0.0
HOLE  16   0.0      -10.1615 0.0
HOLE  17   10.1615  0.0       0.0
HOLE  17   -10.1615 0.0       0.0
CUBOID 5 1 4P10.3051                            2P0.6604
UNIT 71
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   0.0      -0.1584      0.0
UNIT 72
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   0.0      0.1584       0.0
UNIT 73
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   -0.1584   0.0          0.0
UNIT 74
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   0.1584   0.0          0.0
UNIT 75
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X Y'

CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   0.1584   0.1584       0.0
UNIT 76
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE .70   -0.1584   0.1584       0.0
UNIT 77
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X -Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   0.1584   -0.1584       0.0
UNIT 78
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X -Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   -0.1584   -0.1584      0.0
UNIT 79
COM='CENTRAL HOLE'
CUBOID 3 1 4P10.4636                            2P0.6604
'
'  WATER LEVEL BASKET ARRAYS
'
UNIT 80
COM='5X1 WATER LEVEL ARRAY (SMALL ARRAY -X)'
ARRAY 20 -10.4636 -33.6323 -2.1400
UNIT 81
COM='5X1 WATER LEVEL ARRAY (SMALL ARRAY X)'
ARRAY 21 -10.4636 -33.6323 -2.1400
UNIT 82
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY -X)'
ARRAY 22 -10.4636 -56.6549 -2.1400
UNIT 83
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY X)'
ARRAY 23 -10.4636 -56.6549 -2.1400
UNIT 84
COM='13X1 WATER LEVEL ARRAY (LARGE ARRAY-X)'
ARRAY 24 -10.4636 -79.5251 -2.1400
UNIT 85
COM='13X1 WATER LEVEL ARRAY (MIDDLE LARGE ARRAY)'
ARRAY 25 -10.4636 -79.5251 -2.1400
UNIT 86
COM='13X1 WATER LEVEL ARRAY (LARGE ARRAY X)'
ARRAY 26 -10.4636 -79.5251 -2.1400
'
```

Figure 6.7-3 CSAS25 Input for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
'  SUPPORT DISK LEVEL BASKET ARRAYS
'
UNIT 90
COM='5X1 SUPPORT DISK LEVEL ARRAY (SMALL ARRAY -X)'
ARRAY 30 -10.4636 -33.6323 -0.6604
UNIT 91
COM='5X1 SUPPORT DISK LEVEL ARRAY (SMALL ARRAY  X)'
ARRAY 31 -10.4636 -33.6323 -0.6604
UNIT 92
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY -X)'
ARRAY 32 -10.4636 -56.6549 -0.6604
UNIT 93
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY X)'
ARRAY 33 -10.4636 -56.6549 -0.6604
UNIT 94
COM='13X1 SUPPORT DISK LEVEL ARRAY (LARGE ARRAY -X)'
ARRAY 34 -10.4636 -79.5251 -0.6604
UNIT 95
COM='13X1 SUPPORT DISK LEVEL ARRAY (MIDDLE LARGE ARRAY)'
ARRAY 35 -10.4636 -79.5251 -0.6604
UNIT 96
COM='13X1 SUPPORT DISK LEVEL ARRAY (LARGE ARRAY -X)'
ARRAY 36 -10.4636 -79.5251 -0.6604
'
'  HEAT TRANSFER DISK LEVEL BASKET ARRAYS
'
UNIT 100
COM='5X1 HEAT TRANSFER DISK LEVEL ARRAY (SMALL ARRAY -X)'
ARRAY 40 -10.4636 -33.6323 -0.6604
UNIT 101
COM='5X1 HEAT TRANSFER DISK LEVEL ARRAY (SMALL ARRAY X)'
ARRAY 41 -10.4636 -33.6323 -0.6604
UNIT 102
COM='9X1 HEAT TRANSFER DISK LEVEL ARRAY (MEDIUM ARRAY -X)'
ARRAY 42 -10.4636 -56.6549 -0.6604
UNIT 103
COM='9X1 HEAT TRANSFER DISK LEVEL ARRAY (MEDIUM ARRAY  X)'
ARRAY 43 -10.4636 -56.6549 -0.6604
UNIT 104
COM='13X1 HEAT TRANSFER DISK LEVEL ARRAY (LARGE ARRAY -X)'
ARRAY 44 -10.4636 -79.5251 -0.6604
UNIT 105
COM='13X1 HEAT TRANSFER DISK LEVEL ARRAY (MIDDLE LARGE ARRAY)'
ARRAY 45 -10.4636 -79.5251 -0.6604
UNIT 106
COM='13X1 HEAT TRANSFER DISK LEVEL ARRAY (LARGE ARRAY X)'
ARRAY 46 -10.4636 -79.5251 -0.6604
'
'  BASKET ARRAY IN TRANSPORT CASK OVERPACK (LEVEL CONSTRUCTION)
'
UNIT 110
COM='BASKET ARRAY IN TRANSPORT CASK OVERPACK - WATER LEVEL'
ARRAY 50 -33.6323 -79.5251 -2.1400
CYLINDER 3 1 88.1253     2P2.1400
HOLE 80     -69.0614 0.0 0.0
HOLE 82     -46.1912 0.0 0.0
HOLE 81      69.0614 0.0 0.0
HOLE 83      46.1912 0.0 0.0
CYLINDER 5 1 89.7128     2P2.1400
CYLINDER 3 1 90.170      2P2.1400
CYLINDER 5 1 93.98       2P2.1400
CYLINDER 7 1 103.4288    2P2.1400
CYLINDER 5 1 110.109     2P2.1400
CYLINDER 8 1 124.714     2P2.1400
CYLINDER 5 1 125.349     2P2.1400
CUBOID   9 1 4P125.349   2P2.1400
UNIT 111
COM='BASKET ARRAY IN TRANSPORT CASK OVERPACK - SUPPORT DISK LEVEL'
ARRAY 51 -33.6323 -79.5251 -0.6604
CYLINDER 5 1 87.6046     2P0.6604
HOLE 90     -69.0614 0.0 0.0
HOLE 92     -46.1912 0.0 0.0
HOLE 91      69.0614 0.0 0.0
HOLE 93      46.1912 0.0 0.0
CYLINDER 3 1 88.1253     2P0.6604
CYLINDER 5 1 89.7128     2P0.6604
CYLINDER 3 1 90.170      2P0.6604
```

Figure 6.7-3 CSAS25 Input for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
CYLINDER 5 1 93.98       2P0.6604
CYLINDER 7 1 103.4288    2P0.6604
CYLINDER 5 1 110.109     2P0.6604
CYLINDER 8 1 124.714     2P0.6604
CYLINDER 5 1 125.349     2P0.6604
CUBOID   9 1 4P125.349   2P0.6604
UNIT 112
COM='BASKET ARRAY IN TRANSPORT CASK OVERPACK - HEAT TRANSFER DISK LEVEL'
ARRAY 52 -33.6323 -79.5251 -0.6604
CYLINDER 4 1 87.2490     2P0.6604
HOLE 100    -69.0614 0.0 0.0
HOLE 102    -46.1912 0.0 0.0
HOLE 101     69.0614 0.0 0.0
HOLE 103     46.1912 0.0 0.0
CYLINDER 3 1 88.1253     2P0.6604
CYLINDER 5 1 89.7128     2P0.6604
CYLINDER 3 1 90.170      2P0.6604
CYLINDER 5 1 93.98       2P0.6604
CYLINDER 7 1 103.4288    2P0.6604
CYLINDER 5 1 110.109     2P0.6604
CYLINDER 8 1 124.714     2P0.6604
CYLINDER 5 1 125.349     2P0.6604
CUBOID   9 1 4P125.349   2P0.6604

'
'  GLOBAL UNIT
'
GLOBAL UNIT 120
ARRAY 60 -175.349 -175.349 0.0
END GEOM
READ ARRAY
ARA=1 NUX=16 NUY=16 NUZ=1  FILL
1 1 1 1 1 1 1 3 2 2 2 2 2 2 2 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 4 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
END FILL
ARA=2 NUX=16 NUY=16 NUZ=1  FILL
5 5 5 5 5 5 5 7 6 6 6 6 6 6 6 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
7 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 8 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
END FILL
'
'  WATER LEVEL ARRAYS
'
ARA=20  NUX=1 NUY=5 NUZ=1
FILL
55
22
54
```

Figure 6.7-3 CSAS25 Input for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
22
57
END FILL
ARA=21  NUX=1 NUY=5 NUZ=1
FILL
56
22
53
22
58
END FILL
ARA=22  NUX=1 NUY=9 NUZ=1
FILL
55
21
55
22
54
22
57
21
57
END FILL
ARA=23  NUX=1 NUY=9 NUZ=1
FILL
21
56
22
53
22
58
21
58
END FILL
ARA=24  NUX=1 NUY=13 NUZ=1
FILL
55
20
55
21
55
22
54
22
57
21
57
20
57
END FILL
ARA=25  NUX=1 NUY=13 NUZ=1
FILL
52
20
52
21
52
22
59
22
51
21
51
20
51
END FILL
ARA=26  NUX=1 NUY=13 NUZ=1
FILL
56
20
56
21
56
22
53
22
58
```

Figure 6.7-3 CSAS25 Input for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
21
58
20
58
END FILL
'
'  SUPPOR DISK LEVEL ARRAYS
'
ARA=30  NUX=1 NUY=5 NUZ=1
FILL
65
32
64
32
67
END FILL
ARA=31  NUX=1 NUY=5 NUZ=1
FILL
66
32
63
32
68
END FILL
ARA=32  NUX=1 NUY=9 NUZ=1
FILL
65
31
65
32
64
32
67
31
67
END FILL
ARA=33  NUX=1 NUY=9 NUZ=1
FILL
66
31
66
32
63
32
68
31
68
END FILL
ARA=34  NUX=1 NUY=13 NUZ=1
FILL
65
30
65
31
65
32
64
32
67
31
67
30
67
END FILL
ARA=35  NUX=1 NUY=13 NUZ=1
FILL
62
30
62
31
62
32
69
32
61
31
61
```

Figure 6.7-3 CSAS25 Input for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
30
61
END FILL
ARA=36  NUX=1 NUY=13 NUZ=1
FILL
66
30
66
31
66
32
63
32
68
31
68
30
68
END FILL
'
' HEAT TRANSFER DISK LEVEL ARRAYS
'
ARA=40  NUX=1 NUY=5 NUZ=1
FILL
75
42
74
42
77
END FILL
ARA=41  NUX=1 NUY=5 NUZ=1
FILL
76
42
73
42
78
END FILL
ARA=42  NUX=1 NUY=9 NUZ=1
FILL
75
41
75
42
74
42
77
41
77
END FILL
ARA=43  NUX=1 NUY=9 NUZ=1
FILL
76
41
76
42
73
42
78
41
78
END FILL
ARA=44  NUX=1 NUY=13 NUZ=1
FILL
75
40
75
41
75
42
74
42
77
41
77
40
77
```

Figure 6.7-3 CSAS25 Input for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
END FILL
ARA=45  NUX=1 NUY=13 NUZ=1
FILL
72
40
72
41
72
42
79
42
71
41
71

40
71
END FILL
ARA=46  NUX=1 NUY=13 NUZ=1
FILL
76
40
76
41
76
42
73
42
78
41
78
40
78
END FILL
'
'  MAJOR ARRAYS
'
ARA=50 NUX=5 NUY=1 NUZ=1
FILL
84 23 85 23 86
END FILL
ARA=51 NUX=5 NUY=1 NUZ=1
FILL
94 33 95 33 96
END FILL
ARA=52 NUX=5 NUY=1 NUZ=1
FILL
104 43 105 43 106
END FILL
'
'  GLOBAL ARRAY
'
ARA=60 NUX=1 NUY=1 NUZ=4
FILL
112
110
111
110
END FILL
END ARRAY
READ BOUNDS ZFC=PER YXF=MIR END BOUNDS
READ PLOT
SCR=YES PIC=MAT LPI=10
UAX=1.0 VDN=-1.0 NAX=1500
'
' WHOLE BASKET HORIZONTAL SLICES
'
TTL='BASKET X-Y CROSS SECTION AT Z= 0.635 HEAT TRANSFER DISK LEVEL'
XUL=  -130 YUL=  130  ZUL= 0.635
XLR=   130 YLR= -130  ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y CROSS SECTION AT Z= 3.44 WATER LEVEL'
XUL=  -130 YUL=  130  ZUL= 3.44
XLR=   130 YLR= -130  ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y CROSS SECTION AT Z= 6.236 SS DISK LEVEL'
XUL=  -130 YUL=  130  ZUL= 6.236
```

Figure 6.7-3 CSAS25 Input for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
XLR=   130 YLR= -130  ZLR= 6.236
UAX=1.0 VDN=-1.0 NAX=1500 END
'
' HEAT TRANSFER DISK LEVEL BASKET QUADRANTS
'
TTL='BASKET X-Y QUADRANTD I HEAT TRANSFER DISK'
XUL=  12.    YUL= 80      ZUL= 0.635
XLR=  80.0  YLR= 12.0    ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT II HEAT TRANSFER DISK'
XUL=  12.0 YUL= -12.0    ZUL= 0.635
XLR=  80    YLR= -80      ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT III HEAT TRANSFER DISK'
XUL= -80.0  YUL= -12.0  ZUL= 0.635
XLR= -12.0  YLR= -80.0  ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT IV HEAT TRANSFER DISK'
XUL= -80.0  YUL= 80.0    ZUL= 0.635
XLR= -12.0  YLR= 12.0    ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
'
' WATER LEVEL BASKET QUADRANTS
'
TTL='BASKET X-Y QUADRANT I WATER LEVEL'
XUL=  12.     YUL=  80      ZUL= 3.44
XLR=  80.0    YLR=  12.0    ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT II WATER LEVEL'
XUL=  12.0    YUL= -12.0    ZUL= 3.44
XLR=  80      YLR= -80      ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT III WATER LEVEL'
XUL= -80.0    YUL= -12.0    ZUL= 3.44
XLR= -12.0    YLR= -80.0    ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT IV WATER LEVEL'
XUL= -80.0    YUL= 80.0     ZUL= 3.44
XLR= -12.0    YLR= 12.0     ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
'
'  VERTICAL SLICES
'
TTL='BASKET X-Z CROSS SECTION ALUMINUM LEVEL (MIDDLE OF FUEL PIN)'
XUL= -90  YUL=0.4   ZUL= 1.27
XLR=  90  YLR=0.4   ZLR= -.1
UAX=1.0 WDN=-1.0 NAX=1500 END
TTL='BASKET X-Z CROSS SECTION WATER LEVEL (MIDDLE OF FUEL PIN)'

XUL= -90  YUL=0.4   ZUL= 4.318
XLR=  90  YLR=0.4   ZLR= 1.27
UAX=1.0 WDN=-1.0 NAX=1500 END
TTL='BASKET X-Z CROSS SECTION SS LEVEL (MIDDLE OF FUEL PIN)'
XUL= -90  YUL=0.4   ZUL= 6.858
XLR=  90  YLR=0.4   ZLR= 5.588
UAX=1.0 WDN=-1.0 NAX=1500 END
TTL='BASKET X-Z CROSS SECTION ENTIRE MODEL (MIDDLE OF FUEL PIN)'
XUL= -90  YUL=0.4   ZUL= 12
XLR=  90  YLR=0.4   ZLR= 0
UAX=1.0 WDN=-1.0 NAX=1500 END
END PLOT
END DATA
END
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions

```
*******************************************************************************
*******************************************************************************
*******************************************************************************
*****                                                                     *****
*****                    PROGRAM VERIFICATION INFORMATION                 *****
*****                                                                     *****
*****                  CODE SYSTEM:  SCALE-PC VERSION:  4.3               *****
*****                                                                     *****
*******************************************************************************
*******************************************************************************
*****                                                                     *****
*****                                                                     *****
*****             PROGRAM:  CSAS                                          *****
*****                                                                     *****
*****       CREATION DATE:  03-08-96                                      *****
*****                                                                     *****
*****             VOLUME:   ENG                                           *****
*****                                                                     *****
*****            LIBRARY:  G:\scale43\exe                                 *****
*****                                                                     *****
*****                                                                     *****
*****     PRODUCTION CODE:  CSAS                                          *****
*****                                                                     *****
*****            VERSION:  3.1                                            *****
*****                                                                     *****
*****            JOBNAME:  SCALE-PC                                       *****
*****                                                                     *****
*****   DATE OF EXECUTION:  11/13/96                                      *****
*****                                                                     *****
*****   TIME OF EXECUTION:  00:51:47                                      *****
*****                                                                     *****
*****                                                                     *****
*******************************************************************************
*******************************************************************************
*******************************************************************************
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 250.698 CM) (EXT. MOD. VF = 0.


**** PROBLEM PARAMETERS ****

LIB 27GROUPNDF4  LIBRARY
MXX            9 MIXTURES
MSC           18 COMPOSITION SPECIFICATIONS
IZM            4 MATERIAL ZONES
GE  LATTICECELL  GEOMETRY
MORE           0 0/1 DO NOT READ/READ OPTIONAL PARAMETER DATA
MSLN           0 FUEL SOLUTIONS


**** PROBLEM COMPOSITION DESCRIPTION ****

SC  UO2          STANDARD COMPOSITION
MX             1 MIXTURE NO.
VF        0.9500 VOLUME FRACTION
ROTH     10.9600 THEORETICAL DENSITY
NEL            2 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           92000      1.00 ATOM/MOLECULE
                            92235     4.000 WT%
                            92238    96.000 WT%
            8016      2.00 ATOMS/MOLECULE
END

SC  ZIRCALLOY    STANDARD COMPOSITION
MX             2 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      6.5600 THEORETICAL DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           40302      1.00 ATOM/MOLECULE
END

SC  H2O          STANDARD COMPOSITION
MX             3 MIXTURE NO.
VF        0.0001 VOLUME FRACTION
ROTH      0.9982 THEORETICAL DENSITY
NEL            2 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            1001      2.00 ATOMS/MOLECULE
            8016      1.00 ATOM/MOLECULE
END

SC  AL           STANDARD COMPOSITION
MX             4 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      2.7020 THEORETICAL DENSITY
NEL            1 NO. ELEMENTS
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           13027      1.00 ATOM/MOLECULE
END

SC  SS304         STANDARD COMPOSITION
MX             5 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      7.9200 THEORETICAL DENSITY
NEL            4 NO. ELEMENTS
ICP            0 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           24304    19.000 WT%
           25055     2.000 WT%
           26304    69.500 WT%
           28304     9.500 WT%
END

SC  B-10          STANDARD COMPOSITION
MX             6 MIXTURE NO.
VF        0.0450 VOLUME FRACTION
ROTH      2.6226 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            5010      1.00 ATOM/MOLECULE
END

SC  B-11          STANDARD COMPOSITION
MX             6 MIXTURE NO.
VF        0.2736 VOLUME FRACTION
ROTH      2.6226 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            5011      1.00 ATOM/MOLECULE
END

SC  C             STANDARD COMPOSITION
MX             6 MIXTURE NO.
VF        0.0927 VOLUME FRACTION
ROTH      2.6226 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            6012      1.00 ATOM/MOLECULE
END

SC  AL            STANDARD COMPOSITION
MX             6 MIXTURE NO.
VF        0.5737 VOLUME FRACTION
ROTH      2.6226 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
            13027       1.00 ATOM/MOLECULE
END

SC  PB            STANDARD COMPOSITION
MX               7 MIXTURE NO.
VF          1.0000 VOLUME FRACTION
ROTH       11.3440 THEORETICAL DENSITY
NEL              1 NO. ELEMENTS
ICP              1 0/1 MIXTURE/COMPOUND
TEMP         293.0 DEG KELVIN
             82000      1.00 ATOM/MOLECULE
END

SC  H             STANDARD COMPOSITION
MX               8 MIXTURE NO.
VF          0.0600 VOLUME FRACTION
ROTH        1.6291 SPECIFIED DENSITY
NEL              1 NO. ELEMENTS
ICP              1 0/1 MIXTURE/COMPOUND
TEMP         293.0 DEG KELVIN
              1001      1.00 ATOM/MOLECULE
END

SC  O             STANDARD COMPOSITION
MX               8 MIXTURE NO.
VF          0.4250 VOLUME FRACTION
ROTH        1.6291 SPECIFIED DENSITY
NEL              1 NO. ELEMENTS
ICP              1 0/1 MIXTURE/COMPOUND
TEMP         293.0 DEG KELVIN
              8016      1.00 ATOM/MOLECULE
END

SC  C             STANDARD COMPOSITION
MX               8 MIXTURE NO.
VF          0.2770 VOLUME FRACTION
ROTH        1.6291 SPECIFIED DENSITY
NEL              1 NO. ELEMENTS
ICP              1 0/1 MIXTURE/COMPOUND
TEMP         293.0 DEG KELVIN
              6012      1.00 ATOM/MOLECULE
END

SC  N             STANDARD COMPOSITION
MX               8 MIXTURE NO.
VF          0.0200 VOLUME FRACTION
ROTH        1.6291 SPECIFIED DENSITY
NEL              1 NO. ELEMENTS
ICP              1 0/1 MIXTURE/COMPOUND
TEMP         293.0 DEG KELVIN
              7014      1.00 ATOM/MOLECULE
END

SC  AL            STANDARD COMPOSITION
MX               8 MIXTURE NO.
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
VF        0.2140 VOLUME FRACTION
ROTH      1.6291 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           13027       1.00 ATOM/MOLECULE
END

SC  B-10         STANDARD COMPOSITION
MX             8 MIXTURE NO.
VF        0.0010 VOLUME FRACTION
ROTH      1.6291 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            5010       1.00 ATOM/MOLECULE
END

SC  B-11         STANDARD COMPOSITION
MX             8 MIXTURE NO.
VF        0.0040 VOLUME FRACTION
ROTH      1.6291 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            5011       1.00 ATOM/MOLECULE
END

SC  H2O          STANDARD COMPOSITION
MX             9 MIXTURE NO.
VF        0.6000 VOLUME FRACTION
ROTH      0.9982 THEORETICAL DENSITY
NEL            2 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            1001       2.00 ATOMS/MOLECULE
            8016       1.00 ATOM/MOLECULE
END


**** PROBLEM GEOMETRY ****

CTP SQUAREPITCH  CELL TYPE
PITCH     1.1887 CM CENTER TO CENTER SPACING
FUELOD    0.7887 CM FUEL DIAMETER OR SLAB THICKNESS
MFUEL          1 MIXTURE NO. OF FUEL
MMOD           3 MIXTURE NO. OF MODERATOR
CLADOD    0.9271 CM CLAD OUTER DIAMETER
MCLAD          2 MIXTURE NO. OF CLAD
GAPOD     0.8052 CM GAP OUTER DIAMETER
MGAP           0 MIXTURE NO. OF GAP


ZONE SPECIFICATIONS FOR LATTICECELL GEOMETRY
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
ZONE  1 IS FUEL
ZONE  2 IS GAP
ZONE  3 IS CLAD
ZONE  4 IS MOD

********************************************************************************
********************************************************************************
********************************************************************************
*****                                                                      *****
*****                   PROGRAM VERIFICATION INFORMATION                   *****
*****                                                                      *****
*****                  CODE SYSTEM:  SCALE-PC VERSION:  4.3                *****
*****                                                                      *****
********************************************************************************
********************************************************************************
*****                                                                      *****
*****                                                                      *****
*****                PROGRAM:  000002                                      *****
*****                                                                      *****
*****          CREATION DATE:  09-28-95                                    *****
*****                                                                      *****
*****                 VOLUME:  ENG                                         *****
*****                                                                      *****
*****                LIBRARY:  G:\scale43\exe                              *****
*****                                                                      *****
*****                                                                      *****
*****        PRODUCTION CODE:  NITAWL                                      *****
*****                                                                      *****
*****                VERSION:  3.0                                         *****
*****                                                                      *****
*****                JOBNAME:  SCALE-PC                                    *****
*****                                                                      *****
*****      DATE OF EXECUTION:  11/13/96                                    *****
*****                                                                      *****
*****      TIME OF EXECUTION:  00:51:51                                    *****
*****                                                                      *****
*****                                                                      *****
********************************************************************************
********************************************************************************
********************************************************************************
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
       -1Q ARRAY HAS     1 ENTRIES.

        0Q ARRAY HAS     9 ENTRIES.

        1Q ARRAY HAS    12 ENTRIES.

SELECT 25 NUCLIDES FROM THE MASTER  LIBRARY ON LOGICAL  1
        0 NUCLIDES FROM THE WORKING LIBRARY ON LOGICAL  2
        0 NUCLIDES FROM THE WORKING LIBRARY ON LOGICAL  3
          TO CREATE THE NEW WORKING LIBRARY ON LOGICAL  4

        4 RESONANCE CALCULATIONS HAVE BEEN REQUESTED
       -1 OUTPUT OPTION FOR AMPX FORMATTED CROSS SECTION DATA
     2001 MAXIMUM NUMBER OF RESONANCE MESH INTERVALS
        2 ORDER OF RESONANCE LEVEL PROCESSING

THE STORAGE ALLOCATED FOR THIS CASE IS    100000 WORDS

        2Q ARRAY HAS    25 ENTRIES.

        3Q ARRAY HAS    60 ENTRIES.

        4Q ARRAY HAS    25 ENTRIES.

 GENERAL INFORMATION CONCERNING CROSS SECTION LIBRARY
   TAPE IDENTIFICATION NUMBER                 4321
   NUMBER OF NUCLIDES ON TAPE                   26
   NUMBER OF NEUTRON ENERGY GROUPS              27
   FIRST THERMAL NEUTRON ENERGY GROUP           15
   NUMBER OF GAMMA ENERGY GROUPS                 0

   DIRECT ACCESS UNIT NUMBER  9 REQUIRES 117 BLOCKS OF LENGTH  1680 WORDS
 XSDRN TAPE   4321
                        SCALE 4.2 - 27 GROUP NEUTRON GROUP LIBRARY
                           BASED ON ENDF-B VERSION 4 DATA
                              COMPILED FOR NRC     1/27/89
                                 LAST UPDATED                                            08/12/94
                                    L.M.PETRIE   -   ORNL

 NUCLIDES FROM XSDRN TAPE
    1     HYDROGEN      ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94     3001001
    2     HYDROGEN      ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94     8001001
    3     HYDROGEN      ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94     9001001
    4    B-10 1273 218NGP 042375 P-3 293K                       UPDATED 08/12/94     6005010
    5    B-10 1273 218NGP 042375 P-3 293K                       UPDATED 08/12/94     8005010
    6     BORON-11      ENDF/B-IV MAT 1160                      UPDATED 08/12/94     6005011
    7     BORON-11      ENDF/B-IV MAT 1160                      UPDATED 08/12/94     8005011
    8     CARBON-12     ENDF/B-IV MAT 1274/THRM1065             UPDATED 08/12/94     6006012
    9     CARBON-12     ENDF/B-IV MAT 1274/THRM1065             UPDATED 08/12/94     8006012
   10     NITROGEN-14   ENDF/B-IV MAT 1275                      UPDATED 08/12/94     8007014
   11     OXYGEN-16     ENDF/B-IV MAT 1276                      UPDATED 08/12/94     1008016
   12     OXYGEN-16     ENDF/B-IV MAT 1276                      UPDATED 08/12/94     3008016
   13     OXYGEN-16     ENDF/B-IV MAT 1276                      UPDATED 08/12/94     8008016
   14     OXYGEN-16     ENDF/B-IV MAT 1276                      UPDATED 08/12/94     9008016
   15    AL-27 1193 218 GP 040375(5)                            UPDATED 08/12/94     4013027
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
  16    AL-27 1193 218 GP 040375(5)                              UPDATED 08/12/94     6013027
  17    AL-27 1193 218 GP 040375(5)                              UPDATED 08/12/94     8013027
  18    CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)          UPDATED 08/12/94     5024304
  19     MANGANESE-55   ENDF/B-IV MAT 1197                       UPDATED 08/12/94     5025055
  20    FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)          UPDATED 08/12/94     5026304
  21    NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)          UPDATED 08/12/94     5028304
  22     ZIRCALLOY      ENDF/B-IV MAT 1284                       UPDATED 08/12/94     2040302
  23    PB   1288 218NGP 042375 P-3 293K                         UPDATED 08/12/94     7082000
  24     URANIUM-235    ENDF/B-IV MAT 1261                       UPDATED 08/12/94     1092235
  25     URANIUM-238    ENDF/B-IV MAT 1262                       UPDATED 08/12/94     1092238

 HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94   3001001     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94   8001001     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94   9001001     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

B-10 1273 218NGP 042375 P-3 293K                     UPDATED 08/12/94   6005010     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

B-10 1273 218NGP 042375 P-3 293K                     UPDATED 08/12/94   8005010     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 BORON-11       ENDF/B-IV MAT 1160                   UPDATED 08/12/94   6005011     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 BORON-11       ENDF/B-IV MAT 1160                   UPDATED 08/12/94   8005011     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 CARBON-12      ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94   6006012     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 CARBON-12      ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94   8006012     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 NITROGEN-14    ENDF/B-IV MAT 1275                   UPDATED 08/12/94   8007014     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94   1008016     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94   3008016     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94   8008016     TEMPERATURE=   293.00
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
 OXYGEN-16       ENDF/B-IV MAT 1276                      UPDATED 08/12/94   9008016     TEMPERATURE=   293.00
                                                              PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

AL-27 1193 218 GP 040375(5)                              UPDATED 08/12/94   4013027     TEMPERATURE=   293.00
                                                              PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

AL-27 1193 218 GP 040375(5)                              UPDATED 08/12/94   6013027     TEMPERATURE=   293.00
                                                              PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

AL-27 1193 218 GP 040375(5)                              UPDATED 08/12/94   8013027     TEMPERATURE=   293.00
                                                              PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94   5024304     TEMPERATURE=   293.00
                                                              PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 MANGANESE-55   ENDF/B-IV MAT 1197                       UPDATED 08/12/94   5025055     TEMPERATURE=   293.00

GEOMETRY HAS BEEN SET TO HOMOGENEOUS AS LBAR IS  0.0000E+00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =     54.466             TEMPERATURE(KELVIN)       =   293.000

POTENTIAL SCATTER SIGMA  =      2.590             LUMPED NUCLEAR DENSITY    = 1.7363295E-03

SPIN FACTOR (G)          =     14.448             LUMP DIMENSION (A-BAR)    = 0.0000000E+00

INNER RADIUS             = 0.0000000E+00          DANCOFF CORRECTION (C)    = 0.0000000E+00

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1     =    55.845             SIGMA(PER ABSORBER ATOM)= 3.4663022E+02

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2     =    55.925             SIGMA(PER ABSORBER ATOM)= 1.2557598E+02

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 0-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP        RES ABS         RES FISS        RES SCAT
  8      -5.518788E-04   0.000000E+00   -3.944190E-01
  9      -2.797993E-03   0.000000E+00   -2.293471E+00
 10      -3.291452E-01   0.000000E+00   -3.820862E+01
 11      -2.680562E+00   0.000000E+00   -1.159996E+02

EXCESS RESONANCE INTEGRALS

                  RESOLVED

ABSORPTION      3.33719E+00
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
FISSION          0.00000E+00
                                                               PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94   5026304      TEMPERATURE=   293.00
                                                               PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94   5028304      TEMPERATURE=   293.00
                                                               PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 ZIRCALLOY      ENDF/B-IV MAT 1284                       UPDATED 08/12/94   2040302      TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =    90.436          TEMPERATURE(KELVIN)       =   293.000

POTENTIAL SCATTER SIGMA  =     6.385          LUMPED NUCLEAR DENSITY    = 4.3307818E-02

SPIN FACTOR (G)          =     1.079          LUMP DIMENSION (A-BAR)    = 4.6355000E-01

INNER RADIUS             = 4.0259999E-01      DANCOFF CORRECTION (C)    = 8.4757560E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP       RES ABS        RES FISS        RES SCAT
  8     -8.795965E-04   0.000000E+00   -6.970308E-01
  9     -4.269687E-02   0.000000E+00   -1.811447E+00
 10     -4.621373E-02   0.000000E+00   -1.032856E+00
 11     -1.360111E-01   0.000000E+00   -6.097271E-01

EXCESS RESONANCE INTEGRALS

                  RESOLVED

ABSORPTION       3.93040E-01
FISSION          0.00000E+00
                                                               PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

PB   1288 218NGP 042375 P-3 293K                         UPDATED 08/12/94   7082000      TEMPERATURE=   293.00
                                                               PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 URANIUM-235    ENDF/B-IV MAT 1261                       UPDATED 08/12/94   1092235      TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =   233.025          TEMPERATURE(KELVIN)       =   293.000

POTENTIAL SCATTER SIGMA  =    11.500          LUMPED NUCLEAR DENSITY    = 9.4064139E-04

SPIN FACTOR (G)          = 15171.100          LUMP DIMENSION (A-BAR)    = 3.9434999E-01
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
INNER RADIUS              = 0.0000000E+00          DANCOFF CORRECTION (C)     = 9.5888901E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1     =     15.991              SIGMA(PER ABSORBER ATOM)= 1.9199110E+02

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2     =    238.051              SIGMA(PER ABSORBER ATOM)= 2.9209552E+02

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP        RES ABS        RES FISS       RES SCAT
 12      -1.115460E+01   -6.910128E+00   -1.682605E-01
 13      -2.879944E+01   -1.404006E+01   -4.031188E-01
 14      -2.298467E+01   -1.317284E+01   -4.264960E-02
 15      -3.215079E-03   -2.431171E-03    3.882847E-05

EXCESS RESONANCE INTEGRALS

                 RESOLVED

ABSORPTION       1.49929E+02
FISSION          9.24167E+01
                                                    PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 URANIUM-238    ENDF/B-IV MAT 1262                      UPDATED 08/12/94   1092238      TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)           =    236.006             TEMPERATURE(KELVIN)        =   293.000

POTENTIAL SCATTER SIGMA  =     10.599             LUMPED NUCLEAR DENSITY     = 2.2290209E-02

SPIN FACTOR (G)           =    656.527             LUMP DIMENSION (A-BAR)     = 3.9434999E-01

INNER RADIUS              = 0.0000000E+00          DANCOFF CORRECTION (C)     = 9.5888901E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1     =     15.991              SIGMA(PER ABSORBER ATOM)= 8.1019773E+00

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2     =    235.044              SIGMA(PER ABSORBER ATOM)= 5.0228214E-01

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
GROUP       RES ABS         RES FISS        RES SCAT
  9      -8.035530E-02   0.000000E+00   -7.473816E-01
 10      -1.506941E+00  -6.750685E-05   -8.777449E+00
 11      -1.070745E+01   0.000000E+00   -2.894283E+01
 12      -4.478590E+01   0.000000E+00   -5.118077E+01
 13      -5.544063E+01   0.000000E+00   -1.758312E+01
 14      -1.076790E+02   0.000000E+00   -5.655300E+00
 15      -6.314348E-05   0.000000E+00    1.227886E-04

EXCESS RESONANCE INTEGRALS

                 RESOLVED

ABSORPTION       7.05643E+00
FISSION          4.17667E-04
                                                   PROCESS NUMBER 1007 IS AT TEMPERATURE=    293.00
     THIS XSDRN WORKING TAPE WAS CREATED 11/13/96 AT 00:51:51
     THE TITLE OF THE PARENT CASE IS AS FOLLOWS
     SCALE 4.2 - 27 GROUP NEUTRON GROUP LIBRARY
        BASED ON ENDF-B VERSION 4 DATA
           COMPILED FOR NRC      1/27/89
         TAPE ID                            4321        NUMBER OF NUCLIDES                 25
         NUMBER OF NEUTRON GROUPS             27        NUMBER OF GAMMA GROUPS              0
         FIRST THERMAL GROUP                  15        LOGICAL UNIT                        4
                                     TABLE OF CONTENTS
        HYDROGEN      ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94        ID    3001001
        HYDROGEN      ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94        ID    8001001
        HYDROGEN      ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94        ID    9001001
       B-10 1273 218NGP 042375 P-3 293K                       UPDATED 08/12/94        ID    6005010
       B-10 1273 218NGP 042375 P-3 293K                       UPDATED 08/12/94        ID    8005010
        BORON-11      ENDF/B-IV MAT 1160                      UPDATED 08/12/94        ID    6005011
        BORON-11      ENDF/B-IV MAT 1160                      UPDATED 08/12/94        ID    8005011
        CARBON-12     ENDF/B-IV MAT 1274/THRM1065             UPDATED 08/12/94        ID    6006012
        CARBON-12     ENDF/B-IV MAT 1274/THRM1065             UPDATED 08/12/94        ID    8006012
        NITROGEN-14   ENDF/B-IV MAT 1275                      UPDATED 08/12/94        ID    8007014
        OXYGEN-16     ENDF/B-IV MAT 1276                      UPDATED 08/12/94        ID    1008016
        OXYGEN-16     ENDF/B-IV MAT 1276                      UPDATED 08/12/94        ID    3008016
        OXYGEN-16     ENDF/B-IV MAT 1276                      UPDATED 08/12/94        ID    8008016
        OXYGEN-16     ENDF/B-IV MAT 1276                      UPDATED 08/12/94        ID    9008016
       AL-27 1193 218 GP 040375(5)                            UPDATED 08/12/94        ID    4013027
       AL-27 1193 218 GP 040375(5)                            UPDATED 08/12/94        ID    6013027
       AL-27 1193 218 GP 040375(5)                            UPDATED 08/12/94        ID    8013027
       CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94        ID    5024304
        MANGANESE-55  ENDF/B-IV MAT 1197                      UPDATED 08/12/94        ID    5025055
       FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94        ID    5026304
       NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94        ID    5028304
        ZIRCALLOY     ENDF/B-IV MAT 1284                      UPDATED 08/12/94        ID    2040302
       PB   1288 218NGP 042375 P-3 293K                       UPDATED 08/12/94        ID    7082000
        URANIUM-235   ENDF/B-IV MAT 1261                      UPDATED 08/12/94        ID    1092235
        URANIUM-238   ENDF/B-IV MAT 1262                      UPDATED 08/12/94        ID    1092238

         TAPE COPY USED     0 I/O'S, AND TOOK    0.33 SECONDS
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
*******************************************************************************
*******************************************************************************
*******************************************************************************
*****                                                                    *****
*****                   PROGRAM VERIFICATION INFORMATION                 *****
*****                                                                    *****
*****                CODE SYSTEM:   SCALE-PC VERSION:  4.3               *****
*****                                                                    *****
*******************************************************************************
*******************************************************************************
*****                                                                    *****
*****                                                                    *****
*****                   PROGRAM:  000009                                 *****
*****                                                                    *****
*****             CREATION DATE:  03-08-96                               *****
*****                                                                    *****
*****                    VOLUME:  ENG                                    *****
*****                                                                    *****
*****                   LIBRARY:  G:\scale43\exe                         *****
*****                                                                    *****
*****                                                                    *****
*****           PRODUCTION CODE:  KENOVA                                 *****
*****                                                                    *****
*****                   VERSION:  3.1                                    *****
*****                                                                    *****
*****                   JOBNAME:  SCALE-PC                               *****
*****                                                                    *****
*****         DATE OF EXECUTION:  11/13/96                               *****
*****                                                                    *****
*****         TIME OF EXECUTION:  00:52:03                               *****
*****                                                                    *****
*****                                                                    *****
*******************************************************************************
*******************************************************************************
*******************************************************************************
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
*****************************************************************************************************************
***                                                                                                           ***
***                 TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 250.698 CM) (EXT. MOD. VF = 0.***
***                                                                                                           ***
*****************************************************************************************************************
***                        ******       NUMERIC PARAMETERS        ******                                      ***
***                                                                                                           ***
***                                                                                                           ***
***          TME        MAXIMUM PROBLEM TIME (MIN)                      500.00                                ***
***                                                                                                           ***
***          TBA        TIME PER GENERATION (MIN)                         0.50                                ***
***                                                                                                           ***
***          GEN        NUMBER OF GENERATIONS                              203                                ***
***                                                                                                           ***
***          NPG        NUMBER PER GENERATION                             1000                                ***
***                                                                                                           ***
***          NSK        NUMBER OF GENERATIONS TO BE SKIPPED                  3                                ***
***                                                                                                           ***
***          BEG        BEGINNING GENERATION NUMBER                          1                                ***
***                                                                                                           ***
***          RES        GENERATIONS BETWEEN CHECKPOINTS                      0                                ***
***                                                                                                           ***
***          X1D        NUMBER OF EXTRA 1-D CROSS SECTIONS                   1                                ***
***                                                                                                           ***
***          NBK        NEUTRON BANK SIZE                                 1025                                ***
***                                                                                                           ***
***          XNB        EXTRA POSITIONS IN NEUTRON BANK                      0                                ***
***                                                                                                           ***
***          NFB        FISSION BANK SIZE                                 1000                                ***
***                                                                                                           ***
***          XFB        EXTRA POSITIONS IN FISSION BANK                      0                                ***
***                                                                                                           ***
***          WTA        DEFAULT VALUE OF WEIGHT AVERAGE                 0.5000                                ***
***                                                                                                           ***
***          WTH        WEIGHT HIGH FOR SPLITTING                       3.0000                                ***
***                                                                                                           ***
***          WTL        WEIGHT LOW FOR RUSSIAN ROULETTE                 0.3333                                ***
***                                                                                                           ***
***          RND        STARTING RANDOM NUMBER                    BB827100001                                ***
***                                                                                                           ***
***          NB8        NUMBER OF D.A. BLOCKS ON UNIT  8               200                                ***
***                                                                                                           ***
***          NL8        LENGTH OF D.A. BLOCKS ON UNIT  8               512                                ***
***                                                                                                           ***
***          ADJ        MODE OF CALCULATION                            FORWARD                                ***
***                                                                                                           ***
***                     INPUT DATA WRITTEN ON RESTART UNIT                  NO                                ***
***                                                                                                           ***
***                     BINARY DATA INTERFACE                              YES                                ***
***                                                                                                           ***
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
********************************************************************************************************************
     ***                                                                                                         ***
     ***                     TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 250.698 CM) (EXT. MOD. VF = 0.***
     ***                                                                                                         ***
     *******************************************************************************************************************
     ***                          ******     LOGICAL PARAMETERS       ******                                      ***
     ***                                                                                                         ***
     ***  RUN  EXECUTE PROBLEM AFTER CHECKING DATA    YES        PLT  PLOT PICTURE MAP(S)                    NO ***
     ***                                                                                                         ***
     ***  FLX  COMPUTE FLUX                           NO         FDN  COMPUTE FISSION DENSITIES              NO ***
     ***                                                                                                         ***
     ***  SMU  COMPUTE AVG UNIT SELF-MULTIPLICATION   NO         NUB  COMPUTE NU-BAR & AVG FISSION GROUP    YES ***
     ***                                                                                                         ***
     ***  MKU  COMPUTE MATRIX K-EFF BY UNIT NUMBER    NO         MKP  COMPUTE MATRIX K-EFF BY UNIT LOCATION  NO ***
     ***                                                                                                         ***
     ***  CKU  COMPUTE COFACTOR K-EFF BY UNIT NUMBER  NO         CKP  COMPUTE COFACTOR K-EFF BY UNIT LOCATION NO ***
     ***                                                                                                         ***
     ***  FMU  PRINT FISS PROD MATRIX BY UNIT NUMBER  NO         FMP  PRINT FISS PROD MATRIX BY UNIT LOCATION NO ***
     ***                                                                                                         ***
     ***  MKH  COMPUTE MATRIX K-EFF BY HOLE NUMBER    NO         MKA  COMPUTE MATRIX K-EFF BY ARRAY NUMBER   NO ***
     ***                                                                                                         ***
     ***  CKH  COMPUTE COFACTOR K-EFF BY HOLE NUMBER  NO         CKA  COMPUTE COFACTOR K-EFF BY ARRAY NUMBER NO ***
     ***                                                                                                         ***
     ***  FMH  PRINT FISS PROD MATRIX BY HOLE NUMBER  NO         FMA  PRINT FISS PROD MATRIX BY ARRAY NUMBER NO ***
     ***                                                                                                         ***
     ***  HHL  COLLECT MATRIX BY HIGHEST HOLE LEVEL   NO         HAL  COLLECT MATRIX BY HIGHEST ARRAY LEVEL   NO ***
     ***                                                                                                         ***
     ***  AMX  PRINT ALL MIXED CROSS SECTIONS         NO         FAR  PRINT FIS. AND ABS. BY REGION          NO ***
     ***                                                                                                         ***
     ***  XS1  PRINT 1-D MIXTURE X-SECTIONS           NO         GAS  PRINT FAR BY GROUP                     NO ***
     ***                                                                                                         ***
     ***  XS2  PRINT 2-D MIXTURE X-SECTIONS           NO         PAX  PRINT XSEC-ALBEDO CORRELATION TABLES   NO ***
     ***                                                                                                         ***
     ***  XAP  PRINT MIXTURE ANGLES & PROBABILITIES   NO         PWT  PRINT WEIGHT AVERAGE ARRAY             NO ***
     ***                                                                                                         ***
     ***  PKI  PRINT FISSION SPECTRUM                 NO         PGM  PRINT INPUT GEOMETRY                   NO ***
     ***                                                                                                         ***
     ***  P1D  PRINT EXTRA 1-D CROSS SECTIONS         NO         BUG  PRINT DEBUG INFORMATION                NO ***
     ***                                                                                                         ***
     ***                                                         TRK  PRINT TRACKING INFORMATION             NO ***
     ***                                                                                                         ***
     ***                                                                                                         ***
     *******************************************************************************************************************
     *******************************************************************************************************************
     *******************************************************************************************************************
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
                                        PARAMETER INPUT COMPLETED

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 250.698 CM) (EXT. MOD. VF = 0.

                                              MIXING TABLE

                                     NUMBER OF SCATTERING ANGLES =  2
                                 CROSS SECTION MESSAGE THRESHOLD =3.0E-05


MIXTURE =     1          DENSITY(G/CC) =  10.412
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT              NUCLIDE TITLE
   1008016  4.64617E-02  1.18487E-01    8016     15.9904       OXYGEN-16       ENDF/B-IV MAT 1276                              UPDATED
08/12/94
   1092235  9.40641E-04  3.52606E-02    92235    235.0441      URANIUM-235     ENDF/B-IV MAT 1261                              UPDATED
08/12/94
   1092238  2.22902E-02  8.46253E-01    92238    238.0510      URANIUM-238     ENDF/B-IV MAT 1262                              UPDATED
08/12/94

MIXTURE =     2          DENSITY(G/CC) =  6.5600
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT              NUCLIDE TITLE
   2040302  4.33078E-02  1.00000E+00    40000     91.2196      ZIRCALLOY       ENDF/B-IV MAT 1284                              UPDATED
08/12/94

MIXTURE =     3          DENSITY(G/CC) = 0.99817E-04
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT              NUCLIDE TITLE
   3001001  6.67692E-06  1.11927E-01    1001      1.0077        HYDROGEN        ENDF/B-IV MAT 1269/THRM1002                    UPDATED
08/12/94
   3008016  3.33846E-06  8.88074E-01    8016     15.9904       OXYGEN-16       ENDF/B-IV MAT 1276                              UPDATED
08/12/94

MIXTURE =     4          DENSITY(G/CC) =  2.7020
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT              NUCLIDE TITLE
   4013027  6.03066E-02  1.00000E+00    13027     26.9818     AL-27 1193 218 GP 040375(5)                                       UPDATED
08/12/94

MIXTURE =     5          DENSITY(G/CC) =  7.9200
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT              NUCLIDE TITLE
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
   5024304  1.74286E-02  1.90000E-01   24000    51.9957     CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'          UPDATED
08/12/94
   5025055  1.73633E-03  1.99999E-02   25055    54.9379     MANGANESE-55    ENDF/B-IV MAT 1197                       UPDATED
08/12/94
   5026304  5.93579E-02  6.95000E-01   26000    55.8447     FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'          UPDATED
08/12/94
   5028304  7.72070E-03  9.50001E-02   28000    58.6872     NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'          UPDATED
08/12/94

MIXTURE =     6          DENSITY(G/CC) =  2.5833
  NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA      AWT             NUCLIDE TITLE
   6005010  7.09799E-03  4.56855E-02    5010    10.0130    B-10 1273 218NGP 042375 P-3 293K                           UPDATED
08/12/94
   6005011  3.92499E-02  2.77771E-01    5011    11.0096     BORON-11        ENDF/B-IV MAT 1160                        UPDATED
08/12/94
   6006012  1.22006E-02  9.41116E-02    6000    12.0001     CARBON-12       ENDF/B-IV MAT 1274/THRM1065               UPDATED
08/12/94
   6013027  3.35812E-02  5.82432E-01   13027    26.9818    AL-27 1193 218 GP 040375(5)                                UPDATED
08/12/94

MIXTURE =     7          DENSITY(G/CC) =  11.344
  NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA      AWT             NUCLIDE TITLE
   7082000  3.29690E-02  1.00000E+00   82000   207.2100    PB   1288 218NGP 042375 P-3 293K                           UPDATED
08/12/94

MIXTURE =     8          DENSITY(G/CC) =  1.6307
  NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA      AWT             NUCLIDE TITLE
   8001001  5.84084E-02  5.99323E-02    1001     1.0077     HYDROGEN        ENDF/B-IV MAT 1269/THRM1002               UPDATED
08/12/94
   8005010  9.79802E-05  9.99025E-04    5010    10.0130    B-10 1273 218NGP 042375 P-3 293K                           UPDATED
08/12/94
   8005011  3.56450E-04  3.99615E-03    5011    11.0096     BORON-11        ENDF/B-IV MAT 1160                        UPDATED
08/12/94
   8006012  2.26463E-02  2.76729E-01    6000    12.0001     CARBON-12       ENDF/B-IV MAT 1274/THRM1065               UPDATED
08/12/94
   8007014  1.40121E-03  1.99805E-02    7014    14.0033     NITROGEN-14     ENDF/B-IV MAT 1275                        UPDATED
08/12/94
   8008016  2.60749E-02  4.24574E-01    8016    15.9904     OXYGEN-16       ENDF/B-IV MAT 1276                        UPDATED
08/12/94
   8013027  7.78110E-03  2.13789E-01   13027    26.9818    AL-27 1193 218 GP 040375(5)                                UPDATED
08/12/94

MIXTURE =     9          DENSITY(G/CC) = 0.59890
  NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA      AWT             NUCLIDE TITLE
   9001001  4.00615E-02  1.11927E-01    1001     1.0077     HYDROGEN        ENDF/B-IV MAT 1269/THRM1002               UPDATED
08/12/94
   9008016  2.00308E-02  8.88074E-01    8016    15.9904     OXYGEN-16       ENDF/B-IV MAT 1276                        UPDATED
08/12/94


                         3001001     HYDROGEN        ENDF/B-IV MAT 1269/THRM1002           UPDATED 08/12/94
                         8001001     HYDROGEN        ENDF/B-IV MAT 1269/THRM1002           UPDATED 08/12/94
                         9001001     HYDROGEN        ENDF/B-IV MAT 1269/THRM1002           UPDATED 08/12/94
                         6005010    B-10 1273 218NGP 042375 P-3 293K                       UPDATED 08/12/94
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
8005010    B-10 1273 218NGP 042375 P-3 293K                          UPDATED 08/12/94
6005011     BORON-11       ENDF/B-IV MAT 1160                        UPDATED 08/12/94
8005011     BORON-11       ENDF/B-IV MAT 1160                        UPDATED 08/12/94
6006012     CARBON-12      ENDF/B-IV MAT 1274/THRM1065               UPDATED 08/12/94
8006012     CARBON-12      ENDF/B-IV MAT 1274/THRM1065               UPDATED 08/12/94
8007014     NITROGEN-14    ENDF/B-IV MAT 1275                        UPDATED 08/12/94
1008016     OXYGEN-16      ENDF/B-IV MAT 1276                        UPDATED 08/12/94
3008016     OXYGEN-16      ENDF/B-IV MAT 1276                        UPDATED 08/12/94
8008016     OXYGEN-16      ENDF/B-IV MAT 1276                        UPDATED 08/12/94
9008016     OXYGEN-16      ENDF/B-IV MAT 1276                        UPDATED 08/12/94
4013027    AL-27 1193 218 GP 040375(5)                               UPDATED 08/12/94
6013027    AL-27 1193 218 GP 040375(5)                               UPDATED 08/12/94
8013027    AL-27 1193 218 GP 040375(5)                               UPDATED 08/12/94
5024304    CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'          UPDATED 08/12/94
5025055     MANGANESE-55   ENDF/B-IV MAT 1197                        UPDATED 08/12/94
5026304    FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'          UPDATED 08/12/94
5028304    NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'          UPDATED 08/12/94
2040302     ZIRCALLOY      ENDF/B-IV MAT 1284                        UPDATED 08/12/94
7082000    PB   1288 218NGP 042375 P-3 293K                          UPDATED 08/12/94
1092235     URANIUM-235    ENDF/B-IV MAT 1261                        UPDATED 08/12/94
1092238     URANIUM-238    ENDF/B-IV MAT 1262                        UPDATED 08/12/94


  ........   0 IO'S WERE USED MIXING CROSS-SECTIONS        .........

   1-D CROSS SECTION ARRAY ID NUMBERS
      1  2002  1452    27    18  1018

  ........   0 IO'S WERE USED PREPARING THE CROSS SECTIONS      ........
*************************************************************************************************
***                                                                                           ***
***         TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 250.698 CM) (EXT. MOD. VF = 0.  ***
***                                                                                           ***
*************************************************************************************************
*************************************************************************************************
***                                                                                           ***
***                             ****** ADDITIONAL INFORMATION ******                          ***
***                                                                                           ***
***  NUMBER OF ENERGY GROUPS               27       USE LATTICE GEOMETRY                 YES  ***
***                                                                                           ***
***  NO. OF FISSION SPECTRUM SOURCE GROUP  1        GLOBAL ARRAY NUMBER                   60  ***
***                                                                                           ***
***  NO. OF SCATTERING ANGLES IN XSECS     2        NUMBER OF UNITS IN THE GLOBAL X DIR.   1  ***
***                                                                                           ***
***  ENTRIES/NEUTRON IN THE NEUTRON BANK  33        NUMBER OF UNITS IN THE GLOBAL Y DIR.   1  ***
***                                                                                           ***
***  ENTRIES/NEUTRON IN THE FISSION BANK  26        NUMBER OF UNITS IN THE GLOBAL Z DIR.   4  ***
***                                                                                           ***
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
*** NUMBER OF MIXTURES USED                 9     USE A GLOBAL REFLECTOR          YES ***
***                                                                                   ***
*** NUMBER OF BIAS ID'S USED                1     USE NESTED HOLES                YES ***
***                                                                                   ***
*** NUMBER OF DIFFERENTIAL ALBEDOS USED     0     NUMBER OF HOLES                  48 ***
***                                                                                   ***
*** TOTAL INPUT GEOMETRY REGIONS          136     MAXIMUM HOLE NESTING LEVEL        3 ***
***                                                                                   ***
*** NUMBER OF GEOMETRY REGIONS USED       136     USE NESTED ARRAYS               YES ***
***                                                                                   ***
*** LARGEST GEOMETRY UNIT NUMBER          120     NUMBER OF ARRAYS USED            27 ***
***                                                                                   ***
*** LARGEST ARRAY NUMBER                   60     MAXIMUM ARRAY NESTING LEVEL       4 ***
***                                                                                   ***
***                                                                                   ***
*** +X BOUNDARY CONDITION                 MIR     -X BOUNDARY CONDITION           MIR ***
***                                                                                   ***
*** +Y BOUNDARY CONDITION                 MIR     -Y BOUNDARY CONDITION           MIR ***
***                                                                                   ***
*** +Z BOUNDARY CONDITION                 PER     -Z BOUNDARY CONDITION           PER ***
***                                                                                   ***
*****************************************************************************************
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 250.698 CM) (EXT. MOD. VF = 0.

               GENERATION    ELAPSED TIME     AVERAGE        AVG K-EFF        MATRIX       MATRIX K-EFF
  GENERATION   K-EFFECTIVE     MINUTES       K-EFFECTIVE     DEVIATION      K-EFFECTIVE     DEVIATION
KENO MESSAGE NUMBER K5-132    WARNING....ONLY 494 INDEPENDENT FISSION POINTS WERE GENERATED
       1      4.48332E-01   3.85500E-01    1.00000E+00    0.00000E+00    0.00000E+00    0.00000E+00
KENO MESSAGE NUMBER K5-132    WARNING....ONLY 477 INDEPENDENT FISSION POINTS WERE GENERATED
       2      4.43293E-01   7.19500E-01    1.00000E+00    0.00000E+00    0.00000E+00    0.00000E+00
KENO MESSAGE NUMBER K5-132    WARNING....ONLY 534 INDEPENDENT FISSION POINTS WERE GENERATED
       3      4.51460E-01   1.05467E+00    4.51460E-01    0.00000E+00    0.00000E+00    0.00000E+00
       4      4.67077E-01   1.39517E+00    4.59269E-01    7.80828E-03    0.00000E+00    0.00000E+00
       5      4.55744E-01   1.73850E+00    4.58094E-01    4.65870E-03    0.00000E+00    0.00000E+00
       6      4.51320E-01   2.08533E+00    4.56400E-01    3.70404E-03    0.00000E+00    0.00000E+00
       7      4.57700E-01   2.43050E+00    4.56660E-01    2.88088E-03    0.00000E+00    0.00000E+00
       8      4.67890E-01   2.77283E+00    4.58532E-01    3.00603E-03    0.00000E+00    0.00000E+00
       9      4.63798E-01   3.12433E+00    4.59284E-01    2.64962E-03    0.00000E+00    0.00000E+00
      10      4.45528E-01   3.46400E+00    4.57565E-01    2.86743E-03    0.00000E+00    0.00000E+00
      11      4.61534E-01   3.79817E+00    4.58006E-01    2.56700E-03    0.00000E+00    0.00000E+00
      12      4.70475E-01   4.14150E+00    4.59253E-01    2.61275E-03    0.00000E+00    0.00000E+00
      13      4.53302E-01   4.47733E+00    4.58712E-01    2.42445E-03    0.00000E+00    0.00000E+00
      14      4.40243E-01   4.81433E+00    4.57173E-01    2.69573E-03    0.00000E+00    0.00000E+00
      15      4.57565E-01   5.15667E+00    4.57203E-01    2.47989E-03    0.00000E+00    0.00000E+00
      16      4.61519E-01   5.50267E+00    4.57511E-01    2.31654E-03    0.00000E+00    0.00000E+00
      17      4.64866E-01   5.84050E+00    4.58001E-01    2.21162E-03    0.00000E+00    0.00000E+00
      18      4.69900E-01   6.19100E+00    4.58745E-01    2.19839E-03    0.00000E+00    0.00000E+00
      19      4.58153E-01   6.52983E+00    4.58710E-01    2.06532E-03    0.00000E+00    0.00000E+00
      20      4.61944E-01   6.87117E+00    4.58890E-01    1.95547E-03    0.00000E+00    0.00000E+00
```

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

21	4.59987E-01	7.20717E+00	4.58948E-01	1.85059E-03	0.00000E+00	0.00000E+00
22	4.51837E-01	7.55317E+00	4.58592E-01	1.79126E-03	0.00000E+00	0.00000E+00
23	4.57642E-01	7.89467E+00	4.58547E-01	1.70443E-03	0.00000E+00	0.00000E+00
24	4.41768E-01	8.24533E+00	4.57784E-01	1.79517E-03	0.00000E+00	0.00000E+00
25	4.50166E-01	8.58950E+00	4.57453E-01	1.74703E-03	0.00000E+00	0.00000E+00
26	4.82646E-01	8.93367E+00	4.58503E-01	1.97476E-03	0.00000E+00	0.00000E+00
27	4.68136E-01	9.28067E+00	4.58888E-01	1.93292E-03	0.00000E+00	0.00000E+00
28	4.56009E-01	9.62200E+00	4.58777E-01	1.86039E-03	0.00000E+00	0.00000E+00
29	4.56370E-01	9.95800E+00	4.58688E-01	1.79238E-03	0.00000E+00	0.00000E+00
30	4.55737E-01	1.03105E+01	4.58583E-01	1.73039E-03	0.00000E+00	0.00000E+00
31	4.59289E-01	1.06557E+01	4.58607E-01	1.66984E-03	0.00000E+00	0.00000E+00
32	4.50980E-01	1.09878E+01	4.58353E-01	1.63312E-03	0.00000E+00	0.00000E+00
33	4.53890E-01	1.13348E+01	4.58209E-01	1.58611E-03	0.00000E+00	0.00000E+00
34	4.61455E-01	1.16790E+01	4.58310E-01	1.53909E-03	0.00000E+00	0.00000E+00
35	4.45631E-01	1.20068E+01	4.57926E-01	1.54041E-03	0.00000E+00	0.00000E+00
36	4.61928E-01	1.23408E+01	4.58044E-01	1.49905E-03	0.00000E+00	0.00000E+00
37	4.65105E-01	1.26797E+01	4.58246E-01	1.46950E-03	0.00000E+00	0.00000E+00
38	4.50275E-01	1.30202E+01	4.58024E-01	1.44516E-03	0.00000E+00	0.00000E+00
39	4.51914E-01	1.33652E+01	4.57859E-01	1.41523E-03	0.00000E+00	0.00000E+00
40	4.66734E-01	1.37077E+01	4.58093E-01	1.39714E-03	0.00000E+00	0.00000E+00
41	4.53626E-01	1.40500E+01	4.57978E-01	1.36565E-03	0.00000E+00	0.00000E+00
42	4.45578E-01	1.43942E+01	4.57668E-01	1.36669E-03	0.00000E+00	0.00000E+00
43	4.59431E-01	1.47430E+01	4.57711E-01	1.33364E-03	0.00000E+00	0.00000E+00
44	4.68701E-01	1.50898E+01	4.57973E-01	1.32754E-03	0.00000E+00	0.00000E+00
45	4.61495E-01	1.54313E+01	4.58055E-01	1.29889E-03	0.00000E+00	0.00000E+00
46	4.44256E-01	1.57773E+01	4.57741E-01	1.30720E-03	0.00000E+00	0.00000E+00
47	4.47966E-01	1.61115E+01	4.57524E-01	1.29615E-03	0.00000E+00	0.00000E+00
48	4.55078E-01	1.64502E+01	4.57471E-01	1.26878E-03	0.00000E+00	0.00000E+00
49	4.57880E-01	1.67862E+01	4.57479E-01	1.24152E-03	0.00000E+00	0.00000E+00
50	4.66583E-01	1.71303E+01	4.57669E-01	1.23009E-03	0.00000E+00	0.00000E+00
51	4.54401E-01	1.74692E+01	4.57602E-01	1.20656E-03	0.00000E+00	0.00000E+00
52	4.65092E-01	1.78160E+01	4.57752E-01	1.19164E-03	0.00000E+00	0.00000E+00
53	4.56241E-01	1.81685E+01	4.57722E-01	1.16842E-03	0.00000E+00	0.00000E+00
54	4.60041E-01	1.85090E+01	4.57767E-01	1.14659E-03	0.00000E+00	0.00000E+00
55	4.73428E-01	1.88587E+01	4.58063E-01	1.16292E-03	0.00000E+00	0.00000E+00
56	4.72201E-01	1.92002E+01	4.58324E-01	1.17083E-03	0.00000E+00	0.00000E+00
57	4.33760E-01	1.95278E+01	4.57878E-01	1.23307E-03	0.00000E+00	0.00000E+00
58	4.54376E-01	1.98675E+01	4.57815E-01	1.21247E-03	0.00000E+00	0.00000E+00
59	4.64330E-01	2.02080E+01	4.57930E-01	1.19648E-03	0.00000E+00	0.00000E+00
60	4.61638E-01	2.05503E+01	4.57993E-01	1.17740E-03	0.00000E+00	0.00000E+00
61	4.68476E-01	2.08965E+01	4.58171E-01	1.17084E-03	0.00000E+00	0.00000E+00
62	4.61480E-01	2.12378E+01	4.58226E-01	1.15248E-03	0.00000E+00	0.00000E+00
63	4.57134E-01	2.15748E+01	4.58208E-01	1.13357E-03	0.00000E+00	0.00000E+00
64	4.69332E-01	2.19190E+01	4.58388E-01	1.12947E-03	0.00000E+00	0.00000E+00
65	4.43979E-01	2.22577E+01	4.58159E-01	1.13469E-03	0.00000E+00	0.00000E+00
66	4.59447E-01	2.26000E+01	4.58179E-01	1.11700E-03	0.00000E+00	0.00000E+00
67	4.46618E-01	2.29360E+01	4.58001E-01	1.11397E-03	0.00000E+00	0.00000E+00
68	4.48726E-01	2.32775E+01	4.57861E-01	1.10593E-03	0.00000E+00	0.00000E+00
69	4.54201E-01	2.36207E+01	4.57806E-01	1.09067E-03	0.00000E+00	0.00000E+00
70	4.58805E-01	2.39622E+01	4.57821E-01	1.07461E-03	0.00000E+00	0.00000E+00
71	4.48634E-01	2.43137E+01	4.57688E-01	1.06726E-03	0.00000E+00	0.00000E+00
72	4.60830E-01	2.46515E+01	4.57733E-01	1.05286E-03	0.00000E+00	0.00000E+00
73	4.62452E-01	2.49938E+01	4.57799E-01	1.04005E-03	0.00000E+00	0.00000E+00
74	4.58161E-01	2.53490E+01	4.57804E-01	1.02551E-03	0.00000E+00	0.00000E+00
75	4.58480E-01	2.56942E+01	4.57813E-01	1.01141E-03	0.00000E+00	0.00000E+00

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

76	4.67372E-01	2.60365E+01	4.57943E-01	1.00598E-03	0.00000E+00	0.00000E+00
77	4.58155E-01	2.63917E+01	4.57945E-01	9.92477E-04	0.00000E+00	0.00000E+00
78	4.34600E-01	2.67258E+01	4.57638E-01	1.02637E-03	0.00000E+00	0.00000E+00
79	4.50901E-01	2.70792E+01	4.57551E-01	1.01673E-03	0.00000E+00	0.00000E+00
80	4.64665E-01	2.74243E+01	4.57642E-01	1.00775E-03	0.00000E+00	0.00000E+00
81	4.59790E-01	2.77703E+01	4.57669E-01	9.95279E-04	0.00000E+00	0.00000E+00
82	4.55906E-01	2.81082E+01	4.57647E-01	9.83006E-04	0.00000E+00	0.00000E+00
83	4.65838E-01	2.84542E+01	4.57748E-01	9.76047E-04	0.00000E+00	0.00000E+00
84	4.69348E-01	2.88075E+01	4.57890E-01	9.74393E-04	0.00000E+00	0.00000E+00
85	4.61978E-01	2.91472E+01	4.57939E-01	9.63841E-04	0.00000E+00	0.00000E+00
86	4.66666E-01	2.94868E+01	4.58043E-01	9.57948E-04	0.00000E+00	0.00000E+00
87	4.58813E-01	2.98300E+01	4.58052E-01	9.46655E-04	0.00000E+00	0.00000E+00
88	4.66602E-01	3.01743E+01	4.58151E-01	9.40850E-04	0.00000E+00	0.00000E+00
89	4.56168E-01	3.05083E+01	4.58128E-01	9.30252E-04	0.00000E+00	0.00000E+00
90	4.62012E-01	3.08490E+01	4.58173E-01	9.20678E-04	0.00000E+00	0.00000E+00
91	4.61616E-01	3.11867E+01	4.58211E-01	9.11097E-04	0.00000E+00	0.00000E+00
92	4.42385E-01	3.15282E+01	4.58035E-01	9.17919E-04	0.00000E+00	0.00000E+00
93	4.45441E-01	3.18705E+01	4.57897E-01	9.18265E-04	0.00000E+00	0.00000E+00
94	4.42622E-01	3.22075E+01	4.57731E-01	9.23280E-04	0.00000E+00	0.00000E+00
95	4.48923E-01	3.25360E+01	4.57636E-01	9.18196E-04	0.00000E+00	0.00000E+00
96	4.69889E-01	3.28830E+01	4.57767E-01	9.17680E-04	0.00000E+00	0.00000E+00
97	4.65123E-01	3.32318E+01	4.57844E-01	9.11264E-04	0.00000E+00	0.00000E+00
98	4.68931E-01	3.35797E+01	4.57960E-01	9.09088E-04	0.00000E+00	0.00000E+00
99	4.32937E-01	3.39102E+01	4.57702E-01	9.35920E-04	0.00000E+00	0.00000E+00
100	4.75083E-01	3.42525E+01	4.57879E-01	9.43147E-04	0.00000E+00	0.00000E+00
101	4.51684E-01	3.45930E+01	4.57816E-01	9.35667E-04	0.00000E+00	0.00000E+00
102	4.76249E-01	3.49455E+01	4.58001E-01	9.44425E-04	0.00000E+00	0.00000E+00
103	4.43920E-01	3.52805E+01	4.57861E-01	9.45364E-04	0.00000E+00	0.00000E+00
104	4.65394E-01	3.56302E+01	4.57935E-01	9.38958E-04	0.00000E+00	0.00000E+00
105	4.56583E-01	3.59707E+01	4.57922E-01	9.29890E-04	0.00000E+00	0.00000E+00
106	4.58477E-01	3.63205E+01	4.57927E-01	9.20921E-04	0.00000E+00	0.00000E+00
107	4.46813E-01	3.66582E+01	4.57822E-01	9.18230E-04	0.00000E+00	0.00000E+00
108	4.61466E-01	3.69933E+01	4.57856E-01	9.10176E-04	0.00000E+00	0.00000E+00
109	4.56823E-01	3.73412E+01	4.57846E-01	9.01681E-04	0.00000E+00	0.00000E+00
110	4.64921E-01	3.76817E+01	4.57912E-01	8.95692E-04	0.00000E+00	0.00000E+00
111	4.68324E-01	3.80305E+01	4.58007E-01	8.92563E-04	0.00000E+00	0.00000E+00
112	4.64874E-01	3.83655E+01	4.58070E-01	8.86612E-04	0.00000E+00	0.00000E+00
113	4.56108E-01	3.87143E+01	4.58052E-01	8.78766E-04	0.00000E+00	0.00000E+00
114	4.60073E-01	3.90640E+01	4.58070E-01	8.71071E-04	0.00000E+00	0.00000E+00
115	4.67658E-01	3.94118E+01	4.58155E-01	8.67488E-04	0.00000E+00	0.00000E+00
116	4.45389E-01	3.97478E+01	4.58043E-01	8.67106E-04	0.00000E+00	0.00000E+00
117	4.61144E-01	4.01012E+01	4.58070E-01	8.59956E-04	0.00000E+00	0.00000E+00
118	4.67560E-01	4.04380E+01	4.58152E-01	8.56426E-04	0.00000E+00	0.00000E+00
119	4.53482E-01	4.07840E+01	4.58112E-01	8.50012E-04	0.00000E+00	0.00000E+00
120	4.66085E-01	4.11273E+01	4.58179E-01	8.45483E-04	0.00000E+00	0.00000E+00
121	4.57045E-01	4.14623E+01	4.58170E-01	8.38402E-04	0.00000E+00	0.00000E+00
122	4.58942E-01	4.18112E+01	4.58176E-01	8.31411E-04	0.00000E+00	0.00000E+00
123	4.54475E-01	4.21535E+01	4.58146E-01	8.25078E-04	0.00000E+00	0.00000E+00
124	4.49265E-01	4.24932E+01	4.58073E-01	8.21519E-04	0.00000E+00	0.00000E+00
125	4.78256E-01	4.28447E+01	4.58237E-01	8.31171E-04	0.00000E+00	0.00000E+00
126	4.58493E-01	4.31962E+01	4.58239E-01	8.24443E-04	0.00000E+00	0.00000E+00
127	4.63676E-01	4.35458E+01	4.58283E-01	8.18977E-04	0.00000E+00	0.00000E+00
128	4.52209E-01	4.38865E+01	4.58234E-01	8.13879E-04	0.00000E+00	0.00000E+00
129	4.77728E-01	4.42352E+01	4.58388E-01	8.21906E-04	0.00000E+00	0.00000E+00
130	4.59576E-01	4.45895E+01	4.58397E-01	8.15512E-04	0.00000E+00	0.00000E+00

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

131	4.57866E-01	4.49337E+01	4.58393E-01	8.09176E-04	0.00000E+00	0.00000E+00
132	4.53502E-01	4.52733E+01	4.58355E-01	8.03808E-04	0.00000E+00	0.00000E+00
133	4.45038E-01	4.56128E+01	4.58254E-01	8.04101E-04	0.00000E+00	0.00000E+00
134	4.51782E-01	4.59590E+01	4.58205E-01	7.99490E-04	0.00000E+00	0.00000E+00
135	4.60021E-01	4.62948E+01	4.58218E-01	7.93574E-04	0.00000E+00	0.00000E+00
136	4.66765E-01	4.66465E+01	4.58282E-01	7.90207E-04	0.00000E+00	0.00000E+00
137	4.63688E-01	4.69907E+01	4.58322E-01	7.85353E-04	0.00000E+00	0.00000E+00
138	4.49183E-01	4.73285E+01	4.58255E-01	7.82448E-04	0.00000E+00	0.00000E+00
139	4.57541E-01	4.76772E+01	4.58250E-01	7.76734E-04	0.00000E+00	0.00000E+00
140	4.63069E-01	4.80250E+01	4.58285E-01	7.71875E-04	0.00000E+00	0.00000E+00
141	4.60385E-01	4.83683E+01	4.58300E-01	7.66451E-04	0.00000E+00	0.00000E+00
142	4.68164E-01	4.87190E+01	4.58370E-01	7.64212E-04	0.00000E+00	0.00000E+00
143	4.66874E-01	4.90695E+01	4.58431E-01	7.61165E-04	0.00000E+00	0.00000E+00
144	4.57725E-01	4.94092E+01	4.58426E-01	7.55802E-04	0.00000E+00	0.00000E+00
145	4.56155E-01	4.97525E+01	4.58410E-01	7.50666E-04	0.00000E+00	0.00000E+00
146	4.60930E-01	5.01022E+01	4.58427E-01	7.45641E-04	0.00000E+00	0.00000E+00
147	4.48704E-01	5.04390E+01	4.58360E-01	7.43511E-04	0.00000E+00	0.00000E+00
148	4.49969E-01	5.07787E+01	4.58303E-01	7.40634E-04	0.00000E+00	0.00000E+00
149	4.55845E-01	5.11183E+01	4.58286E-01	7.35769E-04	0.00000E+00	0.00000E+00
150	4.49922E-01	5.14633E+01	4.58229E-01	7.32962E-04	0.00000E+00	0.00000E+00
151	4.44525E-01	5.18048E+01	4.58138E-01	7.33813E-04	0.00000E+00	0.00000E+00
152	4.49503E-01	5.21362E+01	4.58080E-01	7.31174E-04	0.00000E+00	0.00000E+00
153	4.57337E-01	5.24758E+01	4.58075E-01	7.26332E-04	0.00000E+00	0.00000E+00
154	4.52312E-01	5.28063E+01	4.58037E-01	7.22534E-04	0.00000E+00	0.00000E+00
155	4.51315E-01	5.31468E+01	4.57993E-01	7.19139E-04	0.00000E+00	0.00000E+00
156	4.70381E-01	5.34938E+01	4.58074E-01	7.18968E-04	0.00000E+00	0.00000E+00
157	4.51343E-01	5.38380E+01	4.58030E-01	7.15633E-04	0.00000E+00	0.00000E+00
158	4.51194E-01	5.41758E+01	4.57986E-01	7.12380E-04	0.00000E+00	0.00000E+00
159	4.58894E-01	5.45337E+01	4.57992E-01	7.07852E-04	0.00000E+00	0.00000E+00
160	4.63779E-01	5.48770E+01	4.58029E-01	7.04311E-04	0.00000E+00	0.00000E+00
161	4.72445E-01	5.52340E+01	4.58119E-01	7.05715E-04	0.00000E+00	0.00000E+00
162	4.48802E-01	5.55672E+01	4.58061E-01	7.03705E-04	0.00000E+00	0.00000E+00
163	4.57398E-01	5.59087E+01	4.58057E-01	6.99332E-04	0.00000E+00	0.00000E+00
164	4.59861E-01	5.62483E+01	4.58068E-01	6.95091E-04	0.00000E+00	0.00000E+00
165	4.47229E-01	5.65815E+01	4.58002E-01	6.94007E-04	0.00000E+00	0.00000E+00
166	4.52014E-01	5.69183E+01	4.57965E-01	6.90728E-04	0.00000E+00	0.00000E+00
167	4.57747E-01	5.72498E+01	4.57964E-01	6.86530E-04	0.00000E+00	0.00000E+00
168	4.73331E-01	5.76050E+01	4.58056E-01	6.88632E-04	0.00000E+00	0.00000E+00
169	4.56556E-01	5.79520E+01	4.58047E-01	6.84555E-04	0.00000E+00	0.00000E+00
170	4.38781E-01	5.82897E+01	4.57933E-01	6.90064E-04	0.00000E+00	0.00000E+00
171	4.66030E-01	5.86367E+01	4.57981E-01	6.87640E-04	0.00000E+00	0.00000E+00
172	4.50684E-01	5.89753E+01	4.57938E-01	6.84929E-04	0.00000E+00	0.00000E+00
173	4.63556E-01	5.93242E+01	4.57971E-01	6.81704E-04	0.00000E+00	0.00000E+00
174	4.55825E-01	5.96583E+01	4.57958E-01	6.77844E-04	0.00000E+00	0.00000E+00
175	4.49008E-01	5.99952E+01	4.57906E-01	6.75898E-04	0.00000E+00	0.00000E+00
176	4.52091E-01	6.03338E+01	4.57873E-01	6.72832E-04	0.00000E+00	0.00000E+00
177	4.64346E-01	6.06863E+01	4.57910E-01	6.69999E-04	0.00000E+00	0.00000E+00
178	4.59222E-01	6.10313E+01	4.57917E-01	6.66223E-04	0.00000E+00	0.00000E+00
179	4.52591E-01	6.13738E+01	4.57887E-01	6.63131E-04	0.00000E+00	0.00000E+00
180	4.57701E-01	6.17180E+01	4.57886E-01	6.59396E-04	0.00000E+00	0.00000E+00
181	4.66480E-01	6.20687E+01	4.57934E-01	6.57457E-04	0.00000E+00	0.00000E+00
182	4.42807E-01	6.24008E+01	4.57850E-01	6.59173E-04	0.00000E+00	0.00000E+00
183	4.44915E-01	6.27470E+01	4.57779E-01	6.59405E-04	0.00000E+00	0.00000E+00
184	4.63822E-01	6.30893E+01	4.57812E-01	6.56613E-04	0.00000E+00	0.00000E+00
185	4.54129E-01	6.34280E+01	4.57792E-01	6.53325E-04	0.00000E+00	0.00000E+00

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

186	4.60407E-01	6.37667E+01	4.57806E-01	6.49920E-04	0.00000E+00	0.00000E+00
187	4.52227E-01	6.41145E+01	4.57776E-01	6.47100E-04	0.00000E+00	0.00000E+00
188	4.77262E-01	6.44597E+01	4.57881E-01	6.52082E-04	0.00000E+00	0.00000E+00
189	4.72561E-01	6.48140E+01	4.57959E-01	6.53320E-04	0.00000E+00	0.00000E+00
190	4.34712E-01	6.51480E+01	4.57836E-01	6.61497E-04	0.00000E+00	0.00000E+00
191	4.51545E-01	6.54877E+01	4.57802E-01	6.58829E-04	0.00000E+00	0.00000E+00
192	4.76042E-01	6.58402E+01	4.57898E-01	6.62346E-04	0.00000E+00	0.00000E+00
193	4.72495E-01	6.61953E+01	4.57975E-01	6.63286E-04	0.00000E+00	0.00000E+00
194	4.47268E-01	6.65340E+01	4.57919E-01	6.62175E-04	0.00000E+00	0.00000E+00
195	4.60527E-01	6.68755E+01	4.57932E-01	6.58874E-04	0.00000E+00	0.00000E+00
196	4.63248E-01	6.72142E+01	4.57960E-01	6.56041E-04	0.00000E+00	0.00000E+00
197	4.55099E-01	6.75565E+01	4.57945E-01	6.52833E-04	0.00000E+00	0.00000E+00
198	4.59402E-01	6.79017E+01	4.57953E-01	6.49536E-04	0.00000E+00	0.00000E+00
199	4.60671E-01	6.82458E+01	4.57966E-01	6.46378E-04	0.00000E+00	0.00000E+00
200	4.59900E-01	6.85882E+01	4.57976E-01	6.43179E-04	0.00000E+00	0.00000E+00
201	4.65762E-01	6.89398E+01	4.58015E-01	6.41134E-04	0.00000E+00	0.00000E+00
202	4.41512E-01	6.92738E+01	4.57933E-01	6.43235E-04	0.00000E+00	0.00000E+00
203	4.63288E-01	6.96208E+01	4.57959E-01	6.40581E-04	0.00000E+00	0.00000E+00

```
KENO MESSAGE NUMBER K5-123          EXECUTION TERMINATED DUE TO COMPLETION OF THE SPECIFIED NUMBER OF GENERATIONS.
                                               TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 250.698 CM) (EXT. MOD. VF = 0.

LIFETIME =  9.45512E-06 + OR -  5.08997E-08            GENERATION TIME =  1.85503E-06 + OR -  1.01955E-08
NU BAR   =  2.54494E+00 + OR -  4.16575E-04       AVERAGE FISSION GROUP =  6.81874E+00 + OR -  6.06833E-03
                    ENERGY(EV) OF THE AVERAGE LETHARGY CAUSING FISSION =  6.68650E+04 + OR -  4.50944E+02
```

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
3	0.45799	+ OR - 0.00064	0.45735 TO 0.45863	0.45671 TO 0.45928	0.45606 TO 0.45992	200000
4	0.45795	+ OR - 0.00064	0.45730 TO 0.45859	0.45666 TO 0.45924	0.45601 TO 0.45988	199000
5	0.45796	+ OR - 0.00065	0.45731 TO 0.45861	0.45666 TO 0.45925	0.45601 TO 0.45990	198000
6	0.45799	+ OR - 0.00065	0.45734 TO 0.45864	0.45669 TO 0.45929	0.45604 TO 0.45994	197000
7	0.45799	+ OR - 0.00065	0.45734 TO 0.45865	0.45669 TO 0.45930	0.45603 TO 0.45995	196000
8	0.45794	+ OR - 0.00065	0.45729 TO 0.45860	0.45663 TO 0.45925	0.45598 TO 0.45991	195000
9	0.45791	+ OR - 0.00066	0.45725 TO 0.45857	0.45660 TO 0.45923	0.45594 TO 0.45988	194000
10	0.45798	+ OR - 0.00066	0.45732 TO 0.45863	0.45666 TO 0.45929	0.45600 TO 0.45995	193000
11	0.45796	+ OR - 0.00066	0.45730 TO 0.45862	0.45664 TO 0.45928	0.45597 TO 0.45994	192000
12	0.45789	+ OR - 0.00066	0.45723 TO 0.45855	0.45657 TO 0.45921	0.45591 TO 0.45988	191000

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

17	0.45796	+ OR - 0.00067	0.45729 TO 0.45863	0.45662 TO 0.45930	0.45594 TO 0.45997	186000
22	0.45789	+ OR - 0.00068	0.45720 TO 0.45857	0.45652 TO 0.45926	0.45584 TO 0.45994	181000
27	0.45783	+ OR - 0.00068	0.45715 TO 0.45851	0.45647 TO 0.45919	0.45579 TO 0.45987	176000
32	0.45789	+ OR - 0.00070	0.45719 TO 0.45859	0.45649 TO 0.45929	0.45580 TO 0.45998	171000
37	0.45790	+ OR - 0.00071	0.45719 TO 0.45861	0.45647 TO 0.45933	0.45576 TO 0.46004	166000
42	0.45803	+ OR - 0.00073	0.45731 TO 0.45876	0.45658 TO 0.45948	0.45585 TO 0.46021	161000
47	0.45809	+ OR - 0.00074	0.45735 TO 0.45882	0.45661 TO 0.45956	0.45587 TO 0.46030	156000
52	0.45803	+ OR - 0.00076	0.45727 TO 0.45879	0.45651 TO 0.45954	0.45575 TO 0.46030	151000
57	0.45799	+ OR - 0.00075	0.45724 TO 0.45874	0.45649 TO 0.45949	0.45573 TO 0.46025	146000
62	0.45785	+ OR - 0.00077	0.45707 TO 0.45862	0.45630 TO 0.45939	0.45553 TO 0.46016	141000
67	0.45794	+ OR - 0.00079	0.45715 TO 0.45873	0.45637 TO 0.45951	0.45558 TO 0.46030	136000
72	0.45808	+ OR - 0.00081	0.45727 TO 0.45889	0.45646 TO 0.45970	0.45565 TO 0.46051	131000
77	0.45797	+ OR - 0.00084	0.45713 TO 0.45880	0.45629 TO 0.45964	0.45546 TO 0.46048	126000
82	0.45817	+ OR - 0.00085	0.45732 TO 0.45901	0.45648 TO 0.45986	0.45563 TO 0.46070	121000
87	0.45789	+ OR - 0.00087	0.45702 TO 0.45876	0.45615 TO 0.45963	0.45528 TO 0.46050	116000
92	0.45790	+ OR - 0.00089	0.45700 TO 0.45879	0.45611 TO 0.45968	0.45522 TO 0.46058	111000

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 250.698 CM) (EXT. MOD. VF = 0.

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
97	0.45806	+ OR - 0.00090	0.45716 TO 0.45897	0.45626 TO 0.45987	0.45535 TO 0.46077	106000
102	0.45792	+ OR - 0.00087	0.45705 TO 0.45879	0.45618 TO 0.45966	0.45531 TO 0.46053	101000
107	0.45811	+ OR - 0.00089	0.45722 TO 0.45900	0.45632 TO 0.45990	0.45543 TO 0.46079	96000
112	0.45783	+ OR - 0.00093	0.45690 TO 0.45876	0.45597 TO 0.45968	0.45504 TO 0.46061	91000
117	0.45781	+ OR - 0.00096	0.45685 TO 0.45878	0.45588 TO 0.45974	0.45492 TO 0.46070	86000
122	0.45764	+ OR - 0.00101	0.45663 TO 0.45865	0.45562 TO 0.45966	0.45461 TO 0.46067	81000
127	0.45743	+ OR - 0.00103	0.45640 TO 0.45846	0.45536 TO 0.45949	0.45433 TO 0.46052	76000
132	0.45723	+ OR - 0.00106	0.45617 TO 0.45830	0.45511 TO 0.45936	0.45405 TO 0.46042	71000

Figure 6.7-4 CSAS25 Output for Canistered Yankee Class Fuel - Normal Conditions (Continued)

```
  137      0.45722   + OR - 0.00111   0.45611 TO 0.45833   0.45500 TO 0.45944   0.45389 TO 0.46055   66000

  142      0.45702   + OR - 0.00117   0.45584 TO 0.45819   0.45467 TO 0.45937   0.45349 TO 0.46054   61000

  147      0.45692   + OR - 0.00126   0.45566 TO 0.45818   0.45441 TO 0.45944   0.45315 TO 0.46069   56000

  152      0.45760   + OR - 0.00133   0.45627 TO 0.45894   0.45494 TO 0.46027   0.45360 TO 0.46161   51000

  157      0.45772   + OR - 0.00144   0.45629 TO 0.45916   0.45485 TO 0.46059   0.45341 TO 0.46203   46000

  162      0.45756   + OR - 0.00154   0.45602 TO 0.45910   0.45448 TO 0.46064   0.45294 TO 0.46218   41000

  167      0.45794   + OR - 0.00172   0.45622 TO 0.45966   0.45449 TO 0.46139   0.45277 TO 0.46311   36000

  172      0.45808   + OR - 0.00180   0.45628 TO 0.45988   0.45448 TO 0.46168   0.45267 TO 0.46348   31000

  177      0.45829   + OR - 0.00208   0.45621 TO 0.46038   0.45412 TO 0.46246   0.45204 TO 0.46454   26000

  182      0.45890   + OR - 0.00243   0.45647 TO 0.46132   0.45404 TO 0.46375   0.45161 TO 0.46618   21000

  187      0.46008   + OR - 0.00300   0.45708 TO 0.46308   0.45408 TO 0.46609   0.45107 TO 0.46909   16000

  192      0.45902   + OR - 0.00257   0.45644 TO 0.46159   0.45387 TO 0.46416   0.45129 TO 0.46674   11000

  197      0.45842   + OR - 0.00352   0.45490 TO 0.46194   0.45138 TO 0.46546   0.44786 TO 0.46898    6000
RANDOM NUMBER=      51564689044D
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 250.698 CM) (EXT. MOD. VF = 0.

                    FREQUENCY FOR GENERATIONS    4 TO  203
0.4208 TO 0.4334    *
0.4334 TO 0.4461    *********************
0.4461 TO 0.4587    *********************************************************************************
0.4587 TO 0.4714    ************************************************************************************
0.4714 TO 0.4840    *************

                    FREQUENCY FOR GENERATIONS   54 TO  203
0.4208 TO 0.4334    *
0.4334 TO 0.4461    ***************
0.4461 TO 0.4587    **********************************************************
0.4587 TO 0.4714    **************************************************************
0.4714 TO 0.4840    ************
                    FREQUENCY FOR GENERATIONS  104 TO  203
0.4208 TO 0.4334
0.4334 TO 0.4461    ********
0.4461 TO 0.4587    *********************************************
0.4587 TO 0.4714    ***************************************
0.4714 TO 0.4840    ********
                    FREQUENCY FOR GENERATIONS  154 TO  203
0.4208 TO 0.4334
0.4334 TO 0.4461    *****
0.4461 TO 0.4587    *********************
0.4587 TO 0.4714    ******************
0.4714 TO 0.4840    ******
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions

```
=CSAS25
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 cm) (IVF = 1.0) (EVF = 1.0)
'
'       THIS IS A MODEL OF THE YNPS NAC-MPC BASKET
'    LOADED WITH 36 UNITED NUCLEAR TYPE A ASSEMBLIES
'
'            PRODUCED FOR THE YANKEE ROWE
'               STC LICENSE AMENDMENT
'
'       INTERIOR MODERATOR VOLUME FRACTION = 1.0
'       EXTERIOR MODERATOR VOLUME FRACTION = 1.0
'           CASK TO CASK PITCH = 300 cm
'               FLOODED PELLET CLAD GAP
'               NEUTRON SHIELD REMOVED
'
27GROUPNDF4 LATTICECELL
UO2         1              0.95    293.0 92235 4.0 92238 96.0 END
ZIRCALLOY   2              1.0     293.0                      END
H2O         3              1.0     293.0                      END
AL          4              1.0     293.0                      END
SS304       5              1.0     293.0                      END
B-10        6  DEN=2.6226 0.0450  293.0                      END
B-11        6  DEN=2.6226 0.2736  293.0                      END
C           6  DEN=2.6226 0.0927  293.0                      END
AL          6  DEN=2.6226 0.5737  293.0                      END
PB          7              1.0     293.0                      END
H           8  DEN=1.6291 0.060   293.0                      END
O           8  DEN=1.6291 0.425   293.0                      END
C           8  DEN=1.6291 0.277   293.0                      END
N           8  DEN=1.6291 0.020   293.0                      END
AL          8  DEN=1.6291 0.214   293.0                      END
B-10        8  DEN=1.6291 0.001   293.0                      END
B-11        8  DEN=1.6291 0.004   293.0                      END
H2O         9              1.0     293.0                      END
H2O         10             1.0     293.0                      END
END COMP
SQUAREPITCH  1.1887 0.7887 1 3 0.9271 2 0.8052 10 END
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 cm) (IVF = 1.0) (EVF = 1.0)
READ PARAM RUN=YES PLT=NO GEN=1003 NPG=1000 TME=500 END PARAM
READ GEOM
'
'  WATER LEVEL UNIT CELLS
'
UNIT  1
COM='FUEL PIN CELL - BETWEEN DISKS'
CYLINDER  1 1  0.3943    2P2.1400
CYLINDER 10 1  0.4026    2P2.1400
CYLINDER  2 1  0.4635    2P2.1400
CUBOID    3 1  4P0.5944  2P2.1400
UNIT  2
COM='WATER CELL - BETWEEN DISKS'
CUBOID    3 1  4P0.5944  2P2.1400
UNIT  3
COM='DISPLACEMENT CELL - BETWEEN DISKS'
CYLINDER  2 1  0.4635    2P2.1400
CUBOID    3 1  4P0.5944  2P2.1400
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
UNIT 4
COM='INSTRUMENT TUBE CELL - BETWEEN DISKS'
CYLINDER 3 1 0.4998    2P2.1400
CYLINDER 5 1 0.5442    2P2.1400
CUBOID   3 1 4P0.5944  2P2.1400
'
' DISK LEVEL UNIT CELLS (BOTH SS AND AL)
'
UNIT 5
COM='FUEL PIN CELL - WITH SS DISK'
CYLINDER 1 1  0.3943   2P0.6604
CYLINDER 10 1 0.4026   2P0.6604
CYLINDER 2 1  0.4635   2P0.6604
CUBOID   3 1  4P0.5944 2P0.6604
UNIT 6
COM='WATER CELL - WITH SS DISK'
CUBOID   3 1  4P0.5944 2P0.6604
UNIT 7
COM='DISPLACEMENT CELL - WITH SS DISK'
CYLINDER 2 1  0.4635   2P0.6604
CUBOID   3 1  4P0.5944 2P0.6604
UNIT 8
COM='INSTRUMENT TUBE CELL - WITH SS DISK'
CYLINDER 3 1  0.4998   2P0.6604
CYLINDER 5 1  0.5442   2P0.6604
CUBOID   3 1  4P0.5944 2P0.6604
'
' WATER LEVEL BORAL SHEETS
'
UNIT 14
COM='X-X BORAL SHEET BETWEEN DISKS'
CUBOID 6 1 2P9.144 2P0.0318 2P2.1400
CUBOID 4 1 2P9.144 2P0.0953 2P2.1400
UNIT 15
COM='Y-Y BORAL SHEET BETWEEN DISKS'
CUBOID 6 1 2P0.0318 2P9.144 2P2.1400
CUBOID 4 1 2P0.0953 2P9.144 2P2.1400
'
' DISK LEVEL BORAL SHEETS (AL AND SS)
'
UNIT 16
COM='X-X BORAL SHEET WITH SS DISK'
CUBOID 6 1 2P9.144 2P0.0318 2P0.6604
CUBOID 4 1 2P9.144 2P0.0953 2P0.6604
UNIT 17
COM='Y-Y BORAL SHEET WITH SS DISK'
CUBOID 6 1 2P0.0318 2P9.144 2P0.6604
CUBOID 4 1 2P0.0953 2P9.144 2P0.6604
'
' WATER LEVEL WEB MATERIAL
'
UNIT 20
COM='WATER LEVEL WEB MATERIAL (SMALL) X-X'
CUBOID   3 1 2P10.4635 2P0.9716 2P2.1400
UNIT 21
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
COM='WATER LEVEL WEB MATERIAL (MEDIUM) X-X'
CUBOID    3 1 2P10.4635 2P1.0478 2P2.1400
UNIT 22
COM='WATER LEVEL WEB MATERIAL (LARGE) X-X'
CUBOID    3 1 2P10.4635 2P1.1208 2P2.1400
UNIT 23
COM='WATER LEVEL WEB MATERIAL (LONG) Y-Y'
CUBOID    3 1 2P1.1208 2P79.5249 2P2.1400
'
'  SUPPORT DISK WEB MATERIAL
'
UNIT 30
COM='SUPPORT DISK WEB MATERIAL (SMALL) X-X'
CUBOID    5 1 2P10.4635 2P0.9716 2P0.6604
UNIT 31
COM='SUPPORT DISK WEB MATERIAL (MEDIUM) X-X'
CUBOID    5 1 2P10.4635 2P1.0478 2P0.6604
UNIT 32
COM='SUPPORT DISK WEB MATERIAL (LARGE) X-X'
CUBOID    5 1 2P10.4635 2P1.1208 2P0.6604
UNIT 33
COM='SUPPORT DISK WEB MATERIAL (LONG) Y-Y'
CUBOID    5 1 2P1.1208 2P79.5249 2P0.6604
'
'  HEAT TRANSFER DISK WEB MATERIAL
'
UNIT 40
COM='HEAT TRANSFER DISK WEB MATERIAL (SMALL) X-X'
CUBOID    4 1 2P10.4635 2P0.9716 2P0.6604
UNIT 41
COM='HEAT TRANSFER DISK WEB MATERIAL (MEDIUM) X-X'
CUBOID    4 1 2P10.4635 2P1.0478 2P0.6604
UNIT 42
COM='HEAT TRANSFER DISK WEB MATERIAL (LARGE) X-X'
CUBOID    4 1 2P10.4635 2P1.1208 2P0.6604
UNIT 43
COM='HEAT TRANSFER DISK WEB MATERIAL (LONG) Y-Y'
CUBOID    4 1 2P1.1208 2P79.5249 2P0.6604
'
'  WATER LEVEL ASSEMBLY ARRAYS
'
UNIT 50
COM='FUEL TUBE AND ASSEMBLY - WATER LEVEL'
ARRAY  1  -9.5104 -9.5104 -2.1400
CUBOID 3 1 4P9.9441                              2P2.1400
CUBOID 5 1 4P10.0661                             2P2.1400
CUBOID 3 1 4P10.25681                            2P2.1400
HOLE  14   0.0       10.1615  0.0
HOLE  14   0.0      -10.1615  0.0
HOLE  15   10.1615  0.0       0.0
HOLE  15   -10.1615 0.0       0.0
CUBOID 5 1 4P10.3051                             2P2.1400
UNIT 51
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -Y'
CUBOID 3 1 4P10.4635                             2P2.1400
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
HOLE  50   0.0       -0.1584      0.0
UNIT 52
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS Y'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   0.0       0.1584       0.0
UNIT 53
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   -0.1584   0.0          0.0
UNIT 54
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   0.1584   0.0           0.0
UNIT 55
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X Y'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   0.1584   0.1584        0.0
UNIT 56
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X Y'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   -0.1584   0.1584       0.0
UNIT 57
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X -Y'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   0.1584   -0.1584       0.0
UNIT 58
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X -Y'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   -0.1584   -0.1584       0.0
UNIT 59
COM='CENTRAL HOLE'
CUBOID 3 1 4P10.4636                             2P2.1400
'
'    SUPPORT DISK LEVEL ASSEMBLY ARRAYS
'
UNIT 60
COM='FUEL TUBE AND ASSEMBLY - SUPPORT DISK LEVEL'
ARRAY  2  -9.5104 -9.5104 -0.6604
CUBOID 3 1 4P9.9441                              2P0.6604
CUBOID 5 1 4P10.0661                             2P0.6604
CUBOID 3 1 4P10.25681                            2P0.6604
HOLE  16   0.0       10.1615  0.0
HOLE  16   0.0       -10.1615 0.0
HOLE  17   10.1615  0.0       0.0
HOLE  17   -10.1615 0.0       0.0
CUBOID 5 1 4P10.3051                             2P0.6604
UNIT 61
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -Y'
CUBOID 3 1 4P10.4635                             2P0.6604
HOLE  60   0.0       -0.1584      0.0
UNIT 62
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS Y'
CUBOID 3 1 4P10.4635                             2P0.6604
HOLE  60   0.0       0.1584       0.0
UNIT 63
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
OM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X'
CUBOID 3 1 4P10.4635                          2P0.6604
HOLE  60   -0.1584  0.0          0.0
UNIT 64
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X'
CUBOID 3 1 4P10.4635                          2P0.6604
HOLE  60   0.1584   0.0          0.0
UNIT 65
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X Y'
CUBOID 3 1 4P10.4635                          2P0.6604
HOLE  60   0.1584   0.1584       0.0
UNIT 66
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X Y'
CUBOID 3 1 4P10.4635                          2P0.6604
HOLE  60   -0.1584  0.1584       0.0
UNIT 67
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X -Y'
CUBOID 3 1 4P10.4635                          2P0.6604
HOLE  60   0.1584   -0.1584      0.0
UNIT 68
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X -Y'
CUBOID 3 1 4P10.4635                          2P0.6604
HOLE  60   -0.1584  -0.1584      0.0
UNIT 69
COM='CENTRAL HOLE'
CUBOID 3 1 4P10.4636   2P0.6604
'
'    HEAT TRANSFER DISK LEVEL ASSEMBLY ARRAYS
'
UNIT 70
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS'
ARRAY  2  -9.5104 -9.5104 -0.6604
CUBOID 3 1 4P9.9441                           2P0.6604
CUBOID 5 1 4P10.0661                          2P0.6604
CUBOID 3 1 4P10.25681                         2P0.6604
HOLE  16   0.0      10.1615  0.0
HOLE  16   0.0      -10.1615 0.0
HOLE  17   10.1615  0.0      0.0
HOLE  17   -10.1615 0.0      0.0
CUBOID 5 1 4P10.3051                          2P0.6604
UNIT 71
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -Y'
CUBOID 3 1 4P10.4635                          2P0.6604
HOLE  70   0.0      -0.1584      0.0
UNIT 72
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS Y'
CUBOID 3 1 4P10.4635                          2P0.6604
HOLE  70   0.0      0.1584       0.0
UNIT 73
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X'
CUBOID 3 1 4P10.4635                          2P0.6604
HOLE  70   -0.1584  0.0          0.0
UNIT 74
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X'
CUBOID 3 1 4P10.4635                          2P0.6604
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
HOLE  70   0.1584   0.0          0.0
UNIT 75
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X Y'
CUBOID 3 1 4P10.4635                           2P0.6604
HOLE  70   0.1584   0.1584       0.0
UNIT 76
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X Y'
CUBOID 3 1 4P10.4635                           2P0.6604
HOLE  70   -0.1584   0.1584       0.0
UNIT 77
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X -Y'
CUBOID 3 1 4P10.4635                           2P0.6604
HOLE  70   0.1584   -0.1584       0.0
UNIT 78
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X -Y'
CUBOID 3 1 4P10.4635                           2P0.6604
HOLE  70   -0.1584   -0.1584      0.0
UNIT 79
COM='CENTRAL HOLE'
CUBOID 3 1 4P10.4636                           2P0.6604
'
'  WATER LEVEL BASKET ARRAYS
'
UNIT 80
COM='5X1 WATER LEVEL ARRAY (SMALL ARRAY -X)'
ARRAY 20 -10.4636 -33.6323 -2.1400
UNIT 81
COM='5X1 WATER LEVEL ARRAY (SMALL ARRAY X)'
ARRAY 21 -10.4636 -33.6323 -2.1400
UNIT 82
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY -X)'
ARRAY 22 -10.4636 -56.6549 -2.1400
UNIT 83
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY X)'
ARRAY 23 -10.4636 -56.6549 -2.1400
UNIT 84
COM='13X1 WATER LEVEL ARRAY (LARGE ARRAY-X)'
ARRAY 24 -10.4636 -79.5251 -2.1400
UNIT 85
COM='13X1 WATER LEVEL ARRAY (MIDDLE LARGE ARRAY)'
ARRAY 25 -10.4636 -79.5251 -2.1400
UNIT 86
COM='13X1 WATER LEVEL ARRAY (LARGE ARRAY X)'
ARRAY 26 -10.4636 -79.5251 -2.1400
'
'  SUPPORT DISK LEVEL BASKET ARRAYS
'
UNIT 90
COM='5X1 SUPPORT DISK LEVEL ARRAY (SMALL ARRAY -X)'
ARRAY 30 -10.4636 -33.6323 -0.6604
UNIT 91
COM='5X1 SUPPORT DISK LEVEL ARRAY (SMALL ARRAY  X)'
ARRAY 31 -10.4636 -33.6323 -0.6604
UNIT 92
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY -X)'
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
ARRAY 32 -10.4636 -56.6549 -0.6604
UNIT 93
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY X)'
ARRAY 33 -10.4636 -56.6549 -0.6604
UNIT 94
COM='13X1 SUPPORT DISK LEVEL ARRAY (LARGE ARRAY -X)'
ARRAY 34 -10.4636 -79.5251 -0.6604
UNIT 95
COM='13X1 SUPPORT DISK LEVEL ARRAY (MIDDLE LARGE ARRAY)'
ARRAY 35 -10.4636 -79.5251 -0.6604
UNIT 96
COM='13X1 SUPPORT DISK LEVEL ARRAY (LARGE ARRAY -X)'
ARRAY 36 -10.4636 -79.5251 -0.6604
'
'  HEAT TRANSFER DISK LEVEL BASKET ARRAYS
'
UNIT 100
COM='5X1 HEAT TRANSFER DISK LEVEL ARRAY (SMALL ARRAY -X)'
ARRAY 40 -10.4636 -33.6323 -0.6604
UNIT 101
COM='5X1 HEAT TRANSFER DISK LEVEL ARRAY (SMALL ARRAY X)'
ARRAY 41 -10.4636 -33.6323 -0.6604
UNIT 102
COM='9X1 HEAT TRANSFER DISK LEVEL ARRAY (MEDIUM ARRAY -X)'
ARRAY 42 -10.4636 -56.6549 -0.6604
UNIT 103
COM='9X1 HEAT TRANSFER DISK LEVEL ARRAY (MEDIUM ARRAY  X)'
ARRAY 43 -10.4636 -56.6549 -0.6604
UNIT 104
COM='13X1 HEAT TRANSFER DISK LEVEL ARRAY (LARGE ARRAY -X)'
ARRAY 44 -10.4636 -79.5251 -0.6604
UNIT 105
COM='13X1 HEAT TRANSFER DISK LEVEL ARRAY (MIDDLE LARGE ARRAY)'
ARRAY 45 -10.4636 -79.5251 -0.6604
UNIT 106
COM='13X1 HEAT TRANSFER DISK LEVEL ARRAY (LARGE ARRAY X)'
ARRAY 46 -10.4636 -79.5251 -0.6604
'
'  BASKET ARRAY IN TRANSPORT CASK OVERPACK (LEVEL CONSTRUCTION)
'
UNIT 110
COM='BASKET ARRAY IN TRANSPORT CASK OVERPACK - WATER LEVEL'
ARRAY 50 -33.6323 -79.5251 -2.1400
CYLINDER 3 1 88.1253     2P2.1400
HOLE 80     -69.0614 0.0 0.0
HOLE 82     -46.1912 0.0 0.0
HOLE 81      69.0614 0.0 0.0
HOLE 83      46.1912 0.0 0.0
CYLINDER 5 1 89.7128     2P2.1400
CYLINDER 3 1 90.170      2P2.1400
CYLINDER 5 1 93.98       2P2.1400
CYLINDER 7 1 103.4288    2P2.1400
CYLINDER 5 1 110.109     2P2.1400
CYLINDER 9 1 124.714     2P2.1400
CYLINDER 9 1 125.349     2P2.1400
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
CUBOID   9 1 4P150        2P2.1400
UNIT 111
COM='BASKET ARRAY IN TRANSPORT CASK OVERPACK - SUPPORT DISK LEVEL'
ARRAY 51 -33.6323 -79.5251 -0.6604
CYLINDER 5 1 87.6046      2P0.6604
HOLE 90      -69.0614 0.0 0.0
HOLE 92      -46.1912 0.0 0.0
HOLE 91       69.0614 0.0 0.0
HOLE 93       46.1912 0.0 0.0
CYLINDER 3 1 88.1253      2P0.6604
CYLINDER 5 1 89.7128      2P0.6604
CYLINDER 3 1 90.170       2P0.6604
CYLINDER 5 1 93.98        2P0.6604
CYLINDER 7 1 103.4288     2P0.6604
CYLINDER 5 1 110.109      2P0.6604
CYLINDER 9 1 124.714      2P0.6604
CYLINDER 9 1 125.349      2P0.6604
CUBOID   9 1 4P150        2P0.6604
UNIT 112
COM='BASKET ARRAY IN TRANSPORT CASK OVERPACK - HEAT TRANSFER DISK LEVEL'
ARRAY 52 -33.6323 -79.5251 -0.6604
CYLINDER 4 1 87.2490      2P0.6604
HOLE 100     -69.0614 0.0 0.0
HOLE 102     -46.1912 0.0 0.0
HOLE 101      69.0614 0.0 0.0
HOLE 103      46.1912 0.0 0.0
CYLINDER 3 1 88.1253      2P0.6604
CYLINDER 5 1 89.7128      2P0.6604
CYLINDER 3 1 90.170       2P0.6604
CYLINDER 5 1 93.98        2P0.6604
CYLINDER 7 1 103.4288     2P0.6604
CYLINDER 5 1 110.109      2P0.6604
CYLINDER 9 1 124.714      2P0.6604
CYLINDER 9 1 125.349      2P0.6604
CUBOID   9 1 4P150        2P0.6604
'
'  GLOBAL UNIT
'
GLOBAL UNIT 120
ARRAY 60 -175.349 -175.349 0.0
END GEOM
READ ARRAY
ARA=1 NUX=16 NUY=16 NUZ=1  FILL
1 1 1 1 1 1 1 3 2 2 2 2 2 2 2 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 4 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
END FILL
ARA=2 NUX=16 NUY=16 NUZ=1  FILL
5 5 5 5 5 5 5 7 6 6 6 6 6 6 6 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
7 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 8 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
END FILL
'
'  WATER LEVEL ARRAYS
'
ARA=20  NUX=1 NUY=5 NUZ=1
FILL
55
22
54
22
57
END FILL
ARA=21  NUX=1 NUY=5 NUZ=1
FILL
56
22
53
22
58
END FILL
ARA=22  NUX=1 NUY=9 NUZ=1
FILL
55
21
55
22
54
22
57
21
57
END FILL
ARA=23  NUX=1 NUY=9 NUZ=1
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
FILL
56
21
56
22
53
22
58
21
58
END FILL
ARA=24  NUX=1 NUY=13 NUZ=1
FILL
55
20
55
21
55
22
54
22
57
21
57
20
57
END FILL
ARA=25  NUX=1 NUY=13 NUZ=1
FILL
52
20
52
21
52
22
59
22
51
21
51
20
51
END FILL
ARA=26  NUX=1 NUY=13 NUZ=1
FILL
56
20
56
21
56
22
53
22
58
21
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
58
20
58
END FILL
'
' SUPPOR DISK LEVEL ARRAYS
'
ARA=30  NUX=1 NUY=5 NUZ=1
FILL
65
32
64
32
67
END FILL
ARA=31  NUX=1 NUY=5 NUZ=1
FILL
66
32
63
32
68
END FILL
ARA=32  NUX=1 NUY=9 NUZ=1
FILL
65
31
65
32
64
32
67
31
67
END FILL
ARA=33  NUX=1 NUY=9 NUZ=1
FILL
66
31
66
32
63
32
68
31
68
END FILL
ARA=34  NUX=1 NUY=13 NUZ=1
FILL
65
30
65
31
65
32
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
64
32
67
31
67
30
67
END FILL
ARA=35  NUX=1 NUY=13 NUZ=1
FILL
62
30
62
31
62
32
69
32
61
31
61
30
61
END FILL
ARA=36  NUX=1 NUY=13 NUZ=1
FILL
66
30
66
31
66
32
63
32
68
31
68
30
68
END FILL
'
'  HEAT TRANSFER DISK LEVEL ARRAYS
'
ARA=40  NUX=1 NUY=5 NUZ=1
FILL
75
42
74
42
77
END FILL
ARA=41  NUX=1 NUY=5 NUZ=1
FILL
76
42
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
73
42
78
END FILL
ARA=42  NUX=1 NUY=9 NUZ=1
FILL
75
41
75
42
74
42
77
41
77
END FILL
ARA=43  NUX=1 NUY=9 NUZ=1
FILL
76
41
76
42
73
42
78
41
78
END FILL
ARA=44  NUX=1 NUY=13 NUZ=1
FILL
75
40
75
41
75
42
74
42
77
41
77
40
77
END FILL
ARA=45  NUX=1 NUY=13 NUZ=1
FILL
72
40
72
41
72
42
79
42
71
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
41
71
40
71
END FILL
ARA=46  NUX=1 NUY=13 NUZ=1
FILL
76
40
76
41
76
42
73
42
78
41
78
40
78
END FILL
'
'  MAJOR ARRAYS
'
ARA=50 NUX=5 NUY=1 NUZ=1
FILL
84 23 85 23 86
END FILL
ARA=51 NUX=5 NUY=1 NUZ=1
FILL
94 33 95 33 96
END FILL
ARA=52 NUX=5 NUY=1 NUZ=1
FILL
104 43 105 43 106
END FILL
'
'  GLOBAL ARRAY
'
ARA=60 NUX=1 NUY=1 NUZ=4
FILL
112
110
111
110
END FILL
END ARRAY
READ BOUNDS ZFC=PER YXF=MIR END BOUNDS
READ PLOT
SCR=YES PIC=MAT LPI=10
UAX=1.0 VDN=-1.0 NAX=1500
'
' WHOLE BASKET HORIZONTAL SLICES
'
TTL='BASKET X-Y CROSS SECTION AT Z= 0.635 HEAT TRANSFER DISK LEVEL'
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
XUL=  -130 YUL=  130  ZUL= 0.635
XLR=   130 YLR= -130  ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y CROSS SECTION AT Z= 3.44 WATER LEVEL'
XUL=  -130 YUL=  130  ZUL= 3.44
XLR=   130 YLR= -130  ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y CROSS SECTION AT Z= 6.236 SS DISK LEVEL'
XUL=  -130 YUL=  130  ZUL= 6.236
XLR=   130 YLR= -130  ZLR= 6.236
UAX=1.0 VDN=-1.0 NAX=1500 END
'
' HEAT TRANSFER DISK LEVEL BASKET QUADRANTS
'
TTL='BASKET X-Y QUADRANTD I HEAT TRANSFER DISK'
XUL=  12.   YUL= 80     ZUL= 0.635
XLR=  80.0  YLR= 12.0   ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT II HEAT TRANSFER DISK'
XUL=  12.0 YUL= -12.0   ZUL= 0.635
XLR=  80   YLR= -80     ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT III HEAT TRANSFER DISK'
XUL= -80.0  YUL= -12.0  ZUL= 0.635
XLR= -12.0  YLR= -80.0  ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT IV HEAT TRANSFER DISK'
XUL= -80.0  YUL= 80.0   ZUL= 0.635
XLR= -12.0  YLR= 12.0   ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
'
' WATER LEVEL BASKET QUADRANTS
'
TTL='BASKET X-Y QUADRANT I WATER LEVEL'
XUL=  12.    YUL=  80     ZUL= 3.44
XLR=  80.0   YLR=  12.0   ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT II WATER LEVEL'
XUL=  12.0   YUL= -12.0   ZUL= 3.44
XLR=  80     YLR= -80     ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT III WATER LEVEL'
XUL= -80.0   YUL= -12.0   ZUL= 3.44
XLR= -12.0   YLR= -80.0   ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT IV WATER LEVEL'
XUL= -80.0   YUL= 80.0    ZUL= 3.44
XLR= -12.0   YLR= 12.0    ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
'
'  VERTICAL SLICES
'
TTL='BASKET X-Z CROSS SECTION ALUMINUM LEVEL (MIDDLE OF FUEL PIN)'
XUL= -90  YUL=0.4   ZUL= 1.27
XLR=  90  YLR=0.4   ZLR= -.1
```

Figure 6.7-5 CSAS25 Input for Canistered Yankee Class Fuel - Accident Conditions (Continued)

```
UAX=1.0 WDN=-1.0 NAX=1500 END
TTL='BASKET X-Z CROSS SECTION WATER LEVEL (MIDDLE OF FUEL PIN)'
XUL= -90  YUL=0.4   ZUL= 4.318
XLR=  90  YLR=0.4   ZLR= 1.27
UAX=1.0 WDN=-1.0 NAX=1500 END
TTL='BASKET X-Z CROSS SECTION SS LEVEL (MIDDLE OF FUEL PIN)'
XUL= -90  YUL=0.4   ZUL= 6.858
XLR=  90  YLR=0.4   ZLR= 5.588
UAX=1.0 WDN=-1.0 NAX=1500 END
TTL='BASKET X-Z CROSS SECTION ENTIRE MODEL (MIDDLE OF FUEL PIN)'
XUL= -90  YUL=0.4   ZUL= 12
XLR=  90  YLR=0.4   ZLR= 0
UAX=1.0 WDN=-1.0 NAX=1500 END
END PLOT
END DATA
END
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions

```
*******************************************************************************
*****                                                                     *****
*****                  PROGRAM VERIFICATION INFORMATION                   *****
*****                                                                     *****
*****                 CODE SYSTEM:  SCALE-PC VERSION:  4.3                *****
*****                                                                     *****
*******************************************************************************
*****                                                                     *****
*****                                                                     *****
*****              PROGRAM:  CSAS                                         *****
*****                                                                     *****
*****        CREATION DATE:  03-08-96                                     *****
*****                                                                     *****
*****               VOLUME:  ENG                                          *****
*****                                                                     *****
*****              LIBRARY:  G:\scale43\exe                               *****
*****                                                                     *****
*****                                                                     *****
*****      PRODUCTION CODE:  CSAS                                         *****
*****                                                                     *****
*****              VERSION:  3.1                                          *****
*****                                                                     *****
*****              JOBNAME:  SCALE-PC                                     *****
*****                                                                     *****
*****    DATE OF EXECUTION:  11/12/96                                     *****
*****                                                                     *****
*****    TIME OF EXECUTION:  16:53:43                                     *****
*****                                                                     *****
*****                                                                     *****
*******************************************************************************
*******************************************************************************
*******************************************************************************

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0


**** PROBLEM PARAMETERS ****

LIB 27GROUPNDF4  LIBRARY
MXX           10 MIXTURES
MSC           19 COMPOSITION SPECIFICATIONS
IZM            4 MATERIAL ZONES
GE  LATTICECELL  GEOMETRY
MORE           0 0/1 DO NOT READ/READ OPTIONAL PARAMETER DATA
MSLN           0 FUEL SOLUTIONS


**** PROBLEM COMPOSITION DESCRIPTION ****

SC  UO2          STANDARD COMPOSITION
MX             1 MIXTURE NO.
VF        0.9500 VOLUME FRACTION
ROTH     10.9600 THEORETICAL DENSITY
NEL            2 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           92000       1.00 ATOM/MOLECULE
                     92235     4.000 WT%
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
                       92238    96.000 WT%
            8016       2.00 ATOMS/MOLECULE
END

SC  ZIRCALLOY    STANDARD COMPOSITION
MX             2 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      6.5600 THEORETICAL DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           40302      1.00 ATOM/MOLECULE
END

SC  H2O          STANDARD COMPOSITION
MX             3 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      0.9982 THEORETICAL DENSITY
NEL            2 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            1001      2.00 ATOMS/MOLECULE
            8016      1.00 ATOM/MOLECULE
END

SC  AL           STANDARD COMPOSITION
MX             4 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      2.7020 THEORETICAL DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           13027      1.00 ATOM/MOLECULE
END

SC  SS304        STANDARD COMPOSITION
MX             5 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      7.9200 THEORETICAL DENSITY
NEL            4 NO. ELEMENTS
ICP            0 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           24304    19.000 WT%
           25055     2.000 WT%
           26304    69.500 WT%
           28304     9.500 WT%
END

SC  B-10         STANDARD COMPOSITION
MX             6 MIXTURE NO.
VF        0.0450 VOLUME FRACTION
ROTH      2.6226 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
              5010       1.00 ATOM/MOLECULE
END

SC  B-11            STANDARD COMPOSITION
MX             6    MIXTURE NO.
VF        0.2736    VOLUME FRACTION
ROTH      2.6226    SPECIFIED DENSITY
NEL            1    NO. ELEMENTS
ICP            1    0/1 MIXTURE/COMPOUND
TEMP       293.0    DEG KELVIN
            5011         1.00 ATOM/MOLECULE
END

SC  C               STANDARD COMPOSITION
MX             6    MIXTURE NO.
VF        0.0927    VOLUME FRACTION
ROTH      2.6226    SPECIFIED DENSITY
NEL            1    NO. ELEMENTS
ICP            1    0/1 MIXTURE/COMPOUND
TEMP       293.0    DEG KELVIN
            6012         1.00 ATOM/MOLECULE
END

SC  AL              STANDARD COMPOSITION
MX             6    MIXTURE NO.
VF        0.5737    VOLUME FRACTION
ROTH      2.6226    SPECIFIED DENSITY
NEL            1    NO. ELEMENTS
ICP            1    0/1 MIXTURE/COMPOUND
TEMP       293.0    DEG KELVIN
           13027         1.00 ATOM/MOLECULE
END

SC  PB              STANDARD COMPOSITION
MX             7    MIXTURE NO.
VF        1.0000    VOLUME FRACTION
ROTH     11.3440    THEORETICAL DENSITY
NEL            1    NO. ELEMENTS
ICP            1    0/1 MIXTURE/COMPOUND
TEMP       293.0    DEG KELVIN
           82000         1.00 ATOM/MOLECULE
END

SC  H               STANDARD COMPOSITION
MX             8    MIXTURE NO.
VF        0.0600    VOLUME FRACTION
ROTH      1.6291    SPECIFIED DENSITY
NEL            1    NO. ELEMENTS
ICP            1    0/1 MIXTURE/COMPOUND
TEMP       293.0    DEG KELVIN
            1001         1.00 ATOM/MOLECULE
END
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
SC  O            STANDARD COMPOSITION
MX             8 MIXTURE NO.
VF        0.4250 VOLUME FRACTION
ROTH      1.6291 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            8016      1.00 ATOM/MOLECULE
END

SC  C            STANDARD COMPOSITION
MX             8 MIXTURE NO.
VF        0.2770 VOLUME FRACTION
ROTH      1.6291 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            6012      1.00 ATOM/MOLECULE
END

SC  N            STANDARD COMPOSITION
MX             8 MIXTURE NO.
VF        0.0200 VOLUME FRACTION
ROTH      1.6291 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            7014      1.00 ATOM/MOLECULE
END

SC  AL           STANDARD COMPOSITION
MX             8 MIXTURE NO.
VF        0.2140 VOLUME FRACTION
ROTH      1.6291 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           13027      1.00 ATOM/MOLECULE
END

SC  B-10         STANDARD COMPOSITION
MX             8 MIXTURE NO.
VF        0.0010 VOLUME FRACTION
ROTH      1.6291 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            5010      1.00 ATOM/MOLECULE
END
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
SC  B-11         STANDARD COMPOSITION
MX           8 MIXTURE NO.
VF      0.0040 VOLUME FRACTION
ROTH    1.6291 SPECIFIED DENSITY
NEL          1 NO. ELEMENTS
ICP          1 0/1 MIXTURE/COMPOUND
TEMP     293.0 DEG KELVIN
          5011       1.00 ATOM/MOLECULE
END

SC  H2O          STANDARD COMPOSITION
MX           9 MIXTURE NO.
VF      1.0000 VOLUME FRACTION
ROTH    0.9982 THEORETICAL DENSITY
NEL          2 NO. ELEMENTS
ICP          1 0/1 MIXTURE/COMPOUND
TEMP     293.0 DEG KELVIN
          1001       2.00 ATOMS/MOLECULE
          8016       1.00 ATOM/MOLECULE
END

SC  H2O          STANDARD COMPOSITION
MX          10 MIXTURE NO.
VF      1.0000 VOLUME FRACTION
ROTH    0.9982 THEORETICAL DENSITY
NEL          2 NO. ELEMENTS
ICP          1 0/1 MIXTURE/COMPOUND
TEMP     293.0 DEG KELVIN
          1001       2.00 ATOMS/MOLECULE
          8016       1.00 ATOM/MOLECULE
END

**** PROBLEM GEOMETRY ****

CTP SQUAREPITCH  CELL TYPE
PITCH   1.1887 CM CENTER TO CENTER SPACING
FUELOD  0.7887 CM FUEL DIAMETER OR SLAB THICKNESS
MFUEL        1 MIXTURE NO. OF FUEL
MMOD         3 MIXTURE NO. OF MODERATOR
CLADOD  0.9271 CM CLAD OUTER DIAMETER
MCLAD        2 MIXTURE NO. OF CLAD
GAPOD   0.8052 CM GAP OUTER DIAMETER
MGAP        10 MIXTURE NO. OF GAP

ZONE SPECIFICATIONS FOR LATTICECELL GEOMETRY

               ZONE  1 IS FUEL
               ZONE  2 IS GAP
               ZONE  3 IS CLAD
               ZONE  4 IS MOD
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
*****                                                                          *****
*****                  PROGRAM VERIFICATION INFORMATION                        *****
*****                                                                          *****
*****                CODE SYSTEM:  SCALE-PC VERSION:  4.3                      *****
*****                                                                          *****
************************************************************************************
************************************************************************************
*****                                                                          *****
*****                                                                          *****
*****             PROGRAM:  000002                                             *****
*****                                                                          *****
*****       CREATION DATE:  09-28-95                                           *****
*****                                                                          *****
*****             VOLUME:   ENG                                                *****
*****                                                                          *****
*****             LIBRARY:  G:\scale43\exe                                     *****
*****                                                                          *****
*****                                                                          *****
*****     PRODUCTION CODE:  NITAWL                                             *****
*****                                                                          *****
*****             VERSION:  3.0                                                *****
*****                                                                          *****
*****             JOBNAME:  SCALE-PC                                           *****
*****                                                                          *****
*****   DATE OF EXECUTION:  11/12/96                                           *****
*****                                                                          *****
*****   TIME OF EXECUTION:  16:53:48                                           *****
*****                                                                          *****
*****                                                                          *****
************************************************************************************
************************************************************************************
************************************************************************************

       -1Q ARRAY HAS      1 ENTRIES.

        0Q ARRAY HAS      9 ENTRIES.

        1Q ARRAY HAS     12 ENTRIES.

SELECT 27 NUCLIDES FROM THE MASTER  LIBRARY ON LOGICAL  1
        0 NUCLIDES FROM THE WORKING LIBRARY ON LOGICAL  2
        0 NUCLIDES FROM THE WORKING LIBRARY ON LOGICAL  3
          TO CREATE THE NEW WORKING LIBRARY ON LOGICAL  4

        4 RESONANCE CALCULATIONS HAVE BEEN REQUESTED
       -1 OUTPUT OPTION FOR AMPX FORMATTED CROSS SECTION DATA
     2001 MAXIMUM NUMBER OF RESONANCE MESH INTERVALS
        2 ORDER OF RESONANCE LEVEL PROCESSING

THE STORAGE ALLOCATED FOR THIS CASE IS    100000 WORDS

        2Q ARRAY HAS     27 ENTRIES.

        3Q ARRAY HAS     60 ENTRIES.

        4Q ARRAY HAS     27 ENTRIES.
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
GENERAL INFORMATION CONCERNING CROSS SECTION LIBRARY
  TAPE IDENTIFICATION NUMBER                  4321
  NUMBER OF NUCLIDES ON TAPE                    27
  NUMBER OF NEUTRON ENERGY GROUPS               27
  FIRST THERMAL NEUTRON ENERGY GROUP            15
  NUMBER OF GAMMA ENERGY GROUPS                  0

  DIRECT ACCESS UNIT NUMBER  9 REQUIRES 117 BLOCKS OF LENGTH  1680 WORDS
XSDRN TAPE   4321
                       SCALE 4.2 - 27 GROUP NEUTRON GROUP LIBRARY
                          BASED ON ENDF-B VERSION 4 DATA
                             COMPILED FOR NRC      1/27/89
                                LAST UPDATED                                              08/12/94
                                   L.M.PETRIE   -   ORNL

NUCLIDES FROM XSDRN TAPE
   1     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94      3001001
   2     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94      8001001
   3     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94      9001001
   4     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002             UPDATED 08/12/94     10001001
   5    B-10 1273 218NGP 042375 P-3 293K                        UPDATED 08/12/94      6005010
   6    B-10 1273 218NGP 042375 P-3 293K                        UPDATED 08/12/94      8005010
   7     BORON-11       ENDF/B-IV MAT 1160                      UPDATED 08/12/94      6005011
   8     BORON-11       ENDF/B-IV MAT 1160                      UPDATED 08/12/94      8005011
   9     CARBON-12      ENDF/B-IV MAT 1274/THRM1065             UPDATED 08/12/94      6006012
  10     CARBON-12      ENDF/B-IV MAT 1274/THRM1065             UPDATED 08/12/94      8006012
  11     NITROGEN-14    ENDF/B-IV MAT 1275                      UPDATED 08/12/94      8007014
  12     OXYGEN-16      ENDF/B-IV MAT 1276                      UPDATED 08/12/94      1008016
  13     OXYGEN-16      ENDF/B-IV MAT 1276                      UPDATED 08/12/94      3008016
  14     OXYGEN-16      ENDF/B-IV MAT 1276                      UPDATED 08/12/94      8008016
  15     OXYGEN-16      ENDF/B-IV MAT 1276                      UPDATED 08/12/94      9008016
  16     OXYGEN-16      ENDF/B-IV MAT 1276                      UPDATED 08/12/94     10008016
  17    AL-27 1193 218 GP 040375(5)                             UPDATED 08/12/94      4013027
  18    AL-27 1193 218 GP 040375(5)                             UPDATED 08/12/94      6013027
  19    AL-27 1193 218 GP 040375(5)                             UPDATED 08/12/94      8013027
  20    CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'        UPDATED 08/12/94      5024304
  21     MANGANESE-55   ENDF/B-IV MAT 1197                      UPDATED 08/12/94      5025055
  22    FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'        UPDATED 08/12/94      5026304
  23    NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'        UPDATED 08/12/94      5028304
  24     ZIRCALLOY      ENDF/B-IV MAT 1284                      UPDATED 08/12/94      2040302
  25    PB   1288 218NGP 042375 P-3 293K                        UPDATED 08/12/94      7082000
  26     URANIUM-235    ENDF/B-IV MAT 1261                      UPDATED 08/12/94      1092235
  27     URANIUM-238    ENDF/B-IV MAT 1262                      UPDATED 08/12/94      1092238

HYDROGEN       ENDF/B-IV MAT 1269/THRM1002           UPDATED 08/12/94   3001001      TEMPERATURE=   293.00
                                                            PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

HYDROGEN       ENDF/B-IV MAT 1269/THRM1002           UPDATED 08/12/94   8001001      TEMPERATURE=   293.00
                                                            PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

HYDROGEN       ENDF/B-IV MAT 1269/THRM1002           UPDATED 08/12/94   9001001      TEMPERATURE=   293.00
                                                            PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
HYDROGEN       ENDF/B-IV MAT 1269/THRM1002            UPDATED 08/12/94  10001001     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

B-10 1273 218NGP 042375 P-3 293K                      UPDATED 08/12/94   6005010     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

B-10 1273 218NGP 042375 P-3 293K                      UPDATED 08/12/94   8005010     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

BORON-11       ENDF/B-IV MAT 1160                     UPDATED 08/12/94   6005011     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

BORON-11       ENDF/B-IV MAT 1160                     UPDATED 08/12/94   8005011     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

CARBON-12      ENDF/B-IV MAT 1274/THRM1065            UPDATED 08/12/94   6006012     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

CARBON-12      ENDF/B-IV MAT 1274/THRM1065            UPDATED 08/12/94   8006012     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

NITROGEN-14    ENDF/B-IV MAT 1275                     UPDATED 08/12/94   8007014     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

OXYGEN-16      ENDF/B-IV MAT 1276                     UPDATED 08/12/94   1008016     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

OXYGEN-16      ENDF/B-IV MAT 1276                     UPDATED 08/12/94   3008016     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

OXYGEN-16      ENDF/B-IV MAT 1276                     UPDATED 08/12/94   8008016     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

OXYGEN-16      ENDF/B-IV MAT 1276                     UPDATED 08/12/94   9008016     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

OXYGEN-16      ENDF/B-IV MAT 1276                     UPDATED 08/12/94  10008016     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

AL-27 1193 218 GP 040375(5)                           UPDATED 08/12/94   4013027     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

AL-27 1193 218 GP 040375(5)                           UPDATED 08/12/94   6013027     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

AL-27 1193 218 GP 040375(5)                           UPDATED 08/12/94   8013027     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'      UPDATED 08/12/94   5024304     TEMPERATURE=   293.00
                                                           PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
 MANGANESE-55   ENDF/B-IV MAT 1197                 UPDATED 08/12/94   5025055      TEMPERATURE=   293.00

GEOMETRY HAS BEEN SET TO HOMOGENEOUS AS LBAR IS  0.0000E+00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)           =    54.466             TEMPERATURE(KELVIN)        =   293.000

POTENTIAL SCATTER SIGMA  =     2.590              LUMPED NUCLEAR DENSITY     = 1.7363295E-03

SPIN FACTOR (G)           =    14.448             LUMP DIMENSION (A-BAR)     = 0.0000000E+00

INNER RADIUS              = 0.0000000E+00         DANCOFF CORRECTION (C)     = 0.0000000E+00

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1     =    55.845             SIGMA(PER ABSORBER ATOM)= 3.4663022E+02

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2     =    55.925             SIGMA(PER ABSORBER ATOM)= 1.2557598E+02

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 0-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP        RES ABS         RES FISS         RES SCAT
  8      -5.518788E-04    0.000000E+00    -3.944190E-01
  9      -2.797993E-03    0.000000E+00    -2.293471E+00
 10      -3.291452E-01    0.000000E+00    -3.820862E+01
 11      -2.680562E+00    0.000000E+00    -1.159996E+02

EXCESS RESONANCE INTEGRALS

                  RESOLVED

ABSORPTION       3.33719E+00
FISSION          0.00000E+00
                                                        PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'      UPDATED 08/12/94   5026304      TEMPERATURE=   293.00
                                                        PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'      UPDATED 08/12/94   5028304      TEMPERATURE=   293.00
                                                        PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 ZIRCALLOY      ENDF/B-IV MAT 1284                 UPDATED 08/12/94   2040302      TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)           =    90.436             TEMPERATURE(KELVIN)        =   293.000
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
POTENTIAL SCATTER SIGMA  =     6.385          LUMPED NUCLEAR DENSITY    = 4.3307818E-02

SPIN FACTOR (G)          =     1.079          LUMP DIMENSION (A-BAR)    = 4.6355000E-01

INNER RADIUS             = 4.0259999E-01      DANCOFF CORRECTION (C)    = 4.8012701E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP       RES ABS          RES FISS          RES SCAT
  8      -3.660543E-04    0.000000E+00    -2.908784E-01
  9      -2.489563E-02    0.000000E+00    -1.027892E+00
 10      -2.529988E-02    0.000000E+00    -5.793766E-01
 11      -8.583183E-02    0.000000E+00    -4.082697E-01

EXCESS RESONANCE INTEGRALS

                  RESOLVED

ABSORPTION       5.46203E-01
FISSION          0.00000E+00
                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

PB   1288 218NGP 042375 P-3 293K              UPDATED 08/12/94   7082000      TEMPERATURE=   293.00
                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 URANIUM-235    ENDF/B-IV MAT 1261            UPDATED 08/12/94   1092235      TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =   233.025          TEMPERATURE(KELVIN)       =   293.000

POTENTIAL SCATTER SIGMA  =    11.500          LUMPED NUCLEAR DENSITY    = 9.4064139E-04

SPIN FACTOR (G)          = 15171.100          LUMP DIMENSION (A-BAR)    = 3.9434999E-01

INNER RADIUS             = 0.0000000E+00      DANCOFF CORRECTION (C)    = 2.9500756E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1     =    15.991          SIGMA(PER ABSORBER ATOM)= 1.9199110E+02

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2     =   238.051          SIGMA(PER ABSORBER ATOM)= 2.9209552E+02

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

GROUP	RES ABS	RES FISS	RES SCAT
12	-4.040891E+00	-2.484752E+00	-9.599491E-02
13	-1.260745E+01	-6.154013E+00	-2.681050E-01
14	-9.467398E+00	-5.597835E+00	-6.275433E-02
15	-5.487491E-04	-4.169921E-04	5.016608E-06

EXCESS RESONANCE INTEGRALS

RESOLVED

ABSORPTION 1.97633E+02
FISSION 1.18625E+02

PROCESS NUMBER 1007 IS AT TEMPERATURE= 293.00

URANIUM-238 ENDF/B-IV MAT 1262 UPDATED 08/12/94 1092238 TEMPERATURE= 293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A) = 236.006 TEMPERATURE(KELVIN) = 293.000

POTENTIAL SCATTER SIGMA = 10.599 LUMPED NUCLEAR DENSITY = 2.2290209E-02

SPIN FACTOR (G) = 656.527 LUMP DIMENSION (A-BAR) = 3.9434999E-01

INNER RADIUS = 0.0000000E+00 DANCOFF CORRECTION (C) = 2.9500756E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1 = 15.991 SIGMA(PER ABSORBER ATOM)= 8.1019773E+00

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2 = 235.044 SIGMA(PER ABSORBER ATOM)= 5.0228214E-01

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP	RES ABS	RES FISS	RES SCAT
9	-4.868848E-02	0.000000E+00	-4.793465E-01
10	-1.166066E+00	-2.527089E-05	-7.025325E+00
11	-9.951198E+00	0.000000E+00	-2.725808E+01
12	-4.311383E+01	0.000000E+00	-5.006018E+01
13	-5.391320E+01	0.000000E+00	-1.768698E+01
14	-1.043868E+02	0.000000E+00	-6.064470E+00
15	-9.692318E-07	0.000000E+00	1.880502E-06

EXCESS RESONANCE INTEGRALS

RESOLVED

ABSORPTION 1.80430E+01
FISSION 4.90718E-04

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
                                                     PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00
THIS XSDRN WORKING TAPE WAS CREATED 11/12/96 AT 16:53:48
THE TITLE OF THE PARENT CASE IS AS FOLLOWS
SCALE 4.2 - 27 GROUP NEUTRON GROUP LIBRARY
  BASED ON ENDF-B VERSION 4 DATA
     COMPILED FOR NRC     1/27/89
    TAPE ID                           4321        NUMBER OF NUCLIDES                27
    NUMBER OF NEUTRON GROUPS            27        NUMBER OF GAMMA GROUPS             0
    FIRST THERMAL GROUP                 15        LOGICAL UNIT                       4
                                 TABLE OF CONTENTS
   HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94        ID   3001001
   HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94        ID   8001001
   HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94        ID   9001001
   HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94        ID  10001001
  B-10 1273 218NGP 042375 P-3 293K                     UPDATED 08/12/94        ID   6005010
  B-10 1273 218NGP 042375 P-3 293K                     UPDATED 08/12/94        ID   8005010
   BORON-11       ENDF/B-IV MAT 1160                   UPDATED 08/12/94        ID   6005011
   BORON-11       ENDF/B-IV MAT 1160                   UPDATED 08/12/94        ID   8005011
   CARBON-12      ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94        ID   6006012
   CARBON-12      ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94        ID   8006012
   NITROGEN-14    ENDF/B-IV MAT 1275                   UPDATED 08/12/94        ID   8007014
   OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94        ID   1008016
   OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94        ID   3008016
   OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94        ID   8008016
   OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94        ID   9008016
   OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94        ID  10008016
  AL-27 1193 218 GP 040375(5)                          UPDATED 08/12/94        ID   4013027
  AL-27 1193 218 GP 040375(5)                          UPDATED 08/12/94        ID   6013027
  AL-27 1193 218 GP 040375(5)                          UPDATED 08/12/94        ID   8013027
  CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'     UPDATED 08/12/94        ID   5024304
   MANGANESE-55   ENDF/B-IV MAT 1197                   UPDATED 08/12/94        ID   5025055
  FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'     UPDATED 08/12/94        ID   5026304
  NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'     UPDATED 08/12/94        ID   5028304
   ZIRCALLOY      ENDF/B-IV MAT 1284                   UPDATED 08/12/94        ID   2040302
  PB   1288 218NGP 042375 P-3 293K                     UPDATED 08/12/94        ID   7082000
   URANIUM-235    ENDF/B-IV MAT 1261                   UPDATED 08/12/94        ID   1092235
   URANIUM-238    ENDF/B-IV MAT 1262                   UPDATED 08/12/94        ID   1092238

    TAPE COPY USED       0 I/O'S, AND TOOK    0.33 SECONDS
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
******************************************************************************
******************************************************************************
******************************************************************************
*****                                                                    *****
*****                 PROGRAM VERIFICATION INFORMATION                   *****
*****                                                                    *****
*****              CODE SYSTEM:  SCALE-PC VERSION:  4.3                  *****
*****                                                                    *****
******************************************************************************
******************************************************************************
*****                                                                    *****
*****                                                                    *****
*****            PROGRAM:  000009                                        *****
*****                                                                    *****
*****      CREATION DATE:  03-08-96                                      *****
*****                                                                    *****
*****             VOLUME:  ENG                                           *****
*****                                                                    *****
*****            LIBRARY:  G:\scale43\exe                                *****
*****                                                                    *****
*****                                                                    *****
*****    PRODUCTION CODE:  KENOVA                                        *****
*****                                                                    *****
*****            VERSION:  3.1                                           *****
*****                                                                    *****
*****            JOBNAME:  SCALE-PC                                      *****
*****                                                                    *****
*****  DATE OF EXECUTION:  11/12/96                                      *****
*****                                                                    *****
*****  TIME OF EXECUTION:  16:54:00                                      *****
*****                                                                    *****
*****                                                                    *****
******************************************************************************
******************************************************************************
******************************************************************************
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
*********************************************************************************************************************
***                                                                                                               ***
***                  TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0***
***                                                                                                               ***
*********************************************************************************************************************
***                         ******      NUMERIC PARAMETERS      ******                                            ***
***                                                                                                               ***
***                                                                                                               ***
***           TME       MAXIMUM PROBLEM TIME (MIN)                        500.00                                  ***
***                                                                                                               ***
***           TBA       TIME PER GENERATION (MIN)                           0.50                                  ***
***                                                                                                               ***
***           GEN       NUMBER OF GENERATIONS                               1003                                  ***
***                                                                                                               ***
***           NPG       NUMBER PER GENERATION                               1000                                  ***
***                                                                                                               ***
***           NSK       NUMBER OF GENERATIONS TO BE SKIPPED                    3                                  ***
***                                                                                                               ***
***           BEG       BEGINNING GENERATION NUMBER                            1                                  ***
***                                                                                                               ***
***           RES       GENERATIONS BETWEEN CHECKPOINTS                        0                                  ***
***                                                                                                               ***
***           X1D       NUMBER OF EXTRA 1-D CROSS SECTIONS                     1                                  ***
***                                                                                                               ***
***           NBK       NEUTRON BANK SIZE                                   1025                                  ***
***                                                                                                               ***
***           XNB       EXTRA POSITIONS IN NEUTRON BANK                        0                                  ***
***                                                                                                               ***
***           NFB       FISSION BANK SIZE                                   1000                                  ***
***                                                                                                               ***
***           XFB       EXTRA POSITIONS IN FISSION BANK                        0                                  ***
***                                                                                                               ***
***           WTA       DEFAULT VALUE OF WEIGHT AVERAGE                   0.5000                                  ***
***                                                                                                               ***
***           WTH       WEIGHT HIGH FOR SPLITTING                         3.0000                                  ***
***                                                                                                               ***
***           WTL       WEIGHT LOW FOR RUSSIAN ROULETTE                   0.3333                                  ***
***                                                                                                               ***
***           RND       STARTING RANDOM NUMBER                      BB827100001                                  ***
***                                                                                                               ***
***           NB8       NUMBER OF D.A. BLOCKS ON UNIT  8                     200                                  ***
***                                                                                                               ***
***           NL8       LENGTH OF D.A. BLOCKS ON UNIT  8                     512                                  ***
***                                                                                                               ***
***           ADJ       MODE OF CALCULATION                              FORWARD                                  ***
***                                                                                                               ***
***                     INPUT DATA WRITTEN ON RESTART UNIT                    NO                                  ***
***                                                                                                               ***
***                     BINARY DATA INTERFACE                                YES                                  ***
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
***                                                                                                            ***
     ***                     TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0***
*******************************************************************************************************
     ***                              ******   LOGICAL PARAMETERS       ******                                ***
     ***                                                                                                      ***
     *** RUN  EXECUTE PROBLEM AFTER CHECKING DATA   YES        PLT  PLOT PICTURE MAP(S)                    NO ***
     ***                                                                                                      ***
     *** FLX  COMPUTE FLUX                          NO         FDN  COMPUTE FISSION DENSITIES              NO ***
     ***                                                                                                      ***
     *** SMU  COMPUTE AVG UNIT SELF-MULTIPLICATION  NO         NUB  COMPUTE NU-BAR & AVG FISSION GROUP    YES ***
     ***                                                                                                      ***
     *** MKU  COMPUTE MATRIX K-EFF BY UNIT NUMBER   NO         MKP  COMPUTE MATRIX K-EFF BY UNIT LOCATION  NO ***
     ***                                                                                                      ***
     *** CKU  COMPUTE COFACTOR K-EFF BY UNIT NUMBER NO         CKP  COMPUTE COFACTOR K-EFF BY UNIT LOCATION NO ***
     ***                                                                                                      ***
     *** FMU  PRINT FISS PROD MATRIX BY UNIT NUMBER NO         FMP  PRINT FISS PROD MATRIX BY UNIT LOCATION NO ***
     ***                                                                                                      ***
     *** MKH  COMPUTE MATRIX K-EFF BY HOLE NUMBER   NO         MKA  COMPUTE MATRIX K-EFF BY ARRAY NUMBER   NO ***
     ***                                                                                                      ***
     *** CKH  COMPUTE COFACTOR K-EFF BY HOLE NUMBER NO         CKA  COMPUTE COFACTOR K-EFF BY ARRAY NUMBER NO ***
     ***                                                                                                      ***
     *** FMH  PRINT FISS PROD MATRIX BY HOLE NUMBER NO         FMA  PRINT FISS PROD MATRIX BY ARRAY NUMBER NO ***
     ***                                                                                                      ***
     *** HHL  COLLECT MATRIX BY HIGHEST HOLE LEVEL  NO         HAL  COLLECT MATRIX BY HIGHEST ARRAY LEVEL  NO ***
     ***                                                                                                      ***
     *** AMX  PRINT ALL MIXED CROSS SECTIONS        NO         FAR  PRINT FIS. AND ABS. BY REGION          NO ***
     ***                                                                                                      ***
     *** XS1  PRINT 1-D MIXTURE X-SECTIONS          NO         GAS  PRINT FAR BY GROUP                     NO ***
     ***                                                                                                      ***
     *** XS2  PRINT 2-D MIXTURE X-SECTIONS          NO         PAX  PRINT XSEC-ALBEDO CORRELATION TABLES   NO ***
     ***                                                                                                      ***
     *** XAP  PRINT MIXTURE ANGLES & PROBABILITIES  NO         PWT  PRINT WEIGHT AVERAGE ARRAY             NO ***
     ***                                                                                                      ***
     *** PKI  PRINT FISSION SPECTRUM                NO         PGM  PRINT INPUT GEOMETRY                   NO ***
     ***                                                                                                      ***
     *** P1D  PRINT EXTRA 1-D CROSS SECTIONS        NO         BUG  PRINT DEBUG INFORMATION                NO ***
     ***                                                                                                      ***
     ***                                                       TRK  PRINT TRACKING INFORMATION             NO ***
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
*****************************************************************************************************
                                   PARAMETER INPUT COMPLETED

                  ........   0 IO'S WERE USED READING THE PARAMETER DATA      ........

                  CROSS SECTIONS READ FROM THE AMPX WORKING LIBRARY ON UNIT    4

                         TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

                                      MIXING TABLE

                          NUMBER OF SCATTERING ANGLES =  2
                       CROSS SECTION MESSAGE THRESHOLD =3.0E-05


MIXTURE =     1          DENSITY(G/CC) =  10.412
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT             NUCLIDE TITLE
   1008016  4.64617E-02  1.18487E-01    8016    15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                         UPDATED
08/12/94
   1092235  9.40641E-04  3.52606E-02   92235   235.0441      URANIUM-235     ENDF/B-IV MAT 1261                         UPDATED
08/12/94
   1092238  2.22902E-02  8.46253E-01   92238   238.0510      URANIUM-238     ENDF/B-IV MAT 1262                         UPDATED
08/12/94

MIXTURE =     2          DENSITY(G/CC) =  6.5600
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT             NUCLIDE TITLE
   2040302  4.33078E-02  1.00000E+00   40000    91.2196      ZIRCALLOY       ENDF/B-IV MAT 1284                         UPDATED
08/12/94

MIXTURE =     3          DENSITY(G/CC) = 0.99817
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT             NUCLIDE TITLE
   3001001  6.67692E-02  1.11927E-01    1001     1.0077      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002                UPDATED
08/12/94
   3008016  3.33846E-02  8.88074E-01    8016    15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                         UPDATED
08/12/94

MIXTURE =     4          DENSITY(G/CC) =  2.7020
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT             NUCLIDE TITLE
   4013027  6.03066E-02  1.00000E+00   13027    26.9818     AL-27 1193 218 GP 040375(5)                                 UPDATED
08/12/94

MIXTURE =     5          DENSITY(G/CC) =  7.9200
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT             NUCLIDE TITLE
   5024304  1.74286E-02  1.90000E-01   24000    51.9957      CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'           UPDATED
08/12/94
   5025055  1.73633E-03  1.99999E-02   25055    54.9379      MANGANESE-55    ENDF/B-IV MAT 1197                         UPDATED
08/12/94
   5026304  5.93579E-02  6.95000E-01   26000    55.8447      FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'           UPDATED
08/12/94
   5028304  7.72070E-03  9.50001E-02   28000    58.6872      NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'           UPDATED
08/12/94

MIXTURE =     6          DENSITY(G/CC) =  2.5833
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT             NUCLIDE TITLE
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
  6005010  7.09799E-03  4.56855E-02    5010    10.0130     B-10 1273 218NGP 042375 P-3 293K                         UPDATED
08/12/94
  6005011  3.92499E-02  2.77771E-01    5011    11.0096      BORON-11        ENDF/B-IV MAT 1160                      UPDATED
08/12/94
  6006012  1.22006E-02  9.41116E-02    6000    12.0001      CARBON-12       ENDF/B-IV MAT 1274/THRM1065             UPDATED
08/12/94
  6013027  3.35812E-02  5.82432E-01   13027    26.9818     AL-27 1193 218 GP 040375(5)                              UPDATED
08/12/94

MIXTURE =     7        DENSITY(G/CC) =  11.344
  NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA      AWT              NUCLIDE TITLE
  7082000  3.29690E-02  1.00000E+00   82000   207.2100     PB    1288 218NGP 042375 P-3 293K                        UPDATED
08/12/94

MIXTURE =    8         DENSITY(G/CC) =  1.6307
  NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA      AWT              NUCLIDE TITLE
  8001001  5.84084E-02  5.99323E-02    1001     1.0077      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002             UPDATED
08/12/94
  8005010  9.79802E-05  9.99025E-04    5010    10.0130     B-10 1273 218NGP 042375 P-3 293K                         UPDATED
08/12/94
  8005011  3.56450E-04  3.99615E-03    5011    11.0096      BORON-11        ENDF/B-IV MAT 1160                      UPDATED
08/12/94
  8006012  2.26463E-02  2.76729E-01    6000    12.0001      CARBON-12       ENDF/B-IV MAT 1274/THRM1065             UPDATED
08/12/94
  8007014  1.40121E-03  1.99805E-02    7014    14.0033      NITROGEN-14     ENDF/B-IV MAT 1275                      UPDATED
08/12/94
  8008016  2.60749E-02  4.24574E-01    8016    15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                      UPDATED
08/12/94
  8013027  7.78110E-03  2.13789E-01   13027    26.9818     AL-27 1193 218 GP 040375(5)                              UPDATED
08/12/94

MIXTURE =    9         DENSITY(G/CC) = 0.99817
  NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA      AWT              NUCLIDE TITLE
  9001001  6.67692E-02  1.11927E-01    1001     1.0077      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002             UPDATED
08/12/94
  9008016  3.33846E-02  8.88074E-01    8016    15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                      UPDATED
08/12/94

MIXTURE =   10         DENSITY(G/CC) = 0.99817
  NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA      AWT              NUCLIDE TITLE
 10001001  6.67692E-02  1.11927E-01    1001     1.0077      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002             UPDATED
08/12/94
 10008016  3.33846E-02  8.88074E-01    8016    15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                      UPDATED
08/12/94

                                  3001001     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94
                                  8001001     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94
                                  9001001     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94
                                 10001001     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94
                                  6005010    B-10 1273 218NGP 042375 P-3 293K                     UPDATED 08/12/94
                                  8005010    B-10 1273 218NGP 042375 P-3 293K                     UPDATED 08/12/94
                                  6005011     BORON-11       ENDF/B-IV MAT 1160                   UPDATED 08/12/94
                                  8005011     BORON-11       ENDF/B-IV MAT 1160                   UPDATED 08/12/94
                                  6006012     CARBON-12      ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94
                                  8006012     CARBON-12      ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
     8007014     NITROGEN-14     ENDF/B-IV MAT 1275                            UPDATED 08/12/94
     1008016     OXYGEN-16       ENDF/B-IV MAT 1276                            UPDATED 08/12/94
     3008016     OXYGEN-16       ENDF/B-IV MAT 1276                            UPDATED 08/12/94
     8008016     OXYGEN-16       ENDF/B-IV MAT 1276                            UPDATED 08/12/94
     9008016     OXYGEN-16       ENDF/B-IV MAT 1276                            UPDATED 08/12/94
    10008016     OXYGEN-16       ENDF/B-IV MAT 1276                            UPDATED 08/12/94
     4013027    AL-27 1193 218 GP 040375(5)                                    UPDATED 08/12/94
     6013027    AL-27 1193 218 GP 040375(5)                                    UPDATED 08/12/94
     8013027    AL-27 1193 218 GP 040375(5)                                    UPDATED 08/12/94
     5024304    CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'               UPDATED 08/12/94
     5025055     MANGANESE-55    ENDF/B-IV MAT 1197                            UPDATED 08/12/94
     5026304    FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'               UPDATED 08/12/94
     5028304    NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'               UPDATED 08/12/94
     2040302     ZIRCALLOY       ENDF/B-IV MAT 1284                            UPDATED 08/12/94
     7082000    PB   1288 218NGP 042375 P-3 293K                               UPDATED 08/12/94
     1092235     URANIUM-235     ENDF/B-IV MAT 1261                            UPDATED 08/12/94
     1092238     URANIUM-238     ENDF/B-IV MAT 1262                            UPDATED 08/12/94

       ........    0 IO'S WERE USED MIXING CROSS-SECTIONS      ........

        1-D CROSS SECTION ARRAY ID NUMBERS
           1  2002  1452   27    18  1018

       ........    0 IO'S WERE USED PREPARING THE CROSS SECTIONS    ........
******************************************************************************************************
             ***                                                                                  ***
      ***          TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0    ***
             ***                                                                                  ***

******************************************************************************************************
             ***                                                                                  ***
             ***                      ****** ADDITIONAL INFORMATION ******                        ***
             ***                                                                                  ***
             ***  NUMBER OF ENERGY GROUPS                  27       USE LATTICE GEOMETRY      YES ***
             ***                                                                                  ***
             ***  NO. OF FISSION SPECTRUM SOURCE GROUP  1       GLOBAL ARRAY NUMBER           60  ***
             ***                                                                                  ***
      ***  NO. OF SCATTERING ANGLES IN XSECS    2       NUMBER OF UNITS IN THE GLOBAL X DIR.    1 ***
             ***                                                                                  ***
 ***  ENTRIES/NEUTRON IN THE NEUTRON BANK  33       NUMBER OF UNITS IN THE GLOBAL Y DIR.     1 ***
             ***                                                                                  ***
     ***  ENTRIES/NEUTRON IN THE FISSION BANK  26       NUMBER OF UNITS IN THE GLOBAL Z DIR.     4  ***
             ***                                                                                  ***
             ***  NUMBER OF MIXTURES USED                  9        USE A GLOBAL REFLECTOR    YES ***
             ***                                                                                  ***
             ***  NUMBER OF BIAS ID'S USED                 1        USE NESTED HOLES          YES ***
             ***                                                                                  ***
             ***  NUMBER OF DIFFERENTIAL ALBEDOS USED   0        NUMBER OF HOLES              48  ***
             ***                                                                                  ***
         ***  TOTAL INPUT GEOMETRY REGIONS          136      MAXIMUM HOLE NESTING LEVEL        3  ***
             ***                                                                                  ***
             ***  NUMBER OF GEOMETRY REGIONS USED      136      USE NESTED ARRAYS         YES ***
             ***                                                                                  ***
             ***  LARGEST GEOMETRY UNIT NUMBER         120      NUMBER OF ARRAYS USED      27 ***
             ***                                                                                  ***
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
***  LARGEST ARRAY NUMBER                 60        MAXIMUM ARRAY NESTING LEVEL                 4  ***
***                                                                                                ***
***                                                                                                ***
***  +X BOUNDARY CONDITION                MIR       -X BOUNDARY CONDITION                     MIR  ***
***                                                                                                ***
***  +Y BOUNDARY CONDITION                MIR       -Y BOUNDARY CONDITION                     MIR  ***
***                                                                                                ***
***  +Z BOUNDARY CONDITION                PER       -Z BOUNDARY CONDITION                     PER  ***
***                                                                                                ***
****************************************************************************************************
```

START TYPE 0 WAS USED.

THE NEUTRONS WERE STARTED WITH A FLAT DISTRIBUTION IN A CUBOID DEFINED BY:
+X= 1.24651E+02 -X=-1.75349E+02 +Y= 1.24651E+02 -Y=-1.75349E+02 +Z= 1.12016E+01 -Z= 0.00000E+00
THE FLAG TO START NEUTRONS IN THE REFLECTOR WAS TURNED OFF

0.04183 MINUTES WERE REQUIRED FOR STARTING. TOTAL ELAPSED TIME IS 0.06400 MINUTES.

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

GENERATION	GENERATION K-EFFECTIVE	ELAPSED TIME MINUTES	AVERAGE K-EFFECTIVE	AVG K-EFF DEVIATION	MATRIX K-EFFECTIVE	MATRIX K-EFF DEVIATION
KENO MESSAGE NUMBER K5-132		WARNING....ONLY 920 INDEPENDENT FISSION POINTS WERE GENERATED				
1	8.45260E-01	1.03500E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
KENO MESSAGE NUMBER K5-132		WARNING....ONLY 948 INDEPENDENT FISSION POINTS WERE GENERATED				
2	8.75995E-01	1.43833E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
KENO MESSAGE NUMBER K5-132		WARNING....ONLY 952 INDEPENDENT FISSION POINTS WERE GENERATED				
3	8.44310E-01	1.82333E-01	8.44310E-01	0.00000E+00	0.00000E+00	0.00000E+00
4	9.03824E-01	2.21667E-01	8.74067E-01	2.97569E-02	0.00000E+00	0.00000E+00
5	9.25732E-01	2.60000E-01	8.91289E-01	2.43257E-02	0.00000E+00	0.00000E+00
6	8.52908E-01	2.99500E-01	8.81693E-01	1.96961E-02	0.00000E+00	0.00000E+00
7	9.20506E-01	3.39667E-01	8.89456E-01	1.71178E-02	0.00000E+00	0.00000E+00
8	8.74987E-01	3.78167E-01	8.87044E-01	1.41832E-02	0.00000E+00	0.00000E+00
9	9.09645E-01	4.19333E-01	8.90273E-01	1.24142E-02	0.00000E+00	0.00000E+00
10	8.48362E-01	4.58667E-01	8.85034E-01	1.19595E-02	0.00000E+00	0.00000E+00
11	9.01759E-01	4.99000E-01	8.86893E-01	1.07097E-02	0.00000E+00	0.00000E+00
12	8.91590E-01	5.38333E-01	8.87362E-01	9.59060E-03	0.00000E+00	0.00000E+00
13	8.26485E-01	5.77667E-01	8.81828E-01	1.02900E-02	0.00000E+00	0.00000E+00
14	8.67572E-01	6.18833E-01	8.80640E-01	9.46828E-03	0.00000E+00	0.00000E+00
15	8.70696E-01	6.59167E-01	8.79875E-01	8.74308E-03	0.00000E+00	0.00000E+00
16	8.80601E-01	6.97667E-01	8.79927E-01	8.09469E-03	0.00000E+00	0.00000E+00
17	8.89377E-01	7.37000E-01	8.80557E-01	7.56203E-03	0.00000E+00	0.00000E+00
18	8.75835E-01	7.75500E-01	8.80262E-01	7.07979E-03	0.00000E+00	0.00000E+00
19	8.89648E-01	8.14833E-01	8.80814E-01	6.67318E-03	0.00000E+00	0.00000E+00
20	8.78751E-01	8.54167E-01	8.80699E-01	6.29258E-03	0.00000E+00	0.00000E+00
21	8.87345E-01	8.92667E-01	8.81049E-01	5.96245E-03	0.00000E+00	0.00000E+00
22	8.89040E-01	9.32833E-01	8.81449E-01	5.67057E-03	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

23	8.61826E-01	9.73167E-01	8.80514E-01	5.47413E-03	0.00000E+00	0.00000E+00
24	8.76392E-01	1.01350E+00	8.80327E-01	5.22274E-03	0.00000E+00	0.00000E+00
25	8.47984E-01	1.05367E+00	8.78921E-01	5.18483E-03	0.00000E+00	0.00000E+00
26	8.31805E-01	1.09217E+00	8.76958E-01	5.33819E-03	0.00000E+00	0.00000E+00
27	8.80334E-01	1.13150E+00	8.77093E-01	5.12199E-03	0.00000E+00	0.00000E+00
28	8.70337E-01	1.17083E+00	8.76833E-01	4.92791E-03	0.00000E+00	0.00000E+00
29	8.58137E-01	1.20933E+00	8.76140E-01	4.79217E-03	0.00000E+00	0.00000E+00
30	8.61912E-01	1.24967E+00	8.75632E-01	4.64572E-03	0.00000E+00	0.00000E+00
31	8.89233E-01	1.28983E+00	8.76101E-01	4.50713E-03	0.00000E+00	0.00000E+00
32	8.58432E-01	1.33017E+00	8.75512E-01	4.39395E-03	0.00000E+00	0.00000E+00
33	8.98718E-01	1.37050E+00	8.76261E-01	4.31527E-03	0.00000E+00	0.00000E+00
34	8.43359E-01	1.40983E+00	8.75233E-01	4.30289E-03	0.00000E+00	0.00000E+00
35	8.82459E-01	1.44917E+00	8.75452E-01	4.17621E-03	0.00000E+00	0.00000E+00
36	8.73248E-01	1.48950E+00	8.75387E-01	4.05203E-03	0.00000E+00	0.00000E+00
37	8.42016E-01	1.52983E+00	8.74433E-01	4.04844E-03	0.00000E+00	0.00000E+00
38	8.60546E-01	1.57000E+00	8.74048E-01	3.95324E-03	0.00000E+00	0.00000E+00
39	8.86106E-01	1.60933E+00	8.74373E-01	3.85870E-03	0.00000E+00	0.00000E+00
40	8.82359E-01	1.64883E+00	8.74584E-01	3.76166E-03	0.00000E+00	0.00000E+00
41	9.16518E-01	1.68817E+00	8.75659E-01	3.81845E-03	0.00000E+00	0.00000E+00
42	8.75414E-01	1.72833E+00	8.75653E-01	3.72177E-03	0.00000E+00	0.00000E+00
43	8.84311E-01	1.76867E+00	8.75864E-01	3.63599E-03	0.00000E+00	0.00000E+00
44	8.32141E-01	1.80717E+00	8.74823E-01	3.69792E-03	0.00000E+00	0.00000E+00
45	9.00927E-01	1.84650E+00	8.75430E-01	3.66158E-03	0.00000E+00	0.00000E+00
46	8.35074E-01	1.88583E+00	8.74513E-01	3.69309E-03	0.00000E+00	0.00000E+00
47	8.67602E-01	1.92517E+00	8.74359E-01	3.61336E-03	0.00000E+00	0.00000E+00
48	8.73287E-01	1.96450E+00	8.74336E-01	3.53401E-03	0.00000E+00	0.00000E+00
49	8.54860E-01	2.00300E+00	8.73922E-01	3.48274E-03	0.00000E+00	0.00000E+00
50	8.77829E-01	2.04417E+00	8.74003E-01	3.41038E-03	0.00000E+00	0.00000E+00
51	8.55167E-01	2.08550E+00	8.73619E-01	3.36211E-03	0.00000E+00	0.00000E+00
52	8.59312E-01	2.12567E+00	8.73332E-01	3.30658E-03	0.00000E+00	0.00000E+00
53	8.91143E-01	2.16600E+00	8.73682E-01	3.25986E-03	0.00000E+00	0.00000E+00
54	8.96038E-01	2.20633E+00	8.74112E-01	3.22534E-03	0.00000E+00	0.00000E+00
55	8.71498E-01	2.24567E+00	8.74062E-01	3.16428E-03	0.00000E+00	0.00000E+00
56	8.65457E-01	2.28500E+00	8.73903E-01	3.10922E-03	0.00000E+00	0.00000E+00
57	8.91218E-01	2.32533E+00	8.74218E-01	3.06836E-03	0.00000E+00	0.00000E+00
58	8.54651E-01	2.36467E+00	8.73868E-01	3.03326E-03	0.00000E+00	0.00000E+00
59	8.85337E-01	2.40483E+00	8.74069E-01	2.98635E-03	0.00000E+00	0.00000E+00
60	8.80429E-01	2.44517E+00	8.74179E-01	2.93646E-03	0.00000E+00	0.00000E+00
61	9.00667E-01	2.48550E+00	8.74628E-01	2.92097E-03	0.00000E+00	0.00000E+00
62	9.14575E-01	2.52667E+00	8.75294E-01	2.94803E-03	0.00000E+00	0.00000E+00
63	8.76602E-01	2.56700E+00	8.75315E-01	2.89938E-03	0.00000E+00	0.00000E+00
64	8.67834E-01	2.60633E+00	8.75195E-01	2.85478E-03	0.00000E+00	0.00000E+00
65	9.14123E-01	2.64567E+00	8.75813E-01	2.87626E-03	0.00000E+00	0.00000E+00
66	8.65798E-01	2.68600E+00	8.75656E-01	2.83528E-03	0.00000E+00	0.00000E+00
67	8.52804E-01	2.72617E+00	8.75305E-01	2.81338E-03	0.00000E+00	0.00000E+00
68	8.47717E-01	2.76550E+00	8.74887E-01	2.80178E-03	0.00000E+00	0.00000E+00
69	8.91544E-01	2.80500E+00	8.75135E-01	2.77082E-03	0.00000E+00	0.00000E+00
70	9.18735E-01	2.84517E+00	8.75776E-01	2.80406E-03	0.00000E+00	0.00000E+00
71	8.49792E-01	2.88467E+00	8.75400E-01	2.78867E-03	0.00000E+00	0.00000E+00
72	9.00198E-01	2.92300E+00	8.75754E-01	2.77128E-03	0.00000E+00	0.00000E+00
73	9.02772E-01	2.96333E+00	8.76135E-01	2.75834E-03	0.00000E+00	0.00000E+00
74	8.58968E-01	3.00267E+00	8.75896E-01	2.73019E-03	0.00000E+00	0.00000E+00
75	8.81546E-01	3.04200E+00	8.75974E-01	2.69364E-03	0.00000E+00	0.00000E+00
76	8.79696E-01	3.08233E+00	8.76024E-01	2.65747E-03	0.00000E+00	0.00000E+00
77	9.05634E-01	3.12267E+00	8.76419E-01	2.65135E-03	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

78	8.53695E-01	3.16200E+00	8.76120E-01	2.63327E-03	0.00000E+00	0.00000E+00
79	7.91697E-01	3.20133E+00	8.75023E-01	2.82065E-03	0.00000E+00	0.00000E+00
80	8.51839E-01	3.24067E+00	8.74726E-01	2.80007E-03	0.00000E+00	0.00000E+00
81	8.92243E-01	3.28100E+00	8.74948E-01	2.77328E-03	0.00000E+00	0.00000E+00
82	8.30263E-01	3.32033E+00	8.74389E-01	2.79478E-03	0.00000E+00	0.00000E+00
83	8.86753E-01	3.35967E+00	8.74542E-01	2.76428E-03	0.00000E+00	0.00000E+00
84	8.83275E-01	3.39817E+00	8.74648E-01	2.73244E-03	0.00000E+00	0.00000E+00
85	8.65620E-01	3.43750E+00	8.74540E-01	2.70151E-03	0.00000E+00	0.00000E+00
86	8.94753E-01	3.47783E+00	8.74780E-01	2.67998E-03	0.00000E+00	0.00000E+00
87	8.83441E-01	3.51617E+00	8.74882E-01	2.65022E-03	0.00000E+00	0.00000E+00
88	8.99252E-01	3.55567E+00	8.75165E-01	2.63450E-03	0.00000E+00	0.00000E+00
89	8.96617E-01	3.59400E+00	8.75412E-01	2.61569E-03	0.00000E+00	0.00000E+00
90	8.96198E-01	3.63333E+00	8.75648E-01	2.59657E-03	0.00000E+00	0.00000E+00
91	8.35135E-01	3.67367E+00	8.75193E-01	2.60727E-03	0.00000E+00	0.00000E+00
92	8.69912E-01	3.71300E+00	8.75134E-01	2.57881E-03	0.00000E+00	0.00000E+00
93	8.48029E-01	3.75233E+00	8.74836E-01	2.56765E-03	0.00000E+00	0.00000E+00
94	8.53762E-01	3.79183E+00	8.74607E-01	2.54989E-03	0.00000E+00	0.00000E+00
95	9.00097E-01	3.83200E+00	8.74881E-01	2.53717E-03	0.00000E+00	0.00000E+00
96	8.58107E-01	3.87050E+00	8.74703E-01	2.51637E-03	0.00000E+00	0.00000E+00
97	9.35373E-01	3.91083E+00	8.75342E-01	2.57034E-03	0.00000E+00	0.00000E+00
98	8.57543E-01	3.95017E+00	8.75156E-01	2.55018E-03	0.00000E+00	0.00000E+00
99	9.56989E-01	3.99133E+00	8.76000E-01	2.66102E-03	0.00000E+00	0.00000E+00
100	8.58730E-01	4.03067E+00	8.75824E-01	2.63962E-03	0.00000E+00	0.00000E+00
101	8.67060E-01	4.07000E+00	8.75735E-01	2.61432E-03	0.00000E+00	0.00000E+00
102	8.55432E-01	4.10950E+00	8.75532E-01	2.59599E-03	0.00000E+00	0.00000E+00
103	8.67743E-01	4.14967E+00	8.75455E-01	2.57132E-03	0.00000E+00	0.00000E+00
104	8.87242E-01	4.18817E+00	8.75571E-01	2.54861E-03	0.00000E+00	0.00000E+00
105	9.38439E-01	4.22850E+00	8.76181E-01	2.59650E-03	0.00000E+00	0.00000E+00
106	8.70252E-01	4.26967E+00	8.76124E-01	2.57205E-03	0.00000E+00	0.00000E+00
107	8.82507E-01	4.30983E+00	8.76185E-01	2.54816E-03	0.00000E+00	0.00000E+00
108	9.13364E-01	4.34933E+00	8.76535E-01	2.54826E-03	0.00000E+00	0.00000E+00
109	8.98171E-01	4.38867E+00	8.76738E-01	2.53242E-03	0.00000E+00	0.00000E+00
110	9.56280E-01	4.42800E+00	8.77474E-01	2.61473E-03	0.00000E+00	0.00000E+00
111	9.00160E-01	4.46917E+00	8.77682E-01	2.59898E-03	0.00000E+00	0.00000E+00
112	8.48352E-01	4.50950E+00	8.77416E-01	2.58901E-03	0.00000E+00	0.00000E+00
113	8.33516E-01	4.54783E+00	8.77020E-01	2.59588E-03	0.00000E+00	0.00000E+00
114	8.74828E-01	4.58733E+00	8.77001E-01	2.57267E-03	0.00000E+00	0.00000E+00
115	8.72743E-01	4.62567E+00	8.76963E-01	2.55008E-03	0.00000E+00	0.00000E+00
116	8.31336E-01	4.66600E+00	8.76563E-01	2.55911E-03	0.00000E+00	0.00000E+00
117	8.95066E-01	4.70533E+00	8.76724E-01	2.54185E-03	0.00000E+00	0.00000E+00
118	8.41890E-01	4.74567E+00	8.76423E-01	2.53768E-03	0.00000E+00	0.00000E+00
119	8.88804E-01	4.78500E+00	8.76529E-01	2.51812E-03	0.00000E+00	0.00000E+00
120	8.95311E-01	4.82533E+00	8.76688E-01	2.50176E-03	0.00000E+00	0.00000E+00
121	8.68667E-01	4.86367E+00	8.76621E-01	2.48156E-03	0.00000E+00	0.00000E+00
122	8.32125E-01	4.90217E+00	8.76250E-01	2.48857E-03	0.00000E+00	0.00000E+00
123	8.86974E-01	4.94250E+00	8.76339E-01	2.46951E-03	0.00000E+00	0.00000E+00
124	8.71056E-01	4.98183E+00	8.76295E-01	2.44957E-03	0.00000E+00	0.00000E+00
125	9.01007E-01	5.02217E+00	8.76496E-01	2.43786E-03	0.00000E+00	0.00000E+00
126	8.72544E-01	5.06150E+00	8.76464E-01	2.41833E-03	0.00000E+00	0.00000E+00
127	8.84640E-01	5.10167E+00	8.76530E-01	2.39980E-03	0.00000E+00	0.00000E+00
128	8.78852E-01	5.14117E+00	8.76548E-01	2.38075E-03	0.00000E+00	0.00000E+00
129	8.69361E-01	5.18133E+00	8.76492E-01	2.36261E-03	0.00000E+00	0.00000E+00
130	8.94987E-01	5.22250E+00	8.76636E-01	2.34853E-03	0.00000E+00	0.00000E+00
131	9.08787E-01	5.26200E+00	8.76885E-01	2.34354E-03	0.00000E+00	0.00000E+00
132	8.63356E-01	5.30217E+00	8.76781E-01	2.32777E-03	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

133	8.90286E-01	5.34250E+00	8.76884E-01	2.31223E-03	0.00000E+00	0.00000E+00
134	9.04771E-01	5.38283E+00	8.77096E-01	2.30435E-03	0.00000E+00	0.00000E+00
135	9.26312E-01	5.42400E+00	8.77466E-01	2.31671E-03	0.00000E+00	0.00000E+00
136	9.01390E-01	5.46433E+00	8.77644E-01	2.30627E-03	0.00000E+00	0.00000E+00
137	9.32573E-01	5.50550E+00	8.78051E-01	2.32501E-03	0.00000E+00	0.00000E+00
138	8.35606E-01	5.54483E+00	8.77739E-01	2.32885E-03	0.00000E+00	0.00000E+00
139	8.92799E-01	5.58417E+00	8.77849E-01	2.31440E-03	0.00000E+00	0.00000E+00
140	8.79671E-01	5.62267E+00	8.77862E-01	2.29761E-03	0.00000E+00	0.00000E+00
141	8.37348E-01	5.66467E+00	8.77571E-01	2.29957E-03	0.00000E+00	0.00000E+00
142	8.78282E-01	5.70417E+00	8.77576E-01	2.28309E-03	0.00000E+00	0.00000E+00
143	8.88879E-01	5.74533E+00	8.77656E-01	2.26826E-03	0.00000E+00	0.00000E+00
144	8.88779E-01	5.78467E+00	8.77734E-01	2.25359E-03	0.00000E+00	0.00000E+00
145	8.73420E-01	5.82400E+00	8.77704E-01	2.23798E-03	0.00000E+00	0.00000E+00
146	8.87679E-01	5.86333E+00	8.77773E-01	2.22346E-03	0.00000E+00	0.00000E+00
147	8.83991E-01	5.90450E+00	8.77816E-01	2.20849E-03	0.00000E+00	0.00000E+00
148	8.63863E-01	5.94483E+00	8.77721E-01	2.19539E-03	0.00000E+00	0.00000E+00
149	8.91174E-01	5.98517E+00	8.77812E-01	2.18232E-03	0.00000E+00	0.00000E+00
150	8.81947E-01	6.02450E+00	8.77840E-01	2.16771E-03	0.00000E+00	0.00000E+00
151	9.01951E-01	6.06383E+00	8.78002E-01	2.15918E-03	0.00000E+00	0.00000E+00
152	9.16983E-01	6.10417E+00	8.78262E-01	2.16043E-03	0.00000E+00	0.00000E+00
153	8.64412E-01	6.14433E+00	8.78170E-01	2.14803E-03	0.00000E+00	0.00000E+00
154	8.93949E-01	6.18383E+00	8.78274E-01	2.13638E-03	0.00000E+00	0.00000E+00
155	9.01515E-01	6.22317E+00	8.78426E-01	2.12780E-03	0.00000E+00	0.00000E+00
156	8.95357E-01	6.26250E+00	8.78536E-01	2.11679E-03	0.00000E+00	0.00000E+00
157	9.15528E-01	6.30367E+00	8.78774E-01	2.11659E-03	0.00000E+00	0.00000E+00
158	8.58517E-01	6.34400E+00	8.78645E-01	2.10698E-03	0.00000E+00	0.00000E+00
159	9.21723E-01	6.38333E+00	8.78919E-01	2.11142E-03	0.00000E+00	0.00000E+00
160	8.86235E-01	6.42183E+00	8.78965E-01	2.09853E-03	0.00000E+00	0.00000E+00
161	8.56564E-01	6.46200E+00	8.78824E-01	2.09004E-03	0.00000E+00	0.00000E+00
162	9.09129E-01	6.50150E+00	8.79014E-01	2.08556E-03	0.00000E+00	0.00000E+00
163	9.03646E-01	6.54083E+00	8.79167E-01	2.07820E-03	0.00000E+00	0.00000E+00
164	8.81791E-01	6.57917E+00	8.79183E-01	2.06540E-03	0.00000E+00	0.00000E+00
165	8.92339E-01	6.61867E+00	8.79264E-01	2.05427E-03	0.00000E+00	0.00000E+00
166	8.53030E-01	6.65700E+00	8.79104E-01	2.04797E-03	0.00000E+00	0.00000E+00
167	8.79323E-01	6.69633E+00	8.79105E-01	2.03552E-03	0.00000E+00	0.00000E+00
168	8.67184E-01	6.73667E+00	8.79033E-01	2.02449E-03	0.00000E+00	0.00000E+00
169	8.69610E-01	6.77700E+00	8.78977E-01	2.01312E-03	0.00000E+00	0.00000E+00
170	8.55339E-01	6.81733E+00	8.78836E-01	2.00604E-03	0.00000E+00	0.00000E+00
171	8.95872E-01	6.85667E+00	8.78937E-01	1.99669E-03	0.00000E+00	0.00000E+00
172	8.57411E-01	6.89500E+00	8.78810E-01	1.98894E-03	0.00000E+00	0.00000E+00
173	9.01362E-01	6.93533E+00	8.78942E-01	1.98167E-03	0.00000E+00	0.00000E+00
174	8.89882E-01	6.97467E+00	8.79006E-01	1.97114E-03	0.00000E+00	0.00000E+00
175	8.82664E-01	7.01583E+00	8.79027E-01	1.95983E-03	0.00000E+00	0.00000E+00
176	8.97747E-01	7.05617E+00	8.79134E-01	1.95150E-03	0.00000E+00	0.00000E+00
177	8.40187E-01	7.09550E+00	8.78912E-01	1.95304E-03	0.00000E+00	0.00000E+00
178	8.70747E-01	7.13483E+00	8.78866E-01	1.94246E-03	0.00000E+00	0.00000E+00
179	8.71556E-01	7.17433E+00	8.78824E-01	1.93190E-03	0.00000E+00	0.00000E+00
180	9.36237E-01	7.21450E+00	8.79147E-01	1.94790E-03	0.00000E+00	0.00000E+00
181	9.06304E-01	7.25483E+00	8.79299E-01	1.94292E-03	0.00000E+00	0.00000E+00
182	9.06124E-01	7.29517E+00	8.79448E-01	1.93784E-03	0.00000E+00	0.00000E+00
183	8.84520E-01	7.33450E+00	8.79476E-01	1.92731E-03	0.00000E+00	0.00000E+00
184	9.03656E-01	7.37383E+00	8.79608E-01	1.92129E-03	0.00000E+00	0.00000E+00
185	8.52782E-01	7.41317E+00	8.79462E-01	1.91638E-03	0.00000E+00	0.00000E+00
186	8.90962E-01	7.45250E+00	8.79524E-01	1.90696E-03	0.00000E+00	0.00000E+00
187	8.75557E-01	7.49283E+00	8.79503E-01	1.89674E-03	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

188	8.63271E-01	7.53217E+00	8.79416E-01	1.88853E-03	0.00000E+00	0.00000E+00
189	8.61642E-01	7.57250E+00	8.79321E-01	1.88081E-03	0.00000E+00	0.00000E+00
190	8.69610E-01	7.61183E+00	8.79269E-01	1.87149E-03	0.00000E+00	0.00000E+00
191	8.73927E-01	7.65217E+00	8.79241E-01	1.86178E-03	0.00000E+00	0.00000E+00
192	8.84263E-01	7.69233E+00	8.79267E-01	1.85214E-03	0.00000E+00	0.00000E+00
193	8.76541E-01	7.73183E+00	8.79253E-01	1.84248E-03	0.00000E+00	0.00000E+00
194	8.97996E-01	7.77117E+00	8.79350E-01	1.83545E-03	0.00000E+00	0.00000E+00
195	8.88123E-01	7.81133E+00	8.79396E-01	1.82648E-03	0.00000E+00	0.00000E+00
196	8.93078E-01	7.85167E+00	8.79466E-01	1.81841E-03	0.00000E+00	0.00000E+00
197	8.51225E-01	7.89200E+00	8.79322E-01	1.81485E-03	0.00000E+00	0.00000E+00
198	9.15090E-01	7.93217E+00	8.79504E-01	1.81477E-03	0.00000E+00	0.00000E+00
199	9.08755E-01	7.97167E+00	8.79653E-01	1.81163E-03	0.00000E+00	0.00000E+00
200	9.10498E-01	8.01100E+00	8.79808E-01	1.80917E-03	0.00000E+00	0.00000E+00
201	8.87103E-01	8.04933E+00	8.79845E-01	1.80043E-03	0.00000E+00	0.00000E+00
202	8.76015E-01	8.08883E+00	8.79826E-01	1.79151E-03	0.00000E+00	0.00000E+00
203	9.11471E-01	8.12817E+00	8.79983E-01	1.78951E-03	0.00000E+00	0.00000E+00
204	9.27111E-01	8.16667E+00	8.80217E-01	1.79585E-03	0.00000E+00	0.00000E+00
205	8.65983E-01	8.20683E+00	8.80146E-01	1.78836E-03	0.00000E+00	0.00000E+00
206	8.94393E-01	8.24717E+00	8.80216E-01	1.78094E-03	0.00000E+00	0.00000E+00
207	8.80920E-01	8.28750E+00	8.80220E-01	1.77223E-03	0.00000E+00	0.00000E+00
208	8.93639E-01	8.32767E+00	8.80285E-01	1.76481E-03	0.00000E+00	0.00000E+00
209	8.73671E-01	8.36700E+00	8.80253E-01	1.75656E-03	0.00000E+00	0.00000E+00
210	9.03334E-01	8.40650E+00	8.80364E-01	1.75161E-03	0.00000E+00	0.00000E+00
211	8.70822E-01	8.44667E+00	8.80318E-01	1.74381E-03	0.00000E+00	0.00000E+00
212	8.83255E-01	8.48600E+00	8.80332E-01	1.73554E-03	0.00000E+00	0.00000E+00
213	8.78893E-01	8.52633E+00	8.80325E-01	1.72731E-03	0.00000E+00	0.00000E+00
214	9.04516E-01	8.56667E+00	8.80440E-01	1.72292E-03	0.00000E+00	0.00000E+00
215	8.48851E-01	8.60500E+00	8.80291E-01	1.72122E-03	0.00000E+00	0.00000E+00
216	8.59963E-01	8.64450E+00	8.80196E-01	1.71579E-03	0.00000E+00	0.00000E+00
217	9.25021E-01	8.68383E+00	8.80405E-01	1.72047E-03	0.00000E+00	0.00000E+00
218	8.92361E-01	8.72317E+00	8.80460E-01	1.71338E-03	0.00000E+00	0.00000E+00
219	8.69228E-01	8.76350E+00	8.80408E-01	1.70625E-03	0.00000E+00	0.00000E+00
220	9.30453E-01	8.80367E+00	8.80638E-01	1.71385E-03	0.00000E+00	0.00000E+00
221	9.24682E-01	8.84483E+00	8.80839E-01	1.71782E-03	0.00000E+00	0.00000E+00
222	8.86384E-01	8.88333E+00	8.80864E-01	1.71018E-03	0.00000E+00	0.00000E+00
223	8.92452E-01	8.92367E+00	8.80917E-01	1.70323E-03	0.00000E+00	0.00000E+00
224	8.67994E-01	8.96400E+00	8.80858E-01	1.69654E-03	0.00000E+00	0.00000E+00
225	8.68701E-01	9.00417E+00	8.80804E-01	1.68979E-03	0.00000E+00	0.00000E+00
226	8.76143E-01	9.04450E+00	8.80783E-01	1.68236E-03	0.00000E+00	0.00000E+00
227	8.81603E-01	9.08300E+00	8.80787E-01	1.67487E-03	0.00000E+00	0.00000E+00
228	8.77044E-01	9.12317E+00	8.80770E-01	1.66752E-03	0.00000E+00	0.00000E+00
229	8.74798E-01	9.16350E+00	8.80744E-01	1.66037E-03	0.00000E+00	0.00000E+00
230	8.72461E-01	9.20383E+00	8.80708E-01	1.65347E-03	0.00000E+00	0.00000E+00
231	8.75838E-01	9.24400E+00	8.80686E-01	1.64637E-03	0.00000E+00	0.00000E+00
232	8.39798E-01	9.28333E+00	8.80509E-01	1.64881E-03	0.00000E+00	0.00000E+00
233	8.94318E-01	9.32367E+00	8.80568E-01	1.64275E-03	0.00000E+00	0.00000E+00
234	8.44157E-01	9.36400E+00	8.80411E-01	1.64316E-03	0.00000E+00	0.00000E+00
235	9.06152E-01	9.40333E+00	8.80522E-01	1.63982E-03	0.00000E+00	0.00000E+00
236	8.72321E-01	9.44367E+00	8.80487E-01	1.63317E-03	0.00000E+00	0.00000E+00
237	8.54980E-01	9.48383E+00	8.80378E-01	1.62983E-03	0.00000E+00	0.00000E+00
238	9.28608E-01	9.52417E+00	8.80583E-01	1.63572E-03	0.00000E+00	0.00000E+00
239	8.85088E-01	9.56350E+00	8.80602E-01	1.62892E-03	0.00000E+00	0.00000E+00
240	8.35209E-01	9.60283E+00	8.80411E-01	1.63323E-03	0.00000E+00	0.00000E+00
241	9.41049E-01	9.64317E+00	8.80665E-01	1.64606E-03	0.00000E+00	0.00000E+00
242	8.86150E-01	9.68350E+00	8.80687E-01	1.63934E-03	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

243	8.89330E-01	9.72183E+00	8.80723E-01	1.63292E-03	0.00000E+00	0.00000E+00
244	8.48041E-01	9.76033E+00	8.80588E-01	1.63176E-03	0.00000E+00	0.00000E+00
245	8.89503E-01	9.79967E+00	8.80625E-01	1.62544E-03	0.00000E+00	0.00000E+00
246	8.49796E-01	9.83900E+00	8.80499E-01	1.62369E-03	0.00000E+00	0.00000E+00
247	8.93381E-01	9.87850E+00	8.80551E-01	1.61790E-03	0.00000E+00	0.00000E+00
248	9.22387E-01	9.91867E+00	8.80721E-01	1.62026E-03	0.00000E+00	0.00000E+00
249	8.50715E-01	9.95717E+00	8.80600E-01	1.61826E-03	0.00000E+00	0.00000E+00
250	8.74574E-01	9.99833E+00	8.80575E-01	1.61190E-03	0.00000E+00	0.00000E+00
251	9.09363E-01	1.00377E+01	8.80691E-01	1.60957E-03	0.00000E+00	0.00000E+00
252	8.94621E-01	1.00770E+01	8.80747E-01	1.60409E-03	0.00000E+00	0.00000E+00
253	8.83174E-01	1.01173E+01	8.80756E-01	1.59771E-03	0.00000E+00	0.00000E+00
254	8.76024E-01	1.01567E+01	8.80738E-01	1.59147E-03	0.00000E+00	0.00000E+00
255	8.51361E-01	1.01952E+01	8.80622E-01	1.58942E-03	0.00000E+00	0.00000E+00
256	8.65048E-01	1.02345E+01	8.80560E-01	1.58433E-03	0.00000E+00	0.00000E+00
257	8.65416E-01	1.02757E+01	8.80501E-01	1.57923E-03	0.00000E+00	0.00000E+00
258	9.26364E-01	1.03170E+01	8.80680E-01	1.58321E-03	0.00000E+00	0.00000E+00
259	9.24431E-01	1.03563E+01	8.80850E-01	1.58620E-03	0.00000E+00	0.00000E+00
260	8.75630E-01	1.03965E+01	8.80830E-01	1.58017E-03	0.00000E+00	0.00000E+00
261	8.99393E-01	1.04360E+01	8.80902E-01	1.57569E-03	0.00000E+00	0.00000E+00
262	8.62231E-01	1.04762E+01	8.80830E-01	1.57126E-03	0.00000E+00	0.00000E+00
263	8.91752E-01	1.05155E+01	8.80872E-01	1.56579E-03	0.00000E+00	0.00000E+00
264	8.75130E-01	1.05550E+01	8.80850E-01	1.55995E-03	0.00000E+00	0.00000E+00
265	8.99767E-01	1.05962E+01	8.80922E-01	1.55568E-03	0.00000E+00	0.00000E+00
266	8.88867E-01	1.06363E+01	8.80952E-01	1.55006E-03	0.00000E+00	0.00000E+00
267	8.99500E-01	1.06767E+01	8.81022E-01	1.54579E-03	0.00000E+00	0.00000E+00
268	8.67928E-01	1.07170E+01	8.80973E-01	1.54075E-03	0.00000E+00	0.00000E+00
269	8.88036E-01	1.07563E+01	8.80999E-01	1.53520E-03	0.00000E+00	0.00000E+00
270	8.86078E-01	1.07967E+01	8.81018E-01	1.52958E-03	0.00000E+00	0.00000E+00
271	8.33581E-01	1.08350E+01	8.80842E-01	1.53405E-03	0.00000E+00	0.00000E+00
272	8.52267E-01	1.08753E+01	8.80736E-01	1.53202E-03	0.00000E+00	0.00000E+00
273	9.12820E-01	1.09157E+01	8.80854E-01	1.53094E-03	0.00000E+00	0.00000E+00
274	8.86218E-01	1.09558E+01	8.80874E-01	1.52543E-03	0.00000E+00	0.00000E+00
275	8.65952E-01	1.09952E+01	8.80819E-01	1.52081E-03	0.00000E+00	0.00000E+00
276	8.83582E-01	1.10347E+01	8.80829E-01	1.51529E-03	0.00000E+00	0.00000E+00
277	8.95305E-01	1.10758E+01	8.80882E-01	1.51068E-03	0.00000E+00	0.00000E+00
278	8.58409E-01	1.11152E+01	8.80801E-01	1.50740E-03	0.00000E+00	0.00000E+00
279	9.31448E-01	1.11555E+01	8.80983E-01	1.51304E-03	0.00000E+00	0.00000E+00
280	8.90012E-01	1.11938E+01	8.81016E-01	1.50793E-03	0.00000E+00	0.00000E+00
281	8.83008E-01	1.12342E+01	8.81023E-01	1.50254E-03	0.00000E+00	0.00000E+00
282	8.77555E-01	1.12735E+01	8.81011E-01	1.49721E-03	0.00000E+00	0.00000E+00
283	8.64853E-01	1.13138E+01	8.80953E-01	1.49298E-03	0.00000E+00	0.00000E+00
284	8.86038E-01	1.13542E+01	8.80971E-01	1.48779E-03	0.00000E+00	0.00000E+00
285	8.78313E-01	1.13943E+01	8.80962E-01	1.48255E-03	0.00000E+00	0.00000E+00
286	9.09924E-01	1.14337E+01	8.81064E-01	1.48084E-03	0.00000E+00	0.00000E+00
287	8.69042E-01	1.14732E+01	8.81022E-01	1.47623E-03	0.00000E+00	0.00000E+00
288	8.76127E-01	1.15125E+01	8.81004E-01	1.47116E-03	0.00000E+00	0.00000E+00
289	8.82672E-01	1.15508E+01	8.81010E-01	1.46604E-03	0.00000E+00	0.00000E+00
290	8.55173E-01	1.15903E+01	8.80921E-01	1.46369E-03	0.00000E+00	0.00000E+00
291	9.01395E-01	1.16305E+01	8.80991E-01	1.46034E-03	0.00000E+00	0.00000E+00
292	8.88075E-01	1.16708E+01	8.81016E-01	1.45550E-03	0.00000E+00	0.00000E+00
293	8.86500E-01	1.17093E+01	8.81035E-01	1.45061E-03	0.00000E+00	0.00000E+00
294	8.80978E-01	1.17487E+01	8.81035E-01	1.44563E-03	0.00000E+00	0.00000E+00
295	9.10626E-01	1.17890E+01	8.81135E-01	1.44423E-03	0.00000E+00	0.00000E+00
296	8.52665E-01	1.18292E+01	8.81039E-01	1.44256E-03	0.00000E+00	0.00000E+00
297	8.91406E-01	1.18695E+01	8.81074E-01	1.43809E-03	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

298	8.97473E-01	1.19098E+01	8.81129E-01	1.43430E-03	0.00000E+00	0.00000E+00
299	8.28838E-01	1.19500E+01	8.80953E-01	1.44026E-03	0.00000E+00	0.00000E+00
300	9.47763E-01	1.19903E+01	8.81177E-01	1.45282E-03	0.00000E+00	0.00000E+00
301	9.02023E-01	1.20315E+01	8.81247E-01	1.44963E-03	0.00000E+00	0.00000E+00
302	8.49101E-01	1.20718E+01	8.81140E-01	1.44876E-03	0.00000E+00	0.00000E+00
303	8.66354E-01	1.21112E+01	8.81091E-01	1.44477E-03	0.00000E+00	0.00000E+00
304	8.63843E-01	1.21505E+01	8.81034E-01	1.44111E-03	0.00000E+00	0.00000E+00
305	8.77762E-01	1.21898E+01	8.81023E-01	1.43639E-03	0.00000E+00	0.00000E+00
306	9.13651E-01	1.22292E+01	8.81130E-01	1.43568E-03	0.00000E+00	0.00000E+00
307	8.80096E-01	1.22687E+01	8.81127E-01	1.43096E-03	0.00000E+00	0.00000E+00
308	8.97984E-01	1.23088E+01	8.81182E-01	1.42734E-03	0.00000E+00	0.00000E+00
309	8.77844E-01	1.23482E+01	8.81171E-01	1.42273E-03	0.00000E+00	0.00000E+00
310	8.76024E-01	1.23877E+01	8.81154E-01	1.41820E-03	0.00000E+00	0.00000E+00
311	8.27738E-01	1.24270E+01	8.80981E-01	1.42413E-03	0.00000E+00	0.00000E+00
312	9.37744E-01	1.24673E+01	8.81165E-01	1.43129E-03	0.00000E+00	0.00000E+00
313	8.85321E-01	1.25057E+01	8.81178E-01	1.42675E-03	0.00000E+00	0.00000E+00
314	8.97061E-01	1.25460E+01	8.81229E-01	1.42308E-03	0.00000E+00	0.00000E+00
315	8.66558E-01	1.25845E+01	8.81182E-01	1.41930E-03	0.00000E+00	0.00000E+00
316	9.08470E-01	1.26247E+01	8.81269E-01	1.41744E-03	0.00000E+00	0.00000E+00
317	9.40257E-01	1.26640E+01	8.81456E-01	1.42528E-03	0.00000E+00	0.00000E+00
318	8.89599E-01	1.27035E+01	8.81482E-01	1.42100E-03	0.00000E+00	0.00000E+00
319	9.10267E-01	1.27428E+01	8.81573E-01	1.41942E-03	0.00000E+00	0.00000E+00
320	9.47962E-01	1.27830E+01	8.81781E-01	1.43027E-03	0.00000E+00	0.00000E+00
321	8.63157E-01	1.28225E+01	8.81723E-01	1.42697E-03	0.00000E+00	0.00000E+00
322	8.87308E-01	1.28608E+01	8.81741E-01	1.42261E-03	0.00000E+00	0.00000E+00
323	8.78837E-01	1.29012E+01	8.81731E-01	1.41820E-03	0.00000E+00	0.00000E+00
324	8.69994E-01	1.29405E+01	8.81695E-01	1.41426E-03	0.00000E+00	0.00000E+00
325	8.48419E-01	1.29808E+01	8.81592E-01	1.41363E-03	0.00000E+00	0.00000E+00
326	8.24851E-01	1.30212E+01	8.81417E-01	1.42010E-03	0.00000E+00	0.00000E+00
327	8.97920E-01	1.30605E+01	8.81468E-01	1.41664E-03	0.00000E+00	0.00000E+00
328	8.87696E-01	1.30998E+01	8.81487E-01	1.41241E-03	0.00000E+00	0.00000E+00
329	8.92020E-01	1.31410E+01	8.81519E-01	1.40846E-03	0.00000E+00	0.00000E+00
330	8.71113E-01	1.31785E+01	8.81487E-01	1.40452E-03	0.00000E+00	0.00000E+00
331	8.52141E-01	1.32188E+01	8.81398E-01	1.40308E-03	0.00000E+00	0.00000E+00
332	8.74587E-01	1.32592E+01	8.81377E-01	1.39897E-03	0.00000E+00	0.00000E+00
333	9.20351E-01	1.32993E+01	8.81495E-01	1.39970E-03	0.00000E+00	0.00000E+00
334	8.33038E-01	1.33387E+01	8.81349E-01	1.40309E-03	0.00000E+00	0.00000E+00
335	8.68112E-01	1.33790E+01	8.81309E-01	1.39943E-03	0.00000E+00	0.00000E+00
336	9.17371E-01	1.34175E+01	8.81417E-01	1.39941E-03	0.00000E+00	0.00000E+00
337	9.08943E-01	1.34587E+01	8.81500E-01	1.39764E-03	0.00000E+00	0.00000E+00
338	8.58098E-01	1.34990E+01	8.81430E-01	1.39522E-03	0.00000E+00	0.00000E+00
339	8.67702E-01	1.35383E+01	8.81389E-01	1.39167E-03	0.00000E+00	0.00000E+00
340	8.96813E-01	1.35785E+01	8.81435E-01	1.38829E-03	0.00000E+00	0.00000E+00
341	9.18136E-01	1.36180E+01	8.81543E-01	1.38842E-03	0.00000E+00	0.00000E+00
342	8.95133E-01	1.36582E+01	8.81583E-01	1.38491E-03	0.00000E+00	0.00000E+00
343	9.00867E-01	1.36985E+01	8.81640E-01	1.38200E-03	0.00000E+00	0.00000E+00
344	8.94506E-01	1.37388E+01	8.81677E-01	1.37846E-03	0.00000E+00	0.00000E+00
345	8.94107E-01	1.37772E+01	8.81713E-01	1.37492E-03	0.00000E+00	0.00000E+00
346	8.91497E-01	1.38157E+01	8.81742E-01	1.37121E-03	0.00000E+00	0.00000E+00
347	8.80193E-01	1.38550E+01	8.81737E-01	1.36724E-03	0.00000E+00	0.00000E+00
348	8.99451E-01	1.38943E+01	8.81789E-01	1.36424E-03	0.00000E+00	0.00000E+00
349	8.68768E-01	1.39347E+01	8.81751E-01	1.36082E-03	0.00000E+00	0.00000E+00
350	8.73630E-01	1.39758E+01	8.81728E-01	1.35710E-03	0.00000E+00	0.00000E+00
351	8.82763E-01	1.40162E+01	8.81731E-01	1.35321E-03	0.00000E+00	0.00000E+00
352	8.84028E-01	1.40555E+01	8.81737E-01	1.34936E-03	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

353	9.03673E-01	1.40958E+01	8.81800E-01	1.34696E-03	0.00000E+00	0.00000E+00
354	8.78421E-01	1.41360E+01	8.81790E-01	1.34316E-03	0.00000E+00	0.00000E+00
355	8.66420E-01	1.41755E+01	8.81747E-01	1.34006E-03	0.00000E+00	0.00000E+00
356	8.70497E-01	1.42157E+01	8.81715E-01	1.33665E-03	0.00000E+00	0.00000E+00
357	9.06568E-01	1.42560E+01	8.81785E-01	1.33471E-03	0.00000E+00	0.00000E+00
358	8.84640E-01	1.42953E+01	8.81793E-01	1.33098E-03	0.00000E+00	0.00000E+00
359	8.86011E-01	1.43365E+01	8.81805E-01	1.32730E-03	0.00000E+00	0.00000E+00
360	8.44734E-01	1.43750E+01	8.81701E-01	1.32763E-03	0.00000E+00	0.00000E+00
361	8.90264E-01	1.44153E+01	8.81725E-01	1.32414E-03	0.00000E+00	0.00000E+00
362	8.87351E-01	1.44555E+01	8.81741E-01	1.32055E-03	0.00000E+00	0.00000E+00
363	8.98732E-01	1.44958E+01	8.81788E-01	1.31773E-03	0.00000E+00	0.00000E+00
364	8.56659E-01	1.45352E+01	8.81718E-01	1.31592E-03	0.00000E+00	0.00000E+00
365	8.96493E-01	1.45745E+01	8.81759E-01	1.31292E-03	0.00000E+00	0.00000E+00
366	9.01091E-01	1.46158E+01	8.81812E-01	1.31038E-03	0.00000E+00	0.00000E+00
367	8.77226E-01	1.46560E+01	8.81800E-01	1.30685E-03	0.00000E+00	0.00000E+00
368	8.87962E-01	1.46953E+01	8.81816E-01	1.30338E-03	0.00000E+00	0.00000E+00
369	9.05514E-01	1.47348E+01	8.81881E-01	1.30143E-03	0.00000E+00	0.00000E+00
370	8.70202E-01	1.47742E+01	8.81849E-01	1.29828E-03	0.00000E+00	0.00000E+00
371	8.99787E-01	1.48135E+01	8.81898E-01	1.29566E-03	0.00000E+00	0.00000E+00
372	8.72817E-01	1.48547E+01	8.81873E-01	1.29239E-03	0.00000E+00	0.00000E+00
373	8.79512E-01	1.48940E+01	8.81867E-01	1.28892E-03	0.00000E+00	0.00000E+00
374	9.08171E-01	1.49333E+01	8.81938E-01	1.28739E-03	0.00000E+00	0.00000E+00
375	9.09237E-01	1.49728E+01	8.82011E-01	1.28602E-03	0.00000E+00	0.00000E+00
376	9.28986E-01	1.50122E+01	8.82136E-01	1.28871E-03	0.00000E+00	0.00000E+00
377	8.86542E-01	1.50515E+01	8.82148E-01	1.28533E-03	0.00000E+00	0.00000E+00
378	8.65032E-01	1.50900E+01	8.82103E-01	1.28271E-03	0.00000E+00	0.00000E+00
379	8.58366E-01	1.51302E+01	8.82040E-01	1.28085E-03	0.00000E+00	0.00000E+00
380	8.71339E-01	1.51697E+01	8.82011E-01	1.27777E-03	0.00000E+00	0.00000E+00
381	9.18535E-01	1.52098E+01	8.82108E-01	1.27803E-03	0.00000E+00	0.00000E+00
382	8.61027E-01	1.52492E+01	8.82052E-01	1.27587E-03	0.00000E+00	0.00000E+00
383	8.84519E-01	1.52887E+01	8.82059E-01	1.27254E-03	0.00000E+00	0.00000E+00
384	8.77978E-01	1.53288E+01	8.82048E-01	1.26925E-03	0.00000E+00	0.00000E+00
385	8.98160E-01	1.53692E+01	8.82090E-01	1.26663E-03	0.00000E+00	0.00000E+00
386	8.63618E-01	1.54085E+01	8.82042E-01	1.26424E-03	0.00000E+00	0.00000E+00
387	9.01063E-01	1.54470E+01	8.82091E-01	1.26192E-03	0.00000E+00	0.00000E+00
388	8.90304E-01	1.54863E+01	8.82113E-01	1.25883E-03	0.00000E+00	0.00000E+00
389	8.91824E-01	1.55267E+01	8.82138E-01	1.25582E-03	0.00000E+00	0.00000E+00
390	8.46748E-01	1.55650E+01	8.82047E-01	1.25589E-03	0.00000E+00	0.00000E+00
391	8.88290E-01	1.56043E+01	8.82063E-01	1.25277E-03	0.00000E+00	0.00000E+00
392	8.88432E-01	1.56428E+01	8.82079E-01	1.24966E-03	0.00000E+00	0.00000E+00
393	8.67039E-01	1.56822E+01	8.82041E-01	1.24705E-03	0.00000E+00	0.00000E+00
394	8.87371E-01	1.57225E+01	8.82054E-01	1.24394E-03	0.00000E+00	0.00000E+00
395	9.11865E-01	1.57628E+01	8.82130E-01	1.24308E-03	0.00000E+00	0.00000E+00
396	8.71234E-01	1.58012E+01	8.82102E-01	1.24023E-03	0.00000E+00	0.00000E+00
397	9.15677E-01	1.58407E+01	8.82187E-01	1.24001E-03	0.00000E+00	0.00000E+00
398	8.89985E-01	1.58808E+01	8.82207E-01	1.23703E-03	0.00000E+00	0.00000E+00
399	8.90441E-01	1.59212E+01	8.82228E-01	1.23408E-03	0.00000E+00	0.00000E+00
400	8.75305E-01	1.59605E+01	8.82210E-01	1.23110E-03	0.00000E+00	0.00000E+00
401	8.87245E-01	1.59998E+01	8.82223E-01	1.22808E-03	0.00000E+00	0.00000E+00
402	9.05891E-01	1.60392E+01	8.82282E-01	1.22643E-03	0.00000E+00	0.00000E+00
403	8.70886E-01	1.60787E+01	8.82254E-01	1.22370E-03	0.00000E+00	0.00000E+00
404	8.79554E-01	1.61188E+01	8.82247E-01	1.22067E-03	0.00000E+00	0.00000E+00
405	8.39682E-01	1.61582E+01	8.82141E-01	1.22221E-03	0.00000E+00	0.00000E+00
406	9.03185E-01	1.61985E+01	8.82193E-01	1.22029E-03	0.00000E+00	0.00000E+00
407	8.56177E-01	1.62388E+01	8.82129E-01	1.21897E-03	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

408	8.84160E-01	1.62782E+01	8.82134E-01	1.21597E-03	0.00000E+00	0.00000E+00
409	9.07301E-01	1.63185E+01	8.82196E-01	1.21456E-03	0.00000E+00	0.00000E+00
410	8.68245E-01	1.63568E+01	8.82162E-01	1.21206E-03	0.00000E+00	0.00000E+00
411	9.07611E-01	1.63963E+01	8.82224E-01	1.21069E-03	0.00000E+00	0.00000E+00
412	8.75487E-01	1.64365E+01	8.82208E-01	1.20785E-03	0.00000E+00	0.00000E+00
413	9.11941E-01	1.64758E+01	8.82280E-01	1.20707E-03	0.00000E+00	0.00000E+00
414	8.55267E-01	1.65153E+01	8.82214E-01	1.20592E-03	0.00000E+00	0.00000E+00
415	8.68168E-01	1.65555E+01	8.82180E-01	1.20348E-03	0.00000E+00	0.00000E+00
416	9.15813E-01	1.65958E+01	8.82262E-01	1.20332E-03	0.00000E+00	0.00000E+00
417	8.99200E-01	1.66343E+01	8.82302E-01	1.20111E-03	0.00000E+00	0.00000E+00
418	8.96912E-01	1.66745E+01	8.82338E-01	1.19873E-03	0.00000E+00	0.00000E+00
419	8.62986E-01	1.67138E+01	8.82291E-01	1.19675E-03	0.00000E+00	0.00000E+00
420	8.96614E-01	1.67523E+01	8.82325E-01	1.19438E-03	0.00000E+00	0.00000E+00
421	8.82352E-01	1.67927E+01	8.82326E-01	1.19152E-03	0.00000E+00	0.00000E+00
422	8.65613E-01	1.68328E+01	8.82286E-01	1.18935E-03	0.00000E+00	0.00000E+00
423	8.82556E-01	1.68723E+01	8.82286E-01	1.18652E-03	0.00000E+00	0.00000E+00
424	9.08713E-01	1.69117E+01	8.82349E-01	1.18536E-03	0.00000E+00	0.00000E+00
425	8.93695E-01	1.69502E+01	8.82376E-01	1.18286E-03	0.00000E+00	0.00000E+00
426	8.70718E-01	1.69895E+01	8.82348E-01	1.18039E-03	0.00000E+00	0.00000E+00
427	9.06052E-01	1.70288E+01	8.82404E-01	1.17893E-03	0.00000E+00	0.00000E+00
428	8.90895E-01	1.70682E+01	8.82424E-01	1.17633E-03	0.00000E+00	0.00000E+00
429	8.72919E-01	1.71085E+01	8.82402E-01	1.17378E-03	0.00000E+00	0.00000E+00
430	8.85284E-01	1.71468E+01	8.82408E-01	1.17105E-03	0.00000E+00	0.00000E+00
431	8.91349E-01	1.71872E+01	8.82429E-01	1.16850E-03	0.00000E+00	0.00000E+00
432	8.57679E-01	1.72275E+01	8.82372E-01	1.16720E-03	0.00000E+00	0.00000E+00
433	8.81645E-01	1.72677E+01	8.82370E-01	1.16449E-03	0.00000E+00	0.00000E+00
434	9.15060E-01	1.73072E+01	8.82446E-01	1.16426E-03	0.00000E+00	0.00000E+00
435	8.39969E-01	1.73473E+01	8.82348E-01	1.16570E-03	0.00000E+00	0.00000E+00
436	9.40917E-01	1.73867E+01	8.82483E-01	1.17082E-03	0.00000E+00	0.00000E+00
437	8.72358E-01	1.74270E+01	8.82459E-01	1.16835E-03	0.00000E+00	0.00000E+00
438	9.35555E-01	1.74663E+01	8.82581E-01	1.17201E-03	0.00000E+00	0.00000E+00
439	8.53128E-01	1.75058E+01	8.82514E-01	1.17127E-03	0.00000E+00	0.00000E+00
440	8.54364E-01	1.75452E+01	8.82449E-01	1.17036E-03	0.00000E+00	0.00000E+00
441	8.48884E-01	1.75845E+01	8.82373E-01	1.17019E-03	0.00000E+00	0.00000E+00
442	8.92398E-01	1.76248E+01	8.82396E-01	1.16775E-03	0.00000E+00	0.00000E+00
443	8.92706E-01	1.76660E+01	8.82419E-01	1.16533E-03	0.00000E+00	0.00000E+00
444	8.41588E-01	1.77062E+01	8.82327E-01	1.16636E-03	0.00000E+00	0.00000E+00
445	8.77350E-01	1.77465E+01	8.82316E-01	1.16378E-03	0.00000E+00	0.00000E+00
446	8.61286E-01	1.77858E+01	8.82268E-01	1.16212E-03	0.00000E+00	0.00000E+00
447	9.02126E-01	1.78252E+01	8.82313E-01	1.16036E-03	0.00000E+00	0.00000E+00
448	9.04592E-01	1.78655E+01	8.82363E-01	1.15883E-03	0.00000E+00	0.00000E+00
449	8.97089E-01	1.79058E+01	8.82396E-01	1.15671E-03	0.00000E+00	0.00000E+00
450	8.76106E-01	1.79452E+01	8.82382E-01	1.15421E-03	0.00000E+00	0.00000E+00
451	8.76715E-01	1.79837E+01	8.82369E-01	1.15170E-03	0.00000E+00	0.00000E+00
452	8.86842E-01	1.80230E+01	8.82379E-01	1.14918E-03	0.00000E+00	0.00000E+00
453	8.95730E-01	1.80632E+01	8.82409E-01	1.14702E-03	0.00000E+00	0.00000E+00
454	8.74973E-01	1.81027E+01	8.82392E-01	1.14459E-03	0.00000E+00	0.00000E+00
455	8.75774E-01	1.81420E+01	8.82378E-01	1.14216E-03	0.00000E+00	0.00000E+00
456	8.41602E-01	1.81813E+01	8.82288E-01	1.14317E-03	0.00000E+00	0.00000E+00
457	8.75021E-01	1.82217E+01	8.82272E-01	1.14077E-03	0.00000E+00	0.00000E+00
458	8.73079E-01	1.82610E+01	8.82252E-01	1.13844E-03	0.00000E+00	0.00000E+00
459	8.32778E-01	1.83003E+01	8.82143E-01	1.14110E-03	0.00000E+00	0.00000E+00
460	8.44397E-01	1.83397E+01	8.82061E-01	1.14158E-03	0.00000E+00	0.00000E+00
461	8.38710E-01	1.83790E+01	8.81966E-01	1.14300E-03	0.00000E+00	0.00000E+00
462	8.82149E-01	1.84185E+01	8.81967E-01	1.14051E-03	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

463	9.06293E-01	1.84587E+01	8.82020E-01	1.13926E-03	0.00000E+00	0.00000E+00
464	8.49087E-01	1.84990E+01	8.81948E-01	1.13902E-03	0.00000E+00	0.00000E+00
465	8.55269E-01	1.85383E+01	8.81891E-01	1.13802E-03	0.00000E+00	0.00000E+00
466	8.89566E-01	1.85787E+01	8.81907E-01	1.13568E-03	0.00000E+00	0.00000E+00
467	8.92740E-01	1.86188E+01	8.81931E-01	1.13348E-03	0.00000E+00	0.00000E+00
468	8.39615E-01	1.86573E+01	8.81840E-01	1.13468E-03	0.00000E+00	0.00000E+00
469	8.74764E-01	1.86985E+01	8.81825E-01	1.13235E-03	0.00000E+00	0.00000E+00
470	8.90642E-01	1.87388E+01	8.81843E-01	1.13009E-03	0.00000E+00	0.00000E+00
471	8.90220E-01	1.87782E+01	8.81861E-01	1.12782E-03	0.00000E+00	0.00000E+00
472	9.61537E-01	1.88175E+01	8.82031E-01	1.13811E-03	0.00000E+00	0.00000E+00
473	9.01940E-01	1.88552E+01	8.82073E-01	1.13648E-03	0.00000E+00	0.00000E+00
474	8.80985E-01	1.88953E+01	8.82071E-01	1.13407E-03	0.00000E+00	0.00000E+00
475	9.04594E-01	1.89347E+01	8.82118E-01	1.13267E-03	0.00000E+00	0.00000E+00
476	8.48742E-01	1.89750E+01	8.82048E-01	1.13247E-03	0.00000E+00	0.00000E+00
477	8.77631E-01	1.90143E+01	8.82039E-01	1.13012E-03	0.00000E+00	0.00000E+00
478	8.69849E-01	1.90537E+01	8.82013E-01	1.12804E-03	0.00000E+00	0.00000E+00
479	8.69407E-01	1.90932E+01	8.81987E-01	1.12598E-03	0.00000E+00	0.00000E+00
480	8.99173E-01	1.91325E+01	8.82023E-01	1.12420E-03	0.00000E+00	0.00000E+00
481	8.52328E-01	1.91727E+01	8.81961E-01	1.12356E-03	0.00000E+00	0.00000E+00
482	8.58089E-01	1.92122E+01	8.81911E-01	1.12232E-03	0.00000E+00	0.00000E+00
483	9.19698E-01	1.92515E+01	8.81989E-01	1.12273E-03	0.00000E+00	0.00000E+00
484	8.83794E-01	1.92917E+01	8.81993E-01	1.12041E-03	0.00000E+00	0.00000E+00
485	8.69506E-01	1.93312E+01	8.81967E-01	1.11838E-03	0.00000E+00	0.00000E+00
486	8.86563E-01	1.93713E+01	8.81977E-01	1.11611E-03	0.00000E+00	0.00000E+00
487	8.56677E-01	1.94098E+01	8.81925E-01	1.11503E-03	0.00000E+00	0.00000E+00
488	8.63728E-01	1.94502E+01	8.81887E-01	1.11336E-03	0.00000E+00	0.00000E+00
489	8.72829E-01	1.94903E+01	8.81869E-01	1.11123E-03	0.00000E+00	0.00000E+00
490	9.02072E-01	1.95288E+01	8.81910E-01	1.10972E-03	0.00000E+00	0.00000E+00
491	8.97118E-01	1.95692E+01	8.81941E-01	1.10789E-03	0.00000E+00	0.00000E+00
492	9.25546E-01	1.96093E+01	8.82030E-01	1.10920E-03	0.00000E+00	0.00000E+00
493	9.15487E-01	1.96488E+01	8.82098E-01	1.10903E-03	0.00000E+00	0.00000E+00
494	8.53320E-01	1.96890E+01	8.82040E-01	1.10832E-03	0.00000E+00	0.00000E+00
495	8.97121E-01	1.97275E+01	8.82070E-01	1.10649E-03	0.00000E+00	0.00000E+00
496	8.71942E-01	1.97678E+01	8.82050E-01	1.10444E-03	0.00000E+00	0.00000E+00
497	8.55946E-01	1.98080E+01	8.81997E-01	1.10347E-03	0.00000E+00	0.00000E+00
498	9.02029E-01	1.98473E+01	8.82038E-01	1.10198E-03	0.00000E+00	0.00000E+00
499	8.60758E-01	1.98868E+01	8.81995E-01	1.10060E-03	0.00000E+00	0.00000E+00
500	9.03307E-01	1.99270E+01	8.82037E-01	1.09922E-03	0.00000E+00	0.00000E+00
501	8.68025E-01	1.99663E+01	8.82009E-01	1.09737E-03	0.00000E+00	0.00000E+00
502	8.70763E-01	2.00067E+01	8.81987E-01	1.09541E-03	0.00000E+00	0.00000E+00
503	8.56129E-01	2.00460E+01	8.81935E-01	1.09444E-03	0.00000E+00	0.00000E+00
KENO MESSAGE NUMBER K5-132		WARNING....ONLY	985 INDEPENDENT	FISSION POINTS WERE	GENERATED	
504	8.17122E-01	2.00863E+01	8.81806E-01	1.09986E-03	0.00000E+00	0.00000E+00
505	8.70737E-01	2.01248E+01	8.81784E-01	1.09789E-03	0.00000E+00	0.00000E+00
506	9.09339E-01	2.01650E+01	8.81839E-01	1.09707E-03	0.00000E+00	0.00000E+00
507	9.19328E-01	2.02045E+01	8.81913E-01	1.09741E-03	0.00000E+00	0.00000E+00
508	9.12408E-01	2.02438E+01	8.81973E-01	1.09690E-03	0.00000E+00	0.00000E+00
509	8.78124E-01	2.02832E+01	8.81966E-01	1.09476E-03	0.00000E+00	0.00000E+00
510	8.79549E-01	2.03225E+01	8.81961E-01	1.09261E-03	0.00000E+00	0.00000E+00
511	9.31643E-01	2.03618E+01	8.82059E-01	1.09482E-03	0.00000E+00	0.00000E+00
512	8.86865E-01	2.04003E+01	8.82068E-01	1.09271E-03	0.00000E+00	0.00000E+00
513	8.84233E-01	2.04397E+01	8.82072E-01	1.09058E-03	0.00000E+00	0.00000E+00
514	9.00211E-01	2.04790E+01	8.82108E-01	1.08903E-03	0.00000E+00	0.00000E+00
515	9.21342E-01	2.05193E+01	8.82184E-01	1.08959E-03	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

516	9.23000E-01	2.05587E+01	8.82264E-01	1.09036E-03	0.00000E+00	0.00000E+00
517	8.93883E-01	2.05990E+01	8.82286E-01	1.08848E-03	0.00000E+00	0.00000E+00
518	8.63400E-01	2.06393E+01	8.82250E-01	1.08698E-03	0.00000E+00	0.00000E+00
519	8.61607E-01	2.06795E+01	8.82210E-01	1.08561E-03	0.00000E+00	0.00000E+00
520	8.63854E-01	2.07188E+01	8.82174E-01	1.08409E-03	0.00000E+00	0.00000E+00
521	8.91655E-01	2.07592E+01	8.82192E-01	1.08216E-03	0.00000E+00	0.00000E+00
522	8.73559E-01	2.07977E+01	8.82176E-01	1.08020E-03	0.00000E+00	0.00000E+00
523	8.68968E-01	2.08360E+01	8.82151E-01	1.07842E-03	0.00000E+00	0.00000E+00
524	8.66051E-01	2.08745E+01	8.82120E-01	1.07680E-03	0.00000E+00	0.00000E+00
525	8.78692E-01	2.09157E+01	8.82113E-01	1.07476E-03	0.00000E+00	0.00000E+00
526	8.47636E-01	2.09568E+01	8.82047E-01	1.07472E-03	0.00000E+00	0.00000E+00
527	8.58411E-01	2.09963E+01	8.82002E-01	1.07361E-03	0.00000E+00	0.00000E+00
528	8.12478E-01	2.10365E+01	8.81870E-01	1.07969E-03	0.00000E+00	0.00000E+00
529	8.82227E-01	2.10768E+01	8.81871E-01	1.07764E-03	0.00000E+00	0.00000E+00
530	8.42374E-01	2.11172E+01	8.81796E-01	1.07820E-03	0.00000E+00	0.00000E+00
531	8.74614E-01	2.11573E+01	8.81782E-01	1.07624E-03	0.00000E+00	0.00000E+00
532	8.86053E-01	2.11967E+01	8.81790E-01	1.07424E-03	0.00000E+00	0.00000E+00
533	9.12332E-01	2.12370E+01	8.81848E-01	1.07376E-03	0.00000E+00	0.00000E+00
534	8.78468E-01	2.12763E+01	8.81842E-01	1.07176E-03	0.00000E+00	0.00000E+00
535	8.90432E-01	2.13167E+01	8.81858E-01	1.06986E-03	0.00000E+00	0.00000E+00
536	8.44220E-01	2.13570E+01	8.81787E-01	1.07018E-03	0.00000E+00	0.00000E+00
537	8.44108E-01	2.13963E+01	8.81717E-01	1.07050E-03	0.00000E+00	0.00000E+00
538	9.23963E-01	2.14357E+01	8.81796E-01	1.07140E-03	0.00000E+00	0.00000E+00
539	8.74314E-01	2.14750E+01	8.81782E-01	1.06950E-03	0.00000E+00	0.00000E+00
540	8.80722E-01	2.15143E+01	8.81780E-01	1.06751E-03	0.00000E+00	0.00000E+00
541	8.89401E-01	2.15538E+01	8.81794E-01	1.06562E-03	0.00000E+00	0.00000E+00
542	8.94953E-01	2.15932E+01	8.81818E-01	1.06392E-03	0.00000E+00	0.00000E+00
543	8.86277E-01	2.16333E+01	8.81827E-01	1.06199E-03	0.00000E+00	0.00000E+00
544	8.90504E-01	2.16737E+01	8.81843E-01	1.06015E-03	0.00000E+00	0.00000E+00
545	8.88598E-01	2.17122E+01	8.81855E-01	1.05827E-03	0.00000E+00	0.00000E+00
546	8.91285E-01	2.17505E+01	8.81872E-01	1.05646E-03	0.00000E+00	0.00000E+00
547	8.96664E-01	2.17908E+01	8.81899E-01	1.05487E-03	0.00000E+00	0.00000E+00
548	9.40468E-01	2.18293E+01	8.82007E-01	1.05839E-03	0.00000E+00	0.00000E+00
549	9.14963E-01	2.18705E+01	8.82067E-01	1.05817E-03	0.00000E+00	0.00000E+00
550	8.68124E-01	2.19090E+01	8.82042E-01	1.05654E-03	0.00000E+00	0.00000E+00
551	8.64745E-01	2.19483E+01	8.82010E-01	1.05508E-03	0.00000E+00	0.00000E+00
552	8.67584E-01	2.19877E+01	8.81984E-01	1.05349E-03	0.00000E+00	0.00000E+00
553	9.01171E-01	2.20288E+01	8.82019E-01	1.05215E-03	0.00000E+00	0.00000E+00
554	9.04750E-01	2.20700E+01	8.82060E-01	1.05105E-03	0.00000E+00	0.00000E+00
555	8.59889E-01	2.21095E+01	8.82020E-01	1.04992E-03	0.00000E+00	0.00000E+00
556	8.73067E-01	2.21478E+01	8.82004E-01	1.04814E-03	0.00000E+00	0.00000E+00
557	8.63804E-01	2.21863E+01	8.81971E-01	1.04677E-03	0.00000E+00	0.00000E+00
558	9.48995E-01	2.22257E+01	8.82091E-01	1.05181E-03	0.00000E+00	0.00000E+00
559	9.20640E-01	2.22660E+01	8.82160E-01	1.05220E-03	0.00000E+00	0.00000E+00
560	8.43694E-01	2.23062E+01	8.82092E-01	1.05258E-03	0.00000E+00	0.00000E+00
561	8.82129E-01	2.23457E+01	8.82092E-01	1.05069E-03	0.00000E+00	0.00000E+00
562	8.97580E-01	2.23850E+01	8.82119E-01	1.04918E-03	0.00000E+00	0.00000E+00
563	8.61908E-01	2.24243E+01	8.82083E-01	1.04792E-03	0.00000E+00	0.00000E+00
564	8.68591E-01	2.24628E+01	8.82059E-01	1.04633E-03	0.00000E+00	0.00000E+00
565	8.66369E-01	2.25030E+01	8.82031E-01	1.04485E-03	0.00000E+00	0.00000E+00
566	9.04905E-01	2.25425E+01	8.82072E-01	1.04378E-03	0.00000E+00	0.00000E+00
567	9.09679E-01	2.25827E+01	8.82121E-01	1.04308E-03	0.00000E+00	0.00000E+00
568	8.82234E-01	2.26230E+01	8.82121E-01	1.04123E-03	0.00000E+00	0.00000E+00
569	8.68176E-01	2.26623E+01	8.82096E-01	1.03968E-03	0.00000E+00	0.00000E+00
570	8.99375E-01	2.27027E+01	8.82127E-01	1.03830E-03	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

571	8.77770E-01	2.27420E+01	8.82119E-01	1.03650E-03	0.00000E+00	0.00000E+00
572	8.44679E-01	2.27832E+01	8.82053E-01	1.03676E-03	0.00000E+00	0.00000E+00
573	8.94850E-01	2.28225E+01	8.82076E-01	1.03519E-03	0.00000E+00	0.00000E+00
574	8.92159E-01	2.28628E+01	8.82094E-01	1.03353E-03	0.00000E+00	0.00000E+00
575	8.96787E-01	2.29032E+01	8.82119E-01	1.03204E-03	0.00000E+00	0.00000E+00
576	9.02736E-01	2.29443E+01	8.82155E-01	1.03087E-03	0.00000E+00	0.00000E+00
577	8.89806E-01	2.29845E+01	8.82168E-01	1.02916E-03	0.00000E+00	0.00000E+00
578	8.72142E-01	2.30240E+01	8.82151E-01	1.02752E-03	0.00000E+00	0.00000E+00
579	8.98391E-01	2.30642E+01	8.82179E-01	1.02612E-03	0.00000E+00	0.00000E+00
580	9.10201E-01	2.31027E+01	8.82228E-01	1.02549E-03	0.00000E+00	0.00000E+00
581	8.87118E-01	2.31420E+01	8.82236E-01	1.02375E-03	0.00000E+00	0.00000E+00
582	8.88775E-01	2.31823E+01	8.82247E-01	1.02205E-03	0.00000E+00	0.00000E+00
583	8.68045E-01	2.32217E+01	8.82223E-01	1.02058E-03	0.00000E+00	0.00000E+00
584	8.66961E-01	2.32620E+01	8.82197E-01	1.01916E-03	0.00000E+00	0.00000E+00
585	8.78780E-01	2.33022E+01	8.82191E-01	1.01743E-03	0.00000E+00	0.00000E+00
586	8.89640E-01	2.33425E+01	8.82204E-01	1.01577E-03	0.00000E+00	0.00000E+00
587	9.04818E-01	2.33810E+01	8.82242E-01	1.01477E-03	0.00000E+00	0.00000E+00
588	8.78231E-01	2.34212E+01	8.82235E-01	1.01306E-03	0.00000E+00	0.00000E+00
589	9.07292E-01	2.34615E+01	8.82278E-01	1.01223E-03	0.00000E+00	0.00000E+00
590	8.71047E-01	2.35000E+01	8.82259E-01	1.01069E-03	0.00000E+00	0.00000E+00
591	8.63600E-01	2.35393E+01	8.82227E-01	1.00947E-03	0.00000E+00	0.00000E+00
592	9.11831E-01	2.35787E+01	8.82277E-01	1.00900E-03	0.00000E+00	0.00000E+00
593	8.96332E-01	2.36190E+01	8.82301E-01	1.00757E-03	0.00000E+00	0.00000E+00
594	9.04535E-01	2.36592E+01	8.82339E-01	1.00657E-03	0.00000E+00	0.00000E+00
595	8.22890E-01	2.36995E+01	8.82239E-01	1.00986E-03	0.00000E+00	0.00000E+00
596	8.87285E-01	2.37388E+01	8.82247E-01	1.00819E-03	0.00000E+00	0.00000E+00
597	8.95198E-01	2.37800E+01	8.82269E-01	1.00673E-03	0.00000E+00	0.00000E+00
598	8.72589E-01	2.38195E+01	8.82253E-01	1.00518E-03	0.00000E+00	0.00000E+00
599	8.68900E-01	2.38597E+01	8.82230E-01	1.00374E-03	0.00000E+00	0.00000E+00
600	8.79766E-01	2.38990E+01	8.82226E-01	1.00207E-03	0.00000E+00	0.00000E+00
601	8.60220E-01	2.39393E+01	8.82189E-01	1.00107E-03	0.00000E+00	0.00000E+00
602	8.94022E-01	2.39805E+01	8.82209E-01	9.99592E-04	0.00000E+00	0.00000E+00
603	8.79061E-01	2.40235E+01	8.82204E-01	9.97942E-04	0.00000E+00	0.00000E+00
604	8.39274E-01	2.40675E+01	8.82132E-01	9.98831E-04	0.00000E+00	0.00000E+00
605	8.76488E-01	2.41097E+01	8.82123E-01	9.97218E-04	0.00000E+00	0.00000E+00
606	8.72621E-01	2.41517E+01	8.82107E-01	9.95690E-04	0.00000E+00	0.00000E+00
607	9.03733E-01	2.41967E+01	8.82143E-01	9.94685E-04	0.00000E+00	0.00000E+00
608	8.49784E-01	2.42397E+01	8.82090E-01	9.94477E-04	0.00000E+00	0.00000E+00
609	9.01798E-01	2.42817E+01	8.82122E-01	9.93368E-04	0.00000E+00	0.00000E+00
610	8.58867E-01	2.43248E+01	8.82084E-01	9.92470E-04	0.00000E+00	0.00000E+00
611	8.66619E-01	2.43668E+01	8.82059E-01	9.91164E-04	0.00000E+00	0.00000E+00
612	8.88378E-01	2.44108E+01	8.82069E-01	9.89592E-04	0.00000E+00	0.00000E+00
613	8.86050E-01	2.44547E+01	8.82075E-01	9.87993E-04	0.00000E+00	0.00000E+00
614	8.60997E-01	2.44968E+01	8.82041E-01	9.86978E-04	0.00000E+00	0.00000E+00
615	9.00311E-01	2.45398E+01	8.82071E-01	9.85818E-04	0.00000E+00	0.00000E+00
616	8.54085E-01	2.45838E+01	8.82025E-01	9.85266E-04	0.00000E+00	0.00000E+00
617	8.91856E-01	2.46260E+01	8.82041E-01	9.83792E-04	0.00000E+00	0.00000E+00
618	9.11750E-01	2.46690E+01	8.82089E-01	9.83377E-04	0.00000E+00	0.00000E+00
619	8.74224E-01	2.47128E+01	8.82077E-01	9.81865E-04	0.00000E+00	0.00000E+00
620	9.02907E-01	2.47550E+01	8.82110E-01	9.80854E-04	0.00000E+00	0.00000E+00
621	8.70416E-01	2.47980E+01	8.82092E-01	9.79450E-04	0.00000E+00	0.00000E+00
622	8.48224E-01	2.48402E+01	8.82037E-01	9.79394E-04	0.00000E+00	0.00000E+00
623	8.75961E-01	2.48822E+01	8.82027E-01	9.77864E-04	0.00000E+00	0.00000E+00
624	8.74830E-01	2.49272E+01	8.82016E-01	9.76360E-04	0.00000E+00	0.00000E+00
625	8.47952E-01	2.49702E+01	8.81961E-01	9.76323E-04	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

626	8.81179E-01	2.50122E+01	8.81960E-01	9.74758E-04	0.00000E+00	0.00000E+00
627	8.96724E-01	2.50562E+01	8.81983E-01	9.73484E-04	0.00000E+00	0.00000E+00
628	8.79372E-01	2.50992E+01	8.81979E-01	9.71937E-04	0.00000E+00	0.00000E+00
629	8.69244E-01	2.51432E+01	8.81959E-01	9.70598E-04	0.00000E+00	0.00000E+00
630	8.40868E-01	2.51853E+01	8.81893E-01	9.71258E-04	0.00000E+00	0.00000E+00
631	8.80322E-01	2.52273E+01	8.81891E-01	9.69715E-04	0.00000E+00	0.00000E+00
632	9.07667E-01	2.52713E+01	8.81932E-01	9.69039E-04	0.00000E+00	0.00000E+00
633	8.89959E-01	2.53152E+01	8.81944E-01	9.67586E-04	0.00000E+00	0.00000E+00
634	8.65669E-01	2.53583E+01	8.81919E-01	9.66397E-04	0.00000E+00	0.00000E+00
635	8.91702E-01	2.54022E+01	8.81934E-01	9.64993E-04	0.00000E+00	0.00000E+00
636	8.66782E-01	2.54452E+01	8.81910E-01	9.63766E-04	0.00000E+00	0.00000E+00
637	8.88486E-01	2.54892E+01	8.81921E-01	9.62303E-04	0.00000E+00	0.00000E+00
638	8.74290E-01	2.55340E+01	8.81909E-01	9.60863E-04	0.00000E+00	0.00000E+00
639	9.21651E-01	2.55780E+01	8.81971E-01	9.61380E-04	0.00000E+00	0.00000E+00
640	8.92408E-01	2.56365E+01	8.81987E-01	9.60012E-04	0.00000E+00	0.00000E+00
641	8.63697E-01	2.56988E+01	8.81959E-01	9.58935E-04	0.00000E+00	0.00000E+00
642	8.38296E-01	2.57455E+01	8.81891E-01	9.59863E-04	0.00000E+00	0.00000E+00
643	8.90787E-01	2.57903E+01	8.81904E-01	9.58465E-04	0.00000E+00	0.00000E+00
644	8.83693E-01	2.58362E+01	8.81907E-01	9.56975E-04	0.00000E+00	0.00000E+00
645	8.55107E-01	2.58800E+01	8.81865E-01	9.56394E-04	0.00000E+00	0.00000E+00
646	8.74671E-01	2.59222E+01	8.81854E-01	9.54973E-04	0.00000E+00	0.00000E+00
647	9.14515E-01	2.59680E+01	8.81905E-01	9.54835E-04	0.00000E+00	0.00000E+00
648	8.87086E-01	2.60118E+01	8.81913E-01	9.53390E-04	0.00000E+00	0.00000E+00
649	9.12143E-01	2.60577E+01	8.81960E-01	9.53061E-04	0.00000E+00	0.00000E+00
650	8.67178E-01	2.61043E+01	8.81937E-01	9.51863E-04	0.00000E+00	0.00000E+00
651	8.59865E-01	2.61492E+01	8.81903E-01	9.51003E-04	0.00000E+00	0.00000E+00
652	8.89124E-01	2.61950E+01	8.81914E-01	9.49604E-04	0.00000E+00	0.00000E+00
653	8.68977E-01	2.62417E+01	8.81894E-01	9.48352E-04	0.00000E+00	0.00000E+00
654	8.87446E-01	2.62902E+01	8.81903E-01	9.46935E-04	0.00000E+00	0.00000E+00
655	8.78722E-01	2.63360E+01	8.81898E-01	9.45496E-04	0.00000E+00	0.00000E+00
656	8.54416E-01	2.63817E+01	8.81856E-01	9.44984E-04	0.00000E+00	0.00000E+00
657	8.85734E-01	2.64283E+01	8.81862E-01	9.43559E-04	0.00000E+00	0.00000E+00
658	8.89068E-01	2.64760E+01	8.81873E-01	9.42184E-04	0.00000E+00	0.00000E+00
659	8.54308E-01	2.65208E+01	8.81831E-01	9.41684E-04	0.00000E+00	0.00000E+00
660	8.96234E-01	2.65685E+01	8.81853E-01	9.40506E-04	0.00000E+00	0.00000E+00
661	8.82145E-01	2.66133E+01	8.81853E-01	9.39078E-04	0.00000E+00	0.00000E+00
662	8.63435E-01	2.66573E+01	8.81825E-01	9.38069E-04	0.00000E+00	0.00000E+00
663	8.60742E-01	2.67012E+01	8.81793E-01	9.37192E-04	0.00000E+00	0.00000E+00
664	8.80474E-01	2.67460E+01	8.81791E-01	9.35777E-04	0.00000E+00	0.00000E+00
665	9.24087E-01	2.67890E+01	8.81855E-01	9.36540E-04	0.00000E+00	0.00000E+00
666	8.89245E-01	2.68293E+01	8.81866E-01	9.35195E-04	0.00000E+00	0.00000E+00
667	9.02053E-01	2.68697E+01	8.81897E-01	9.34281E-04	0.00000E+00	0.00000E+00
668	9.07235E-01	2.69098E+01	8.81935E-01	9.33652E-04	0.00000E+00	0.00000E+00
669	9.15363E-01	2.69502E+01	8.81985E-01	9.33598E-04	0.00000E+00	0.00000E+00
670	8.80778E-01	2.69905E+01	8.81983E-01	9.32201E-04	0.00000E+00	0.00000E+00
671	9.00666E-01	2.70307E+01	8.82011E-01	9.31225E-04	0.00000E+00	0.00000E+00
672	9.02518E-01	2.70710E+01	8.82041E-01	9.30338E-04	0.00000E+00	0.00000E+00
673	8.60191E-01	2.71103E+01	8.82009E-01	9.29521E-04	0.00000E+00	0.00000E+00
674	8.43162E-01	2.71498E+01	8.81951E-01	9.29935E-04	0.00000E+00	0.00000E+00
675	8.54494E-01	2.71892E+01	8.81910E-01	9.29448E-04	0.00000E+00	0.00000E+00
676	9.00082E-01	2.72285E+01	8.81937E-01	9.28460E-04	0.00000E+00	0.00000E+00
677	8.76369E-01	2.72670E+01	8.81929E-01	9.27120E-04	0.00000E+00	0.00000E+00
678	9.21882E-01	2.73072E+01	8.81988E-01	9.27632E-04	0.00000E+00	0.00000E+00
679	8.66146E-01	2.73475E+01	8.81965E-01	9.26556E-04	0.00000E+00	0.00000E+00
680	9.41145E-01	2.73878E+01	8.82052E-01	9.29297E-04	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

681	9.21572E-01	2.74272E+01	8.82110E-01	9.29751E-04	0.00000E+00	0.00000E+00
682	8.82706E-01	2.74673E+01	8.82111E-01	9.28383E-04	0.00000E+00	0.00000E+00
683	9.30870E-01	2.75077E+01	8.82183E-01	9.29780E-04	0.00000E+00	0.00000E+00
684	9.18676E-01	2.75818E+01	8.82236E-01	9.29956E-04	0.00000E+00	0.00000E+00
685	8.72945E-01	2.76222E+01	8.82223E-01	9.28693E-04	0.00000E+00	0.00000E+00
686	8.96501E-01	2.76615E+01	8.82243E-01	9.27570E-04	0.00000E+00	0.00000E+00
687	8.84210E-01	2.77960E+01	8.82246E-01	9.26219E-04	0.00000E+00	0.00000E+00
688	8.55255E-01	2.79398E+01	8.82207E-01	9.25704E-04	0.00000E+00	0.00000E+00
689	9.27962E-01	2.79792E+01	8.82274E-01	9.26752E-04	0.00000E+00	0.00000E+00
690	8.87273E-01	2.81960E+01	8.82281E-01	9.25433E-04	0.00000E+00	0.00000E+00
691	8.73215E-01	2.82757E+01	8.82268E-01	9.24182E-04	0.00000E+00	0.00000E+00
692	8.60825E-01	2.83160E+01	8.82237E-01	9.23365E-04	0.00000E+00	0.00000E+00
693	8.83965E-01	2.83710E+01	8.82239E-01	9.22031E-04	0.00000E+00	0.00000E+00
694	8.60877E-01	2.85503E+01	8.82208E-01	9.21215E-04	0.00000E+00	0.00000E+00
695	8.61498E-01	2.87912E+01	8.82178E-01	9.20370E-04	0.00000E+00	0.00000E+00
696	8.61356E-01	2.89998E+01	8.82148E-01	9.19533E-04	0.00000E+00	0.00000E+00
697	8.77909E-01	2.91883E+01	8.82142E-01	9.18229E-04	0.00000E+00	0.00000E+00
698	9.06079E-01	2.93550E+01	8.82177E-01	9.17553E-04	0.00000E+00	0.00000E+00
699	8.99207E-01	2.94987E+01	8.82201E-01	9.16562E-04	0.00000E+00	0.00000E+00
700	9.05328E-01	2.95382E+01	8.82234E-01	9.15847E-04	0.00000E+00	0.00000E+00
701	8.97019E-01	2.95775E+01	8.82255E-01	9.14781E-04	0.00000E+00	0.00000E+00
702	8.86855E-01	2.96168E+01	8.82262E-01	9.13497E-04	0.00000E+00	0.00000E+00
703	8.88162E-01	2.96553E+01	8.82270E-01	9.12231E-04	0.00000E+00	0.00000E+00
704	8.78811E-01	2.96955E+01	8.82265E-01	9.10944E-04	0.00000E+00	0.00000E+00
705	9.02841E-01	2.97358E+01	8.82295E-01	9.10118E-04	0.00000E+00	0.00000E+00
706	8.86654E-01	2.97762E+01	8.82301E-01	9.08846E-04	0.00000E+00	0.00000E+00
707	8.27798E-01	2.98163E+01	8.82224E-01	9.10842E-04	0.00000E+00	0.00000E+00
708	9.01544E-01	2.98567E+01	8.82251E-01	9.09963E-04	0.00000E+00	0.00000E+00
709	8.88350E-01	2.98970E+01	8.82260E-01	9.08716E-04	0.00000E+00	0.00000E+00
710	8.47905E-01	2.99363E+01	8.82211E-01	9.08728E-04	0.00000E+00	0.00000E+00
711	8.85558E-01	2.99757E+01	8.82216E-01	9.07458E-04	0.00000E+00	0.00000E+00
712	8.65596E-01	3.00168E+01	8.82192E-01	9.06481E-04	0.00000E+00	0.00000E+00
713	8.86826E-01	3.00543E+01	8.82199E-01	9.05229E-04	0.00000E+00	0.00000E+00
714	8.84887E-01	3.00947E+01	8.82203E-01	9.03964E-04	0.00000E+00	0.00000E+00
715	8.66677E-01	3.01340E+01	8.82181E-01	9.02958E-04	0.00000E+00	0.00000E+00
716	9.05605E-01	3.01733E+01	8.82214E-01	9.02289E-04	0.00000E+00	0.00000E+00
717	8.80338E-01	3.02147E+01	8.82211E-01	9.01030E-04	0.00000E+00	0.00000E+00
718	9.11642E-01	3.02540E+01	8.82252E-01	9.00709E-04	0.00000E+00	0.00000E+00
719	8.58942E-01	3.02942E+01	8.82220E-01	9.00039E-04	0.00000E+00	0.00000E+00
720	8.78557E-01	3.03337E+01	8.82214E-01	8.98799E-04	0.00000E+00	0.00000E+00
721	8.92727E-01	3.03730E+01	8.82229E-01	8.97668E-04	0.00000E+00	0.00000E+00
722	8.84814E-01	3.04113E+01	8.82233E-01	8.96427E-04	0.00000E+00	0.00000E+00
723	8.93520E-01	3.04517E+01	8.82248E-01	8.95320E-04	0.00000E+00	0.00000E+00
724	8.78659E-01	3.04910E+01	8.82243E-01	8.94093E-04	0.00000E+00	0.00000E+00
725	8.61449E-01	3.05295E+01	8.82215E-01	8.93318E-04	0.00000E+00	0.00000E+00
726	8.99401E-01	3.05688E+01	8.82238E-01	8.92400E-04	0.00000E+00	0.00000E+00
727	8.80250E-01	3.06100E+01	8.82236E-01	8.91172E-04	0.00000E+00	0.00000E+00
728	9.15883E-01	3.06495E+01	8.82282E-01	8.91150E-04	0.00000E+00	0.00000E+00
729	8.86874E-01	3.06897E+01	8.82288E-01	8.89945E-04	0.00000E+00	0.00000E+00
730	8.63398E-01	3.07290E+01	8.82262E-01	8.89101E-04	0.00000E+00	0.00000E+00
731	8.69945E-01	3.07703E+01	8.82245E-01	8.88041E-04	0.00000E+00	0.00000E+00
732	8.43399E-01	3.08087E+01	8.82192E-01	8.88419E-04	0.00000E+00	0.00000E+00
733	8.80263E-01	3.08490E+01	8.82190E-01	8.87207E-04	0.00000E+00	0.00000E+00
734	9.32397E-01	3.08883E+01	8.82258E-01	8.88645E-04	0.00000E+00	0.00000E+00
735	8.37599E-01	3.09287E+01	8.82197E-01	8.89521E-04	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

736	9.27630E-01	3.09680E+01	8.82259E-01	8.90462E-04	0.00000E+00	0.00000E+00
737	8.93560E-01	3.10083E+01	8.82275E-01	8.89382E-04	0.00000E+00	0.00000E+00
738	8.74518E-01	3.10477E+01	8.82264E-01	8.88236E-04	0.00000E+00	0.00000E+00
739	8.89837E-01	3.10870E+01	8.82274E-01	8.87089E-04	0.00000E+00	0.00000E+00
740	8.95250E-01	3.11263E+01	8.82292E-01	8.86061E-04	0.00000E+00	0.00000E+00
741	8.90671E-01	3.11657E+01	8.82303E-01	8.84934E-04	0.00000E+00	0.00000E+00
742	9.08882E-01	3.12042E+01	8.82339E-01	8.84467E-04	0.00000E+00	0.00000E+00
743	8.81208E-01	3.12435E+01	8.82338E-01	8.83273E-04	0.00000E+00	0.00000E+00
744	8.66451E-01	3.12838E+01	8.82316E-01	8.82342E-04	0.00000E+00	0.00000E+00
745	8.88192E-01	3.13232E+01	8.82324E-01	8.81189E-04	0.00000E+00	0.00000E+00
746	9.00612E-01	3.13617E+01	8.82349E-01	8.80347E-04	0.00000E+00	0.00000E+00
747	8.93411E-01	3.14000E+01	8.82364E-01	8.79290E-04	0.00000E+00	0.00000E+00
748	8.71527E-01	3.14395E+01	8.82349E-01	8.78231E-04	0.00000E+00	0.00000E+00
749	8.73503E-01	3.14788E+01	8.82337E-01	8.77134E-04	0.00000E+00	0.00000E+00
750	9.01890E-01	3.15182E+01	8.82363E-01	8.76351E-04	0.00000E+00	0.00000E+00
751	9.04663E-01	3.15575E+01	8.82393E-01	8.75686E-04	0.00000E+00	0.00000E+00
752	8.95468E-01	3.15968E+01	8.82410E-01	8.74692E-04	0.00000E+00	0.00000E+00
753	8.93231E-01	3.16363E+01	8.82425E-01	8.73645E-04	0.00000E+00	0.00000E+00
754	9.01668E-01	3.16765E+01	8.82450E-01	8.72858E-04	0.00000E+00	0.00000E+00
755	8.86805E-01	3.17177E+01	8.82456E-01	8.71717E-04	0.00000E+00	0.00000E+00
756	8.72417E-01	3.17572E+01	8.82443E-01	8.70662E-04	0.00000E+00	0.00000E+00
757	9.05284E-01	3.17965E+01	8.82473E-01	8.70034E-04	0.00000E+00	0.00000E+00
758	8.35064E-01	3.18358E+01	8.82410E-01	8.71142E-04	0.00000E+00	0.00000E+00
759	9.00576E-01	3.18743E+01	8.82434E-01	8.70322E-04	0.00000E+00	0.00000E+00
760	8.87853E-01	3.19155E+01	8.82442E-01	8.69202E-04	0.00000E+00	0.00000E+00
761	8.72461E-01	3.19557E+01	8.82428E-01	8.68156E-04	0.00000E+00	0.00000E+00
762	8.85743E-01	3.19952E+01	8.82433E-01	8.67024E-04	0.00000E+00	0.00000E+00
763	8.73777E-01	3.20345E+01	8.82421E-01	8.65958E-04	0.00000E+00	0.00000E+00
764	9.05848E-01	3.20720E+01	8.82452E-01	8.65368E-04	0.00000E+00	0.00000E+00
765	8.88970E-01	3.21123E+01	8.82461E-01	8.64275E-04	0.00000E+00	0.00000E+00
766	8.86938E-01	3.21517E+01	8.82467E-01	8.63163E-04	0.00000E+00	0.00000E+00
767	8.62881E-01	3.21918E+01	8.82441E-01	8.62414E-04	0.00000E+00	0.00000E+00
768	8.64585E-01	3.22303E+01	8.82418E-01	8.61603E-04	0.00000E+00	0.00000E+00
769	8.93415E-01	3.22715E+01	8.82432E-01	8.60598E-04	0.00000E+00	0.00000E+00
770	9.08474E-01	3.23118E+01	8.82466E-01	8.60145E-04	0.00000E+00	0.00000E+00
771	8.86524E-01	3.23522E+01	8.82471E-01	8.59042E-04	0.00000E+00	0.00000E+00
772	9.25830E-01	3.23915E+01	8.82528E-01	8.59772E-04	0.00000E+00	0.00000E+00
773	8.63911E-01	3.24318E+01	8.82503E-01	8.58995E-04	0.00000E+00	0.00000E+00
774	8.67589E-01	3.24712E+01	8.82484E-01	8.58100E-04	0.00000E+00	0.00000E+00
775	9.13670E-01	3.25105E+01	8.82524E-01	8.57938E-04	0.00000E+00	0.00000E+00
776	9.01353E-01	3.25498E+01	8.82549E-01	8.57174E-04	0.00000E+00	0.00000E+00
777	8.82232E-01	3.25892E+01	8.82548E-01	8.56067E-04	0.00000E+00	0.00000E+00
778	9.19355E-01	3.26303E+01	8.82596E-01	8.56278E-04	0.00000E+00	0.00000E+00
779	9.06316E-01	3.26698E+01	8.82626E-01	8.55720E-04	0.00000E+00	0.00000E+00
780	9.08899E-01	3.27100E+01	8.82660E-01	8.55286E-04	0.00000E+00	0.00000E+00
781	8.49661E-01	3.27493E+01	8.82618E-01	8.55238E-04	0.00000E+00	0.00000E+00
782	9.16196E-01	3.27888E+01	8.82661E-01	8.55224E-04	0.00000E+00	0.00000E+00
783	8.94910E-01	3.28290E+01	8.82676E-01	8.54273E-04	0.00000E+00	0.00000E+00
784	8.66590E-01	3.28693E+01	8.82656E-01	8.53428E-04	0.00000E+00	0.00000E+00
785	9.22746E-01	3.29078E+01	8.82707E-01	8.53873E-04	0.00000E+00	0.00000E+00
786	9.06284E-01	3.29490E+01	8.82737E-01	8.53314E-04	0.00000E+00	0.00000E+00
787	9.42388E-01	3.29875E+01	8.82813E-01	8.55607E-04	0.00000E+00	0.00000E+00
788	9.02136E-01	3.30268E+01	8.82838E-01	8.54871E-04	0.00000E+00	0.00000E+00
789	9.14190E-01	3.30662E+01	8.82878E-01	8.54713E-04	0.00000E+00	0.00000E+00
790	8.85970E-01	3.31055E+01	8.82881E-01	8.53637E-04	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

791	8.49674E-01	3.31448E+01	8.82839E-01	8.53593E-04	0.00000E+00	0.00000E+00
792	9.12428E-01	3.31833E+01	8.82877E-01	8.53334E-04	0.00000E+00	0.00000E+00
793	8.72720E-01	3.32237E+01	8.82864E-01	8.52351E-04	0.00000E+00	0.00000E+00
794	8.34076E-01	3.32630E+01	8.82802E-01	8.53500E-04	0.00000E+00	0.00000E+00
795	8.64122E-01	3.33023E+01	8.82779E-01	8.52748E-04	0.00000E+00	0.00000E+00
796	8.74886E-01	3.33435E+01	8.82769E-01	8.51732E-04	0.00000E+00	0.00000E+00
797	8.48514E-01	3.33828E+01	8.82726E-01	8.51750E-04	0.00000E+00	0.00000E+00
798	8.59517E-01	3.34232E+01	8.82697E-01	8.51179E-04	0.00000E+00	0.00000E+00
799	8.55769E-01	3.34617E+01	8.82663E-01	8.50782E-04	0.00000E+00	0.00000E+00
800	8.80327E-01	3.35010E+01	8.82660E-01	8.49720E-04	0.00000E+00	0.00000E+00
801	8.92688E-01	3.35412E+01	8.82672E-01	8.48748E-04	0.00000E+00	0.00000E+00
802	8.80447E-01	3.35815E+01	8.82670E-01	8.47691E-04	0.00000E+00	0.00000E+00
803	8.65536E-01	3.36208E+01	8.82648E-01	8.46903E-04	0.00000E+00	0.00000E+00
804	8.77887E-01	3.36612E+01	8.82642E-01	8.45867E-04	0.00000E+00	0.00000E+00
805	8.66415E-01	3.37005E+01	8.82622E-01	8.45055E-04	0.00000E+00	0.00000E+00
806	8.55633E-01	3.37398E+01	8.82589E-01	8.44670E-04	0.00000E+00	0.00000E+00
807	8.76156E-01	3.37802E+01	8.82581E-01	8.43658E-04	0.00000E+00	0.00000E+00
808	8.65543E-01	3.38187E+01	8.82559E-01	8.42876E-04	0.00000E+00	0.00000E+00
809	8.98443E-01	3.38598E+01	8.82579E-01	8.42061E-04	0.00000E+00	0.00000E+00
810	8.72591E-01	3.38992E+01	8.82567E-01	8.41109E-04	0.00000E+00	0.00000E+00
811	8.63937E-01	3.39395E+01	8.82544E-01	8.40384E-04	0.00000E+00	0.00000E+00
812	8.59286E-01	3.39807E+01	8.82515E-01	8.39837E-04	0.00000E+00	0.00000E+00
813	8.92750E-01	3.40200E+01	8.82528E-01	8.38896E-04	0.00000E+00	0.00000E+00
814	8.70065E-01	3.40603E+01	8.82512E-01	8.38002E-04	0.00000E+00	0.00000E+00
815	9.06882E-01	3.41005E+01	8.82542E-01	8.37508E-04	0.00000E+00	0.00000E+00
816	9.02221E-01	3.41390E+01	8.82566E-01	8.36827E-04	0.00000E+00	0.00000E+00
817	8.79265E-01	3.41783E+01	8.82562E-01	8.35810E-04	0.00000E+00	0.00000E+00
818	9.30025E-01	3.42177E+01	8.82621E-01	8.36809E-04	0.00000E+00	0.00000E+00
819	8.94065E-01	3.42572E+01	8.82635E-01	8.35901E-04	0.00000E+00	0.00000E+00
820	9.15666E-01	3.42965E+01	8.82675E-01	8.35855E-04	0.00000E+00	0.00000E+00
821	8.91504E-01	3.43368E+01	8.82686E-01	8.34903E-04	0.00000E+00	0.00000E+00
822	8.93009E-01	3.43770E+01	8.82698E-01	8.33979E-04	0.00000E+00	0.00000E+00
823	8.86628E-01	3.44163E+01	8.82703E-01	8.32977E-04	0.00000E+00	0.00000E+00
824	8.61377E-01	3.44777E+01	8.82677E-01	8.32367E-04	0.00000E+00	0.00000E+00
825	8.75953E-01	3.45217E+01	8.82669E-01	8.31395E-04	0.00000E+00	0.00000E+00
826	8.70027E-01	3.45620E+01	8.82654E-01	8.30527E-04	0.00000E+00	0.00000E+00
827	8.77346E-01	3.46003E+01	8.82647E-01	8.29545E-04	0.00000E+00	0.00000E+00
828	8.80828E-01	3.46398E+01	8.82645E-01	8.28543E-04	0.00000E+00	0.00000E+00
829	8.50566E-01	3.46800E+01	8.82606E-01	8.28449E-04	0.00000E+00	0.00000E+00
830	8.81076E-01	3.47193E+01	8.82604E-01	8.27450E-04	0.00000E+00	0.00000E+00
831	8.42050E-01	3.47588E+01	8.82555E-01	8.27898E-04	0.00000E+00	0.00000E+00
832	8.87007E-01	3.47982E+01	8.82561E-01	8.26917E-04	0.00000E+00	0.00000E+00
833	9.30243E-01	3.48365E+01	8.82618E-01	8.27912E-04	0.00000E+00	0.00000E+00
834	8.80511E-01	3.48760E+01	8.82616E-01	8.26920E-04	0.00000E+00	0.00000E+00
835	8.96821E-01	3.49162E+01	8.82633E-01	8.26103E-04	0.00000E+00	0.00000E+00
836	8.68988E-01	3.49555E+01	8.82616E-01	8.25274E-04	0.00000E+00	0.00000E+00
837	8.71200E-01	3.49950E+01	8.82603E-01	8.24399E-04	0.00000E+00	0.00000E+00
838	8.90257E-01	3.50343E+01	8.82612E-01	8.23463E-04	0.00000E+00	0.00000E+00
839	8.66278E-01	3.50737E+01	8.82592E-01	8.22710E-04	0.00000E+00	0.00000E+00
840	8.88377E-01	3.51122E+01	8.82599E-01	8.21757E-04	0.00000E+00	0.00000E+00
841	8.82194E-01	3.51515E+01	8.82599E-01	8.20777E-04	0.00000E+00	0.00000E+00
842	8.79707E-01	3.51908E+01	8.82595E-01	8.19806E-04	0.00000E+00	0.00000E+00
843	9.10384E-01	3.52293E+01	8.82628E-01	8.19497E-04	0.00000E+00	0.00000E+00
844	8.94507E-01	3.52687E+01	8.82642E-01	8.18645E-04	0.00000E+00	0.00000E+00
845	8.90709E-01	3.53098E+01	8.82652E-01	8.17729E-04	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

846	8.69568E-01	3.53502E+01	8.82637E-01	8.16907E-04	0.00000E+00	0.00000E+00
847	8.87264E-01	3.53895E+01	8.82642E-01	8.15958E-04	0.00000E+00	0.00000E+00
848	8.94858E-01	3.54280E+01	8.82656E-01	8.15121E-04	0.00000E+00	0.00000E+00
849	8.37074E-01	3.54663E+01	8.82603E-01	8.15935E-04	0.00000E+00	0.00000E+00
850	9.13930E-01	3.55067E+01	8.82640E-01	8.15809E-04	0.00000E+00	0.00000E+00
851	8.79032E-01	3.55460E+01	8.82635E-01	8.14858E-04	0.00000E+00	0.00000E+00
852	8.85122E-01	3.55845E+01	8.82638E-01	8.13904E-04	0.00000E+00	0.00000E+00
853	8.94571E-01	3.56248E+01	8.82652E-01	8.13068E-04	0.00000E+00	0.00000E+00
854	9.62724E-01	3.56642E+01	8.82746E-01	8.17533E-04	0.00000E+00	0.00000E+00
855	8.82731E-01	3.57043E+01	8.82746E-01	8.16574E-04	0.00000E+00	0.00000E+00
856	8.89285E-01	3.57428E+01	8.82754E-01	8.15654E-04	0.00000E+00	0.00000E+00
857	9.23743E-01	3.57822E+01	8.82802E-01	8.16108E-04	0.00000E+00	0.00000E+00
858	8.76216E-01	3.58225E+01	8.82794E-01	8.15191E-04	0.00000E+00	0.00000E+00
859	8.61300E-01	3.58618E+01	8.82769E-01	8.14625E-04	0.00000E+00	0.00000E+00
860	8.91294E-01	3.59003E+01	8.82779E-01	8.13736E-04	0.00000E+00	0.00000E+00
861	9.30004E-01	3.59397E+01	8.82834E-01	8.14645E-04	0.00000E+00	0.00000E+00
862	9.32903E-01	3.59790E+01	8.82892E-01	8.15777E-04	0.00000E+00	0.00000E+00
863	8.97895E-01	3.60193E+01	8.82910E-01	8.15016E-04	0.00000E+00	0.00000E+00
864	9.10402E-01	3.60587E+01	8.82942E-01	8.14694E-04	0.00000E+00	0.00000E+00
865	8.65754E-01	3.60990E+01	8.82922E-01	8.13993E-04	0.00000E+00	0.00000E+00
866	8.69823E-01	3.61392E+01	8.82906E-01	8.13192E-04	0.00000E+00	0.00000E+00
867	8.88938E-01	3.61795E+01	8.82913E-01	8.12281E-04	0.00000E+00	0.00000E+00
868	9.00093E-01	3.62198E+01	8.82933E-01	8.11585E-04	0.00000E+00	0.00000E+00
869	9.15167E-01	3.62592E+01	8.82970E-01	8.11501E-04	0.00000E+00	0.00000E+00
870	8.96414E-01	3.62995E+01	8.82986E-01	8.10713E-04	0.00000E+00	0.00000E+00
871	8.49652E-01	3.63378E+01	8.82948E-01	8.10688E-04	0.00000E+00	0.00000E+00
872	9.15365E-01	3.63790E+01	8.82985E-01	8.10612E-04	0.00000E+00	0.00000E+00
873	8.71667E-01	3.64193E+01	8.82972E-01	8.09785E-04	0.00000E+00	0.00000E+00
874	9.00009E-01	3.64587E+01	8.82991E-01	8.09092E-04	0.00000E+00	0.00000E+00
875	8.50244E-01	3.64980E+01	8.82954E-01	8.09035E-04	0.00000E+00	0.00000E+00
876	8.84192E-01	3.65383E+01	8.82955E-01	8.08110E-04	0.00000E+00	0.00000E+00
877	8.94833E-01	3.65787E+01	8.82969E-01	8.07300E-04	0.00000E+00	0.00000E+00
878	8.59358E-01	3.66180E+01	8.82942E-01	8.06828E-04	0.00000E+00	0.00000E+00
879	8.80722E-01	3.66592E+01	8.82939E-01	8.05912E-04	0.00000E+00	0.00000E+00
880	8.72658E-01	3.66985E+01	8.82928E-01	8.05078E-04	0.00000E+00	0.00000E+00
881	8.36667E-01	3.67378E+01	8.82875E-01	8.05882E-04	0.00000E+00	0.00000E+00
882	8.81112E-01	3.67773E+01	8.82873E-01	8.04968E-04	0.00000E+00	0.00000E+00
883	8.93337E-01	3.68167E+01	8.82885E-01	8.04142E-04	0.00000E+00	0.00000E+00
884	8.95296E-01	3.68560E+01	8.82899E-01	8.03353E-04	0.00000E+00	0.00000E+00
885	8.84254E-01	3.68953E+01	8.82901E-01	8.02444E-04	0.00000E+00	0.00000E+00
886	9.00281E-01	3.69347E+01	8.82920E-01	8.01777E-04	0.00000E+00	0.00000E+00
887	8.85138E-01	3.69760E+01	8.82923E-01	8.00874E-04	0.00000E+00	0.00000E+00
888	9.13759E-01	3.70172E+01	8.82957E-01	8.00727E-04	0.00000E+00	0.00000E+00
889	8.64624E-01	3.70573E+01	8.82937E-01	8.00090E-04	0.00000E+00	0.00000E+00
890	8.92166E-01	3.70968E+01	8.82947E-01	7.99257E-04	0.00000E+00	0.00000E+00
891	8.66125E-01	3.71362E+01	8.82928E-01	7.98581E-04	0.00000E+00	0.00000E+00
892	9.02822E-01	3.71755E+01	8.82951E-01	7.97997E-04	0.00000E+00	0.00000E+00
893	8.68450E-01	3.72158E+01	8.82934E-01	7.97266E-04	0.00000E+00	0.00000E+00
894	8.92813E-01	3.72552E+01	8.82945E-01	7.96449E-04	0.00000E+00	0.00000E+00
895	8.64901E-01	3.72927E+01	8.82925E-01	7.95813E-04	0.00000E+00	0.00000E+00
896	8.41329E-01	3.73330E+01	8.82879E-01	7.96283E-04	0.00000E+00	0.00000E+00
897	8.45436E-01	3.73732E+01	8.82837E-01	7.96493E-04	0.00000E+00	0.00000E+00
898	9.02403E-01	3.74135E+01	8.82859E-01	7.95903E-04	0.00000E+00	0.00000E+00
899	8.89752E-01	3.74520E+01	8.82866E-01	7.95052E-04	0.00000E+00	0.00000E+00
900	8.89794E-01	3.74913E+01	8.82874E-01	7.94204E-04	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

901	8.60332E-01	3.75298E+01	8.82849E-01	7.93716E-04	0.00000E+00	0.00000E+00
902	9.30763E-01	3.75710E+01	8.82902E-01	7.94619E-04	0.00000E+00	0.00000E+00
903	8.80199E-01	3.76112E+01	8.82899E-01	7.93742E-04	0.00000E+00	0.00000E+00
904	9.03355E-01	3.76515E+01	8.82922E-01	7.93186E-04	0.00000E+00	0.00000E+00
905	8.98741E-01	3.76945E+01	8.82939E-01	7.92501E-04	0.00000E+00	0.00000E+00
906	8.96136E-01	3.77338E+01	8.82954E-01	7.91758E-04	0.00000E+00	0.00000E+00
907	8.69383E-01	3.77733E+01	8.82939E-01	7.91025E-04	0.00000E+00	0.00000E+00
908	8.44234E-01	3.78127E+01	8.82896E-01	7.91305E-04	0.00000E+00	0.00000E+00
909	8.63161E-01	3.78510E+01	8.82875E-01	7.90732E-04	0.00000E+00	0.00000E+00
910	8.81043E-01	3.78905E+01	8.82873E-01	7.89863E-04	0.00000E+00	0.00000E+00
911	8.85773E-01	3.79317E+01	8.82876E-01	7.89000E-04	0.00000E+00	0.00000E+00
912	8.78173E-01	3.79700E+01	8.82871E-01	7.88150E-04	0.00000E+00	0.00000E+00
913	8.76063E-01	3.80103E+01	8.82863E-01	7.87320E-04	0.00000E+00	0.00000E+00
914	9.00040E-01	3.80497E+01	8.82882E-01	7.86681E-04	0.00000E+00	0.00000E+00
915	8.73214E-01	3.80900E+01	8.82871E-01	7.85891E-04	0.00000E+00	0.00000E+00
916	8.86104E-01	3.81293E+01	8.82875E-01	7.85038E-04	0.00000E+00	0.00000E+00
917	8.75636E-01	3.81687E+01	8.82867E-01	7.84220E-04	0.00000E+00	0.00000E+00
918	8.84182E-01	3.82072E+01	8.82868E-01	7.83364E-04	0.00000E+00	0.00000E+00
919	9.22498E-01	3.82475E+01	8.82912E-01	7.83702E-04	0.00000E+00	0.00000E+00
920	8.96132E-01	3.82877E+01	8.82926E-01	7.82980E-04	0.00000E+00	0.00000E+00
921	9.25559E-01	3.83280E+01	8.82972E-01	7.83503E-04	0.00000E+00	0.00000E+00
922	8.97636E-01	3.83673E+01	8.82988E-01	7.82813E-04	0.00000E+00	0.00000E+00
923	8.52250E-01	3.84067E+01	8.82955E-01	7.82674E-04	0.00000E+00	0.00000E+00
924	9.24079E-01	3.84452E+01	8.83000E-01	7.83096E-04	0.00000E+00	0.00000E+00
925	8.83102E-01	3.84855E+01	8.83000E-01	7.82247E-04	0.00000E+00	0.00000E+00
926	8.92250E-01	3.85257E+01	8.83010E-01	7.81464E-04	0.00000E+00	0.00000E+00
927	9.02516E-01	3.85642E+01	8.83031E-01	7.80904E-04	0.00000E+00	0.00000E+00
928	8.62153E-01	3.86035E+01	8.83008E-01	7.80386E-04	0.00000E+00	0.00000E+00
929	9.16951E-01	3.86447E+01	8.83045E-01	7.80403E-04	0.00000E+00	0.00000E+00
930	8.92503E-01	3.86842E+01	8.83055E-01	7.79628E-04	0.00000E+00	0.00000E+00
931	8.78143E-01	3.87235E+01	8.83050E-01	7.78806E-04	0.00000E+00	0.00000E+00
932	8.79195E-01	3.87628E+01	8.83046E-01	7.77980E-04	0.00000E+00	0.00000E+00
933	8.97217E-01	3.88032E+01	8.83061E-01	7.77293E-04	0.00000E+00	0.00000E+00
934	8.88467E-01	3.88425E+01	8.83067E-01	7.76480E-04	0.00000E+00	0.00000E+00
935	8.92736E-01	3.88818E+01	8.83077E-01	7.75716E-04	0.00000E+00	0.00000E+00
936	8.37429E-01	3.89212E+01	8.83028E-01	7.76425E-04	0.00000E+00	0.00000E+00
937	8.99421E-01	3.89623E+01	8.83046E-01	7.75792E-04	0.00000E+00	0.00000E+00
938	9.14554E-01	3.90018E+01	8.83079E-01	7.75694E-04	0.00000E+00	0.00000E+00
939	8.58625E-01	3.90412E+01	8.83053E-01	7.75305E-04	0.00000E+00	0.00000E+00
940	8.47818E-01	3.90805E+01	8.83016E-01	7.75389E-04	0.00000E+00	0.00000E+00
941	8.56232E-01	3.91208E+01	8.82987E-01	7.75087E-04	0.00000E+00	0.00000E+00
942	9.31864E-01	3.91610E+01	8.83039E-01	7.76006E-04	0.00000E+00	0.00000E+00
943	9.12862E-01	3.92003E+01	8.83071E-01	7.75829E-04	0.00000E+00	0.00000E+00
944	8.79352E-01	3.92398E+01	8.83067E-01	7.75015E-04	0.00000E+00	0.00000E+00
945	8.88809E-01	3.92782E+01	8.83073E-01	7.74216E-04	0.00000E+00	0.00000E+00
946	8.97479E-01	3.93175E+01	8.83088E-01	7.73546E-04	0.00000E+00	0.00000E+00
947	8.66574E-01	3.93578E+01	8.83071E-01	7.72925E-04	0.00000E+00	0.00000E+00
948	9.03253E-01	3.93982E+01	8.83092E-01	7.72402E-04	0.00000E+00	0.00000E+00
949	9.01569E-01	3.94375E+01	8.83112E-01	7.71833E-04	0.00000E+00	0.00000E+00
950	8.75947E-01	3.94778E+01	8.83104E-01	7.71055E-04	0.00000E+00	0.00000E+00
951	8.75460E-01	3.95190E+01	8.83096E-01	7.70285E-04	0.00000E+00	0.00000E+00
952	8.95944E-01	3.95575E+01	8.83110E-01	7.69592E-04	0.00000E+00	0.00000E+00
953	8.96185E-01	3.95968E+01	8.83123E-01	7.68905E-04	0.00000E+00	0.00000E+00
954	8.74146E-01	3.96352E+01	8.83114E-01	7.68155E-04	0.00000E+00	0.00000E+00
955	9.05963E-01	3.96755E+01	8.83138E-01	7.67723E-04	0.00000E+00	0.00000E+00

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

956	9.06859E-01	3.97140E+01	8.83163E-01	7.67321E-04	0.00000E+00	0.00000E+00
957	8.83999E-01	3.97542E+01	8.83164E-01	7.66518E-04	0.00000E+00	0.00000E+00
958	9.09150E-01	3.97937E+01	8.83191E-01	7.66198E-04	0.00000E+00	0.00000E+00
959	8.57473E-01	3.98338E+01	8.83164E-01	7.65868E-04	0.00000E+00	0.00000E+00
960	8.94787E-01	3.98732E+01	8.83176E-01	7.65165E-04	0.00000E+00	0.00000E+00
961	8.97012E-01	3.99135E+01	8.83190E-01	7.64502E-04	0.00000E+00	0.00000E+00
962	9.30624E-01	3.99538E+01	8.83240E-01	7.65302E-04	0.00000E+00	0.00000E+00
963	8.89713E-01	3.99940E+01	8.83247E-01	7.64535E-04	0.00000E+00	0.00000E+00
964	8.49902E-01	4.00335E+01	8.83212E-01	7.64526E-04	0.00000E+00	0.00000E+00
965	8.76986E-01	4.00728E+01	8.83205E-01	7.63759E-04	0.00000E+00	0.00000E+00
966	8.78277E-01	4.01122E+01	8.83200E-01	7.62984E-04	0.00000E+00	0.00000E+00
967	8.85869E-01	4.01507E+01	8.83203E-01	7.62198E-04	0.00000E+00	0.00000E+00
968	8.87499E-01	4.01900E+01	8.83208E-01	7.61421E-04	0.00000E+00	0.00000E+00
969	8.49915E-01	4.02293E+01	8.83173E-01	7.61412E-04	0.00000E+00	0.00000E+00
970	8.78878E-01	4.02687E+01	8.83169E-01	7.60638E-04	0.00000E+00	0.00000E+00
971	8.67161E-01	4.03072E+01	8.83152E-01	7.60032E-04	0.00000E+00	0.00000E+00
972	8.86124E-01	4.03483E+01	8.83155E-01	7.59255E-04	0.00000E+00	0.00000E+00
973	8.91461E-01	4.03877E+01	8.83164E-01	7.58521E-04	0.00000E+00	0.00000E+00
974	9.03433E-01	4.04262E+01	8.83185E-01	7.58027E-04	0.00000E+00	0.00000E+00
975	8.74918E-01	4.04665E+01	8.83176E-01	7.57295E-04	0.00000E+00	0.00000E+00
976	8.61610E-01	4.05067E+01	8.83154E-01	7.56841E-04	0.00000E+00	0.00000E+00
977	9.49750E-01	4.05470E+01	8.83222E-01	7.59143E-04	0.00000E+00	0.00000E+00
978	8.64457E-01	4.05873E+01	8.83203E-01	7.58609E-04	0.00000E+00	0.00000E+00
979	8.95833E-01	4.06275E+01	8.83216E-01	7.57942E-04	0.00000E+00	0.00000E+00
980	9.00901E-01	4.06678E+01	8.83234E-01	7.57383E-04	0.00000E+00	0.00000E+00
981	9.08891E-01	4.07063E+01	8.83260E-01	7.57062E-04	0.00000E+00	0.00000E+00
982	8.83295E-01	4.07457E+01	8.83260E-01	7.56290E-04	0.00000E+00	0.00000E+00
983	8.70552E-01	4.07860E+01	8.83247E-01	7.55629E-04	0.00000E+00	0.00000E+00
984	9.07649E-01	4.08262E+01	8.83272E-01	7.55268E-04	0.00000E+00	0.00000E+00
985	9.11443E-01	4.08655E+01	8.83301E-01	7.55044E-04	0.00000E+00	0.00000E+00
986	8.71276E-01	4.09050E+01	8.83289E-01	7.54375E-04	0.00000E+00	0.00000E+00
987	8.49950E-01	4.09443E+01	8.83255E-01	7.54368E-04	0.00000E+00	0.00000E+00
988	8.96020E-01	4.09837E+01	8.83268E-01	7.53714E-04	0.00000E+00	0.00000E+00
989	8.92620E-01	4.10248E+01	8.83277E-01	7.53010E-04	0.00000E+00	0.00000E+00
990	9.06883E-01	4.10660E+01	8.83301E-01	7.52626E-04	0.00000E+00	0.00000E+00
991	8.86281E-01	4.11063E+01	8.83304E-01	7.51871E-04	0.00000E+00	0.00000E+00
992	8.75118E-01	4.11467E+01	8.83296E-01	7.51157E-04	0.00000E+00	0.00000E+00
993	8.92430E-01	4.11860E+01	8.83305E-01	7.50455E-04	0.00000E+00	0.00000E+00
994	9.04477E-01	4.12262E+01	8.83326E-01	7.50002E-04	0.00000E+00	0.00000E+00
995	8.64342E-01	4.12665E+01	8.83307E-01	7.49490E-04	0.00000E+00	0.00000E+00
996	8.91975E-01	4.13068E+01	8.83316E-01	7.48786E-04	0.00000E+00	0.00000E+00
997	9.12615E-01	4.13462E+01	8.83345E-01	7.48613E-04	0.00000E+00	0.00000E+00
998	8.50638E-01	4.13855E+01	8.83313E-01	7.48581E-04	0.00000E+00	0.00000E+00
999	9.06102E-01	4.14258E+01	8.83336E-01	7.48180E-04	0.00000E+00	0.00000E+00
1000	8.96657E-01	4.14652E+01	8.83349E-01	7.47549E-04	0.00000E+00	0.00000E+00
1001	8.77960E-01	4.15055E+01	8.83343E-01	7.46819E-04	0.00000E+00	0.00000E+00
1002	9.06259E-01	4.15457E+01	8.83366E-01	7.46424E-04	0.00000E+00	0.00000E+00
1003	8.59517E-01	4.15852E+01	8.83343E-01	7.46059E-04	0.00000E+00	0.00000E+00

KENO MESSAGE NUMBER K5-123 EXECUTION TERMINATED DUE TO COMPLETION OF THE SPECIFIED NUMBER OF GENERATIONS.

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

LIFETIME = 3.48455E-05 + OR - 6.93436E-08 GENERATION TIME = 2.47240E-05 + OR - 3.63759E-08
NU BAR = 2.44275E+00 + OR - 6.92320E-05 AVERAGE FISSION GROUP = 2.16236E+01 + OR - 3.91568E-03
ENERGY(EV) OF THE AVERAGE LETHARGY CAUSING FISSION = 3.01215E-01 + OR - 9.58153E-04

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
3	0.88338	+ OR - 0.00075	0.88264 TO 0.88413	0.88189 TO 0.88487	0.88114 TO 0.88562	1000000
4	0.88336	+ OR - 0.00075	0.88261 TO 0.88411	0.88187 TO 0.88485	0.88112 TO 0.88560	999000
5	0.88332	+ OR - 0.00075	0.88257 TO 0.88406	0.88183 TO 0.88481	0.88108 TO 0.88556	998000
6	0.88335	+ OR - 0.00075	0.88260 TO 0.88410	0.88186 TO 0.88484	0.88111 TO 0.88559	997000
7	0.88331	+ OR - 0.00075	0.88257 TO 0.88406	0.88182 TO 0.88480	0.88107 TO 0.88555	996000
8	0.88332	+ OR - 0.00075	0.88257 TO 0.88407	0.88183 TO 0.88481	0.88108 TO 0.88556	995000
9	0.88329	+ OR - 0.00075	0.88255 TO 0.88404	0.88180 TO 0.88479	0.88105 TO 0.88553	994000
10	0.88333	+ OR - 0.00075	0.88258 TO 0.88408	0.88184 TO 0.88482	0.88109 TO 0.88557	993000
11	0.88331	+ OR - 0.00075	0.88256 TO 0.88406	0.88182 TO 0.88480	0.88107 TO 0.88555	992000
12	0.88330	+ OR - 0.00075	0.88255 TO 0.88405	0.88181 TO 0.88480	0.88106 TO 0.88555	991000
17	0.88338	+ OR - 0.00075	0.88264 TO 0.88413	0.88189 TO 0.88488	0.88114 TO 0.88563	986000
22	0.88338	+ OR - 0.00075	0.88263 TO 0.88413	0.88188 TO 0.88489	0.88112 TO 0.88564	981000
27	0.88350	+ OR - 0.00075	0.88275 TO 0.88426	0.88200 TO 0.88501	0.88124 TO 0.88576	976000
32	0.88358	+ OR - 0.00076	0.88283 TO 0.88434	0.88207 TO 0.88510	0.88132 TO 0.88585	971000
37	0.88367	+ OR - 0.00076	0.88291 TO 0.88442	0.88215 TO 0.88518	0.88139 TO 0.88594	966000
42	0.88366	+ OR - 0.00076	0.88290 TO 0.88442	0.88214 TO 0.88518	0.88138 TO 0.88594	961000
47	0.88377	+ OR - 0.00076	0.88301 TO 0.88453	0.88225 TO 0.88529	0.88149 TO 0.88605	956000
52	0.88387	+ OR - 0.00076	0.88311 TO 0.88463	0.88234 TO 0.88539	0.88158 TO 0.88616	951000
57	0.88387	+ OR - 0.00077	0.88311 TO 0.88464	0.88234 TO 0.88540	0.88158 TO 0.88617	946000
62	0.88386	+ OR - 0.00077	0.88309 TO 0.88462	0.88232 TO 0.88539	0.88155 TO 0.88616	941000

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

67	0.88390	+ OR - 0.00077	0.88313 TO 0.88467	0.88236 TO 0.88544	0.88159 TO 0.88621	936000
72	0.88391	+ OR - 0.00077	0.88314 TO 0.88468	0.88237 TO 0.88546	0.88160 TO 0.88623	931000
77	0.88390	+ OR - 0.00077	0.88313 TO 0.88468	0.88235 TO 0.88545	0.88158 TO 0.88623	926000
82	0.88412	+ OR - 0.00077	0.88335 TO 0.88489	0.88258 TO 0.88566	0.88181 TO 0.88643	921000
87	0.88413	+ OR - 0.00077	0.88335 TO 0.88490	0.88258 TO 0.88567	0.88181 TO 0.88645	916000
92	0.88415	+ OR - 0.00077	0.88338 TO 0.88493	0.88260 TO 0.88570	0.88183 TO 0.88648	911000

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
97	0.88418	+ OR - 0.00077	0.88341 TO 0.88496	0.88263 TO 0.88573	0.88186 TO 0.88650	906000
102	0.88421	+ OR - 0.00077	0.88344 TO 0.88498	0.88266 TO 0.88575	0.88189 TO 0.88653	901000
107	0.88418	+ OR - 0.00077	0.88341 TO 0.88496	0.88263 TO 0.88573	0.88186 TO 0.88650	896000
112	0.88407	+ OR - 0.00077	0.88330 TO 0.88485	0.88253 TO 0.88562	0.88176 TO 0.88639	891000
117	0.88420	+ OR - 0.00077	0.88343 TO 0.88497	0.88266 TO 0.88574	0.88189 TO 0.88652	886000
122	0.88431	+ OR - 0.00077	0.88354 TO 0.88508	0.88276 TO 0.88585	0.88199 TO 0.88662	881000
127	0.88431	+ OR - 0.00078	0.88354 TO 0.88509	0.88276 TO 0.88587	0.88199 TO 0.88664	876000
132	0.88432	+ OR - 0.00078	0.88354 TO 0.88510	0.88276 TO 0.88588	0.88198 TO 0.88666	871000
137	0.88417	+ OR - 0.00078	0.88339 TO 0.88495	0.88261 TO 0.88573	0.88183 TO 0.88651	866000
142	0.88428	+ OR - 0.00078	0.88350 TO 0.88506	0.88272 TO 0.88584	0.88194 TO 0.88662	861000
147	0.88428	+ OR - 0.00078	0.88349 TO 0.88506	0.88271 TO 0.88585	0.88193 TO 0.88663	856000
152	0.88424	+ OR - 0.00079	0.88345 TO 0.88503	0.88266 TO 0.88581	0.88188 TO 0.88660	851000
157	0.88418	+ OR - 0.00079	0.88339 TO 0.88497	0.88260 TO 0.88576	0.88181 TO 0.88655	846000
162	0.88417	+ OR - 0.00079	0.88337 TO 0.88496	0.88258 TO 0.88575	0.88179 TO 0.88654	841000
167	0.88418	+ OR - 0.00080	0.88338 TO 0.88497	0.88259 TO 0.88577	0.88179 TO 0.88656	836000
172	0.88427	+ OR - 0.00080	0.88347 TO 0.88507	0.88267 TO 0.88587	0.88188 TO 0.88666	831000
177	0.88428	+ OR - 0.00080	0.88348 TO 0.88508	0.88268 TO 0.88588	0.88188 TO 0.88668	826000

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

182	0.88420	+ OR - 0.00080	0.88339 TO 0.88500	0.88259 TO 0.88580	0.88179 TO 0.88660	821000
187	0.88421	+ OR - 0.00081	0.88341 TO 0.88502	0.88260 TO 0.88582	0.88180 TO 0.88663	816000
192	0.88430	+ OR - 0.00081	0.88349 TO 0.88511	0.88268 TO 0.88592	0.88187 TO 0.88672	811000
197	0.88432	+ OR - 0.00081	0.88350 TO 0.88513	0.88269 TO 0.88594	0.88188 TO 0.88675	806000
202	0.88422	+ OR - 0.00082	0.88340 TO 0.88504	0.88259 TO 0.88585	0.88177 TO 0.88667	801000
207	0.88415	+ OR - 0.00082	0.88333 TO 0.88496	0.88251 TO 0.88578	0.88169 TO 0.88660	796000
212	0.88414	+ OR - 0.00082	0.88332 TO 0.88496	0.88250 TO 0.88579	0.88167 TO 0.88661	791000
217	0.88415	+ OR - 0.00082	0.88332 TO 0.88497	0.88250 TO 0.88579	0.88168 TO 0.88662	786000
222	0.88404	+ OR - 0.00082	0.88322 TO 0.88487	0.88239 TO 0.88569	0.88157 TO 0.88652	781000
227	0.88408	+ OR - 0.00083	0.88325 TO 0.88491	0.88242 TO 0.88574	0.88159 TO 0.88657	776000

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
232	0.88419	+ OR - 0.00083	0.88336 TO 0.88502	0.88252 TO 0.88585	0.88169 TO 0.88669	771000
237	0.88425	+ OR - 0.00083	0.88342 TO 0.88509	0.88258 TO 0.88592	0.88175 TO 0.88676	766000
242	0.88418	+ OR - 0.00083	0.88335 TO 0.88501	0.88252 TO 0.88584	0.88168 TO 0.88668	761000
247	0.88425	+ OR - 0.00084	0.88341 TO 0.88508	0.88258 TO 0.88592	0.88174 TO 0.88675	756000
252	0.88421	+ OR - 0.00084	0.88337 TO 0.88504	0.88253 TO 0.88588	0.88170 TO 0.88672	751000
257	0.88431	+ OR - 0.00084	0.88347 TO 0.88515	0.88263 TO 0.88600	0.88179 TO 0.88684	746000
262	0.88422	+ OR - 0.00084	0.88338 TO 0.88507	0.88254 TO 0.88591	0.88170 TO 0.88675	741000
267	0.88418	+ OR - 0.00085	0.88333 TO 0.88503	0.88248 TO 0.88587	0.88164 TO 0.88672	736000
272	0.88431	+ OR - 0.00085	0.88346 TO 0.88515	0.88261 TO 0.88600	0.88176 TO 0.88685	731000
277	0.88427	+ OR - 0.00085	0.88342 TO 0.88513	0.88257 TO 0.88598	0.88172 TO 0.88683	726000
282	0.88425	+ OR - 0.00086	0.88339 TO 0.88510	0.88254 TO 0.88596	0.88168 TO 0.88681	721000
287	0.88427	+ OR - 0.00086	0.88341 TO 0.88513	0.88255 TO 0.88599	0.88169 TO 0.88685	716000
292	0.88429	+ OR - 0.00086	0.88343 TO 0.88516	0.88256 TO 0.88602	0.88170 TO 0.88689	711000

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

297	0.88429	+ OR - 0.00087	0.88342 TO 0.88516	0.88255 TO 0.88603	0.88168 TO 0.88690	706000
302	0.88429	+ OR - 0.00086	0.88342 TO 0.88515	0.88256 TO 0.88601	0.88169 TO 0.88688	701000
307	0.88431	+ OR - 0.00087	0.88344 TO 0.88518	0.88258 TO 0.88605	0.88171 TO 0.88692	696000
312	0.88432	+ OR - 0.00087	0.88345 TO 0.88519	0.88258 TO 0.88605	0.88172 TO 0.88692	691000
317	0.88421	+ OR - 0.00087	0.88334 TO 0.88508	0.88247 TO 0.88595	0.88160 TO 0.88681	686000
322	0.88410	+ OR - 0.00087	0.88323 TO 0.88496	0.88236 TO 0.88583	0.88149 TO 0.88670	681000
327	0.88424	+ OR - 0.00087	0.88338 TO 0.88511	0.88251 TO 0.88598	0.88164 TO 0.88685	676000
332	0.88431	+ OR - 0.00087	0.88344 TO 0.88518	0.88256 TO 0.88606	0.88169 TO 0.88693	671000
337	0.88427	+ OR - 0.00087	0.88340 TO 0.88514	0.88253 TO 0.88601	0.88165 TO 0.88689	666000
342	0.88425	+ OR - 0.00088	0.88337 TO 0.88512	0.88250 TO 0.88600	0.88162 TO 0.88687	661000
347	0.88419	+ OR - 0.00088	0.88331 TO 0.88507	0.88242 TO 0.88595	0.88154 TO 0.88683	656000
352	0.88421	+ OR - 0.00089	0.88332 TO 0.88509	0.88243 TO 0.88598	0.88154 TO 0.88687	651000
357	0.88420	+ OR - 0.00089	0.88331 TO 0.88509	0.88241 TO 0.88598	0.88152 TO 0.88688	646000
362	0.88424	+ OR - 0.00090	0.88334 TO 0.88514	0.88245 TO 0.88604	0.88155 TO 0.88693	641000

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
367	0.88423	+ OR - 0.00090	0.88333 TO 0.88513	0.88242 TO 0.88603	0.88152 TO 0.88694	636000
372	0.88420	+ OR - 0.00091	0.88330 TO 0.88511	0.88239 TO 0.88602	0.88148 TO 0.88693	631000
377	0.88406	+ OR - 0.00091	0.88315 TO 0.88497	0.88224 TO 0.88588	0.88133 TO 0.88679	626000
382	0.88413	+ OR - 0.00091	0.88322 TO 0.88505	0.88230 TO 0.88596	0.88139 TO 0.88687	621000
387	0.88412	+ OR - 0.00092	0.88320 TO 0.88504	0.88228 TO 0.88596	0.88136 TO 0.88688	616000
392	0.88415	+ OR - 0.00093	0.88322 TO 0.88507	0.88230 TO 0.88600	0.88137 TO 0.88693	611000
397	0.88410	+ OR - 0.00093	0.88317 TO 0.88503	0.88224 TO 0.88596	0.88131 TO 0.88689	606000
402	0.88405	+ OR - 0.00094	0.88311 TO 0.88498	0.88218 TO 0.88592	0.88124 TO 0.88686	601000
407	0.88417	+ OR - 0.00094	0.88323 TO 0.88511	0.88229 TO 0.88605	0.88135 TO 0.88699	596000

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

412	0.88413	+ OR - 0.00095	0.88318 TO 0.88508	0.88224 TO 0.88602	0.88129 TO 0.88697	591000
417	0.88408	+ OR - 0.00095	0.88313 TO 0.88503	0.88218 TO 0.88598	0.88123 TO 0.88693	586000
422	0.88411	+ OR - 0.00096	0.88315 TO 0.88506	0.88220 TO 0.88602	0.88124 TO 0.88697	581000
427	0.88403	+ OR - 0.00096	0.88307 TO 0.88500	0.88211 TO 0.88596	0.88115 TO 0.88692	576000
432	0.88407	+ OR - 0.00097	0.88311 TO 0.88504	0.88214 TO 0.88601	0.88117 TO 0.88698	571000
437	0.88402	+ OR - 0.00097	0.88305 TO 0.88499	0.88209 TO 0.88595	0.88112 TO 0.88692	566000
442	0.88409	+ OR - 0.00097	0.88312 TO 0.88505	0.88215 TO 0.88602	0.88119 TO 0.88698	561000
447	0.88417	+ OR - 0.00097	0.88320 TO 0.88514	0.88223 TO 0.88611	0.88126 TO 0.88708	556000
452	0.88413	+ OR - 0.00098	0.88315 TO 0.88511	0.88217 TO 0.88608	0.88120 TO 0.88706	551000
457	0.88423	+ OR - 0.00098	0.88325 TO 0.88522	0.88227 TO 0.88620	0.88129 TO 0.88718	546000
462	0.88451	+ OR - 0.00098	0.88353 TO 0.88549	0.88255 TO 0.88647	0.88157 TO 0.88745	541000
467	0.88457	+ OR - 0.00099	0.88358 TO 0.88555	0.88260 TO 0.88654	0.88161 TO 0.88752	536000
472	0.88450	+ OR - 0.00098	0.88352 TO 0.88548	0.88254 TO 0.88646	0.88156 TO 0.88744	531000
477	0.88452	+ OR - 0.00099	0.88353 TO 0.88551	0.88255 TO 0.88649	0.88156 TO 0.88748	526000
482	0.88466	+ OR - 0.00099	0.88367 TO 0.88565	0.88268 TO 0.88664	0.88169 TO 0.88763	521000
487	0.88468	+ OR - 0.00100	0.88368 TO 0.88567	0.88268 TO 0.88667	0.88169 TO 0.88766	516000
492	0.88460	+ OR - 0.00100	0.88360 TO 0.88560	0.88260 TO 0.88660	0.88160 TO 0.88760	511000
497	0.88466	+ OR - 0.00100	0.88365 TO 0.88566	0.88265 TO 0.88667	0.88165 TO 0.88767	506000

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
502	0.88470	+ OR - 0.00101	0.88368 TO 0.88571	0.88267 TO 0.88672	0.88166 TO 0.88773	501000
507	0.88480	+ OR - 0.00101	0.88379 TO 0.88580	0.88279 TO 0.88681	0.88178 TO 0.88782	496000
512	0.88467	+ OR - 0.00101	0.88366 TO 0.88568	0.88265 TO 0.88669	0.88164 TO 0.88770	491000
517	0.88446	+ OR - 0.00101	0.88345 TO 0.88548	0.88243 TO 0.88649	0.88142 TO 0.88750	486000
522	0.88460	+ OR - 0.00102	0.88358 TO 0.88563	0.88256 TO 0.88665	0.88154 TO 0.88767	481000

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

527	0.88482	+ OR - 0.00103	0.88379 TO 0.88585	0.88277 TO 0.88687	0.88174 TO 0.88790	476000
532	0.88509	+ OR - 0.00102	0.88407 TO 0.88611	0.88305 TO 0.88713	0.88203 TO 0.88815	471000
537	0.88521	+ OR - 0.00102	0.88419 TO 0.88623	0.88316 TO 0.88725	0.88214 TO 0.88828	466000
542	0.88513	+ OR - 0.00103	0.88410 TO 0.88616	0.88307 TO 0.88719	0.88204 TO 0.88822	461000
547	0.88507	+ OR - 0.00104	0.88403 TO 0.88611	0.88299 TO 0.88715	0.88194 TO 0.88819	456000
552	0.88500	+ OR - 0.00104	0.88396 TO 0.88604	0.88292 TO 0.88708	0.88188 TO 0.88812	451000
557	0.88505	+ OR - 0.00105	0.88400 TO 0.88610	0.88295 TO 0.88715	0.88191 TO 0.88819	446000
562	0.88490	+ OR - 0.00104	0.88385 TO 0.88594	0.88281 TO 0.88698	0.88177 TO 0.88802	441000
567	0.88493	+ OR - 0.00105	0.88388 TO 0.88597	0.88283 TO 0.88702	0.88178 TO 0.88807	436000
572	0.88505	+ OR - 0.00106	0.88399 TO 0.88610	0.88294 TO 0.88716	0.88188 TO 0.88821	431000
577	0.88493	+ OR - 0.00107	0.88386 TO 0.88599	0.88280 TO 0.88706	0.88173 TO 0.88813	426000
582	0.88485	+ OR - 0.00108	0.88378 TO 0.88593	0.88270 TO 0.88700	0.88162 TO 0.88808	421000
587	0.88489	+ OR - 0.00109	0.88380 TO 0.88598	0.88272 TO 0.88706	0.88163 TO 0.88815	416000
592	0.88487	+ OR - 0.00109	0.88378 TO 0.88597	0.88268 TO 0.88706	0.88159 TO 0.88815	411000
597	0.88492	+ OR - 0.00110	0.88382 TO 0.88601	0.88273 TO 0.88711	0.88163 TO 0.88820	406000
602	0.88504	+ OR - 0.00111	0.88393 TO 0.88614	0.88283 TO 0.88725	0.88172 TO 0.88836	401000
607	0.88517	+ OR - 0.00111	0.88406 TO 0.88629	0.88295 TO 0.88740	0.88184 TO 0.88851	396000
612	0.88533	+ OR - 0.00112	0.88421 TO 0.88645	0.88309 TO 0.88757	0.88197 TO 0.88869	391000
617	0.88542	+ OR - 0.00113	0.88429 TO 0.88654	0.88316 TO 0.88767	0.88203 TO 0.88880	386000
622	0.88547	+ OR - 0.00113	0.88433 TO 0.88660	0.88320 TO 0.88774	0.88206 TO 0.88887	381000
627	0.88560	+ OR - 0.00114	0.88446 TO 0.88675	0.88331 TO 0.88789	0.88217 TO 0.88903	376000
632	0.88574	+ OR - 0.00115	0.88459 TO 0.88689	0.88344 TO 0.88804	0.88229 TO 0.88919	371000

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
637	0.88581	+ OR - 0.00116	0.88465 TO 0.88697	0.88348 TO 0.88814	0.88232 TO 0.88930	366000

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

642	0.88592	+ OR - 0.00117	0.88475 TO 0.88708	0.88359 TO 0.88825	0.88242 TO 0.88941	361000
647	0.88595	+ OR - 0.00118	0.88477 TO 0.88712	0.88360 TO 0.88830	0.88242 TO 0.88947	356000
652	0.88599	+ OR - 0.00119	0.88480 TO 0.88717	0.88361 TO 0.88836	0.88243 TO 0.88955	351000
657	0.88615	+ OR - 0.00120	0.88495 TO 0.88735	0.88375 TO 0.88854	0.88255 TO 0.88974	346000
662	0.88628	+ OR - 0.00121	0.88507 TO 0.88749	0.88386 TO 0.88870	0.88265 TO 0.88991	341000
667	0.88620	+ OR - 0.00122	0.88498 TO 0.88742	0.88376 TO 0.88864	0.88254 TO 0.88987	336000
672	0.88598	+ OR - 0.00123	0.88474 TO 0.88721	0.88351 TO 0.88844	0.88228 TO 0.88967	331000
677	0.88627	+ OR - 0.00124	0.88503 TO 0.88751	0.88380 TO 0.88874	0.88256 TO 0.88998	326000
682	0.88595	+ OR - 0.00123	0.88472 TO 0.88718	0.88349 TO 0.88842	0.88225 TO 0.88965	321000
687	0.88572	+ OR - 0.00124	0.88448 TO 0.88696	0.88324 TO 0.88820	0.88200 TO 0.88943	316000
692	0.88580	+ OR - 0.00124	0.88455 TO 0.88704	0.88331 TO 0.88828	0.88207 TO 0.88953	311000
697	0.88607	+ OR - 0.00126	0.88481 TO 0.88732	0.88356 TO 0.88858	0.88230 TO 0.88984	306000
702	0.88586	+ OR - 0.00127	0.88458 TO 0.88713	0.88331 TO 0.88840	0.88204 TO 0.88967	301000
707	0.88601	+ OR - 0.00128	0.88473 TO 0.88728	0.88345 TO 0.88856	0.88218 TO 0.88984	296000
712	0.88615	+ OR - 0.00129	0.88486 TO 0.88744	0.88357 TO 0.88873	0.88228 TO 0.89002	291000
717	0.88617	+ OR - 0.00131	0.88486 TO 0.88748	0.88355 TO 0.88879	0.88225 TO 0.89010	286000
722	0.88619	+ OR - 0.00132	0.88486 TO 0.88751	0.88354 TO 0.88884	0.88221 TO 0.89016	281000
727	0.88625	+ OR - 0.00134	0.88491 TO 0.88759	0.88356 TO 0.88894	0.88222 TO 0.89028	276000
732	0.88644	+ OR - 0.00135	0.88509 TO 0.88779	0.88374 TO 0.88914	0.88239 TO 0.89049	271000
737	0.88629	+ OR - 0.00134	0.88495 TO 0.88764	0.88361 TO 0.88898	0.88226 TO 0.89032	266000
742	0.88619	+ OR - 0.00137	0.88482 TO 0.88755	0.88346 TO 0.88892	0.88209 TO 0.89028	261000
747	0.88619	+ OR - 0.00139	0.88480 TO 0.88758	0.88342 TO 0.88897	0.88203 TO 0.89036	256000
752	0.88613	+ OR - 0.00141	0.88472 TO 0.88754	0.88331 TO 0.88895	0.88190 TO 0.89036	251000
757	0.88601	+ OR - 0.00143	0.88458 TO 0.88744	0.88314 TO 0.88888	0.88171 TO 0.89031	246000
762	0.88621	+ OR - 0.00145	0.88477 TO 0.88766	0.88332 TO 0.88910	0.88187 TO 0.89055	241000
767	0.88626	+ OR - 0.00147	0.88480 TO 0.88773	0.88333 TO 0.88920	0.88186 TO 0.89067	236000

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
772	0.88606	+ OR - 0.00149	0.88457 TO 0.88754	0.88309 TO 0.88903	0.88160 TO 0.89052	231000
777	0.88607	+ OR - 0.00151	0.88456 TO 0.88757	0.88305 TO 0.88908	0.88155 TO 0.89059	226000
782	0.88575	+ OR - 0.00151	0.88424 TO 0.88726	0.88273 TO 0.88877	0.88121 TO 0.89028	221000
787	0.88527	+ OR - 0.00151	0.88376 TO 0.88677	0.88225 TO 0.88828	0.88074 TO 0.88979	216000
792	0.88509	+ OR - 0.00152	0.88357 TO 0.88661	0.88204 TO 0.88813	0.88052 TO 0.88965	211000
797	0.88572	+ OR - 0.00152	0.88420 TO 0.88724	0.88268 TO 0.88877	0.88116 TO 0.89029	206000
802	0.88602	+ OR - 0.00155	0.88447 TO 0.88757	0.88293 TO 0.88911	0.88138 TO 0.89066	201000
807	0.88647	+ OR - 0.00157	0.88490 TO 0.88804	0.88333 TO 0.88961	0.88176 TO 0.89118	196000
812	0.88685	+ OR - 0.00159	0.88526 TO 0.88844	0.88367 TO 0.89004	0.88207 TO 0.89163	191000
817	0.88676	+ OR - 0.00163	0.88513 TO 0.88839	0.88351 TO 0.89001	0.88188 TO 0.89164	186000
822	0.88626	+ OR - 0.00165	0.88462 TO 0.88791	0.88297 TO 0.88955	0.88133 TO 0.89120	181000
827	0.88660	+ OR - 0.00168	0.88492 TO 0.88828	0.88324 TO 0.88996	0.88156 TO 0.89165	176000
832	0.88714	+ OR - 0.00170	0.88544 TO 0.88883	0.88374 TO 0.89053	0.88205 TO 0.89223	171000
837	0.88706	+ OR - 0.00172	0.88534 TO 0.88878	0.88362 TO 0.89051	0.88190 TO 0.89223	166000
842	0.88724	+ OR - 0.00177	0.88547 TO 0.88901	0.88370 TO 0.89078	0.88193 TO 0.89255	161000
847	0.88714	+ OR - 0.00182	0.88532 TO 0.88895	0.88351 TO 0.89077	0.88169 TO 0.89258	156000
852	0.88731	+ OR - 0.00184	0.88547 TO 0.88914	0.88364 TO 0.89098	0.88180 TO 0.89281	151000
857	0.88651	+ OR - 0.00181	0.88470 TO 0.88832	0.88289 TO 0.89012	0.88109 TO 0.89193	146000
862	0.88609	+ OR - 0.00180	0.88428 TO 0.88789	0.88248 TO 0.88970	0.88068 TO 0.89150	141000
867	0.88607	+ OR - 0.00185	0.88422 TO 0.88792	0.88237 TO 0.88977	0.88052 TO 0.89162	136000
872	0.88572	+ OR - 0.00187	0.88385 TO 0.88759	0.88198 TO 0.88946	0.88011 TO 0.89133	131000
877	0.88594	+ OR - 0.00192	0.88402 TO 0.88785	0.88211 TO 0.88977	0.88019 TO 0.89168	126000
882	0.88676	+ OR - 0.00193	0.88482 TO 0.88869	0.88289 TO 0.89063	0.88095 TO 0.89256	121000

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

887	0.88655	+ OR - 0.00201	0.88453 TO 0.88856	0.88252 TO 0.89057	0.88051 TO 0.89258	116000
892	0.88648	+ OR - 0.00207	0.88442 TO 0.88855	0.88235 TO 0.89062	0.88029 TO 0.89268	111000
897	0.88761	+ OR - 0.00206	0.88555 TO 0.88968	0.88349 TO 0.89174	0.88142 TO 0.89380	106000
902	0.88727	+ OR - 0.00210	0.88517 TO 0.88937	0.88307 TO 0.89147	0.88097 TO 0.89357	101000

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
907	0.88715	+ OR - 0.00219	0.88496 TO 0.88934	0.88277 TO 0.89152	0.88058 TO 0.89371	96000
912	0.88806	+ OR - 0.00224	0.88582 TO 0.89030	0.88358 TO 0.89254	0.88134 TO 0.89478	91000
917	0.88840	+ OR - 0.00235	0.88605 TO 0.89075	0.88370 TO 0.89311	0.88135 TO 0.89546	86000
922	0.88737	+ OR - 0.00241	0.88496 TO 0.88978	0.88255 TO 0.89218	0.88014 TO 0.89459	81000
927	0.88714	+ OR - 0.00247	0.88467 TO 0.88961	0.88220 TO 0.89208	0.87973 TO 0.89455	76000
932	0.88723	+ OR - 0.00258	0.88465 TO 0.88981	0.88207 TO 0.89239	0.87949 TO 0.89497	71000
937	0.88755	+ OR - 0.00266	0.88489 TO 0.89021	0.88223 TO 0.89286	0.87957 TO 0.89552	66000
942	0.88802	+ OR - 0.00257	0.88545 TO 0.89059	0.88287 TO 0.89316	0.88030 TO 0.89573	61000
947	0.88793	+ OR - 0.00273	0.88520 TO 0.89066	0.88247 TO 0.89339	0.87974 TO 0.89612	56000
952	0.88768	+ OR - 0.00295	0.88473 TO 0.89063	0.88178 TO 0.89358	0.87883 TO 0.89653	51000
957	0.88706	+ OR - 0.00320	0.88386 TO 0.89026	0.88066 TO 0.89346	0.87746 TO 0.89666	46000
962	0.88575	+ OR - 0.00329	0.88246 TO 0.88903	0.87918 TO 0.89232	0.87589 TO 0.89560	41000
967	0.88708	+ OR - 0.00359	0.88349 TO 0.89067	0.87991 TO 0.89425	0.87632 TO 0.89784	36000
972	0.88920	+ OR - 0.00391	0.88529 TO 0.89311	0.88138 TO 0.89702	0.87747 TO 0.90094	31000
977	0.88785	+ OR - 0.00379	0.88406 TO 0.89164	0.88027 TO 0.89543	0.87648 TO 0.89922	26000
982	0.88718	+ OR - 0.00439	0.88279 TO 0.89157	0.87841 TO 0.89595	0.87402 TO 0.90034	21000
987	0.88874	+ OR - 0.00462	0.88413 TO 0.89336	0.87951 TO 0.89798	0.87489 TO 0.90260	16000
992	0.88754	+ OR - 0.00641	0.88114 TO 0.89395	0.87473 TO 0.90036	0.86832 TO 0.90676	11000
997	0.88286	+ OR - 0.00981	0.87305 TO 0.89266	0.86324 TO 0.90247	0.85344 TO 0.91228	6000

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
RANDOM NUMBER=          4BC7185F6126
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0
                                     FREQUENCY FOR GENERATIONS    4 TO 1003
0.7895 TO 0.7925     *
0.7925 TO 0.7954
0.7954 TO 0.7984
0.7984 TO 0.8014
0.8014 TO 0.8043
0.8043 TO 0.8073
0.8073 TO 0.8103
0.8103 TO 0.8132     *
0.8132 TO 0.8162
0.8162 TO 0.8192     *
0.8192 TO 0.8221
0.8221 TO 0.8251     **
0.8251 TO 0.8281     ***
0.8281 TO 0.8310     **
0.8310 TO 0.8340     ********
0.8340 TO 0.8369     *******
0.8369 TO 0.8399     **********
0.8399 TO 0.8429     **********
0.8429 TO 0.8458     ************
0.8458 TO 0.8488     ***************
0.8488 TO 0.8518     *******************
0.8518 TO 0.8547     ********************
0.8547 TO 0.8577     ***********************
0.8577 TO 0.8607     **************************
0.8607 TO 0.8636     *******************************
0.8636 TO 0.8666     ******************************************
0.8666 TO 0.8695     ******************************************
0.8695 TO 0.8725     *****************************************
0.8725 TO 0.8755     ***********************************************
0.8755 TO 0.8784     ************************************************
0.8784 TO 0.8814     ****************************************************
0.8814 TO 0.8844     ********************************************
0.8844 TO 0.8873     *********************************************************
0.8873 TO 0.8903     *********************************************************
0.8903 TO 0.8933     ****************************************************
0.8933 TO 0.8962     **********************************************
0.8962 TO 0.8992     **************************************
0.8992 TO 0.9022     ***************************************************
0.9022 TO 0.9051     ******************************
0.9051 TO 0.9081     ****************************
0.9081 TO 0.9110     ************************
0.9110 TO 0.9140     *******************
0.9140 TO 0.9170     ********************
0.9170 TO 0.9199     *********
0.9199 TO 0.9229     ***********
0.9229 TO 0.9259     ************
0.9259 TO 0.9288     ******
0.9288 TO 0.9318     **********
0.9318 TO 0.9348     ****
0.9348 TO 0.9377     ***
0.9377 TO 0.9407     ****
0.9407 TO 0.9437     ****
0.9437 TO 0.9466
0.9466 TO 0.9496     ***
0.9496 TO 0.9525     *
0.9525 TO 0.9555
0.9555 TO 0.9585     **
0.9585 TO 0.9614
0.9614 TO 0.9644     **
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0
                               FREQUENCY FOR GENERATIONS  254 TO 1003
0.7895 TO 0.7925
0.7925 TO 0.7954
0.7954 TO 0.7984
0.7984 TO 0.8014
0.8014 TO 0.8043
0.8043 TO 0.8073
0.8073 TO 0.8103
0.8103 TO 0.8132     *
0.8132 TO 0.8162
0.8162 TO 0.8192     *
0.8192 TO 0.8221
0.8221 TO 0.8251     **
0.8251 TO 0.8281     **
0.8281 TO 0.8310     *
0.8310 TO 0.8340     ***
0.8340 TO 0.8369     ***
0.8369 TO 0.8399     ********
0.8399 TO 0.8429     *******
0.8429 TO 0.8458     **********
0.8458 TO 0.8488     *********
0.8488 TO 0.8518     **************
0.8518 TO 0.8547     ************
0.8547 TO 0.8577     ***************
0.8577 TO 0.8607     *****************
0.8607 TO 0.8636     **************************
0.8636 TO 0.8666     ************************************
0.8666 TO 0.8695     *******************************
0.8695 TO 0.8725     ****************************
0.8725 TO 0.8755     ***********************************
0.8755 TO 0.8784     *************************************
0.8784 TO 0.8814     ******************************************
0.8814 TO 0.8844     *****************************
0.8844 TO 0.8873     *********************************************
0.8873 TO 0.8903     *******************************************
0.8903 TO 0.8933     ****************************************
0.8933 TO 0.8962     ********************************
0.8962 TO 0.8992     *********************************
0.8992 TO 0.9022     ***************************************
0.9022 TO 0.9051     ***********************
0.9051 TO 0.9081     ************************
0.9081 TO 0.9110     ******************
0.9110 TO 0.9140     *****************
0.9140 TO 0.9170     ***************
0.9170 TO 0.9199     *******
0.9199 TO 0.9229     ********
0.9229 TO 0.9259     *********
0.9259 TO 0.9288     ***
0.9288 TO 0.9318     *********
0.9318 TO 0.9348     ***
0.9348 TO 0.9377     *
0.9377 TO 0.9407     ***
0.9407 TO 0.9437     ***
0.9437 TO 0.9466
0.9466 TO 0.9496     ***
0.9496 TO 0.9525     *
0.9525 TO 0.9555
0.9555 TO 0.9585
0.9585 TO 0.9614
0.9614 TO 0.9644     **
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0
                              FREQUENCY FOR GENERATIONS  504 TO 1003
0.7895 TO 0.7925
0.7925 TO 0.7954
0.7954 TO 0.7984
0.7984 TO 0.8014
0.8014 TO 0.8043
0.8043 TO 0.8073
0.8073 TO 0.8103
0.8103 TO 0.8132     *
0.8132 TO 0.8162
0.8162 TO 0.8192     *
0.8192 TO 0.8221
0.8221 TO 0.8251     *
0.8251 TO 0.8281     *
0.8281 TO 0.8310
0.8310 TO 0.8340
0.8340 TO 0.8369     ***
0.8369 TO 0.8399     *****
0.8399 TO 0.8429     ****
0.8429 TO 0.8458     ********
0.8458 TO 0.8488     ******
0.8488 TO 0.8518     **********
0.8518 TO 0.8547     *****
0.8547 TO 0.8577     ******
0.8577 TO 0.8607     *************
0.8607 TO 0.8636     *******************
0.8636 TO 0.8666     *************************
0.8666 TO 0.8695     ********************
0.8695 TO 0.8725     ****************
0.8725 TO 0.8755     ************************
0.8755 TO 0.8784     ********************
0.8784 TO 0.8814     ***********************************
0.8814 TO 0.8844     ******************
0.8844 TO 0.8873     *******************************
0.8873 TO 0.8903     ****************************
0.8903 TO 0.8933     ***************************
0.8933 TO 0.8962     **************************
0.8962 TO 0.8992     *******************
0.8992 TO 0.9022     ************************
0.9022 TO 0.9051     ******************
0.9051 TO 0.9081     *****************
0.9081 TO 0.9110     **********
0.9110 TO 0.9140     *************
0.9140 TO 0.9170     ***********
0.9170 TO 0.9199     ***
0.9199 TO 0.9229     *******
0.9229 TO 0.9259     *******
0.9259 TO 0.9288     **
0.9288 TO 0.9318     *******
0.9318 TO 0.9348     ***
0.9348 TO 0.9377
0.9377 TO 0.9407     *
0.9407 TO 0.9437     **
0.9437 TO 0.9466
0.9466 TO 0.9496     *
0.9496 TO 0.9525     *
0.9525 TO 0.9555
0.9555 TO 0.9585
0.9585 TO 0.9614
0.9614 TO 0.9644     *
```

Figure 6.7-6 CSAS25 Output for Canistered Yankee-Class Fuel - Accident Conditions (Continued)

```
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0
                                   FREQUENCY FOR GENERATIONS  754 TO 1003
0.7895 TO 0.7925
0.7925 TO 0.7954
0.7954 TO 0.7984
0.7984 TO 0.8014
0.8014 TO 0.8043
0.8043 TO 0.8073
0.8073 TO 0.8103
0.8103 TO 0.8132
0.8132 TO 0.8162
0.8162 TO 0.8192
0.8192 TO 0.8221
0.8221 TO 0.8251
0.8251 TO 0.8281
0.8281 TO 0.8310
0.8310 TO 0.8340
0.8340 TO 0.8369     ***
0.8369 TO 0.8399     **
0.8399 TO 0.8429     **
0.8429 TO 0.8458     **
0.8458 TO 0.8488     **
0.8488 TO 0.8518     *********
0.8518 TO 0.8547     *
0.8547 TO 0.8577     ****
0.8577 TO 0.8607     ******
0.8607 TO 0.8636     ******
0.8636 TO 0.8666     ***************
0.8666 TO 0.8695     ******
0.8695 TO 0.8725     **********
0.8725 TO 0.8755     **********
0.8755 TO 0.8784     *************
0.8784 TO 0.8814     ***************
0.8814 TO 0.8844     *********
0.8844 TO 0.8873     ***************
0.8873 TO 0.8903     ************
0.8903 TO 0.8933     ***************
0.8933 TO 0.8962     ****************
0.8962 TO 0.8992     **********
0.8992 TO 0.9022     ***********
0.9022 TO 0.9051     ********
0.9051 TO 0.9081     ***********
0.9081 TO 0.9110     ******
0.9110 TO 0.9140     *******
0.9140 TO 0.9170     *******
0.9170 TO 0.9199     *
0.9199 TO 0.9229     **
0.9229 TO 0.9259     ****
0.9259 TO 0.9288
0.9288 TO 0.9318     *****
0.9318 TO 0.9348     **
0.9348 TO 0.9377
0.9377 TO 0.9407
0.9407 TO 0.9437     *
0.9437 TO 0.9466
0.9466 TO 0.9496
0.9496 TO 0.9525     *
0.9525 TO 0.9555
0.9555 TO 0.9585
0.9585 TO 0:9614
0.9614 TO 0.9644     *
```

Figure 6.7-7 CSAS25 Input/Output for Reconfigured Fuel Assembly Analysis

```
PRIMARY MODULE ACCESS AND INPUT RECORD ( SCALE DRIVER - 95/03/29 - 09:06:37 )
   MODULE CSAS25   WILL BE CALLED
     Failed Fuel Assembly Analysis - UNC Type fuel - Zr/SS clads homogenized
     '
     '      UNITED NUCLEAR ASSEMBLY
     '
     '  MAXIMUM INITAIL ENRICHMENT = 4.0% U-235
     '  CLAD MATERIAL              = ZIRCAOLLY
     '
     '  ANALYSIS PREFORMED FOR THE YANKEE ROWE
     '       SPENT FUEL STORAGE PROJECT
     '
     27GROUPNDF4 LATTICECELL
     UO2          1  0.95             293.0 92235 4.0 92238 96.0 END
     ZIRCALLOY    2  1.0              293.0 END
     H2O          3  1.0              293.0 END
     AL           4  1.0              293.0 END
     SS304        5  1.0              293.0 END
     B-10         6 DEN=2.6266 0.0450 293.0 END
     B-11         6 DEN=2.6266 0.2731 293.0 END
     C            6 DEN=2.6266 0.0925 293.0 END
     AL           6 DEN=2.6266 0.5744 293.0 END
     H2O          7  1.0              293.0 END
     ZIRCALLOY    8 DEN=4.6640 0.3080 293.0 END
     H2O          8 DEN=4.6640 0.0917 293.0 END
     SS304        8 DEN=4.6640 0.6003 293.0 END
     END COMP
     SQUAREPITCH  1.905 0.7887 1 3 1.27 8 0.8052 7 END
     Failed Fuel Assembly Analysis - UNC Type fuel - Zr/SS clads homogenized
     READ PARAM RUN=yes PLT=no GEN=1003 NPG=1000 TME=500 END PARAM
     READ GEOM
     '
     '  WATER LEVEL UNIT CELLS
     '
     UNIT  1
     COM='FUEL PIN CELL - BETWEEN DISKS'
     CYLINDER  1 1  0.3943    2P2.1654
     CYLINDER  7 1  0.4026    2P2.1654
     CYLINDER  8 1  0.635     2P2.1654
     CUBOID    3 1  4P0.9525  2P2.1654
     '
     '  DISK LEVEL UNIT CELLS (BOTH SS AND AL)
     '
     UNIT  2
     COM='FUEL PIN CELL - WITH SS/AL DISK'
     CYLINDER  1 1  0.3943    2P0.635
     CYLINDER  7 1  0.4026    2P0.635
     CYLINDER  8 1  0.635     2P0.635
     CUBOID    3 1  4P0.9525  2P0.635
     '
     '  WATER LEVEL BORAL SHEETS
     '
     UNIT 14
     COM='X-X BORAL SHEET BETWEEN DISKS'
     CUBOID 6 1 2P9.144 2P0.0318 2P2.1654
     CUBOID 4 1 2P9.144 2P0.0953 2P2.1654
     UNIT 15
     COM='Y-Y BORAL SHEET BETWEEN DISKS'
     CUBOID 6 1 2P0.0318 2P9.144 2P2.1654
     CUBOID 4 1 2P0.0953 2P9.144 2P2.1654
     '
     '  DISK LEVEL BORAL SHEETS (AL AND SS)
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
'
UNIT 16
COM='X-X BORAL SHEET WITH SS DISK'
CUBOID 6 1 2P9.144 2P0.0318 2P0.635
CUBOID 4 1 2P9.144 2P0.0953 2P0.635
UNIT 17
COM='Y-Y BORAL SHEET WITH SS DISK'
CUBOID 6 1 2P0.0318 2P9.144 2P0.635
CUBOID 4 1 2P0.0953 2P9.144 2P0.635
'
'  ASSEMBLY ARRAYS
'
UNIT 18
COM='WATER LEVEL FUEL TUBE'
ARRAY  1  -7.6200 -7.6200     -2.1654
CUBOID 3 1 4P9.04875         2P2.1654
CUBOID 5 1 4P9.37387         2P2.1654
CUBOID 3 1 4P9.906           2P2.1654
CUBOID 5 1 4P10.028          2P2.1654
CUBOID 3 1 4P10.2187         2P2.1654
HOLE  14   0.0      10.1234 0.0
HOLE  14   0.0     -10.1234 0.0
HOLE  15  10.1234    0.0    0.0
HOLE  15 -10.1234    0.0    0.0
CUBOID 5 1 4P10.267          2P2.1654
CUBOID 3 1 4P10.4826         2P2.1654
CUBOID 3 1 4P11.594          2P2.1654

UNIT 19
COM='SS DISK LEVEL FUEL TUBE'
ARRAY  2 -7.6200 -7.6200      -0.635
CUBOID 3 1 4P9.04875         2P0.635
CUBOID 5 1 4P9.37387         2P0.635
CUBOID 3 1 4P9.906           2P0.635
CUBOID 5 1 4P10.028          2P0.635
CUBOID 3 1 4P10.2187         2P0.635
HOLE  16   0.0      10.1234 0.0
HOLE  16   0.0     -10.1234 0.0
HOLE  17  10.1234    0.0    0.0
HOLE  17 -10.1234    0.0    0.0
CUBOID 5 1 4P10.267          2P0.635
CUBOID 3 1 4P10.4826         2P0.635
CUBOID 5 1 4P11.594          2P0.635
UNIT 20
COM='AL DISK LEVEL FUEL TUBE'
ARRAY  2 -7.6200 -7.6200      -0.635
CUBOID 3 1 4P9.04875         2P0.635
CUBOID 5 1 4P9.37387         2P0.635
CUBOID 3 1 4P9.906           2P0.635
CUBOID 5 1 4P10.028          2P0.635
CUBOID 3 1 4P10.2187         2P0.635
HOLE  16   0.0      10.1234 0.0
HOLE  16   0.0     -10.1234 0.0
HOLE  17  10.1234    0.0    0.0
HOLE  17 -10.1234    0.0    0.0
CUBOID 5 1 4P10.267          2P0.635
CUBOID 3 1 4P10.4445         2P0.635
CUBOID 4 1 4P11.594          2P0.635
'
'  GLOBAL UNIT
'
GLOBAL UNIT 40
ARRAY 30 -11.594 -11.594 -5.6008
END GEOM

READ ARRAY
ARA=1 NUX=8 NUY=8 NUZ=1  FILL
1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1
END FILL
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
ARA=2 NUX=8 NUY=8 NUZ=1  FILL
2 2 2 2 2 2 2 2
2 2 2 2 2 2 2 2
2 2 2 2 2 2 2 2
2 2 2 2 2 2 2 2
2 2 2 2 2 2 2 2
2 2 2 2 2 2 2 2
2 2 2 2 2 2 2 2
2 2 2 2 2 2 2 2
END FILL

ARA=30 NUX=1 NUY=1 NUZ=4
FILL
20
18
19
18
END FILL
END ARRAY

READ BOUNDS ZFC=PER YXF=REFLECT END BOUNDS

READ PLOT
SCR=YES PIC=MAT LPI=10
TTL='BASKET X-Y CROSS SECTION AT Z= -2.1654 WATER LEVEL'
XUL=  -12 YUL=  12   ZUL= -2.1654
XLR=   12 YLR= -12   ZLR= -2.1654
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y CROSS SECTION AT Z= -4.9657 AL DISK LEVEL'
XUL=  -12 YUL=  12   ZUL= -4.9657
XLR=   12 YLR= -12   ZLR= -4.9657
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y CROSS SECTION AT Z= 0.25 DISK LEVEL'
XUL=  -12 YUL=  12   ZUL= 0.25
XLR=   12 YLR= -12   ZLR= 0.25
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Z CROSS SECTION AT Y=0.9525 (MIDDLE OF FUEL PIN)'
XUL= -11.6  YUL=0.9525   ZUL= 5.608
XLR=  11.6  YLR=0.9525   ZLR=-5.608
UAX=1.0 WDN=-1.0 NAX=1500 END
END PLOT
END DATA
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
****************************************************************************
****************************************************************************
****************************************************************************
*****                                                                  *****
*****                PROGRAM VERIFICATION INFORMATION                  *****
*****                                                                  *****
*****              CODE SYSTEM:  SCALE-PC VERSION:  4.3                *****
*****                                                                  *****
****************************************************************************
****************************************************************************
*****                                                                  *****
*****                                                                  *****
*****                   PROGRAM:  CSAS                                 *****
*****                                                                  *****
*****             CREATION DATE:  03-08-96                             *****
*****                                                                  *****
*****                    VOLUME:  ENG                                  *****
*****                                                                  *****
*****                   LIBRARY:  G:\SCALE43\EXE                       *****
*****                                                                  *****
*****                                                                  *****
*****           PRODUCTION CODE:  CSAS                                 *****
*****                                                                  *****
*****                   VERSION:  3.1                                  *****
*****                                                                  *****
*****                   JOBNAME:  SCALE-PC                             *****
*****                                                                  *****
*****         DATE OF EXECUTION:  04/03/97                             *****
*****                                                                  *****
*****         TIME OF EXECUTION:  20:59:48                             *****
*****                                                                  *****
*****                                                                  *****
****************************************************************************
****************************************************************************
****************************************************************************

FAILED FUEL ASSEMBLY ANALYSIS - UNC TYPE FUEL - ZR/SS CLADS HOMOGENIZED


**** PROBLEM PARAMETERS ****

LIB 27GROUPNDF4  LIBRARY
MXX            8 MIXTURES
MSC           13 COMPOSITION SPECIFICATIONS
IZM            4 MATERIAL ZONES
GE  LATTICECELL  GEOMETRY
MORE           0 0/1 DO NOT READ/READ OPTIONAL PARAMETER DATA
MSLN           0 FUEL SOLUTIONS


**** PROBLEM COMPOSITION DESCRIPTION ****

SC  UO2          STANDARD COMPOSITION
MX             1 MIXTURE NO.
VF        0.9500 VOLUME FRACTION
ROTH     10.9600 THEORETICAL DENSITY
NEL            2 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           92000      1.00 ATOM/MOLECULE
                           92235     4.000 WT%
                           92238    96.000 WT%
            8016      2.00 ATOMS/MOLECULE
END

SC  ZIRCALLOY    STANDARD COMPOSITION
MX             2 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      6.5600 THEORETICAL DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
             40302       1.00 ATOM/MOLECULE
    END

    SC  H2O           STANDARD COMPOSITION
    MX              3 MIXTURE NO.
    VF         1.0000 VOLUME FRACTION
    ROTH       0.9982 THEORETICAL DENSITY
    NEL             2 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
             1001        2.00 ATOMS/MOLECULE
             8016        1.00 ATOM/MOLECULE
    END

    SC  AL            STANDARD COMPOSITION
    MX              4 MIXTURE NO.
    VF         1.0000 VOLUME FRACTION
    ROTH       2.7020 THEORETICAL DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
            13027        1.00 ATOM/MOLECULE
    END

    SC  SS304         STANDARD COMPOSITION
    MX              5 MIXTURE NO.
    VF         1.0000 VOLUME FRACTION
    ROTH       7.9200 THEORETICAL DENSITY
    NEL             4 NO. ELEMENTS
    ICP             0 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
            24304     19.000 WT%
            25055      2.000 WT%
            26304     69.500 WT%
            28304      9.500 WT%
    END

    SC  B-10          STANDARD COMPOSITION
    MX              6 MIXTURE NO.
    VF         0.0450 VOLUME FRACTION
    ROTH       2.6266 SPECIFIED DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
             5010        1.00 ATOM/MOLECULE
    END

    SC  B-11          STANDARD COMPOSITION
    MX              6 MIXTURE NO.
    VF         0.2731 VOLUME FRACTION
    ROTH       2.6266 SPECIFIED DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
             5011        1.00 ATOM/MOLECULE
    END

    SC  C             STANDARD COMPOSITION
    MX              6 MIXTURE NO.
    VF         0.0925 VOLUME FRACTION
    ROTH       2.6266 SPECIFIED DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
             6012        1.00 ATOM/MOLECULE
    END

    SC  AL            STANDARD COMPOSITION
    MX              6 MIXTURE NO.
    VF         0.5744 VOLUME FRACTION
    ROTH       2.6266 SPECIFIED DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
            13027        1.00 ATOM/MOLECULE
    END
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
SC  H2O           STANDARD COMPOSITION
MX               7 MIXTURE NO.
VF          1.0000 VOLUME FRACTION
ROTH        0.9982 THEORETICAL DENSITY
NEL              2 NO. ELEMENTS
ICP              1 0/1 MIXTURE/COMPOUND
TEMP         293.0 DEG KELVIN
              1001       2.00 ATOMS/MOLECULE
              8016       1.00 ATOM/MOLECULE
END

SC  ZIRCALLOY     STANDARD COMPOSITION
MX               8 MIXTURE NO.
VF          0.3080 VOLUME FRACTION
ROTH        4.6640 SPECIFIED DENSITY
NEL              1 NO. ELEMENTS
ICP              1 0/1 MIXTURE/COMPOUND
TEMP         293.0 DEG KELVIN
             40302       1.00 ATOM/MOLECULE
END

SC  H2O           STANDARD COMPOSITION
MX               8 MIXTURE NO.
VF          0.0917 VOLUME FRACTION
ROTH        4.6640 SPECIFIED DENSITY
NEL              2 NO. ELEMENTS
ICP              1 0/1 MIXTURE/COMPOUND
TEMP         293.0 DEG KELVIN
              1001       2.00 ATOMS/MOLECULE
              8016       1.00 ATOM/MOLECULE
END

SC  SS304         STANDARD COMPOSITION
MX               8 MIXTURE NO.
VF          0.6003 VOLUME FRACTION
ROTH        4.6640 SPECIFIED DENSITY
NEL              4 NO. ELEMENTS
ICP              0 0/1 MIXTURE/COMPOUND
TEMP         293.0 DEG KELVIN
             24304     19.000 WT%
             25055      2.000 WT%
             26304     69.500 WT%
             28304      9.500 WT%
END


**** PROBLEM GEOMETRY ****

CTP SQUAREPITCH  CELL TYPE
PITCH       1.9050 CM CENTER TO CENTER SPACING
FUELOD      0.7887 CM FUEL DIAMETER OR SLAB THICKNESS
MFUEL            1 MIXTURE NO. OF FUEL
MMOD             3 MIXTURE NO. OF MODERATOR
CLADOD      1.2700 CM CLAD OUTER DIAMETER
MCLAD            8 MIXTURE NO. OF CLAD
GAPOD       0.8052 CM GAP OUTER DIAMETER
MGAP             7 MIXTURE NO. OF GAP


ZONE SPECIFICATIONS FOR LATTICECELL GEOMETRY

               ZONE  1 IS FUEL
               ZONE  2 IS GAP
               ZONE  3 IS CLAD
               ZONE  4 IS MOD
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
*****************************************************************************
*****************************************************************************
*****************************************************************************
*****                                                                   *****
*****              PROGRAM VERIFICATION INFORMATION                     *****
*****                                                                   *****
*****             CODE SYSTEM:  SCALE-PC VERSION:  4.3                  *****
*****                                                                   *****
*****************************************************************************
*****************************************************************************
*****                                                                   *****
*****                                                                   *****
*****              PROGRAM:  000002                                     *****
*****                                                                   *****
*****        CREATION DATE:  09-28-95                                   *****
*****                                                                   *****
*****              VOLUME:  ENG                                         *****
*****                                                                   *****
*****             LIBRARY:  G:\SCALE43\EXE                              *****
*****                                                                   *****
*****                                                                   *****
*****     PRODUCTION CODE:  NITAWL                                      *****
*****                                                                   *****
*****             VERSION:  3.0                                         *****
*****                                                                   *****
*****             JOBNAME:  SCALE-PC                                    *****
*****                                                                   *****
*****    DATE OF EXECUTION:  04/03/97                                   *****
*****                                                                   *****
*****    TIME OF EXECUTION:  20:59:51                                   *****
*****                                                                   *****
*****                                                                   *****
*****************************************************************************
*****************************************************************************
*****************************************************************************
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
       -1Q ARRAY HAS      1 ENTRIES.

        0Q ARRAY HAS      9 ENTRIES.

        1Q ARRAY HAS     12 ENTRIES.

SELECT 24 NUCLIDES FROM THE MASTER  LIBRARY ON LOGICAL  1
        0 NUCLIDES FROM THE WORKING LIBRARY ON LOGICAL  2
        0 NUCLIDES FROM THE WORKING LIBRARY ON LOGICAL  3
          TO CREATE THE NEW WORKING LIBRARY ON LOGICAL  4

        6 RESONANCE CALCULATIONS HAVE BEEN REQUESTED
       -1 OUTPUT OPTION FOR AMPX FORMATTED CROSS SECTION DATA
     2001 MAXIMUM NUMBER OF RESONANCE MESH INTERVALS
        2 ORDER OF RESONANCE LEVEL PROCESSING

THE STORAGE ALLOCATED FOR THIS CASE IS    100000 WORDS

        2Q ARRAY HAS     24 ENTRIES.

        3Q ARRAY HAS     90 ENTRIES.

        4Q ARRAY HAS     24 ENTRIES.

 GENERAL INFORMATION CONCERNING CROSS SECTION LIBRARY
   TAPE IDENTIFICATION NUMBER                 4321
   NUMBER OF NUCLIDES ON TAPE                   24
   NUMBER OF NEUTRON ENERGY GROUPS              27
   FIRST THERMAL NEUTRON ENERGY GROUP           15
   NUMBER OF GAMMA ENERGY GROUPS                 0

   DIRECT ACCESS UNIT NUMBER  9 REQUIRES 117 BLOCKS OF LENGTH  1680 WORDS
 XSDRN TAPE   4321
                       SCALE 4.2 - 27 GROUP NEUTRON GROUP LIBRARY
                          BASED ON ENDF-B VERSION 4 DATA
                             COMPILED FOR NRC     1/27/89
                                LAST UPDATED                                                   08/12/94
                                   L.M.PETRIE   -   ORNL

 NUCLIDES FROM XSDRN TAPE
    1     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002              UPDATED 08/12/94     3001001
    2     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002              UPDATED 08/12/94     7001001
    3     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002              UPDATED 08/12/94     8001001
    4    B-10 1273 218NGP 042375 P-3 293K                         UPDATED 08/12/94     6005010
    5     BORON-11       ENDF/B-IV MAT 1160                       UPDATED 08/12/94     6005011
    6     CARBON-12      ENDF/B-IV MAT 1274/THRM1065              UPDATED 08/12/94     6006012
    7     OXYGEN-16      ENDF/B-IV MAT 1276                       UPDATED 08/12/94     1008016
    8     OXYGEN-16      ENDF/B-IV MAT 1276                       UPDATED 08/12/94     3008016
    9     OXYGEN-16      ENDF/B-IV MAT 1276                       UPDATED 08/12/94     7008016
   10     OXYGEN-16      ENDF/B-IV MAT 1276                       UPDATED 08/12/94     8008016
   11    AL-27 1193 218 GP 040375(5)                              UPDATED 08/12/94     4013027
   12    AL-27 1193 218 GP 040375(5)                              UPDATED 08/12/94     6013027
   13    CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94     5024304
   14    CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94     8024304
   15     MANGANESE-55   ENDF/B-IV MAT 1197                       UPDATED 08/12/94     5025055
   16     MANGANESE-55   ENDF/B-IV MAT 1197                       UPDATED 08/12/94     8025055
   17    FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94     5026304
   18    FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94     8026304
   19    NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94     5028304
   20    NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED 08/12/94     8028304
   21     ZIRCALLOY      ENDF/B-IV MAT 1284                       UPDATED 08/12/94     2040302
   22     ZIRCALLOY      ENDF/B-IV MAT 1284                       UPDATED 08/12/94     8040302
   23     URANIUM-235    ENDF/B-IV MAT 1261                       UPDATED 08/12/94     1092235
   24     URANIUM-238    ENDF/B-IV MAT 1262                       UPDATED 08/12/94     1092238

 HYDROGEN      ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94   3001001      TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 HYDROGEN      ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94   7001001      TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 HYDROGEN      ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94   8001001      TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
B-10 1273 218NGP 042375 P-3 293K                     UPDATED 08/12/94  6005010     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 BORON-11       ENDF/B-IV MAT 1160                   UPDATED 08/12/94  6005011     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 CARBON-12      ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94  6006012     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94  1008016     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94  3008016     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94  7008016     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 OXYGEN-16      ENDF/B-IV MAT 1276                   UPDATED 08/12/94  8008016     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00


AL-27 1193 218 GP 040375(5)                          UPDATED 08/12/94  4013027     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

AL-27 1193 218 GP 040375(5)                          UPDATED 08/12/94  6013027     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'     UPDATED 08/12/94  5024304     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'     UPDATED 08/12/94  8024304     TEMPERATURE=   293.00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 MANGANESE-55   ENDF/B-IV MAT 1197                   UPDATED 08/12/94  5025055     TEMPERATURE=   293.00

GEOMETRY HAS BEEN SET TO HOMOGENEOUS AS LBAR IS  0.0000E+00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =    54.466          TEMPERATURE(KELVIN)        =   293.000

POTENTIAL SCATTER SIGMA  =     2.590          LUMPED NUCLEAR DENSITY     = 1.7363295E-03

SPIN FACTOR (G)          =    14.448          LUMP DIMENSION (A-BAR)     = 0.0000000E+00

INNER RADIUS             = 0.0000000E+00      DANCOFF CORRECTION (C)     = 0.0000000E+00

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1    =     55.845          SIGMA(PER ABSORBER ATOM)= 3.4663022E+02

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2    =     55.925          SIGMA(PER ABSORBER ATOM)= 1.2557598E+02

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 0-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP       RES ABS         RES FISS        RES SCAT
  8     -5.518788E-04    0.000000E+00   -3.944190E-01
  9     -2.797993E-03    0.000000E+00   -2.293471E+00
 10     -3.291452E-01    0.000000E+00   -3.820862E+01
 11     -2.680562E+00    0.000000E+00   -1.159996E+02

EXCESS RESONANCE INTEGRALS

                  RESOLVED

ABSORPTION       3.33719E+00
FISSION          0.00000E+00
                                                         PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
 MANGANESE-55    ENDF/B-IV MAT 1197                    UPDATED 08/12/94   8025055     TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =    54.466             TEMPERATURE(KELVIN)        =   293.000

POTENTIAL SCATTER SIGMA  =     2.590             LUMPED NUCLEAR DENSITY     = 6.1380991E-04

SPIN FACTOR (G)          =    14.448             LUMP DIMENSION (A-BAR)     = 6.3499999E-01

INNER RADIUS             = 4.0259999E-01         DANCOFF CORRECTION (C)     = 3.2576096E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1    =     1.008             SIGMA(PER ABSORBER ATOM)= 9.4989429E+02

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2    =    43.937             SIGMA(PER ABSORBER ATOM)= 6.6430096E+02

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP       RES ABS         RES FISS        RES SCAT
  8      -4.632522E-05    0.000000E+00   -2.604041E-02
  9      -1.038829E-04    0.000000E+00   -9.882612E-02
 10      -5.790435E-02    0.000000E+00   -2.306738E+00
 11      -3.794656E-01    0.000000E+00   -1.751240E+01

EXCESS RESONANCE INTEGRALS

                  RESOLVED

ABSORPTION      8.52043E+00
FISSION         0.00000E+00
                                                            PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94   5026304     TEMPERATURE=   293.00
                                                            PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94   8026304     TEMPERATURE=   293.00
                                                            PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94   5028304     TEMPERATURE=   293.00
                                                            PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94   8028304     TEMPERATURE=   293.00
                                                            PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 ZIRCALLOY      ENDF/B-IV MAT 1284                     UPDATED 08/12/94   2040302     TEMPERATURE=   293.00

GEOMETRY HAS BEEN SET TO HOMOGENEOUS AS LBAR IS  0.0000E+00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =    90.436             TEMPERATURE(KELVIN)        =   293.000

POTENTIAL SCATTER SIGMA  =     6.385             LUMPED NUCLEAR DENSITY     = 4.3307818E-02

SPIN FACTOR (G)          =     1.079             LUMP DIMENSION (A-BAR)     = 0.0000000E+00

INNER RADIUS             = 0.0000000E+00         DANCOFF CORRECTION (C)     = 0.0000000E+00

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 0-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP       RES ABS         RES FISS        RES SCAT
  8      -2.531564E-03    0.000000E+00   -2.069429E+00
  9      -7.143981E-02    0.000000E+00   -3.266492E+00
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
 10      -7.703653E-02    0.000000E+00   -1.746459E+00
 11      -1.954898E-01    0.000000E+00   -8.103043E-01

EXCESS RESONANCE INTEGRALS

                  RESOLVED

ABSORPTION       1.75363E-01
FISSION          0.00000E+00
                                                            PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 ZIRCALLOY      ENDF/B-IV MAT 1284                     UPDATED 08/12/94   8040302     TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =    90.436             TEMPERATURE(KELVIN)        =   293.000

POTENTIAL SCATTER SIGMA  =     6.385             LUMPED NUCLEAR DENSITY     = 9.4835665E-03

SPIN FACTOR (G)          =     1.079             LUMP DIMENSION (A-BAR)     = 6.3499999E-01

INNER RADIUS             = 4.0259999E-01         DANCOFF CORRECTION (C)     = 3.2576096E-01

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1     =     1.008            SIGMA(PER ABSORBER ATOM)= 6.1480515E+01

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2     =    40.227            SIGMA(PER ABSORBER ATOM)= 3.6691963E+01

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP        RES ABS         RES FISS        RES SCAT
  8      -1.628454E-04    0.000000E+00   -1.293278E-01
  9      -1.405488E-02    0.000000E+00   -5.710824E-01
 10      -1.309752E-02    0.000000E+00   -3.091693E-01
 11      -5.092335E-02    0.000000E+00   -2.514589E-01

EXCESS RESONANCE INTEGRALS

                  RESOLVED

ABSORPTION       6.45563E-01
FISSION          0.00000E+00
                                                            PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 URANIUM-235    ENDF/B-IV MAT 1261                     UPDATED 08/12/94   1092235     TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =   233.025             TEMPERATURE(KELVIN)        =   293.000

POTENTIAL SCATTER SIGMA  =    11.500             LUMPED NUCLEAR DENSITY     = 9.4064139E-04

SPIN FACTOR (G)          = 15171.100             LUMP DIMENSION (A-BAR)     = 3.9434999E-01

INNER RADIUS             = 0.0000000E+00         DANCOFF CORRECTION (C)     = 5.1593807E-02

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1     =    15.991            SIGMA(PER ABSORBER ATOM)= 1.9199110E+02

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2     =   238.051            SIGMA(PER ABSORBER ATOM)= 2.9209552E+02

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP        RES ABS         RES FISS        RES SCAT
 12      -3.024781E+00   -1.858535E+00   -7.440431E-02
 13      -9.829280E+00   -4.807918E+00   -2.158688E-01
 14      -7.256217E+00   -4.316991E+00   -5.064887E-02
 15      -3.783771E-04   -2.876999E-04    3.180036E-06

EXCESS RESONANCE INTEGRALS

                 RESOLVED

ABSORPTION       2.04765E+02
FISSION          1.22513E+02
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00

 URANIUM-238    ENDF/B-IV MAT 1262                   UPDATED 08/12/94   1092238     TEMPERATURE=   293.00

RESONANCE DATA FOR THIS NUCLIDE

MASS NUMBER (A)          =   236.006           TEMPERATURE(KELVIN)       =   293.000

POTENTIAL SCATTER SIGMA  =    10.599           LUMPED NUCLEAR DENSITY    = 2.2290209E-02

SPIN FACTOR (G)          =   656.527           LUMP DIMENSION (A-BAR)    = 3.9434999E-01

INNER RADIUS             = 0.0000000E+00       DANCOFF CORRECTION (C)    = 5.1593807E-02

THE ABSORBER WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-1    =    15.991          SIGMA(PER ABSORBER ATOM)= 8.1019773E+00

MODERATOR-1 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

MASS OF MODERATOR-2    =   235.044          SIGMA(PER ABSORBER ATOM)= 5.0228214E-01

MODERATOR-2 WILL BE TREATED BY THE NORDHEIM INTEGRAL METHOD.

THIS RESONANCE MATERIAL WILL BE TREATED AS A 2-DIMENSIONAL OBJECT.

VOLUME FRACTION OF LUMP IN CELL USED TO ACCOUNT FOR SPATIAL SELF-SHIELDING=1.00000

GROUP        RES ABS         RES FISS        RES SCAT
  9      -4.118901E-02    0.000000E+00   -4.144779E-01
 10      -1.071716E+00   -1.898310E-05   -6.558035E+00
 11      -9.741570E+00    0.000000E+00   -2.679138E+01
 12      -4.269218E+01    0.000000E+00   -4.964766E+01
 13      -5.346131E+01    0.000000E+00   -1.756231E+01
 14      -1.034559E+02    0.000000E+00   -6.027745E+00
 15      -6.122580E-07    0.000000E+00    1.186307E-06

EXCESS RESONANCE INTEGRALS

                 RESOLVED

ABSORPTION       2.07674E+01
FISSION          5.01450E-04
                                                          PROCESS NUMBER 1007 IS AT TEMPERATURE=   293.00
     THIS XSDRN WORKING TAPE WAS CREATED 04/03/97 AT 20:59:51
     THE TITLE OF THE PARENT CASE IS AS FOLLOWS
     SCALE 4.2 - 27 GROUP NEUTRON GROUP LIBRARY
        BASED ON ENDF-B VERSION 4 DATA
           COMPILED FOR NRC     1/27/89
         TAPE ID                          4321         NUMBER OF NUCLIDES                   24
         NUMBER OF NEUTRON GROUPS           27         NUMBER OF GAMMA GROUPS                0
         FIRST THERMAL GROUP                15         LOGICAL UNIT                          4
                                    TABLE OF CONTENTS
        HYDROGEN      ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94       ID   3001001
        HYDROGEN      ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94       ID   7001001
        HYDROGEN      ENDF/B-IV MAT 1269/THRM1002          UPDATED 08/12/94       ID   8001001
       B-10 1273 218NGP 042375 P-3 293K                    UPDATED 08/12/94       ID   6005010
        BORON-11      ENDF/B-IV MAT 1160                   UPDATED 08/12/94       ID   6005011
        CARBON-12     ENDF/B-IV MAT 1274/THRM1065          UPDATED 08/12/94       ID   6006012
        OXYGEN-16     ENDF/B-IV MAT 1276                   UPDATED 08/12/94       ID   1008016
        OXYGEN-16     ENDF/B-IV MAT 1276                   UPDATED 08/12/94       ID   3008016
        OXYGEN-16     ENDF/B-IV MAT 1276                   UPDATED 08/12/94       ID   7008016
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
 OXYGEN-16      ENDF/B-IV MAT 1276                     UPDATED 08/12/94       ID   8008016
AL-27 1193 218 GP 040375(5)                            UPDATED 08/12/94       ID   4013027
AL-27 1193 218 GP 040375(5)                            UPDATED 08/12/94       ID   6013027
CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94       ID   5024304
CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94       ID   8024304
 MANGANESE-55   ENDF/B-IV MAT 1197                     UPDATED 08/12/94       ID   5025055
 MANGANESE-55   ENDF/B-IV MAT 1197                     UPDATED 08/12/94       ID   8025055
FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94       ID   5026304
FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94       ID   8026304
NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94       ID   5028304
NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94       ID   8028304
 ZIRCALLOY      ENDF/B-IV MAT 1284                     UPDATED 08/12/94       ID   2040302
 ZIRCALLOY      ENDF/B-IV MAT 1284                     UPDATED 08/12/94       ID   8040302
 URANIUM-235    ENDF/B-IV MAT 1261                     UPDATED 08/12/94       ID   1092235
 URANIUM-238    ENDF/B-IV MAT 1262                     UPDATED 08/12/94       ID   1092238

  TAPE COPY USED      0 I/O'S, AND TOOK     0.27 SECONDS

                 ********************************************************************************
                 ********************************************************************************
                 ********************************************************************************
                 *****                                                                      *****
                 *****                  PROGRAM VERIFICATION INFORMATION                    *****
                 *****                                                                      *****
                 *****                 CODE SYSTEM:  SCALE-PC VERSION:  4.3                 *****
                 *****                                                                      *****
                 ********************************************************************************
                 ********************************************************************************
                 *****                                                                      *****
                 *****                                                                      *****
                 *****              PROGRAM:  000009                                        *****
                 *****                                                                      *****
                 *****        CREATION DATE:  03-08-96                                      *****
                 *****                                                                      *****
                 *****              VOLUME:  ENG                                            *****
                 *****                                                                      *****
                 *****             LIBRARY:  G:\SCALE43\EXE                                 *****
                 *****                                                                      *****
                 *****                                                                      *****
                 *****      PRODUCTION CODE:  KENOVA                                        *****
                 *****                                                                      *****
                 *****             VERSION:  3.1                                            *****
                 *****                                                                      *****
                 *****             JOBNAME:  SCALE-PC                                       *****
                 *****                                                                      *****
                 *****    DATE OF EXECUTION:  04/03/97                                      *****
                 *****                                                                      *****
                 *****    TIME OF EXECUTION:  21:00:04                                      *****
                 *****                                                                      *****
                 *****                                                                      *****
                 ********************************************************************************
                 ********************************************************************************
                 ********************************************************************************
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
*****************************************************************************************************************
***                                                                                                           ***
***                    FAILED FUEL ASSEMBLY ANALYSIS - UNC TYPE FUEL - ZR/SS CLADS HOMOGENIZED                ***
***                                                                                                           ***
*****************************************************************************************************************
***                              ******      NUMERIC PARAMETERS      ******                                   ***
***                                                                                                           ***
***                                                                                                           ***
***                 TME       MAXIMUM PROBLEM TIME (MIN)                           500.00                     ***
***                                                                                                           ***
***                 TBA       TIME PER GENERATION (MIN)                              0.50                     ***
***                                                                                                           ***
***                 GEN       NUMBER OF GENERATIONS                                  1003                     ***
***                                                                                                           ***
***                 NPG       NUMBER PER GENERATION                                  1000                     ***
***                                                                                                           ***
***                 NSK       NUMBER OF GENERATIONS TO BE SKIPPED                       3                     ***
***                                                                                                           ***
***                 BEG       BEGINNING GENERATION NUMBER                               1                     ***
***                                                                                                           ***
***                 RES       GENERATIONS BETWEEN CHECKPOINTS                           0                     ***
***                                                                                                           ***
***                 X1D       NUMBER OF EXTRA 1-D CROSS SECTIONS                        1                     ***
***                                                                                                           ***
***                 NBK       NEUTRON BANK SIZE                                      1025                     ***
***                                                                                                           ***
***                 XNB       EXTRA POSITIONS IN NEUTRON BANK                           0                     ***
***                                                                                                           ***
***                 NFB       FISSION BANK SIZE                                      1000                     ***
***                                                                                                           ***
***                 XFB       EXTRA POSITIONS IN FISSION BANK                           0                     ***
***                                                                                                           ***
***                 WTA       DEFAULT VALUE OF WEIGHT AVERAGE                      0.5000                     ***
***                                                                                                           ***
***                 WTH       WEIGHT HIGH FOR SPLITTING                            3.0000                     ***
***                                                                                                           ***
***                 WTL       WEIGHT LOW FOR RUSSIAN ROULETTE                      0.3333                     ***
***                                                                                                           ***
***                 RND       STARTING RANDOM NUMBER                          BB827100001                     ***
***                                                                                                           ***
***                 NB8       NUMBER OF D.A. BLOCKS ON UNIT  8                        200                     ***
***                                                                                                           ***
***                 NL8       LENGTH OF D.A. BLOCKS ON UNIT  8                        512                     ***
***                                                                                                           ***
***                 ADJ       MODE OF CALCULATION                                 FORWARD                     ***
***                                                                                                           ***
***                           INPUT DATA WRITTEN ON RESTART UNIT                       NO                     ***
***                                                                                                           ***
***                           BINARY DATA INTERFACE                                   YES                     ***
***                                                                                                           ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
*****************************************************************************************************************
*****************************************************************************************************************
***                                                                                                           ***
***                     FAILED FUEL ASSEMBLY ANALYSIS - UNC TYPE FUEL - ZR/SS CLADS HOMOGENIZED               ***
***                                                                                                           ***
*****************************************************************************************************************
***                               ******    LOGICAL PARAMETERS      ******                                    ***
***                                                                                                           ***
*** RUN  EXECUTE PROBLEM AFTER CHECKING DATA    YES          PLT  PLOT PICTURE MAP(S)                       NO ***
***                                                                                                           ***
*** FLX  COMPUTE FLUX                            NO          FDN  COMPUTE FISSION DENSITIES                 NO ***
***                                                                                                           ***
*** SMU  COMPUTE AVG UNIT SELF-MULTIPLICATION    NO          NUB  COMPUTE NU-BAR & AVG FISSION GROUP       YES ***
***                                                                                                           ***
*** MKU  COMPUTE MATRIX K-EFF BY UNIT NUMBER     NO          MKP  COMPUTE MATRIX K-EFF BY UNIT LOCATION     NO ***
***                                                                                                           ***
*** CKU  COMPUTE COFACTOR K-EFF BY UNIT NUMBER   NO          CKP  COMPUTE COFACTOR K-EFF BY UNIT LOCATION   NO ***
***                                                                                                           ***
*** FMU  PRINT FISS PROD MATRIX BY UNIT NUMBER   NO          FMP  PRINT FISS PROD MATRIX BY UNIT LOCATION   NO ***
***                                                                                                           ***
*** MKH  COMPUTE MATRIX K-EFF BY HOLE NUMBER     NO          MKA  COMPUTE MATRIX K-EFF BY ARRAY NUMBER      NO ***
***                                                                                                           ***
*** CKH  COMPUTE COFACTOR K-EFF BY HOLE NUMBER   NO          CKA  COMPUTE COFACTOR K-EFF BY ARRAY NUMBER    NO ***
***                                                                                                           ***
*** FMH  PRINT FISS PROD MATRIX BY HOLE NUMBER   NO          FMA  PRINT FISS PROD MATRIX BY ARRAY NUMBER    NO ***
***                                                                                                           ***
*** HHL  COLLECT MATRIX BY HIGHEST HOLE LEVEL    NO          HAL  COLLECT MATRIX BY HIGHEST ARRAY LEVEL     NO ***
***                                                                                                           ***
*** AMX  PRINT ALL MIXED CROSS SECTIONS          NO          FAR  PRINT FIS. AND ABS. BY REGION             NO ***
***                                                                                                           ***
*** XS1  PRINT 1-D MIXTURE X-SECTIONS            NO          GAS  PRINT FAR BY GROUP                        NO ***
***                                                                                                           ***
*** XS2  PRINT 2-D MIXTURE X-SECTIONS            NO          PAX  PRINT XSEC-ALBEDO CORRELATION TABLES      NO ***
***                                                                                                           ***
*** XAP  PRINT MIXTURE ANGLES & PROBABILITIES    NO          PWT  PRINT WEIGHT AVERAGE ARRAY                NO ***
***                                                                                                           ***
*** PKI  PRINT FISSION SPECTRUM                  NO          PGM  PRINT INPUT GEOMETRY                      NO ***
***                                                                                                           ***
*** P1D  PRINT EXTRA 1-D CROSS SECTIONS          NO          BUG  PRINT DEBUG INFORMATION                   NO ***
***                                                                                                           ***
***                                                          TRK  PRINT TRACKING INFORMATION                NO ***
***                                                                                                           ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
*****************************************************************************************************************
                                           PARAMETER INPUT COMPLETED
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
*********************************************************************************************
***                                                                                      ***
***          FAILED FUEL ASSEMBLY ANALYSIS - UNC TYPE FUEL - ZR/SS CLADS HOMOGENIZED     ***
***                                                                                      ***
*********************************************************************************************
*********************************************************************************************
***                                                                                      ***
***                          ****** ADDITIONAL INFORMATION ******                        ***
***                                                                                      ***
*** NUMBER OF ENERGY GROUPS              27      USE LATTICE GEOMETRY               YES ***
***                                                                                      ***
*** NO. OF FISSION SPECTRUM SOURCE GROUP  1      GLOBAL ARRAY NUMBER                 30 ***
***                                                                                      ***
*** NO. OF SCATTERING ANGLES IN XSECS     2      NUMBER OF UNITS IN THE GLOBAL X DIR.  1 ***
***                                                                                      ***
*** ENTRIES/NEUTRON IN THE NEUTRON BANK  22      NUMBER OF UNITS IN THE GLOBAL Y DIR.  1 ***
***                                                                                      ***
*** ENTRIES/NEUTRON IN THE FISSION BANK  15      NUMBER OF UNITS IN THE GLOBAL Z DIR.  4 ***
***                                                                                      ***
*** NUMBER OF MIXTURES USED               7      USE A GLOBAL REFLECTOR             YES ***
***                                                                                      ***
*** NUMBER OF BIAS ID'S USED              1      USE NESTED HOLES                    NO ***
***                                                                                      ***
*** NUMBER OF DIFFERENTIAL ALBEDOS USED   0      NUMBER OF HOLES                     12 ***
***                                                                                      ***
*** TOTAL INPUT GEOMETRY REGIONS         44      MAXIMUM HOLE NESTING LEVEL           1 ***
***                                                                                      ***
*** NUMBER OF GEOMETRY REGIONS USED      44      USE NESTED ARRAYS                  YES ***
***                                                                                      ***
*** LARGEST GEOMETRY UNIT NUMBER         40      NUMBER OF ARRAYS USED                3 ***
***                                                                                      ***
*** LARGEST ARRAY NUMBER                 30      MAXIMUM ARRAY NESTING LEVEL          2 ***
***                                                                                      ***
***                                                                                      ***
*** +X BOUNDARY CONDITION           REFLECT      -X BOUNDARY CONDITION          REFLECT ***
***                                                                                      ***
*** +Y BOUNDARY CONDITION           REFLECT      -Y BOUNDARY CONDITION          REFLECT ***
***                                                                                      ***
*** +Z BOUNDARY CONDITION               PER      -Z BOUNDARY CONDITION              PER ***
***                                                                                      ***
*********************************************************************************************
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

FAILED FUEL ASSEMBLY ANALYSIS - UNC TYPE FUEL - ZR/SS CLADS HOMOGENIZED

GENERATION	GENERATION K-EFFECTIVE	ELAPSED TIME MINUTES	AVERAGE K-EFFECTIVE	AVG K-EFF DEVIATION	MATRIX K-EFFECTIVE	MATRIX K-EFF DEVIATION
KENO MESSAGE NUMBER K5-132		WARNING....ONLY	696 INDEPENDENT	FISSION POINTS WERE	GENERATED	
1	6.16925E-01	7.50000E-02	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
KENO MESSAGE NUMBER K5-132		WARNING....ONLY	662 INDEPENDENT	FISSION POINTS WERE	GENERATED	
2	5.93491E-01	1.06167E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
KENO MESSAGE NUMBER K5-132		WARNING....ONLY	728 INDEPENDENT	FISSION POINTS WERE	GENERATED	
3	6.84356E-01	1.38167E-01	6.84356E-01	0.00000E+00	0.00000E+00	0.00000E+00
4	6.26718E-01	1.68333E-01	6.55537E-01	2.88194E-02	0.00000E+00	0.00000E+00
5	6.46315E-01	2.00500E-01	6.52463E-01	1.69205E-02	0.00000E+00	0.00000E+00
6	6.22181E-01	2.31500E-01	6.44893E-01	1.41585E-02	0.00000E+00	0.00000E+00
7	6.14499E-01	2.62667E-01	6.38814E-01	1.25391E-02	0.00000E+00	0.00000E+00
8	6.30625E-01	2.93833E-01	6.37449E-01	1.03287E-02	0.00000E+00	0.00000E+00
9	5.98297E-01	3.25000E-01	6.31856E-01	1.03675E-02	0.00000E+00	0.00000E+00
10	6.34209E-01	3.57833E-01	6.32150E-01	8.98335E-03	0.00000E+00	0.00000E+00
11	6.72266E-01	3.90000E-01	6.36607E-01	9.09035E-03	0.00000E+00	0.00000E+00
12	6.70923E-01	4.22833E-01	6.40039E-01	8.82513E-03	0.00000E+00	0.00000E+00
13	6.12652E-01	4.54000E-01	6.37549E-01	8.36187E-03	0.00000E+00	0.00000E+00
14	5.95713E-01	4.86000E-01	6.34063E-01	8.39179E-03	0.00000E+00	0.00000E+00
15	6.55639E-01	5.17167E-01	6.35722E-01	7.89573E-03	0.00000E+00	0.00000E+00
16	6.32060E-01	5.48333E-01	6.35461E-01	7.31470E-03	0.00000E+00	0.00000E+00
17	6.36867E-01	5.79333E-01	6.35555E-01	6.81026E-03	0.00000E+00	0.00000E+00
18	6.03067E-01	6.10500E-01	6.33524E-01	6.68618E-03	0.00000E+00	0.00000E+00
19	6.23159E-01	6.42500E-01	6.32914E-01	6.31009E-03	0.00000E+00	0.00000E+00
20	5.77865E-01	6.72833E-01	6.29856E-01	6.68927E-03	0.00000E+00	0.00000E+00
21	6.18462E-01	7.03833E-01	6.29256E-01	6.35577E-03	0.00000E+00	0.00000E+00
22	5.87318E-01	7.36000E-01	6.27160E-01	6.38383E-03	0.00000E+00	0.00000E+00
23	6.10810E-01	7.67000E-01	6.26381E-01	6.12194E-03	0.00000E+00	0.00000E+00
24	6.48811E-01	7.99167E-01	6.27401E-01	5.92542E-03	0.00000E+00	0.00000E+00
25	6.25223E-01	8.30167E-01	6.27306E-01	5.66272E-03	0.00000E+00	0.00000E+00
26	6.38680E-01	8.61333E-01	6.27780E-01	5.44232E-03	0.00000E+00	0.00000E+00
27	6.22584E-01	8.92500E-01	6.27572E-01	5.22422E-03	0.00000E+00	0.00000E+00
28	6.47331E-01	9.24500E-01	6.28332E-01	5.07648E-03	0.00000E+00	0.00000E+00
29	6.29750E-01	9.56500E-01	6.28384E-01	4.88512E-03	0.00000E+00	0.00000E+00
30	6.02498E-01	9.86833E-01	6.27460E-01	4.79735E-03	0.00000E+00	0.00000E+00
31	6.50960E-01	1.01883E+00	6.28270E-01	4.69936E-03	0.00000E+00	0.00000E+00
32	6.05531E-01	1.05083E+00	6.27512E-01	4.60285E-03	0.00000E+00	0.00000E+00
33	6.41554E-01	1.08200E+00	6.27965E-01	4.47489E-03	0.00000E+00	0.00000E+00
34	6.21800E-01	1.11317E+00	6.27773E-01	4.33707E-03	0.00000E+00	0.00000E+00
35	6.43167E-01	1.14600E+00	6.28239E-01	4.22940E-03	0.00000E+00	0.00000E+00
36	6.63242E-01	1.17717E+00	6.29269E-01	4.23030E-03	0.00000E+00	0.00000E+00
37	6.25348E-01	1.20833E+00	6.29157E-01	4.10918E-03	0.00000E+00	0.00000E+00
38	6.20709E-01	1.24033E+00	6.28922E-01	4.00029E-03	0.00000E+00	0.00000E+00
39	6.47035E-01	1.27150E+00	6.29411E-01	3.92135E-03	0.00000E+00	0.00000E+00
40	6.04600E-01	1.30350E+00	6.28759E-01	3.87221E-03	0.00000E+00	0.00000E+00
41	6.40663E-01	1.33550E+00	6.29064E-01	3.78395E-03	0.00000E+00	0.00000E+00
42	6.42787E-01	1.36583E+00	6.29407E-01	3.70406E-03	0.00000E+00	0.00000E+00
43	6.11997E-01	1.39683E+00	6.28982E-01	3.63746E-03	0.00000E+00	0.00000E+00
44	6.26649E-01	1.42800E+00	6.28927E-01	3.55023E-03	0.00000E+00	0.00000E+00

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974	6.37237E-01	3.07747E+01	6.28018E-01	6.60183E-04	0.00000E+00	0.00000E+00
975	6.36545E-01	3.08077E+01	6.28027E-01	6.59562E-04	0.00000E+00	0.00000E+00
976	6.11214E-01	3.08407E+01	6.28009E-01	6.59111E-04	0.00000E+00	0.00000E+00
977	6.09838E-01	3.08753E+01	6.27991E-01	6.58698E-04	0.00000E+00	0.00000E+00
978	6.06053E-01	3.09093E+01	6.27968E-01	6.58407E-04	0.00000E+00	0.00000E+00
979	6.15457E-01	3.09422E+01	6.27956E-01	6.57857E-04	0.00000E+00	0.00000E+00
980	6.20476E-01	3.09762E+01	6.27948E-01	6.57229E-04	0.00000E+00	0.00000E+00
981	6.27725E-01	3.10100E+01	6.27948E-01	6.56557E-04	0.00000E+00	0.00000E+00
982	6.23040E-01	3.10430E+01	6.27943E-01	6.55906E-04	0.00000E+00	0.00000E+00
983	6.02461E-01	3.10758E+01	6.27917E-01	6.55752E-04	0.00000E+00	0.00000E+00
984	6.34254E-01	3.11088E+01	6.27923E-01	6.55115E-04	0.00000E+00	0.00000E+00
985	6.56145E-01	3.11427E+01	6.27952E-01	6.55078E-04	0.00000E+00	0.00000E+00
986	6.42057E-01	3.11765E+01	6.27966E-01	6.54569E-04	0.00000E+00	0.00000E+00
987	6.26932E-01	3.12105E+01	6.27965E-01	6.53905E-04	0.00000E+00	0.00000E+00
988	6.04356E-01	3.12433E+01	6.27941E-01	6.53680E-04	0.00000E+00	0.00000E+00
989	6.26007E-01	3.12773E+01	6.27939E-01	6.53020E-04	0.00000E+00	0.00000E+00
990	6.38937E-01	3.13102E+01	6.27950E-01	6.52454E-04	0.00000E+00	0.00000E+00
991	6.52287E-01	3.13442E+01	6.27975E-01	6.52258E-04	0.00000E+00	0.00000E+00

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

992	5.99947E-01	3.13762E+01	6.27947E-01	6.52214E-04	0.00000E+00	0.00000E+00
993	6.57162E-01	3.14110E+01	6.27976E-01	6.52222E-04	0.00000E+00	0.00000E+00
994	6.25303E-01	3.14448E+01	6.27973E-01	6.51570E-04	0.00000E+00	0.00000E+00
995	6.57301E-01	3.14787E+01	6.28003E-01	6.51583E-04	0.00000E+00	0.00000E+00
996	6.58375E-01	3.15125E+01	6.28034E-01	6.51644E-04	0.00000E+00	0.00000E+00
997	6.38912E-01	3.15473E+01	6.28044E-01	6.51080E-04	0.00000E+00	0.00000E+00
998	6.69186E-01	3.15822E+01	6.28086E-01	6.51737E-04	0.00000E+00	0.00000E+00
999	5.99814E-01	3.16142E+01	6.28057E-01	6.51700E-04	0.00000E+00	0.00000E+00
1000	6.05547E-01	3.16472E+01	6.28035E-01	6.51437E-04	0.00000E+00	0.00000E+00
1001	6.35923E-01	3.16818E+01	6.28043E-01	6.50833E-04	0.00000E+00	0.00000E+00
1002	6.20651E-01	3.17148E+01	6.28035E-01	6.50224E-04	0.00000E+00	0.00000E+00
1003	6.54362E-01	3.17497E+01	6.28062E-01	6.50106E-04	0.00000E+00	0.00000E+00

KENO MESSAGE NUMBER K5-123 EXECUTION TERMINATED DUE TO COMPLETION OF THE SPECIFIED NUMBER OF GENERATIONS.
FAILED FUEL ASSEMBLY ANALYSIS - UNC TYPE FUEL - ZR/SS CLADS HOMOGENIZED

LIFETIME = 5.84212E-05 + OR - 6.19514E-08 GENERATION TIME = 5.82236E-05 + OR - 7.57390E-08
NU BAR = 2.43220E+00 + OR - 5.41433E-05 AVERAGE FISSION GROUP = 2.34261E+01 + OR - 3.14843E-03
ENERGY(EV) OF THE AVERAGE LETHARGY CAUSING FISSION = 8.29065E-02 + OR - 2.34787E-04

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
3	0.62801	+ OR - 0.00065	0.62736 TO 0.62865	0.62671 TO 0.62930	0.62606 TO 0.62995	1000000
4	0.62801	+ OR - 0.00065	0.62736 TO 0.62866	0.62671 TO 0.62930	0.62606 TO 0.62995	999000
5	0.62799	+ OR - 0.00065	0.62734 TO 0.62864	0.62669 TO 0.62929	0.62604 TO 0.62994	998000
6	0.62799	+ OR - 0.00065	0.62734 TO 0.62864	0.62669 TO 0.62929	0.62604 TO 0.62994	997000
7	0.62801	+ OR - 0.00065	0.62736 TO 0.62866	0.62671 TO 0.62931	0.62606 TO 0.62996	996000
8	0.62801	+ OR - 0.00065	0.62735 TO 0.62866	0.62670 TO 0.62931	0.62605 TO 0.62996	995000
9	0.62803	+ OR - 0.00065	0.62738 TO 0.62869	0.62673 TO 0.62934	0.62608 TO 0.62999	994000
10	0.62803	+ OR - 0.00065	0.62738 TO 0.62868	0.62673 TO 0.62933	0.62607 TO 0.62998	993000
11	0.62798	+ OR - 0.00065	0.62733 TO 0.62863	0.62668 TO 0.62929	0.62603 TO 0.62994	992000
12	0.62794	+ OR - 0.00065	0.62729 TO 0.62859	0.62664 TO 0.62924	0.62599 TO 0.62989	991000
17	0.62795	+ OR - 0.00065	0.62730 TO 0.62860	0.62664 TO 0.62925	0.62599 TO 0.62990	986000
22	0.62808	+ OR - 0.00065	0.62743 TO 0.62873	0.62678 TO 0.62938	0.62613 TO 0.63003	981000
27	0.62807	+ OR - 0.00065	0.62742 TO 0.62873	0.62677 TO 0.62938	0.62611 TO 0.63004	976000
32	0.62808	+ OR - 0.00066	0.62742 TO 0.62873	0.62677 TO 0.62939	0.62611 TO 0.63004	971000
37	0.62802	+ OR - 0.00066	0.62736 TO 0.62868	0.62671 TO 0.62934	0.62605 TO 0.62999	966000
42	0.62801	+ OR - 0.00066	0.62735 TO 0.62867	0.62669 TO 0.62933	0.62603 TO 0.62998	961000

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907	0.62920	+ OR - 0.00210	0.62709 TO 0.63130	0.62499 TO 0.63341	0.62288 TO 0.63551	96000
912	0.62889	+ OR - 0.00220	0.62669 TO 0.63109	0.62449 TO 0.63330	0.62229 TO 0.63550	91000
917	0.62841	+ OR - 0.00224	0.62617 TO 0.63065	0.62392 TO 0.63289	0.62168 TO 0.63513	86000
922	0.62901	+ OR - 0.00233	0.62668 TO 0.63135	0.62435 TO 0.63368	0.62202 TO 0.63601	81000
927	0.62951	+ OR - 0.00245	0.62706 TO 0.63196	0.62461 TO 0.63441	0.62216 TO 0.63686	76000
932	0.62985	+ OR - 0.00260	0.62725 TO 0.63245	0.62466 TO 0.63505	0.62206 TO 0.63765	71000
937	0.62965	+ OR - 0.00279	0.62687 TO 0.63244	0.62408 TO 0.63523	0.62129 TO 0.63801	66000

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

942	0.63042	+ OR - 0.00294	0.62748 TO 0.63336	0.62454 TO 0.63630	0.62160 TO 0.63924	61000
947	0.62861	+ OR - 0.00291	0.62570 TO 0.63152	0.62280 TO 0.63443	0.61989 TO 0.63733	56000
952	0.62923	+ OR - 0.00301	0.62623 TO 0.63224	0.62322 TO 0.63524	0.62022 TO 0.63825	51000
957	0.62924	+ OR - 0.00324	0.62600 TO 0.63247	0.62276 TO 0.63571	0.61953 TO 0.63895	46000
962	0.62837	+ OR - 0.00333	0.62504 TO 0.63170	0.62171 TO 0.63503	0.61837 TO 0.63837	41000
967	0.62847	+ OR - 0.00356	0.62491 TO 0.63203	0.62135 TO 0.63559	0.61779 TO 0.63914	36000
972	0.62969	+ OR - 0.00355	0.62614 TO 0.63323	0.62259 TO 0.63678	0.61904 TO 0.64033	31000
977	0.63072	+ OR - 0.00408	0.62664 TO 0.63480	0.62255 TO 0.63888	0.61847 TO 0.64297	26000
982	0.63362	+ OR - 0.00479	0.62882 TO 0.63841	0.62403 TO 0.64320	0.61924 TO 0.64799	21000
987	0.63400	+ OR - 0.00579	0.62821 TO 0.63979	0.62242 TO 0.64559	0.61663 TO 0.65138	16000
992	0.63841	+ OR - 0.00699	0.63142 TO 0.64540	0.62444 TO 0.65239	0.61745 TO 0.65938	11000
997	0.63091	+ OR - 0.01119	0.61972 TO 0.64210	0.60854 TO 0.65329	0.59735 TO 0.66448	6000

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
FAILED FUEL ASSEMBLY ANALYSIS - UNC TYPE FUEL - ZR/SS CLADS HOMOGENIZED

                                   FREQUENCY FOR GENERATIONS    4 TO 1003
0.5452 TO 0.5481     *
0.5481 TO 0.5509
0.5509 TO 0.5537
0.5537 TO 0.5566
0.5566 TO 0.5594
0.5594 TO 0.5623
0.5623 TO 0.5651
0.5651 TO 0.5679     *
0.5679 TO 0.5708
0.5708 TO 0.5736     *
0.5736 TO 0.5765     *
0.5765 TO 0.5793     ****
0.5793 TO 0.5821     *********
0.5821 TO 0.5850     *****
0.5850 TO 0.5878     ****
0.5878 TO 0.5907     *********
0.5907 TO 0.5935     *****************
0.5935 TO 0.5963     ************
0.5963 TO 0.5992     ***************
0.5992 TO 0.6020     **********************
0.6020 TO 0.6048     ******************************
0.6048 TO 0.6077     ****************************************
0.6077 TO 0.6105     *******************************
0.6105 TO 0.6134     **************************************
0.6134 TO 0.6162     ************************************
0.6162 TO 0.6190     *******************************************
0.6190 TO 0.6219     *******************************************************
0.6219 TO 0.6247     *****************************************************
0.6247 TO 0.6276     ***********************************************
0.6276 TO 0.6304     ***************************************************************
0.6304 TO 0.6332     ************************************************************
0.6332 TO 0.6361     ************************************************************
0.6361 TO 0.6389     ********************************************
0.6389 TO 0.6418     ***************************************************
0.6418 TO 0.6446     **************************************
0.6446 TO 0.6474     ************************************
0.6474 TO 0.6503     **********************************
0.6503 TO 0.6531     *****************************
0.6531 TO 0.6560     *******************************
0.6560 TO 0.6588     ************************
0.6588 TO 0.6616     *******
0.6616 TO 0.6645     *****************
0.6645 TO 0.6673     *******
0.6673 TO 0.6702     ****
0.6702 TO 0.6730     *****
0.6730 TO 0.6758     *******
0.6758 TO 0.6787     **
0.6787 TO 0.6815     **
0.6815 TO 0.6844     ****
0.6844 TO 0.6872
0.6872 TO 0.6900
0.6900 TO 0.6929
0.6929 TO 0.6957
0.6957 TO 0.6986
0.6986 TO 0.7014     *
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

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FAILED FUEL ASSEMBLY ANALYSIS - UNC TYPE FUEL - ZR/SS CLADS HOMOGENIZED

                                   FREQUENCY FOR GENERATIONS  254 TO 1003
0.5452 TO 0.5481     *
0.5481 TO 0.5509
0.5509 TO 0.5537
0.5537 TO 0.5566
0.5566 TO 0.5594
0.5594 TO 0.5623
0.5623 TO 0.5651
0.5651 TO 0.5679     *
0.5679 TO 0.5708
0.5708 TO 0.5736     *
0.5736 TO 0.5765     *
0.5765 TO 0.5793     ***
0.5793 TO 0.5821     *********
0.5821 TO 0.5850     ****
0.5850 TO 0.5878     **
0.5878 TO 0.5907     ******
0.5907 TO 0.5935     *************
0.5935 TO 0.5963     *********
0.5963 TO 0.5992     *************
0.5992 TO 0.6020     *********************
0.6020 TO 0.6048     *********************
0.6048 TO 0.6077     **********************************
0.6077 TO 0.6105     **************************
0.6105 TO 0.6134     ****************************
0.6134 TO 0.6162     *****************************
0.6162 TO 0.6190     ******************************
0.6190 TO 0.6219     **************************************
0.6219 TO 0.6247     ***************************************
0.6247 TO 0.6276     **********************************
0.6276 TO 0.6304     *********************************************
0.6304 TO 0.6332     ********************************************
0.6332 TO 0.6361     *************************************************
0.6361 TO 0.6389     ************************************
0.6389 TO 0.6418     ****************************************
0.6418 TO 0.6446     ************************
0.6446 TO 0.6474     **************************
0.6474 TO 0.6503     *************************
0.6503 TO 0.6531     ******************
0.6531 TO 0.6560     ************************
0.6560 TO 0.6588     *****************
0.6588 TO 0.6616     ******
0.6616 TO 0.6645     **********
0.6645 TO 0.6673     ******
0.6673 TO 0.6702     ***
0.6702 TO 0.6730     **
0.6730 TO 0.6758     ****
0.6758 TO 0.6787     **
0.6787 TO 0.6815     **
0.6815 TO 0.6844     ***
0.6844 TO 0.6872
0.6872 TO 0.6900
0.6900 TO 0.6929
0.6929 TO 0.6957
0.6957 TO 0.6986
0.6986 TO 0.7014     *
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
FAILED FUEL ASSEMBLY ANALYSIS - UNC TYPE FUEL - ZR/SS CLADS HOMOGENIZED

                                FREQUENCY FOR GENERATIONS  504 TO 1003
0.5452 TO 0.5481
0.5481 TO 0.5509
0.5509 TO 0.5537
0.5537 TO 0.5566
0.5566 TO 0.5594
0.5594 TO 0.5623
0.5623 TO 0.5651
0.5651 TO 0.5679     *
0.5679 TO 0.5708
0.5708 TO 0.5736     *
0.5736 TO 0.5765     *
0.5765 TO 0.5793
0.5793 TO 0.5821     ****
0.5821 TO 0.5850     ***
0.5850 TO 0.5878     **
0.5878 TO 0.5907     *****
0.5907 TO 0.5935     ********
0.5935 TO 0.5963     *****
0.5963 TO 0.5992     **********
0.5992 TO 0.6020     ************
0.6020 TO 0.6048     ***************
0.6048 TO 0.6077     **********************
0.6077 TO 0.6105     ****************
0.6105 TO 0.6134     ************************
0.6134 TO 0.6162     *****************
0.6162 TO 0.6190     ********************
0.6190 TO 0.6219     ****************************
0.6219 TO 0.6247     ************************
0.6247 TO 0.6276     **********************
0.6276 TO 0.6304     **************************
0.6304 TO 0.6332     **********************************
0.6332 TO 0.6361     ******************************
0.6361 TO 0.6389     *****************
0.6389 TO 0.6418     ******************************
0.6418 TO 0.6446     ***************
0.6446 TO 0.6474     ******************
0.6474 TO 0.6503     *******************
0.6503 TO 0.6531     ***********
0.6531 TO 0.6560     *****************
0.6560 TO 0.6588     ************
0.6588 TO 0.6616     *****
0.6616 TO 0.6645     ********
0.6645 TO 0.6673     ******
0.6673 TO 0.6702     **
0.6702 TO 0.6730     *
0.6730 TO 0.6758     ***
0.6758 TO 0.6787     **
0.6787 TO 0.6815     **
0.6815 TO 0.6844     *
0.6844 TO 0.6872
0.6872 TO 0.6900
0.6900 TO 0.6929
0.6929 TO 0.6957
0.6957 TO 0.6986
0.6986 TO 0.7014     *
```

Figure 6.7-7 CSAS25 Input / Output for Reconfigured Fuel Assembly Analysis (continued)

```
FAILED FUEL ASSEMBLY ANALYSIS - UNC TYPE FUEL - ZR/SS CLADS HOMOGENIZED

                               FREQUENCY FOR GENERATIONS  754 TO 1003
0.5452 TO 0.5481
0.5481 TO 0.5509
0.5509 TO 0.5537
0.5537 TO 0.5566
0.5566 TO 0.5594
0.5594 TO 0.5623
0.5623 TO 0.5651
0.5651 TO 0.5679
0.5679 TO 0.5708
0.5708 TO 0.5736
0.5736 TO 0.5765
0.5765 TO 0.5793
0.5793 TO 0.5821     **
0.5821 TO 0.5850     **
0.5850 TO 0.5878     *
0.5878 TO 0.5907     ***
0.5907 TO 0.5935     *****
0.5935 TO 0.5963     ***
0.5963 TO 0.5992     *****
0.5992 TO 0.6020     *******
0.6020 TO 0.6048     *******
0.6048 TO 0.6077     ************
0.6077 TO 0.6105     ****
0.6105 TO 0.6134     *************
0.6134 TO 0.6162     ***********
0.6162 TO 0.6190     *******
0.6190 TO 0.6219     ******************
0.6219 TO 0.6247     *************
0.6247 TO 0.6276     ************
0.6276 TO 0.6304     ***************
0.6304 TO 0.6332     ***********
0.6332 TO 0.6361     ****************
0.6361 TO 0.6389     **************
0.6389 TO 0.6418     *************
0.6418 TO 0.6446     ******
0.6446 TO 0.6474     ***********
0.6474 TO 0.6503     ********
0.6503 TO 0.6531     *****
0.6531 TO 0.6560     ******
0.6560 TO 0.6588     ******
0.6588 TO 0.6616     **
0.6616 TO 0.6645     *
0.6645 TO 0.6673     *****
0.6673 TO 0.6702     *
0.6702 TO 0.6730
0.6730 TO 0.6758     *
0.6758 TO 0.6787     *
0.6787 TO 0.6815     **
0.6815 TO 0.6844     *
0.6844 TO 0.6872
0.6872 TO 0.6900
0.6900 TO 0.6929
0.6929 TO 0.6957
0.6957 TO 0.6986
0.6986 TO 0.7014
```

Figure 6.7-8 CSAS25 Input/Output for Enlarged Fuel Tube Model

```
PRIMARY MODULE ACCESS AND INPUT RECORD ( SCALE DRIVER - 95/03/29 - 09:06:37 )
MODULE CSAS25   WILL BE CALLED
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 cm) (IVF = 1.0) (EVF = 1.0
'
'       THIS IS A MODEL OF THE YNPS NAC-MPC BASKET
'   LOADED WITH 36 UNITED NUCLEAR TYPE A ASSEMBLIES
'                     WITH MODIFIED TUBE ASSEMBLY 98
'            PRODUCED FOR THE YANKEE ROWE
'               STC LICENSE AMENDMENT
'
'       INTERIOR MODERATOR VOLUME FRACTION = 1.0
'       EXTERIOR MODERATOR VOLUME FRACTION = 1.0
'           CASK TO CASK PITCH = 300 cm
'               FLOODED PELLET CLAD GAP
'               NEUTRON SHIELD REMOVED
'
27GROUPNDF4 LATTICECELL
UO2         1               0.95    293.0 92235 4.0 92238 96.0 END
ZIRCALLOY   2               1.0     293.0                      END
H2O         3               1.0     293.0                      END
AL          4               1.0     293.0                      END
SS304       5               1.0     293.0                      END
B-10        6  DEN=2.6226 0.0450  293.0                        END
B-11        6  DEN=2.6226 0.2736  293.0                        END
C           6  DEN=2.6226 0.0927  293.0                        END
AL          6  DEN=2.6226 0.5737  293.0                        END
PB          7               1.0     293.0                      END
H           8  DEN=1.6291 0.060   293.0                        END
O           8  DEN=1.6291 0.425   293.0                        END
C           8  DEN=1.6291 0.277   293.0                        END
N           8  DEN=1.6291 0.020   293.0                        END
AL          8  DEN=1.6291 0.214   293.0                        END
B-10        8  DEN=1.6291 0.001   293.0                        END
B-11        8  DEN=1.6291 0.004   293.0                        END
H2O         9               1.0     293.0                      END
H2O         10              1.0     293.0                      END
END COMP
SQUAREPITCH  1.1887 0.7887 1 3 0.9271 2 0.8052 10 END
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 cm) (IVF = 1.0) (EVF = 1.0
READ PARAM RUN=YES PLT=NO GEN=1003 NPG=1000 TME=500 END PARAM
READ GEOM
'
'  WATER LEVEL UNIT CELLS
'
UNIT  1
COM='FUEL PIN CELL - BETWEEN DISKS'
CYLINDER  1 1  0.3943    2P2.1400
CYLINDER 10 1  0.4026    2P2.1400
CYLINDER  2 1  0.4635    2P2.1400
CUBOID    3 1  4P0.5944  2P2.1400
UNIT  2
COM='WATER CELL - BETWEEN DISKS'
CUBOID    3 1  4P0.5944  2P2.1400
UNIT  3
COM='DISPLACEMENT CELL - BETWEEN DISKS'
CYLINDER  2 1  0.4635    2P2.1400
CUBOID    3 1  4P0.5944  2P2.1400
UNIT  4
COM='INSTRUMENT TUBE CELL - BETWEEN DISKS'
CYLINDER  3 1  0.4998    2P2.1400
CYLINDER  5 1  0.5442    2P2.1400
CUBOID    3 1  4P0.5944  2P2.1400
'
'  DISK LEVEL UNIT CELLS (BOTH SS AND AL)
'
UNIT  5
COM='FUEL PIN CELL - WITH SS DISK'
CYLINDER  1 1  0.3943    2P0.6604
CYLINDER 10 1  0.4026    2P0.6604
CYLINDER  2 1  0.4635    2P0.6604
CUBOID    3 1  4P0.5944 2P0.6604
UNIT  6
COM='WATER CELL - WITH SS DISK'
CUBOID    3 1  4P0.5944 2P0.6604
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
UNIT  7
COM='DISPLACEMENT CELL - WITH SS DISK'
CYLINDER  2 1  0.4635   2P0.6604
CUBOID    3 1  4P0.5944 2P0.6604
UNIT  8
COM='INSTRUMENT TUBE CELL - WITH SS DISK'
CYLINDER  3 1  0.4998   2P0.6604
CYLINDER  5 1  0.5442   2P0.6604
CUBOID    3 1  4P0.5944 2P0.6604

'  WATER LEVEL BORAL SHEETS
'
UNIT 14
COM='X-X BORAL SHEET BETWEEN DISKS'
CUBOID 6 1 2P9.144 2P0.0318 2P2.1400
CUBOID 4 1 2P9.144 2P0.0953 2P2.1400
UNIT 15
COM='Y-Y BORAL SHEET BETWEEN DISKS'
CUBOID 6 1 2P0.0318 2P9.144 2P2.1400
CUBOID 4 1 2P0.0953 2P9.144 2P2.1400
'
'  DISK LEVEL BORAL SHEETS (AL AND SS)
'
UNIT 16
COM='X-X BORAL SHEET WITH SS DISK'
CUBOID 6 1 2P9.144 2P0.0318 2P0.6604
CUBOID 4 1 2P9.144 2P0.0953 2P0.6604
UNIT 17
COM='Y-Y BORAL SHEET WITH SS DISK'
CUBOID 6 1 2P0.0318 2P9.144 2P0.6604
CUBOID 4 1 2P0.0953 2P9.144 2P0.6604
'
' WATER LEVEL WEB MATERIAL
'
UNIT 20
COM='WATER LEVEL WEB MATERIAL (SMALL) X-X'
CUBOID    3 1 2P10.4635 2P0.9716 2P2.1400
UNIT 21
COM='WATER LEVEL WEB MATERIAL (MEDIUM) X-X'
CUBOID    3 1 2P10.4635 2P1.0478 2P2.1400
UNIT 22
COM='WATER LEVEL WEB MATERIAL (LARGE) X-X'
CUBOID    3 1 2P10.4635 2P1.1208 2P2.1400
UNIT 23
COM='WATER LEVEL WEB MATERIAL (LONG) Y-Y'
CUBOID    3 1 2P1.1208 2P79.5249 2P2.1400
'
' SUPPORT DISK WEB MATERIAL
'
UNIT 30
COM='SUPPORT DISK WEB MATERIAL (SMALL) X-X'
CUBOID    5 1 2P10.4635 2P0.9716 2P0.6604
UNIT 31
COM='SUPPORT DISK WEB MATERIAL (MEDIUM) X-X'
CUBOID    5 1 2P10.4635 2P1.0478 2P0.6604
UNIT 32
COM='SUPPORT DISK WEB MATERIAL (LARGE) X-X'
CUBOID    5 1 2P10.4635 2P1.1208 2P0.6604
UNIT 33
COM='SUPPORT DISK WEB MATERIAL (LONG) Y-Y'
CUBOID    5 1 2P1.1208 2P79.5249 2P0.6604
'
'  HEAT TRANSFER DISK WEB MATERIAL
'
UNIT 40
COM='HEAT TRANSFER DISK WEB MATERIAL (SMALL) X-X'
CUBOID    4 1 2P10.4635 2P0.9716 2P0.6604
UNIT 41
COM='HEAT TRANSFER DISK WEB MATERIAL (MEDIUM) X-X'
CUBOID    4 1 2P10.4635 2P1.0478 2P0.6604
UNIT 42
COM='HEAT TRANSFER DISK WEB MATERIAL (LARGE) X-X'
CUBOID    4 1 2P10.4635 2P1.1208 2P0.6604
UNIT 43
COM='HEAT TRANSFER DISK WEB MATERIAL (LONG) Y-Y'
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
CUBOID    4 1 2P1.1208 2P79.5249 2P0.6604
'
'  WATER LEVEL ASSEMBLY ARRAYS
'
UNIT 50
COM='FUEL TUBE AND ASSEMBLY - WATER LEVEL'
ARRAY  1  -9.5104 -9.5104 -2.1400
CUBOID 3 1 4P9.9441                              2P2.1400
CUBOID 5 1 4P10.0661                             2P2.1400
CUBOID 3 1 4P10.25681                            2P2.1400
HOLE  14   0.0       10.1615  0.0
HOLE  14   0.0      -10.1615  0.0
HOLE  15   10.1615  0.0       0.0
HOLE  15   -10.1615 0.0       0.0
CUBOID 5 1 4P10.3051                             2P2.1400
UNIT 51
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -Y'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   0.0      -0.1584      0.0
UNIT 52
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS Y'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   0.0       0.1584      0.0
UNIT 53
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   -0.1584   0.0          0.0
UNIT 54
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   0.1584   0.0          0.0
UNIT 55
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X Y'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   0.1584   0.1584       0.0
UNIT 56
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X Y'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   -0.1584   0.1584       0.0
UNIT 57
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X -Y'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   0.1584   -0.1584       0.0
UNIT 58
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X -Y'
CUBOID 3 1 4P10.4635                             2P2.1400
HOLE  50   -0.1584   -0.1584       0.0
UNIT 59
COM='CENTRAL HOLE'
CUBOID 3 1 4P10.4636                             2P2.1400
'
'   SUPPORT DISK LEVEL ASSEMBLY ARRAYS
'
UNIT 60
COM='FUEL TUBE AND ASSEMBLY - SUPPORT DISK LEVEL'
ARRAY  2  -9.5104 -9.5104 -0.6604
CUBOID 3 1 4P9.9441                              2P0.6604
CUBOID 5 1 4P10.0661                             2P0.6604
CUBOID 3 1 4P10.25681                            2P0.6604
HOLE  16   0.0       10.1615  0.0
HOLE  16   0.0      -10.1615  0.0
HOLE  17   10.1615  0.0       0.0
HOLE  17   -10.1615 0.0       0.0
CUBOID 5 1 4P10.3051                             2P0.6604
UNIT 61
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -Y'
CUBOID 3 1 4P10.4635                             2P0.6604
HOLE  60   0.0      -0.1584      0.0
UNIT 62
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS Y'
CUBOID 3 1 4P10.4635                             2P0.6604
HOLE  60   0.0       0.1584      0.0
UNIT 63
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X'
CUBOID 3 1 4P10.4635                             2P0.6604
HOLE  60   -0.1584   0.0          0.0
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
UNIT 64
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  60   0.1584   0.0          0.0
UNIT 65
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  60   0.1584   0.1584       0.0
UNIT 66
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  60   -0.1584   0.1584      0.0
UNIT 67
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X -Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  60   0.1584   -0.1584      0.0
UNIT 68
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X -Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  60   -0.1584   -0.1584      0.0
UNIT 69
COM='CENTRAL HOLE'
CUBOID 3 1 4P10.4636   2P0.6604
'
'   HEAT TRANSFER DISK LEVEL ASSEMBLY ARRAYS
UNIT 70
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS'
ARRAY  2  -9.5104 -9.5104 -0.6604
CUBOID 3 1 4P9.9441                             2P0.6604
CUBOID 5 1 4P10.0661                            2P0.6604
CUBOID 3 1 4P10.25681                           2P0.6604
HOLE  16   0.0       10.1615  0.0
HOLE  16   0.0       -10.1615 0.0
HOLE  17   10.1615  0.0       0.0
HOLE  17   -10.1615 0.0       0.0
CUBOID 5 1 4P10.3051                            2P0.6604
UNIT 71
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   0.0      -0.1584      0.0
UNIT 72
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   0.0      0.1584       0.0
UNIT 73
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   -0.1584  0.0          0.0
UNIT 74
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   0.1584   0.0          0.0
UNIT 75
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   0.1584   0.1584       0.0
UNIT 76
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   -0.1584   0.1584      0.0
UNIT 77
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X -Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   0.1584   -0.1584      0.0
UNIT 78
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X -Y'
CUBOID 3 1 4P10.4635                            2P0.6604
HOLE  70   -0.1584   -0.1584      0.0
UNIT 79
COM='CENTRAL HOLE'
CUBOID 3 1 4P10.4636                            2P0.6604
'
'  WATER LEVEL BASKET ARRAYS
UNIT 80
COM='5X1 WATER LEVEL ARRAY (SMALL ARRAY -X)'
ARRAY 20 -10.4636 -33.6323 -2.1400
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
UNIT 81
COM='5X1 WATER LEVEL ARRAY (SMALL ARRAY X)'
ARRAY 21 -10.4636 -33.6323 -2.1400
UNIT 82
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY -X)'
ARRAY 22 -10.4636 -56.6549 -2.1400
UNIT 83
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY X)'
ARRAY 23 -10.4636 -56.6549 -2.1400
UNIT 84
COM='13X1 WATER LEVEL ARRAY (LARGE ARRAY-X)'
ARRAY 24 -10.4636 -79.5251 -2.1400
UNIT 85
COM='13X1 WATER LEVEL ARRAY (MIDDLE LARGE ARRAY)'
ARRAY 25 -10.4636 -79.5251 -2.1400
UNIT 86
COM='13X1 WATER LEVEL ARRAY (LARGE ARRAY X)'
ARRAY 26 -10.4636 -79.5251 -2.1400
'
'  SUPPORT DISK LEVEL BASKET ARRAYS
'
UNIT 90
COM='5X1 SUPPORT DISK LEVEL ARRAY (SMALL ARRAY -X)'
ARRAY 30 -10.4636 -33.6323 -0.6604
UNIT 91
COM='5X1 SUPPORT DISK LEVEL ARRAY (SMALL ARRAY  X)'
ARRAY 31 -10.4636 -33.6323 -0.6604
UNIT 92
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY -X)'
ARRAY 32 -10.4636 -56.6549 -0.6604
UNIT 93
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY X)'
ARRAY 33 -10.4636 -56.6549 -0.6604
UNIT 94
COM='13X1 SUPPORT DISK LEVEL ARRAY (LARGE ARRAY -X)'
ARRAY 34 -10.4636 -79.5251 -0.6604
UNIT 95
COM='13X1 SUPPORT DISK LEVEL ARRAY (MIDDLE LARGE ARRAY)'
ARRAY 35 -10.4636 -79.5251 -0.6604
UNIT 96
COM='13X1 SUPPORT DISK LEVEL ARRAY (LARGE ARRAY -X)'
ARRAY 36 -10.4636 -79.5251 -0.6604
'
'  HEAT TRANSFER DISK LEVEL BASKET ARRAYS
'
UNIT 100
COM='5X1 HEAT TRANSFER DISK LEVEL ARRAY (SMALL ARRAY -X)'
ARRAY 40 -10.4636 -33.6323 -0.6604
UNIT 101
COM='5X1 HEAT TRANSFER DISK LEVEL ARRAY (SMALL ARRAY X)'
ARRAY 41 -10.4636 -33.6323 -0.6604
UNIT 102
COM='9X1 HEAT TRANSFER DISK LEVEL ARRAY (MEDIUM ARRAY -X)'
ARRAY 42 -10.4636 -56.6549 -0.6604
UNIT 103
COM='9X1 HEAT TRANSFER DISK LEVEL ARRAY (MEDIUM ARRAY  X)'
ARRAY 43 -10.4636 -56.6549 -0.6604
UNIT 104
COM='13X1 HEAT TRANSFER DISK LEVEL ARRAY (LARGE ARRAY -X)'
ARRAY 44 -10.4636 -79.5251 -0.6604
UNIT 105
COM='13X1 HEAT TRANSFER DISK LEVEL ARRAY (MIDDLE LARGE ARRAY)'
ARRAY 45 -10.4636 -79.5251 -0.6604
UNIT 106
COM='13X1 HEAT TRANSFER DISK LEVEL ARRAY (LARGE ARRAY X)'
ARRAY 46 -10.4636 -79.5251 -0.6604
'
'  BASKET ARRAY IN TRANSPORT CASK OVERPACK (LEVEL CONSTRUCTION)
UNIT 110
COM='BASKET ARRAY IN TRANSPORT CASK OVERPACK - WATER LEVEL'
ARRAY 50 -33.6323 -79.5251 -2.1400
CYLINDER 3 1 88.1253     2P2.1400
HOLE 80     -69.0614 0.0 0.0
HOLE 82     -46.1912 0.0 0.0
HOLE 81      69.0614 0.0 0.0
HOLE 83      46.1912 0.0 0.0
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
CYLINDER 5 1 89.7128     2P2.1400
CYLINDER 3 1 90.170      2P2.1400
CYLINDER 5 1 93.98       2P2.1400
CYLINDER 7 1 103.4288    2P2.1400
CYLINDER 5 1 110.109     2P2.1400
CYLINDER 9 1 124.714     2P2.1400
CYLINDER 9 1 125.349     2P2.1400
CUBOID   9 1 4P150       2P2.1400
UNIT 111
COM='BASKET ARRAY IN TRANSPORT CASK OVERPACK - SUPPORT DISK LEVEL'
ARRAY 51 -33.6323 -79.5251 -0.6604
CYLINDER 5 1 87.6046     2P0.6604
HOLE 90     -69.0614 0.0 0.0
HOLE 92     -46.1912 0.0 0.0
HOLE 91      69.0614 0.0 0.0
HOLE 93      46.1912 0.0 0.0
CYLINDER 3 1 88.1253     2P0.6604
CYLINDER 5 1 89.7128     2P0.6604
CYLINDER 3 1 90.170      2P0.6604
CYLINDER 5 1 93.98       2P0.6604
CYLINDER 7 1 103.4288    2P0.6604
CYLINDER 5 1 110.109     2P0.6604
CYLINDER 9 1 124.714     2P0.6604
CYLINDER 9 1 125.349     2P0.6604
CUBOID   9 1 4P150       2P0.6604
UNIT 112
COM='BASKET ARRAY IN TRANSPORT CASK OVERPACK - HEAT TRANSFER DISK LEVEL'
ARRAY 52 -33.6323 -79.5251 -0.6604
CYLINDER 4 1 87.2490     2P0.6604
HOLE 100    -69.0614 0.0 0.0
HOLE 102    -46.1912 0.0 0.0
HOLE 101     69.0614 0.0 0.0
HOLE 103     46.1912 0.0 0.0
CYLINDER 3 1 88.1253     2P0.6604
CYLINDER 5 1 89.7128     2P0.6604
CYLINDER 3 1 90.170      2P0.6604
CYLINDER 5 1 93.98       2P0.6604
CYLINDER 7 1 103.4288    2P0.6604
CYLINDER 5 1 110.109     2P0.6604
CYLINDER 9 1 124.714     2P0.6604
CYLINDER 9 1 125.349     2P0.6604
CUBOID   9 1 4P150       2P0.6604

UNIT 130
COM='OVERSIZED FUEL TUBE AND ASSEMBLY 98- WATER LEVEL'
ARRAY  1  -9.5104 -9.5104 -2.1400
CUBOID 3 1 4P10.1473                         2P2.1400
CUBOID 5 1 4P10.26922                        2P2.1400
CUBOID 3 1 4P10.3051                         2P2.1400
UNIT 131
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - WATER LEVEL +X +Y'
CUBOID 3 1 4P10.4635                         2P2.1400
HOLE  130   0.1584   0.1584       0.0
UNIT 132
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - WATER LEVEL -X +Y'
CUBOID 3 1 4P10.4635                         2P2.1400
HOLE  130   -0.1584   0.1584       0.0
UNIT 133
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - WATER LEVEL +X -Y'
CUBOID 3 1 4P10.4635                         2P2.1400
HOLE  130   0.1584   -0.1584       0.0
UNIT 134
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - WATER LEVEL -X -Y'
CUBOID 3 1 4P10.4635                         2P2.1400
HOLE  130   -0.1584   -0.1584       0.0
UNIT 140
COM='OVERSIZED FUEL TUBE AND ASSEMBLY 98- SUPPORT DISK LEVEL'
ARRAY  2  -9.5104 -9.5104 -0.6604
CUBOID 3 1 4P10.1473                         2P0.6604
CUBOID 5 1 4P10.26922                        2P0.6604
CUBOID 3 1 4P10.3051                         2P0.6604
UNIT 141
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - SUPPORT DISK LEVEL +X +Y'
CUBOID 3 1 4P10.4635                         2P0.6604
HOLE  140   0.1584   0.1584       0.0
UNIT 142
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - SUPPORT DISK LEVEL -X +Y'
CUBOID 3 1 4P10.4635                        2P0.6604
HOLE  140   -0.1584   0.1584        0.0
UNIT 143
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - SUPPORT DISK LEVEL +X -Y'
CUBOID 3 1 4P10.4635                        2P0.6604
HOLE  140   0.1584   -0.1584        0.0
UNIT 144
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - SUPPORT DISK LEVEL -X -Y'
CUBOID 3 1 4P10.4635                        2P0.6604
HOLE  140   -0.1584   -0.1584        0.0
'
UNIT 150
COM='OVERSIZED FUEL TUBE AND ASSEMBLY 98- HEAT TRANSFER DISK LEVEL'
ARRAY  2  -9.5104 -9.5104 -0.6604
CUBOID 3 1 4P10.1473                        2P0.6604
CUBOID 5 1 4P10.26922                       2P0.6604
CUBOID 3 1 4P10.3051                        2P0.6604
UNIT 151
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - HEAT TRANSFER DISK LEVEL +X +Y'
CUBOID 3 1 4P10.4635                        2P0.6604
HOLE  150   0.1584   0.1584        0.0
UNIT 152
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - HEAT TRANSFER DISK LEVEL -X +Y'
CUBOID 3 1 4P10.4635                        2P0.6604
HOLE  150   -0.1584   0.1584        0.0
UNIT 153
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - HEAT TRANSFER DISK LEVEL +X -Y'
CUBOID 3 1 4P10.4635                        2P0.6604
HOLE  150   0.1584   -0.1584        0.0
UNIT 154
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - HEAT TRANSFER DISK LEVEL -X -Y'
CUBOID 3 1 4P10.4635                        2P0.6604
HOLE  150   -0.1584   -0.1584        0.0
'
'  GLOBAL UNIT
GLOBAL UNIT 120
ARRAY 60 -175.349 -175.349 0.0
END GEOM
READ ARRAY
ARA=1 NUX=16 NUY=16 NUZ=1  FILL
1 1 1 1 1 1 1 1 3 2 2 2 2 2 2 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 4 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
END FILL
ARA=2 NUX=16 NUY=16 NUZ=1  FILL
5 5 5 5 5 5 5 5 7 6 6 6 6 6 6 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
7 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 8 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
END FILL
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
'  WATER LEVEL ARRAYS
'
ARA=20  NUX=1 NUY=5 NUZ=1
FILL
55
22
54
22
57
END FILL
ARA=21  NUX=1 NUY=5 NUZ=1
FILL
56
22
53
22
58
END FILL
ARA=22  NUX=1 NUY=9 NUZ=1
FILL
131
21
55
22
54
22
57
21
133
END FILL
ARA=23  NUX=1 NUY=9 NUZ=1
FILL
132
21
56
22
53
22
58
21
134
END FILL
ARA=24  NUX=1 NUY=13 NUZ=1
FILL
55
20
55
21
55
22
54
22
57
21
57
20
57
END FILL
ARA=25  NUX=1 NUY=13 NUZ=1
FILL
52
20
52
21
52
22
59
22
51
21
51
20
51
END FILL
ARA=26  NUX=1 NUY=13 NUZ=1
FILL
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
56
20
56
21
56
22
53
22
58
21
58
20
58
END FILL
'
'  SUPPOR DISK LEVEL ARRAYS
ARA=30  NUX=1 NUY=5 NUZ=1
FILL
65
32
64
32
67
END FILL
ARA=31  NUX=1 NUY=5 NUZ=1
FILL
66
32
63
32
68
END FILL
ARA=32  NUX=1 NUY=9 NUZ=1
FILL
141
31
65
32
64
32
67
31
143
END FILL
ARA=33  NUX=1 NUY=9 NUZ=1
FILL
142
31
66
32
63
32
68
31
144
END FILL
ARA=34  NUX=1 NUY=13 NUZ=1
FILL
65
30
65
31
65
32
64
32
67
31
67
30
67
END FILL
ARA=35  NUX=1 NUY=13 NUZ=1
FILL
62
30
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
62
31
62
32
69
32
61
31
61
30
61
END FILL
ARA=36  NUX=1 NUY=13 NUZ=1
FILL
66
30
66
31
66
32
63
32
68
31
68
30
68
END FILL
'
'  HEAT TRANSFER DISK LEVEL ARRAYS
ARA=40  NUX=1 NUY=5 NUZ=1
FILL
75
42
74
42
77
END FILL
ARA=41  NUX=1 NUY=5 NUZ=1
FILL
76
42
73
42
78
END FILL
ARA=42  NUX=1 NUY=9 NUZ=1
FILL
151
41
75
42
74
42
77
41
153
END FILL
ARA=43  NUX=1 NUY=9 NUZ=1
FILL
152
41
76
42
73
42
78
41
154
END FILL
ARA=44  NUX=1 NUY=13 NUZ=1
FILL
75
40
75
41
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
75
42
74
42
77
41
77
40
77
END FILL
ARA=45  NUX=1 NUY=13 NUZ=1
FILL
72
40
72
41
72
42
79
42
71
41
71
40
71
END FILL
ARA=46  NUX=1 NUY=13 NUZ=1
FILL
76
40
76
41
76
42
73
42
78
41
78
40
78
END FILL
'
'  MAJOR ARRAYS
'
ARA=50 NUX=5 NUY=1 NUZ=1
FILL
84 23 85 23 86
END FILL
ARA=51 NUX=5 NUY=1 NUZ=1
FILL
94 33 95 33 96
END FILL
ARA=52 NUX=5 NUY=1 NUZ=1
FILL
104 43 105 43 106
END FILL
'
'  GLOBAL ARRAY
'
ARA=60 NUX=1 NUY=1 NUZ=4
FILL
112
110
111
110
END FILL
END ARRAY
READ BOUNDS ZFC=PER YXF=MIR END BOUNDS
READ PLOT
SCR=YES PIC=MAT LPI=10
UAX=1.0 VDN=-1.0 NAX=1500
'
' WHOLE BASKET HORIZONTAL SLICES
TTL='BASKET X-Y CROSS SECTION AT Z= 0.635 HEAT TRANSFER DISK LEVEL'
XUL=  -130 YUL=  130  ZUL= 0.635
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
  XLR=   130 YLR= -130  ZLR= 0.635
  UAX=1.0 VDN=-1.0 NAX=1500 END
  TTL='BASKET X-Y CROSS SECTION AT Z= 3.44 WATER LEVEL'
  XUL=  -130 YUL=  130  ZUL= 3.44
  XLR=   130 YLR= -130  ZLR= 3.44
  UAX=1.0 VDN=-1.0 NAX=1500 END
  TTL='BASKET X-Y CROSS SECTION AT Z= 6.236 SS DISK LEVEL'
  XUL=  -130 YUL=  130  ZUL= 6.236
  XLR=   130 YLR= -130  ZLR= 6.236
  UAX=1.0 VDN=-1.0 NAX=1500 END
  '
  ' HEAT TRANSFER DISK LEVEL BASKET QUADRANTS
  '
  TTL='BASKET X-Y QUADRANTD I HEAT TRANSFER DISK'
  XUL=  12.   YUL= 80      ZUL= 0.635
  XLR=  80.0  YLR= 12.0    ZLR= 0.635
  UAX=1.0 VDN=-1.0 NAX=1500 END
  TTL='BASKET X-Y QUADRANT II HEAT TRANSFER DISK'
  XUL=  12.0 YUL= -12.0    ZUL= 0.635
  XLR=  80   YLR= -80      ZLR= 0.635
  UAX=1.0 VDN=-1.0 NAX=1500 END
  TTL='BASKET X-Y QUADRANT III HEAT TRANSFER DISK'
  XUL= -80.0  YUL= -12.0  ZUL= 0.635
  XLR= -12.0  YLR= -80.0  ZLR= 0.635
  UAX=1.0 VDN=-1.0 NAX=1500 END
  TTL='BASKET X-Y QUADRANT IV HEAT TRANSFER DISK'
  XUL= -80.0  YUL= 80.0    ZUL= 0.635
  XLR= -12.0  YLR= 12.0    ZLR= 0.635
  UAX=1.0 VDN=-1.0 NAX=1500 END
  '
  ' WATER LEVEL BASKET QUADRANTS
  '
  TTL='BASKET X-Y QUADRANT I WATER LEVEL'
  XUL=  12.     YUL=  80     ZUL= 3.44
  XLR=  80.0    YLR=  12.0   ZLR= 3.44
  UAX=1.0 VDN=-1.0 NAX=1500 END
  TTL='BASKET X-Y QUADRANT II WATER LEVEL'
  XUL=  12.0    YUL= -12.0   ZUL= 3.44
  XLR=  80      YLR= -80     ZLR= 3.44
  UAX=1.0 VDN=-1.0 NAX=1500 END
  TTL='BASKET X-Y QUADRANT III WATER LEVEL'
  XUL= -80.0    YUL= -12.0   ZUL= 3.44
  XLR= -12.0    YLR= -80.0   ZLR= 3.44
  UAX=1.0 VDN=-1.0 NAX=1500 END
  TTL='BASKET X-Y QUADRANT IV WATER LEVEL'
  XUL= -80.0    YUL= 80.0    ZUL= 3.44
  XLR= -12.0    YLR= 12.0    ZLR= 3.44
  UAX=1.0 VDN=-1.0 NAX=1500 END
  '
  '  VERTICAL SLICES
  '
  TTL='BASKET X-Z CROSS SECTION ALUMINUM LEVEL (MIDDLE OF FUEL PIN)'
  XUL= -90  YUL=0.4   ZUL= 1.27
  XLR=  90  YLR=0.4   ZLR= -.1
  UAX=1.0 WDN=-1.0 NAX=1500 END
  TTL='BASKET X-Z CROSS SECTION WATER LEVEL (MIDDLE OF FUEL PIN)'
  XUL= -90  YUL=0.4   ZUL= 4.318
  XLR=  90  YLR=0.4   ZLR= 1.27
  UAX=1.0 WDN=-1.0 NAX=1500 END
  TTL='BASKET X-Z CROSS SECTION SS LEVEL (MIDDLE OF FUEL PIN)'
  XUL= -90  YUL=0.4   ZUL= 6.858
  XLR=  90  YLR=0.4   ZLR= 5.588
  UAX=1.0 WDN=-1.0 NAX=1500 END
  TTL='BASKET X-Z CROSS SECTION ENTIRE MODEL (MIDDLE OF FUEL PIN)'
  XUL= -90  YUL=0.4   ZUL= 12
  XLR=  90  YLR=0.4   ZLR= 0
  UAX=1.0 WDN=-1.0 NAX=1500 END
  END PLOT
  END DATA
SECONDARY MODULE 000008   HAS BEEN CALLED.
MODULE 000008   IS FINISHED. COMPLETION CODE     0. CPU TIME USED     0.77 (SECONDS).
SECONDARY MODULE 000002   HAS BEEN CALLED.
MODULE 000002   IS FINISHED. COMPLETION CODE     0. CPU TIME USED     6.64 (SECONDS).
SECONDARY MODULE 000009   HAS BEEN CALLED.
MODULE 000009   IS FINISHED. COMPLETION CODE     0. CPU TIME USED  1247.14 (SECONDS).
MODULE CSAS25   IS FINISHED. COMPLETION CODE     0. CPU TIME USED  1257.46 (SECONDS).
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
  CCCCCCCCCCC    SSSSSSSSSSS     AAAAAAAAA     SSSSSSSSSSS    22222222222    5555555555555
 CCCCCCCCCCCCC  SSSSSSSSSSSSS   AAAAAAAAAAA   SSSSSSSSSSSSS  2222222222222   5555555555555
 CC         CC  SS         SS  AA         AA  SS         SS  22         22   55
 CC             SS             AA         AA  SS                        22   55
 CC             SS             AA         AA  SS                        22   55
 CC             SSSSSSSSSSSS   AAAAAAAAAAAAA  SSSSSSSSSSSS             22    555555555555
 CC              SSSSSSSSSSSS  AAAAAAAAAAAAA   SSSSSSSSSSSS          22      5555555555555
 CC                        SS  AA         AA             SS        22                   55
 CC                        SS  AA         AA             SS      22                     55
 CC         CC  SS         SS  AA         AA  SS         SS    22            55         55
 CCCCCCCCCCCCC  SSSSSSSSSSSSS  AA         AA  SSSSSSSSSSSSS  2222222222222   5555555555555
  CCCCCCCCCCC    SSSSSSSSSSS   AA         AA   SSSSSSSSSSS   2222222222222    55555555555


  SSSSSSSSSSS    CCCCCCCCCCC     AAAAAAAAA    LL             EEEEEEEEEEEEE                  PPPPPPPPPPPP    CCCCCCCCCCC
 SSSSSSSSSSSSS  CCCCCCCCCCCCC   AAAAAAAAAAA   LL             EEEEEEEEEEEEE                  PPPPPPPPPPPPP  CCCCCCCCCCCCC
 SS         SS  CC         CC  AA         AA  LL             EE                             PP         PP  CC         CC
 SS             CC             AA         AA  LL             EE                             PP         PP  CC
 SS             CC             AA         AA  LL             EE                             PP         PP  CC
 SSSSSSSSSSSS   CC             AAAAAAAAAAAAA  LL             EEEEEEEEE     -------------    PPPPPPPPPPPPP  CC
  SSSSSSSSSSSS  CC             AAAAAAAAAAAAA  LL             EEEEEEEEE     -------------    PPPPPPPPPPPP   CC
            SS  CC             AA         AA  LL             EE                             PP             CC
            SS  CC             AA         AA  LL             EE                             PP             CC
 SS         SS  CC         CC  AA         AA  LL             EE                             PP             CC         CC
 SSSSSSSSSSSSS  CCCCCCCCCCCCC  AA         AA  LLLLLLLLLLLLL  EEEEEEEEEEEEE                  PP             CCCCCCCCCCCCC
  SSSSSSSSSSS    CCCCCCCCCCC   AA         AA  LLLLLLLLLLLLL  EEEEEEEEEEEEE                  PP              CCCCCCCCCCC


   0000000       88888888888            //        11         5555555555555            //     0000000         0000000
  000000000     8888888888888          //        111         5555555555555           //     000000000       000000000
 00       00    88         88         //        1111         55                     //     00       00     00       00
 00       00    88         88        //           11         55                    //     00         00  00         00
 00       00    88         88       //            11         55                   //      00         00  00         00
 00       00     88888888888       //             11         555555555555        //       00         00  00         00
 00       00     88888888888      //              11         5555555555555      //        00         00  00         00
 00       00    88         88    //               11                    55     //         00         00  00         00
 00       00    88         88   //                11                    55    //          00         00  00         00
 00       00    88         88  //                 11         55         55   //            00       00    00       00
  000000000     8888888888888 //               11111111      5555555555555  //              000000000     000000000
   0000000       88888888888 //                11111111       55555555555  //                0000000       0000000


   0000000       88888888888                      44         7777777777777                   44              44
  000000000     8888888888888                    444         777777777777                   444             444
 00       00    88         88     :::           4444         77         77       :::       4444            4444
 00       00    88         88     :::          44 44                   77        :::      44 44           44 44
 00       00    88         88     :::         44  44                 77          :::     44  44          44  44
 00       00     88888888888                 44   44               77                   44   44         44   44
 00       00     88888888888                44    44              77                   44    44        44    44
 00       00    88         88     :::      444444444444            77            :::   444444444444   444444444444
 00       00    88         88     :::      4444444444444           77            :::   4444444444444  4444444444444
 00       00    88         88     :::                44           77             :::             44             44
  000000000     8888888888888                        44           77                             44             44
   0000000       88888888888                         44           77                             44             44
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
  SSSSSSSSSSS    CCCCCCCCCCC     AAAAAAAAA    LL            EEEEEEEEEEEEE                PPPPPPPPPPPP    CCCCCCCCCCC
 SSSSSSSSSSSSS  CCCCCCCCCCCCC   AAAAAAAAAAA   LL            EEEEEEEEEEEEE                PPPPPPPPPPPPP  CCCCCCCCCCCCC
 SS         SS  CC         CC  AA         AA  LL            EE                           PP         PP  CC         CC
 SS             CC             AA         AA  LL            EE                           PP         PP  CC
 SS             CC             AA         AA  LL            EE                           PP         PP  CC
 SSSSSSSSSSSS   CC             AAAAAAAAAAAAA  LL            EEEEEEEEE     -------------  PPPPPPPPPPPPP  CC
  SSSSSSSSSSSS  CC             AAAAAAAAAAAAA  LL            EEEEEEEEE     -------------  PPPPPPPPPPPP   CC
            SS  CC             AA         AA  LL            EE                           PP             CC
            SS  CC             AA         AA  LL            EE                           PP             CC
 SS         SS  CC         CC  AA         AA  LL            EE                           PP             CC         CC
 SSSSSSSSSSSSS  CCCCCCCCCCCCC  AA         AA  LLLLLLLLLLLLL EEEEEEEEEEEEE                PP             CCCCCCCCCCCCC
  SSSSSSSSSSS    CCCCCCCCCCC   AA         AA  LLLLLLLLLLLLL EEEEEEEEEEEEE                PP              CCCCCCCCCCC
```

```
*******************************************************************************
*******************************************************************************
*******************************************************************************
*****                                                                     *****
*****                  PROGRAM VERIFICATION INFORMATION                   *****
*****                                                                     *****
*****                 CODE SYSTEM:   SCALE-PC VERSION:   4.3              *****
*****                                                                     *****
*******************************************************************************
*******************************************************************************
*****                                                                     *****
*****                                                                     *****
*****              PROGRAM:  CSAS                                         *****
*****                                                                     *****
*****        CREATION DATE:  03/08/96                                     *****
*****                                                                     *****
*****              VOLUME:   ENG                                          *****
*****                                                                     *****
*****              LIBRARY:  G:\SCALE43\WIN_NT\EXE                        *****
*****                                                                     *****
*****                                                                     *****
*****      PRODUCTION CODE:  CSAS                                         *****
*****                                                                     *****
*****              VERSION:  3.1                                          *****
*****                                                                     *****
*****              JOBNAME:  SCALE-PC                                     *****
*****                                                                     *****
*****    DATE OF EXECUTION:  08/15/00                                     *****
*****                                                                     *****
*****    TIME OF EXECUTION:  08:47:44                                     *****
*****                                                                     *****
*****                                                                     *****
*******************************************************************************
*******************************************************************************
*******************************************************************************
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
**** PROBLEM PARAMETERS ****

LIB 27GROUPNDF4  LIBRARY
MXX           10 MIXTURES
MSC           19 COMPOSITION SPECIFICATIONS
IZM            4 MATERIAL ZONES
GE  LATTICECELL  GEOMETRY
MORE           0 0/1 DO NOT READ/READ OPTIONAL PARAMETER DATA
MSLN           0 FUEL SOLUTIONS

**** PROBLEM COMPOSITION DESCRIPTION ****

SC  UO2          STANDARD COMPOSITION
MX             1 MIXTURE NO.
VF        0.9500 VOLUME FRACTION
ROTH     10.9600 THEORETICAL DENSITY
NEL            2 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           92000      1.00 ATOM/MOLECULE
                            92235     4.000 WT%
                            92238    96.000 WT%
            8016      2.00 ATOMS/MOLECULE
END

SC  ZIRCALLOY    STANDARD COMPOSITION
MX             2 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      6.5600 THEORETICAL DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           40302      1.00 ATOM/MOLECULE
END

SC  H2O          STANDARD COMPOSITION
MX             3 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      0.9982 THEORETICAL DENSITY
NEL            2 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            1001      2.00 ATOMS/MOLECULE
            8016      1.00 ATOM/MOLECULE
END

SC  AL           STANDARD COMPOSITION
MX             4 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      2.7020 THEORETICAL DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           13027      1.00 ATOM/MOLECULE
END

SC  SS304        STANDARD COMPOSITION
MX             5 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      7.9200 THEORETICAL DENSITY
NEL            4 NO. ELEMENTS
ICP            0 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           24304    19.000 WT%
           25055     2.000 WT%
           26304    69.500 WT%
           28304     9.500 WT%
END

SC  B-10         STANDARD COMPOSITION
MX             6 MIXTURE NO.
VF        0.0450 VOLUME FRACTION
ROTH      2.6226 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
            5010        1.00 ATOM/MOLECULE
 END

 SC  B-11          STANDARD COMPOSITION
 MX             6 MIXTURE NO.
 VF        0.2736 VOLUME FRACTION
 ROTH      2.6226 SPECIFIED DENSITY
 NEL            1 NO. ELEMENTS
 ICP            1 0/1 MIXTURE/COMPOUND
 TEMP       293.0 DEG KELVIN
            5011        1.00 ATOM/MOLECULE
 END

 SC  C             STANDARD COMPOSITION
 MX             6 MIXTURE NO.
 VF        0.0927 VOLUME FRACTION
 ROTH      2.6226 SPECIFIED DENSITY
 NEL            1 NO. ELEMENTS
 ICP            1 0/1 MIXTURE/COMPOUND
 TEMP       293.0 DEG KELVIN
            6012        1.00 ATOM/MOLECULE
 END

 SC  AL            STANDARD COMPOSITION
 MX             6 MIXTURE NO.
 VF        0.5737 VOLUME FRACTION
 ROTH      2.6226 SPECIFIED DENSITY
 NEL            1 NO. ELEMENTS
 ICP            1 0/1 MIXTURE/COMPOUND
 TEMP       293.0 DEG KELVIN
           13027        1.00 ATOM/MOLECULE
 END

 SC  PB            STANDARD COMPOSITION
 MX             7 MIXTURE NO.
 VF        1.0000 VOLUME FRACTION
 ROTH     11.3440 THEORETICAL DENSITY
 NEL            1 NO. ELEMENTS
 ICP            1 0/1 MIXTURE/COMPOUND
 TEMP       293.0 DEG KELVIN
           82000        1.00 ATOM/MOLECULE
 END

 SC  H             STANDARD COMPOSITION
 MX             8 MIXTURE NO.
 VF        0.0600 VOLUME FRACTION
 ROTH      1.6291 SPECIFIED DENSITY
 NEL            1 NO. ELEMENTS
 ICP            1 0/1 MIXTURE/COMPOUND
 TEMP       293.0 DEG KELVIN
            1001        1.00 ATOM/MOLECULE
 END

 SC  O             STANDARD COMPOSITION
 MX             8 MIXTURE NO.
 VF        0.4250 VOLUME FRACTION
 ROTH      1.6291 SPECIFIED DENSITY
 NEL            1 NO. ELEMENTS
 ICP            1 0/1 MIXTURE/COMPOUND
 TEMP       293.0 DEG KELVIN
            8016        1.00 ATOM/MOLECULE
 END

 SC  C             STANDARD COMPOSITION
 MX             8 MIXTURE NO.
 VF        0.2770 VOLUME FRACTION
 ROTH      1.6291 SPECIFIED DENSITY
 NEL            1 NO. ELEMENTS
 ICP            1 0/1 MIXTURE/COMPOUND
 TEMP       293.0 DEG KELVIN
            6012        1.00 ATOM/MOLECULE
 END

 SC  N             STANDARD COMPOSITION
 MX             8 MIXTURE NO.
 VF        0.0200 VOLUME FRACTION
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
    ROTH       1.6291 SPECIFIED DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
                 7014       1.00 ATOM/MOLECULE
    END

    SC  AL              STANDARD COMPOSITION
    MX              8 MIXTURE NO.
    VF         0.2140 VOLUME FRACTION
    ROTH       1.6291 SPECIFIED DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
                13027       1.00 ATOM/MOLECULE
    END

    SC  B-10            STANDARD COMPOSITION
    MX              8 MIXTURE NO.
    VF         0.0010 VOLUME FRACTION
    ROTH       1.6291 SPECIFIED DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
                 5010       1.00 ATOM/MOLECULE
    END

    SC  B-11            STANDARD COMPOSITION
    MX              8 MIXTURE NO.
    VF         0.0040 VOLUME FRACTION
    ROTH       1.6291 SPECIFIED DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
                 5011       1.00 ATOM/MOLECULE
    END

    SC  H2O             STANDARD COMPOSITION
    MX              9 MIXTURE NO.
    VF         1.0000 VOLUME FRACTION
    ROTH       0.9982 THEORETICAL DENSITY
    NEL             2 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
                 1001       2.00 ATOMS/MOLECULE
                 8016       1.00 ATOM/MOLECULE
    END

    SC  H2O             STANDARD COMPOSITION
    MX             10 MIXTURE NO.
    VF         1.0000 VOLUME FRACTION
    ROTH       0.9982 THEORETICAL DENSITY
    NEL             2 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
                 1001       2.00 ATOMS/MOLECULE
                 8016       1.00 ATOM/MOLECULE
    END

**** PROBLEM GEOMETRY ****
    CTP SQUAREPITCH  CELL TYPE
    PITCH      1.1887 CM CENTER TO CENTER SPACING
    FUELOD     0.7887 CM FUEL DIAMETER OR SLAB THICKNESS
    MFUEL           1 MIXTURE NO. OF FUEL
    MMOD            3 MIXTURE NO. OF MODERATOR
    CLADOD     0.9271 CM CLAD OUTER DIAMETER
    MCLAD           2 MIXTURE NO. OF CLAD
    GAPOD      0.8052 CM GAP OUTER DIAMETER
    MGAP           10 MIXTURE NO. OF GAP

ZONE SPECIFICATIONS FOR LATTICECELL GEOMETRY

                   ZONE  1 IS FUEL
                   ZONE  2 IS GAP
                   ZONE  3 IS CLAD
                   ZONE  4 IS MOD
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
*******************************************************************************************************************
      ***                                                                                                    ***
      ***                     TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0***
      ***                                                                                                    ***
      ******************************************************************************************************************
      ******************************************************************************************************************
      ***                                                                                                    ***
      ***                       ********** DATA LIBRARY INFORMATION **********                              ***
      ***                                                                                                    ***
      ***      UNIT                                             VOLUME                                       ***
      ***     NUMBER              DATA SET NAME                  NAME       UNIT FUNCTION                    ***
      ***     ------              -------------                  ----       -------------                    ***
      ***                                                                                                    ***
      ***       89     G:\scale43\DATALIB\FT89F001                          STANDARD COMPOSITION LIBRARY     ***
      ***                                                                                                    ***
      ***       82     G:\scale43\DATALIB\FT82F001                          CROSS SECTION LIBRARY            ***
      ***                                                                                                    ***
      ***       11     D:\zjr\Yankee\tpa300-F_r1\FT11F001                   SHORT CROSS SECTION LIBRARY      ***
      ***                                                                                                    ***
      ***       90     D:\zjr\Yankee\tpa300-F_r1\FT90F001                   INPUT DATA DIRECT ACCESS         ***
      ***                                                                                                    ***
      ******************************************************************************************************************
      ******************************************************************************************************************
      ***                                                                                                    ***
      ***                                                                                                    ***
      ***                             STANDARD COMPOSITION LIBRARY DATA                                      ***
      ***                             ---------------------------------                                      ***
      ***                                                                                                    ***
      ***       UNIT NUMBER  :  89                                                                           ***
      ***                                                                                                    ***
      ***       DATASET NAME :  G:\scale43\DATALIB\FT89F001                                                  ***
      ***                                                                                                    ***
      ***       LIBRARY TITLE:  SCALE-4 STANDARD COMPOSITION LIBRARY                                         ***
      ***                       637 STANDARD COMPOSITIONS, 490 NUCLIDES                                      ***
      ***                       90 ELEMENTS WITH VARIABLE ISOTOPIC DISTRBUTIONS.                             ***
      ***                                                                                                    ***
      ***       CREATION DATE:   6/30/95                                                                     ***
      ***                                                                                                    ***
      ***                                                                                                    ***
      ***                                                                                                    ***
      ***                                 CROSS SECTION LIBRARY DATA                                         ***
      ***                                 --------------------------                                         ***
      ***                                                                                                    ***
      ***       UNIT NUMBER  :  82                                                                           ***
      ***                                                                                                    ***
      ***       DATASET NAME :  G:\scale43\DATALIB\FT82F001                                                  ***
      ***                                                                                                    ***
      ***       LIBRARY TITLE:  SCALE 4.2 - 27 GROUP NEUTRON GROUP LIBRARY                                   ***
      ***                          BASED ON ENDF-B VERSION 4 DATA                                            ***
      ***                             COMPILED FOR NRC     1/27/89                                           ***
      ***                                LAST UPDATED                                        08/12/94        ***
      ***                                   L.M.PETRIE   -   ORNL                                          ***
      ***                                                                                                    ***
      ***                                                                                                    ***
      ***                                                                                                    ***
      ***                                                                                                    ***
      ******************************************************************************************************************
      ******************************************************************************************************************
                        ........   0 IO'S WERE USED BEFORE READING KENO V DATA    ........
........   0 IO'S WERE USED READING THE KENO V PARAMETER DATA    ........
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
                  KK        KK  EEEEEEEEEEEEE  NN          NN   00000000000                   VV          VV
                  KK       KK   EEEEEEEEEEEEE  NNN         NN  0000000000000                  VV          VV
                  KK      KK    EE             NNNN        NN  00         00                  VV          VV
                  KK     KK     EE             NN NN       NN  00         00                  VV          VV
                  KK    KK      EE             NN  NN      NN  00         00                  VV          VV
                  KKKKKKKK      EEEEEEEEE      NN   NN     NN  00         00  -------------   VV          VV
                  KKKKKKKK      EEEEEEEEE      NN    NN    NN  00         00  -------------    VV        VV
                  KK    KK      EE             NN     NN   NN  00         00                    VV     VV
                  KK     KK     EE             NN      NN  NN  00         00                     VV   VV
                  KK      KK    EE             NN       NNNN   00         00                      VV VV
                  KK       KK   EEEEEEEEEEEEE  NN        NNN   0000000000000                       VVV
                  KK        KK  EEEEEEEEEEEEE  NN         NN    00000000000                         V


  SSSSSSSSSSS    CCCCCCCCCCC     AAAAAAAAA    LL              EEEEEEEEEEEEE                  PPPPPPPPPPPP    CCCCCCCCCCC
 SSSSSSSSSSSSS  CCCCCCCCCCCCC   AAAAAAAAAAA   LL              EEEEEEEEEEEEE                  PPPPPPPPPPPPP  CCCCCCCCCCCCC
 SS         SS  CC         CC  AA         AA  LL              EE                             PP         PP  CC         CC
 SS             CC             AA         AA  LL              EE                             PP         PP  CC
 SS             CC             AA         AA  LL              EE                             PP         PP  CC
 SSSSSSSSSSSS   CC             AAAAAAAAAAAAA  LL              EEEEEEEEE      -------------   PPPPPPPPPPPPP  CC
  SSSSSSSSSSSS  CC             AAAAAAAAAAAAA  LL              EEEEEEEEE      -------------   PPPPPPPPPPPP   CC
            SS  CC             AA         AA  LL              EE                             PP             CC
            SS  CC             AA         AA  LL              EE                             PP             CC
 SS         SS  CC         CC  AA         AA  LL              EE                             PP             CC         CC
 SSSSSSSSSSSSS  CCCCCCCCCCCCC  AA         AA  LLLLLLLLLLLLL   EEEEEEEEEEEEE                  PP             CCCCCCCCCCCCC
  SSSSSSSSSSS    CCCCCCCCCCC   AA         AA  LLLLLLLLLLLLL   EEEEEEEEEEEEE                  PP              CCCCCCCCCCC


   0000000       88888888888           //         11          5555555555555          //     0000000         0000000
  000000000     8888888888888         //         111          5555555555555         //     000000000       000000000
 00       00    88         88        //         1111          55                   //     00       00     00       00
00         00   88         88       //            11          55                  //     00         00   00         00
00         00   88         88      //             11          55                 //      00         00   00         00
00         00    88888888888      //              11          555555555555      //       00         00   00         00
00         00    88888888888     //               11          5555555555555    //        00         00   00         00
00         00   88         88   //                11                     55   //         00         00   00         00
00         00   88         88  //                 11                     55  //          00         00   00         00
 00       00    88         88 //                  11          55         55 //            00       00     00       00
  000000000     8888888888888//              11111111         5555555555555//              000000000       000000000
   0000000       88888888888 //              11111111          55555555555//                0000000         0000000


   0000000       88888888888                      44          7777777777777                  5555555555555   33333333333
  000000000     8888888888888                    444          777777777777                   5555555555555  3333333333333
 00       00    88         88        :::        4444          77         77         :::      55             33         33
00         00   88         88        :::       44 44                    77          :::      55                        33
00         00   88         88        :::      44  44                   77           :::      55                        33
00         00    88888888888                 44   44                  77                     555555555555            333
00         00    88888888888                44    44                 77                      5555555555555           333
00         00   88         88        :::    444444444444            77          :::                     55             33
00         00   88         88        :::   4444444444444           77           :::                     55             33
 00       00    88         88        :::          44              77            :::      55         55  33         33
  000000000     8888888888888                     44             77                      5555555555555  3333333333333
   0000000       88888888888                      44             77                       55555555555    33333333333

  SSSSSSSSSSS    CCCCCCCCCCC     AAAAAAAAA    LL              EEEEEEEEEEEEE                  PPPPPPPPPPPP    CCCCCCCCCCC
 SSSSSSSSSSSSS  CCCCCCCCCCCCC   AAAAAAAAAAA   LL              EEEEEEEEEEEEE                  PPPPPPPPPPPPP  CCCCCCCCCCCCC
 SS         SS  CC         CC  AA         AA  LL              EE                             PP         PP  CC         CC
 SS             CC             AA         AA  LL              EE                             PP         PP  CC
 SS             CC             AA         AA  LL              EE                             PP         PP  CC
 SSSSSSSSSSSS   CC             AAAAAAAAAAAAA  LL              EEEEEEEEE      -------------   PPPPPPPPPPPPP  CC
  SSSSSSSSSSSS  CC             AAAAAAAAAAAAA  LL              EEEEEEEEE      -------------   PPPPPPPPPPPP   CC
            SS  CC             AA         AA  LL              EE                             PP             CC
            SS  CC             AA         AA  LL              EE                             PP             CC
 SS         SS  CC         CC  AA         AA  LL              EE                             PP             CC         CC
 SSSSSSSSSSSSS  CCCCCCCCCCCCC  AA         AA  LLLLLLLLLLLLL   EEEEEEEEEEEEE                  PP             CCCCCCCCCCCCC
  SSSSSSSSSSS    CCCCCCCCCCC   AA         AA  LLLLLLLLLLLLL   EEEEEEEEEEEEE                  PP              CCCCCCCCCCC
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
*****************************************************************************
*****                  PROGRAM VERIFICATION INFORMATION                 *****
*****                  CODE SYSTEM:  SCALE-PC VERSION:  4.3             *****
*****************************************************************************
*****                                                                   *****
*****               PROGRAM:  000009                                    *****
*****                                                                   *****
*****         CREATION DATE:  03/08/96                                  *****
*****                                                                   *****
*****                VOLUME:  ENG                                       *****
*****                                                                   *****
*****               LIBRARY:  G:\SCALE43\WIN_NT\EXE                     *****
*****                                                                   *****
*****       PRODUCTION CODE:  KENOVA                                    *****
*****                                                                   *****
*****               VERSION:  3.1                                       *****
*****                                                                   *****
*****               JOBNAME:  SCALE-PC                                  *****
*****                                                                   *****
*****     DATE OF EXECUTION:  08/15/00                                  *****
*****                                                                   *****
*****     TIME OF EXECUTION:  08:47:53                                  *****
*****                                                                   *****
*****************************************************************************

*****************************************************************************************************************
***                                                                                                           ***
***                          TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0***
***                                                                                                           ***
*****************************************************************************************************************
***                          ******       NUMERIC PARAMETERS       ******                                     ***
***                                                                                                           ***
***              TME        MAXIMUM PROBLEM TIME (MIN)                         500.00                         ***
***                                                                                                           ***
***              TBA        TIME PER GENERATION (MIN)                            0.50                         ***
***                                                                                                           ***
***              GEN        NUMBER OF GENERATIONS                                1003                         ***
***                                                                                                           ***
***              NPG        NUMBER PER GENERATION                                1000                         ***
***                                                                                                           ***
***              NSK        NUMBER OF GENERATIONS TO BE SKIPPED                     3                         ***
***                                                                                                           ***
***              BEG        BEGINNING GENERATION NUMBER                             1                         ***
***                                                                                                           ***
***              RES        GENERATIONS BETWEEN CHECKPOINTS                         0                         ***
***                                                                                                           ***
***              X1D        NUMBER OF EXTRA 1-D CROSS SECTIONS                      1                         ***
***                                                                                                           ***
***              NBK        NEUTRON BANK SIZE                                    1025                         ***
***                                                                                                           ***
***              XNB        EXTRA POSITIONS IN NEUTRON BANK                         0                         ***
***                                                                                                           ***
***              NFB        FISSION BANK SIZE                                    1000                         ***
***                                                                                                           ***
***              XFB        EXTRA POSITIONS IN FISSION BANK                         0                         ***
***                                                                                                           ***
***              WTA        DEFAULT VALUE OF WEIGHT AVERAGE                    0.5000                         ***
***                                                                                                           ***
***              WTH        WEIGHT HIGH FOR SPLITTING                          3.0000                         ***
***                                                                                                           ***
***              WTL        WEIGHT LOW FOR RUSSIAN ROULETTE                    0.3333                         ***
***                                                                                                           ***
***              RND        STARTING RANDOM NUMBER                        BB827100001                         ***
***                                                                                                           ***
***              NB8        NUMBER OF D.A. BLOCKS ON UNIT  8                      200                         ***
***                                                                                                           ***
***              NL8        LENGTH OF D.A. BLOCKS ON UNIT  8                      512                         ***
***                                                                                                           ***
***              ADJ        MODE OF CALCULATION                               FORWARD                         ***
***                                                                                                           ***
***                         INPUT DATA WRITTEN ON RESTART UNIT                     NO                         ***
***                                                                                                           ***
***                         BINARY DATA INTERFACE                                 YES                         ***
***                                                                                                           ***
*****************************************************************************************************************
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
*****************************************************************************************************************
***                                                                                                           ***
***                        TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0***
***                                                                                                           ***
*****************************************************************************************************************
***                              ******   LOGICAL PARAMETERS      ******                                      ***
***                                                                                                           ***
***  RUN  EXECUTE PROBLEM AFTER CHECKING DATA    YES          PLT  PLOT PICTURE MAP(S)                     NO ***
***                                                                                                           ***
***  FLX  COMPUTE FLUX                            NO          FDN  COMPUTE FISSION DENSITIES               NO ***
***                                                                                                           ***
***  SMU  COMPUTE AVG UNIT SELF-MULTIPLICATION    NO          NUB  COMPUTE NU-BAR & AVG FISSION GROUP     YES ***
***                                                                                                           ***
***  MKU  COMPUTE MATRIX K-EFF BY UNIT NUMBER     NO          MKP  COMPUTE MATRIX K-EFF BY UNIT LOCATION   NO ***
***                                                                                                           ***
***  CKU  COMPUTE COFACTOR K-EFF BY UNIT NUMBER   NO          CKP  COMPUTE COFACTOR K-EFF BY UNIT LOCATION NO ***
***                                                                                                           ***
***  FMU  PRINT FISS PROD MATRIX BY UNIT NUMBER   NO          FMP  PRINT FISS PROD MATRIX BY UNIT LOCATION NO ***
***                                                                                                           ***
***  MKH  COMPUTE MATRIX K-EFF BY HOLE NUMBER     NO          MKA  COMPUTE MATRIX K-EFF BY ARRAY NUMBER    NO ***
***                                                                                                           ***
***  CKH  COMPUTE COFACTOR K-EFF BY HOLE NUMBER   NO          CKA  COMPUTE COFACTOR K-EFF BY ARRAY NUMBER  NO ***
***                                                                                                           ***
***  FMH  PRINT FISS PROD MATRIX BY HOLE NUMBER   NO          FMA  PRINT FISS PROD MATRIX BY ARRAY NUMBER  NO ***
***                                                                                                           ***
***  HHL  COLLECT MATRIX BY HIGHEST HOLE LEVEL    NO          HAL  COLLECT MATRIX BY HIGHEST ARRAY LEVEL   NO ***
***                                                                                                           ***
***  AMX  PRINT ALL MIXED CROSS SECTIONS          NO          FAR  PRINT FIS. AND ABS. BY REGION           NO ***
***                                                                                                           ***
***  XS1  PRINT 1-D MIXTURE X-SECTIONS            NO          GAS  PRINT FAR BY GROUP                      NO ***
***                                                                                                           ***
***  XS2  PRINT 2-D MIXTURE X-SECTIONS            NO          PAX  PRINT XSEC-ALBEDO CORRELATION TABLES    NO ***
***                                                                                                           ***
***  XAP  PRINT MIXTURE ANGLES & PROBABILITIES    NO          PWT  PRINT WEIGHT AVERAGE ARRAY              NO ***
***                                                                                                           ***
***  PKI  PRINT FISSION SPECTRUM                  NO          PGM  PRINT INPUT GEOMETRY                    NO ***
***                                                                                                           ***
***  P1D  PRINT EXTRA 1-D CROSS SECTIONS          NO          BUG  PRINT DEBUG INFORMATION                 NO ***
***                                                                                                           ***
***                                                           TRK  PRINT TRACKING INFORMATION              NO ***
***                                                                                                           ***
*****************************************************************************************************************
                                        PARAMETER INPUT COMPLETED
                            ........  0 IO'S WERE USED READING THE PARAMETER DATA       ........
                           *************** DATA READING COMPLETED ***************
*****************************************************************************************************************
***                                                                                                           ***
***                        TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0***
***                                                                                                           ***
*****************************************************************************************************************
***          UNIT                                                  VOLUME                                     ***
***         NUMBER                 DATA SET NAME                    NAME      UNIT FUNCTION                   ***
***         ------                 -------------                    ----      -------------                   ***
***       XSC  14    D:\zjr\Yankee\tpa300-F_r1\FT14F001                       MIXED CROSS SECTIONS            ***
***                                                                                                           ***
***       ALB  79    G:\scale43\DATALIB\FT79F001                              INPUT ALBEDOS                   ***
***                                                                                                           ***
***       WTS  80    G:\scale43\DATALIB\FT80F001                              INPUT WEIGHTS                   ***
***                                                                                                           ***
***       SKT  16     UNKNOWN                                                 WRITE SCRATCH DATA              ***
***                                                                                                           ***
***       BIN  95    D:\zjr\Yankee\tpa300-F_r1\FT95F001                       BINARY INPUT DATA               ***
***                                                                                                           ***
***       RST  95    D:\zjr\Yankee\tpa300-F_r1\FT95F001                       READ RESTART DATA               ***
***                                                                                                           ***
***       LIB   4    D:\zjr\Yankee\tpa300-F_r1\FT04F001                       INPUT AMPX WORKING LIBRARY      ***
***                                                                                                           ***
***             8    D:\zjr\Yankee\tpa300-F_r1\FT08F001                       INPUT DATA DIRECT ACCESS        ***
***                                                                                                           ***
***             9     UNKNOWN                                                 SUPER GROUPED DIRECT ACCESS     ***
***                                                                                                           ***
***            10     UNKNOWN                                                 XSEC MIXING DIRECT ACCESS       ***
***                                                                                                           ***
*****************************************************************************************************************
                            ........  0 IO'S WERE USED PREPARING INPUT DATA    ........
                             CROSS SECTIONS READ FROM THE AMPX WORKING LIBRARY ON UNIT     4
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
                    TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

                                     MIXING TABLE

                              NUMBER OF SCATTERING ANGLES =  2
                            CROSS SECTION MESSAGE THRESHOLD =3.0E-05

MIXTURE =     1          DENSITY(G/CC) = 10.412
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA      AWT             NUCLIDE TITLE
   1008016  4.64617E-02  1.18487E-01   8016    15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                          UPDATED
08/12/94
   1092235  9.40641E-04  3.52606E-02  92235   235.0441      URANIUM-235     ENDF/B-IV MAT 1261                          UPDATED
08/12/94
   1092238  2.22902E-02  8.46253E-01  92238   238.0510      URANIUM-238     ENDF/B-IV MAT 1262                          UPDATED
08/12/94

MIXTURE =     2          DENSITY(G/CC) =  6.5600
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA      AWT             NUCLIDE TITLE
   2040302  4.33078E-02  1.00000E+00  40000    91.2196      ZIRCALLOY       ENDF/B-IV MAT 1284                          UPDATED
08/12/94

MIXTURE =     3          DENSITY(G/CC) = 0.99817
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA      AWT             NUCLIDE TITLE
   3001001  6.67692E-02  1.11927E-01   1001     1.0077       HYDROGEN        ENDF/B-IV MAT 1269/THRM1002                UPDATED
08/12/94
   3008016  3.33846E-02  8.88074E-01   8016    15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                          UPDATED
08/12/94

MIXTURE =     4          DENSITY(G/CC) =  2.7020
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA      AWT             NUCLIDE TITLE
   4013027  6.03066E-02  1.00000E+00  13027    26.9818     AL-27 1193 218 GP 040375(5)                                  UPDATED
08/12/94

MIXTURE =     5          DENSITY(G/CC) =  7.9200
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA      AWT             NUCLIDE TITLE
   5024304  1.74286E-02  1.90000E-01  24000    51.9957      CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'            UPDATED
08/12/94
   5025055  1.73633E-03  1.99999E-02  25055    54.9379      MANGANESE-55    ENDF/B-IV MAT 1197                          UPDATED
08/12/94
   5026304  5.93579E-02  6.95000E-01  26000    55.8447      FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'            UPDATED
08/12/94
   5028304  7.72070E-03  9.50001E-02  28000    58.6872      NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'            UPDATED
08/12/94

MIXTURE =     6          DENSITY(G/CC) =  2.5833
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA      AWT             NUCLIDE TITLE
   6005010  7.09799E-03  4.56855E-02   5010    10.0130     B-10 1273 218NGP 042375 P-3 293K                             UPDATED
08/12/94
   6005011  3.92499E-02  2.77771E-01   5011    11.0096      BORON-11        ENDF/B-IV MAT 1160                          UPDATED
08/12/94
   6006012  1.22006E-02  9.41116E-02   6000    12.0001       CARBON-12       ENDF/B-IV MAT 1274/THRM1065                UPDATED
08/12/94
   6013027  3.35812E-02  5.82432E-01  13027    26.9818     AL-27 1193 218 GP 040375(5)                                  UPDATED
08/12/94

MIXTURE =     7          DENSITY(G/CC) = 11.344
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA      AWT             NUCLIDE TITLE
   7082000  3.29690E-02  1.00000E+00  82000   207.2100     PB   1288 218NGP 042375 P-3 293K                             UPDATED
08/12/94

MIXTURE =     8          DENSITY(G/CC) =  1.6307
   NUCLIDE  ATOM-DENS.  WGT. FRAC.     ZA      AWT             NUCLIDE TITLE
   8001001  5.84084E-02  5.99323E-02   1001     1.0077       HYDROGEN        ENDF/B-IV MAT 1269/THRM1002                UPDATED
08/12/94
   8005010  9.79802E-05  9.99025E-04   5010    10.0130     B-10 1273 218NGP 042375 P-3 293K                             UPDATED
08/12/94
   8005011  3.56450E-04  3.99615E-03   5011    11.0096      BORON-11        ENDF/B-IV MAT 1160                          UPDATED
08/12/94
   8006012  2.26463E-02  2.76729E-01   6000    12.0001       CARBON-12       ENDF/B-IV MAT 1274/THRM1065                UPDATED
08/12/94
   8007014  1.40121E-03  1.99805E-02   7014    14.0033      NITROGEN-14     ENDF/B-IV MAT 1275                          UPDATED
08/12/94
   8008016  2.60749E-02  4.24574E-01   8016    15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                          UPDATED
08/12/94
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
  8013027  7.78110E-03  2.13789E-01   13027     26.9818       AL-27 1193 218 GP 040375(5)                                   UPDATED
08/12/94

MIXTURE =      9          DENSITY(G/CC) = 0.99817
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT              NUCLIDE TITLE
   9001001  6.67692E-02  1.11927E-01    1001      1.0077        HYDROGEN         ENDF/B-IV MAT 1269/THRM1002               UPDATED
08/12/94
   9008016  3.33846E-02  8.88074E-01    8016     15.9904        OXYGEN-16       ENDF/B-IV MAT 1276                         UPDATED
08/12/94

MIXTURE =     10          DENSITY(G/CC) = 0.99817
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT              NUCLIDE TITLE
  10001001  6.67692E-02  1.11927E-01    1001      1.0077        HYDROGEN         ENDF/B-IV MAT 1269/THRM1002               UPDATED
08/12/94
  10008016  3.33846E-02  8.88074E-01    8016     15.9904        OXYGEN-16       ENDF/B-IV MAT 1276                         UPDATED
08/12/94
                             3001001      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002            UPDATED 08/12/94
                             8001001      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002            UPDATED 08/12/94
                             9001001      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002            UPDATED 08/12/94
                            10001001      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002            UPDATED 08/12/94
                             6005010     B-10 1273 218NGP 042375 P-3 293K                        UPDATED 08/12/94
                             8005010     B-10 1273 218NGP 042375 P-3 293K                        UPDATED 08/12/94
                             6005011      BORON-11        ENDF/B-IV MAT 1160                     UPDATED 08/12/94
                             8005011      BORON-11        ENDF/B-IV MAT 1160                     UPDATED 08/12/94
                             6006012      CARBON-12       ENDF/B-IV MAT 1274/THRM1065            UPDATED 08/12/94
                             8006012      CARBON-12       ENDF/B-IV MAT 1274/THRM1065            UPDATED 08/12/94
                             8007014      NITROGEN-14     ENDF/B-IV MAT 1275                     UPDATED 08/12/94
                             1008016      OXYGEN-16       ENDF/B-IV MAT 1276                     UPDATED 08/12/94
                             3008016      OXYGEN-16       ENDF/B-IV MAT 1276                     UPDATED 08/12/94
                             8008016      OXYGEN-16       ENDF/B-IV MAT 1276                     UPDATED 08/12/94
                             9008016      OXYGEN-16       ENDF/B-IV MAT 1276                     UPDATED 08/12/94
                            10008016      OXYGEN-16       ENDF/B-IV MAT 1276                     UPDATED 08/12/94
                             4013027     AL-27 1193 218 GP 040375(5)                             UPDATED 08/12/94
                             6013027     AL-27 1193 218 GP 040375(5)                             UPDATED 08/12/94
                             8013027     AL-27 1193 218 GP 040375(5)                             UPDATED 08/12/94
                             5024304     CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'        UPDATED 08/12/94
                             5025055      MANGANESE-55    ENDF/B-IV MAT 1197                     UPDATED 08/12/94
                             5026304     FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'        UPDATED 08/12/94
                             5028304     NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'        UPDATED 08/12/94
                             2040302      ZIRCALLOY       ENDF/B-IV MAT 1284                     UPDATED 08/12/94
                             7082000     PB   1288 218NGP 042375 P-3 293K                        UPDATED 08/12/94
                             1092235      URANIUM-235     ENDF/B-IV MAT 1261                     UPDATED 08/12/94
                             1092238      URANIUM-238     ENDF/B-IV MAT 1262                     UPDATED 08/12/94

KENO MESSAGE NUMBER K5-222        1 TRANSFERS FOR MIXTURE     3 WERE CORRECTED FOR BAD MOMENTS.

KENO MESSAGE NUMBER K5-222        2 TRANSFERS FOR MIXTURE     8 WERE CORRECTED FOR BAD MOMENTS.

KENO MESSAGE NUMBER K5-222        1 TRANSFERS FOR MIXTURE     9 WERE CORRECTED FOR BAD MOMENTS.

KENO MESSAGE NUMBER K5-222        1 TRANSFERS FOR MIXTURE    10 WERE CORRECTED FOR BAD MOMENTS.

                               ........    0 IO'S WERE USED MIXING CROSS-SECTIONS       ........

                                1-D CROSS SECTION ARRAY ID NUMBERS
                                   1  2002  1452    27    18  1018

                               ........    0 IO'S WERE USED PREPARING THE CROSS SECTIONS     ........
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
**************************************************************************************************
***                                                                                            ***
***        TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0    ***
***                                                                                            ***
**************************************************************************************************
**************************************************************************************************
***                                                                                            ***
***                              ****** ADDITIONAL INFORMATION ******                          ***
***                                                                                            ***
*** NUMBER OF ENERGY GROUPS               27       USE LATTICE GEOMETRY                   YES  ***
***                                                                                            ***
*** NO. OF FISSION SPECTRUM SOURCE GROUP  1        GLOBAL ARRAY NUMBER                     60  ***
***                                                                                            ***
*** NO. OF SCATTERING ANGLES IN XSECS     2        NUMBER OF UNITS IN THE GLOBAL X DIR.     1  ***
***                                                                                            ***
*** ENTRIES/NEUTRON IN THE NEUTRON BANK  33        NUMBER OF UNITS IN THE GLOBAL Y DIR.     1  ***
***                                                                                            ***
*** ENTRIES/NEUTRON IN THE FISSION BANK  26        NUMBER OF UNITS IN THE GLOBAL Z DIR.     4  ***
***                                                                                            ***
*** NUMBER OF MIXTURES USED               9        USE A GLOBAL REFLECTOR                 YES  ***
***                                                                                            ***
*** NUMBER OF BIAS ID'S USED              1        USE NESTED HOLES                       YES  ***
***                                                                                            ***
*** NUMBER OF DIFFERENTIAL ALBEDOS USED   0        NUMBER OF HOLES                         60  ***
***                                                                                            ***
*** TOTAL INPUT GEOMETRY REGIONS        160        MAXIMUM HOLE NESTING LEVEL               3  ***
***                                                                                            ***
*** NUMBER OF GEOMETRY REGIONS USED     160        USE NESTED ARRAYS                      YES  ***
***                                                                                            ***
*** LARGEST GEOMETRY UNIT NUMBER        154        NUMBER OF ARRAYS USED                   27  ***
***                                                                                            ***
*** LARGEST ARRAY NUMBER                 60        MAXIMUM ARRAY NESTING LEVEL              4  ***
***                                                                                            ***
***                                                                                            ***
*** +X BOUNDARY CONDITION               MIR        -X BOUNDARY CONDITION                  MIR  ***
***                                                                                            ***
*** +Y BOUNDARY CONDITION               MIR        -Y BOUNDARY CONDITION                  MIR  ***
***                                                                                            ***
*** +Z BOUNDARY CONDITION               PER        -Z BOUNDARY CONDITION                  PER  ***
***                                                                                            ***
**************************************************************************************************
                        TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0
                                     TOTAL MIXTURE VOLUMES
                               MIXTURE      TOTAL VOLUME            MASS(G)
                                  1       4.66804E+04 CM**3      4.86035E+05
                                  2       1.63811E+04 CM**3      1.07460E+05
                                  3       1.80087E+05 CM**3      1.79757E+05
                                  4       1.35152E+04 CM**3      3.65179E+04
                                  5       1.00696E+05 CM**3      7.97513E+05
                                  6       1.66768E+03 CM**3      4.30809E+03
                                  7       6.56407E+04 CM**3      7.44628E+05
                                  9       5.81490E+05 CM**3      5.80427E+05
                                 10       1.98592E+03 CM**3      1.98228E+03

*************************************************************************************************************
***                                                                                                       ***
***                                         BIASING INFORMATION                                           ***
***                                                                                                       ***
***   A DEFAULT WEIGHT OF    0.500 WILL BE USED FOR ALL BIAS ID'S.                                        ***
***                                                                                                       ***
*************************************************************************************************************

                   ........    0 IO'S WERE USED IN KENO-V BEFORE TRACKING       ........

                   ........  0.01383 MINUTES WERE USED PROCESSING DATA.        ........

VOLUME FRACTION OF FISSILE MATERIAL IN THE CORE= 4.63033E-02

START TYPE 0 WAS USED.

THE NEUTRONS WERE STARTED WITH A FLAT DISTRIBUTION IN A CUBOID DEFINED BY:
                  +X= 1.24651E+02  -X=-1.75349E+02  +Y= 1.24651E+02  -Y=-1.75349E+02  +Z= 1.12016E+01  -Z= 0.00000E+00
THE FLAG TO START NEUTRONS IN THE REFLECTOR WAS TURNED OFF

0.43433 MINUTES WERE REQUIRED FOR STARTING.   TOTAL ELAPSED TIME IS 0.44800 MINUTES.
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

GENERATION	GENERATION K-EFFECTIVE	ELAPSED TIME MINUTES	AVERAGE K-EFFECTIVE	AVG K-EFF DEVIATION	MATRIX K-EFFECTIVE	MATRIX K-EFF DEVIATION
1	8.99752E-01	4.66000E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
2	9.15757E-01	4.85167E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
KENO MESSAGE NUMBER K5-132	WARNING....ONLY 975 INDEPENDENT FISSION POINTS WERE GENERATED					
3	8.81083E-01	5.08167E-01	8.81083E-01	0.00000E+00	0.00000E+00	0.00000E+00
4	8.95401E-01	5.27333E-01	8.88242E-01	7.15911E-03	0.00000E+00	0.00000E+00
5	8.83993E-01	5.50167E-01	8.86825E-01	4.36926E-03	0.00000E+00	0.00000E+00
6	9.29745E-01	5.69500E-01	8.97555E-01	1.11658E-02	0.00000E+00	0.00000E+00
7	9.21681E-01	5.89667E-01	9.02380E-01	9.90387E-03	0.00000E+00	0.00000E+00
8	8.86503E-01	6.09667E-01	8.99734E-01	8.50845E-03	0.00000E+00	0.00000E+00
9	9.05096E-01	6.30833E-01	9.00500E-01	7.23163E-03	0.00000E+00	0.00000E+00
10	8.72586E-01	6.50000E-01	8.97011E-01	7.16920E-03	0.00000E+00	0.00000E+00
11	8.92029E-01	6.71000E-01	8.96457E-01	6.34683E-03	0.00000E+00	0.00000E+00
12	8.70002E-01	6.90333E-01	8.93812E-01	6.26294E-03	0.00000E+00	0.00000E+00
13	8.78336E-01	7.13167E-01	8.92405E-01	5.83712E-03	0.00000E+00	0.00000E+00
14	9.19176E-01	7.32333E-01	8.94636E-01	5.77669E-03	0.00000E+00	0.00000E+00
15	9.13891E-01	7.52500E-01	8.96117E-01	5.51635E-03	0.00000E+00	0.00000E+00
16	8.63450E-01	7.72667E-01	8.93784E-01	5.61493E-03	0.00000E+00	0.00000E+00
17	8.98462E-01	7.95500E-01	8.94096E-01	5.23651E-03	0.00000E+00	0.00000E+00
18	9.03556E-01	8.15667E-01	8.94687E-01	4.93387E-03	0.00000E+00	0.00000E+00
19	9.00677E-01	8.35833E-01	8.95039E-01	4.64794E-03	0.00000E+00	0.00000E+00
20	8.82546E-01	8.56833E-01	8.94345E-01	4.43674E-03	0.00000E+00	0.00000E+00
21	9.03549E-01	8.78000E-01	8.94830E-01	4.22460E-03	0.00000E+00	0.00000E+00
22	8.97150E-01	8.97167E-01	8.94946E-01	4.00949E-03	0.00000E+00	0.00000E+00
23	9.24417E-01	9.17333E-01	8.96349E-01	4.06379E-03	0.00000E+00	0.00000E+00
24	8.94524E-01	9.36500E-01	8.96266E-01	3.87556E-03	0.00000E+00	0.00000E+00
25	8.99957E-01	9.56667E-01	8.96426E-01	3.70671E-03	0.00000E+00	0.00000E+00
978	9.20387E-01	2.02703E+01	9.00271E-01	7.43267E-04	0.00000E+00	0.00000E+00
979	8.97272E-01	2.02905E+01	9.00268E-01	7.42512E-04	0.00000E+00	0.00000E+00
980	9.27792E-01	2.03107E+01	9.00296E-01	7.42286E-04	0.00000E+00	0.00000E+00
981	8.68171E-01	2.03298E+01	9.00263E-01	7.42253E-04	0.00000E+00	0.00000E+00
982	8.95645E-01	2.03508E+01	9.00258E-01	7.41510E-04	0.00000E+00	0.00000E+00
983	8.75421E-01	2.03710E+01	9.00233E-01	7.41186E-04	0.00000E+00	0.00000E+00
984	9.06928E-01	2.03902E+01	9.00240E-01	7.40463E-04	0.00000E+00	0.00000E+00
985	9.20851E-01	2.04103E+01	9.00261E-01	7.40006E-04	0.00000E+00	0.00000E+00
986	8.97710E-01	2.04315E+01	9.00258E-01	7.39258E-04	0.00000E+00	0.00000E+00
987	8.99171E-01	2.04515E+01	9.00257E-01	7.38508E-04	0.00000E+00	0.00000E+00
988	9.12688E-01	2.04717E+01	9.00270E-01	7.37867E-04	0.00000E+00	0.00000E+00
989	8.80411E-01	2.04918E+01	9.00250E-01	7.37393E-04	0.00000E+00	0.00000E+00
990	8.85791E-01	2.05120E+01	9.00235E-01	7.36792E-04	0.00000E+00	0.00000E+00
991	9.36212E-01	2.05322E+01	9.00271E-01	7.36945E-04	0.00000E+00	0.00000E+00
992	8.75343E-01	2.05513E+01	9.00246E-01	7.36631E-04	0.00000E+00	0.00000E+00
993	9.14852E-01	2.05705E+01	9.00261E-01	7.36034E-04	0.00000E+00	0.00000E+00
994	8.95530E-01	2.05917E+01	9.00256E-01	7.35308E-04	0.00000E+00	0.00000E+00
995	8.87804E-01	2.06118E+01	9.00244E-01	7.34674E-04	0.00000E+00	0.00000E+00
996	8.94301E-01	2.06310E+01	9.00238E-01	7.33959E-04	0.00000E+00	0.00000E+00
997	9.11712E-01	2.06520E+01	9.00249E-01	7.33311E-04	0.00000E+00	0.00000E+00
998	9.13794E-01	2.06722E+01	9.00263E-01	7.32701E-04	0.00000E+00	0.00000E+00
999	8.80324E-01	2.06923E+01	9.00243E-01	7.32239E-04	0.00000E+00	0.00000E+00
1000	8.92098E-01	2.07125E+01	9.00235E-01	7.31550E-04	0.00000E+00	0.00000E+00
1001	9.08588E-01	2.07345E+01	9.00243E-01	7.30865E-04	0.00000E+00	0.00000E+00
1002	8.77806E-01	2.07545E+01	9.00221E-01	7.30479E-04	0.00000E+00	0.00000E+00
1003	9.11293E-01	2.07747E+01	9.00232E-01	7.29833E-04	0.00000E+00	0.00000E+00

KENO MESSAGE NUMBER K5-123 EXECUTION TERMINATED DUE TO COMPLETION OF THE SPECIFIED NUMBER OF GENERATIONS.
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

LIFETIME = 4.13717E-05 + OR - 8.50918E-08 GENERATION TIME = 2.75056E-05 + OR - 4.33736E-08
NU BAR = 2.44194E+00 + OR - 6.63172E-05 AVERAGE FISSION GROUP = 2.17289E+01 + OR - 3.82379E-03
ENERGY(EV) OF THE AVERAGE LETHARGY CAUSING FISSION = 2.78690E-01 + OR - 8.49711E-04

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
3	0.90025	+ OR - 0.00073	0.89952 TO 0.90098	0.89879 TO 0.90171	0.89806 TO 0.90244	1000000
4	0.90026	+ OR - 0.00073	0.89952 TO 0.90099	0.89879 TO 0.90172	0.89806 TO 0.90245	999000
5	0.90027	+ OR - 0.00073	0.89954 TO 0.90100	0.89881 TO 0.90174	0.89808 TO 0.90247	998000

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

6	0.90024	+ OR - 0.00073	0.89951 TO 0.90097	0.89878 TO 0.90171	0.89805 TO 0.90244	997000
7	0.90022	+ OR - 0.00073	0.89949 TO 0.90095	0.89876 TO 0.90169	0.89802 TO 0.90242	996000
8	0.90023	+ OR - 0.00073	0.89950 TO 0.90097	0.89877 TO 0.90170	0.89804 TO 0.90243	995000
9	0.90023	+ OR - 0.00073	0.89950 TO 0.90096	0.89876 TO 0.90170	0.89803 TO 0.90243	994000
10	0.90026	+ OR - 0.00073	0.89952 TO 0.90099	0.89879 TO 0.90172	0.89806 TO 0.90246	993000
11	0.90027	+ OR - 0.00073	0.89953 TO 0.90100	0.89880 TO 0.90173	0.89806 TO 0.90247	992000
12	0.90030	+ OR - 0.00073	0.89956 TO 0.90103	0.89883 TO 0.90177	0.89809 TO 0.90250	991000
17	0.90033	+ OR - 0.00074	0.89959 TO 0.90106	0.89885 TO 0.90180	0.89812 TO 0.90253	986000
22	0.90034	+ OR - 0.00074	0.89960 TO 0.90108	0.89886 TO 0.90182	0.89812 TO 0.90256	981000
937	0.90243	+ OR - 0.00297	0.89945 TO 0.90540	0.89648 TO 0.90837	0.89351 TO 0.91135	66000
942	0.90335	+ OR - 0.00304	0.90030 TO 0.90639	0.89726 TO 0.90944	0.89421 TO 0.91248	61000
947	0.90475	+ OR - 0.00314	0.90161 TO 0.90789	0.89846 TO 0.91103	0.89532 TO 0.91417	56000
952	0.90405	+ OR - 0.00320	0.90084 TO 0.90725	0.89764 TO 0.91046	0.89444 TO 0.91366	51000
957	0.90012	+ OR - 0.00284	0.89728 TO 0.90297	0.89444 TO 0.90581	0.89160 TO 0.90865	46000
962	0.90262	+ OR - 0.00288	0.89974 TO 0.90549	0.89687 TO 0.90837	0.89399 TO 0.91124	41000
967	0.90216	+ OR - 0.00306	0.89910 TO 0.90521	0.89604 TO 0.90827	0.89298 TO 0.91133	36000
972	0.90098	+ OR - 0.00343	0.89754 TO 0.90441	0.89411 TO 0.90785	0.89068 TO 0.91128	31000
977	0.89953	+ OR - 0.00348	0.89605 TO 0.90301	0.89257 TO 0.90650	0.88909 TO 0.90998	26000
982	0.89898	+ OR - 0.00366	0.89532 TO 0.90264	0.89166 TO 0.90630	0.88800 TO 0.90997	21000
987	0.89866	+ OR - 0.00434	0.89431 TO 0.90300	0.88997 TO 0.90735	0.88563 TO 0.91169	16000
992	0.89892	+ OR - 0.00413	0.89478 TO 0.90305	0.89065 TO 0.90719	0.88652 TO 0.91132	11000
997	0.89732	+ OR - 0.00656	0.89076 TO 0.90388	0.88420 TO 0.91043	0.87764 TO 0.91699	6000

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

PLOT OF AVERAGE K-EFFECTIVE BY GENERATION RUN.
THE LINE REPRESENTS K-EFF = 0.9003 + OR - 0.0007 WHICH OCCURS FOR 1003 GENERATIONS RUN.

0.8897 0.8987 0.9077

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

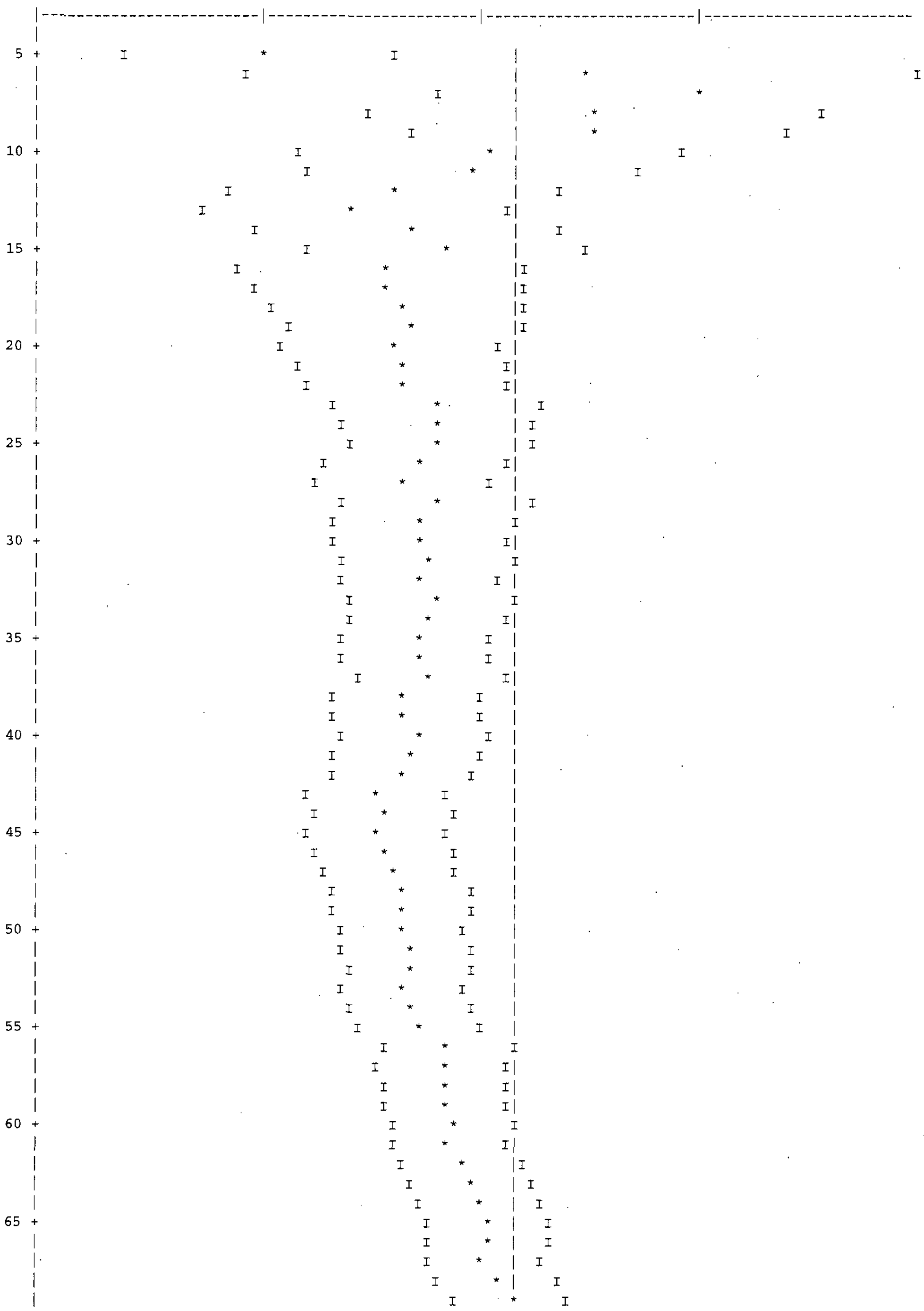

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
     |                                                    I *| I
 965 +                                                    I *| I
     |                                                    I  * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
 970 +                                                     I * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
 975 +                                                     I * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
 980 +                                                     I * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
 985 +                                                     I * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
 990 +                                                     I * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
 995 +                                                     I * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
1000 +                                                     I * I
     |                                                     I * I
     |                                                     I * I
     |                                                     I * I
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0
SKIPPING 3 GENERATIONS

GROUP	FISSION FRACTION	UNIT	REGION	FISSIONS	PERCENT DEVIATION	ABSORPTIONS	PERCENT DEVIATION	LEAKAGE	PERCENT DEVIATION
1	0.0059			5.34103E-03	1.0952	2.62006E-03	0.9146	0.00000E+00	0.0000
2	0.0233			2.09376E-02	0.3533	9.83986E-03	0.3143	0.00000E+00	0.0000
3	0.0254			2.28570E-02	0.3148	9.30230E-03	0.3096	0.00000E+00	0.0000
4	0.0105			9.47524E-03	0.3936	4.43581E-03	0.3867	0.00000E+00	0.0000
5	0.0034			3.05215E-03	0.2922	2.79613E-03	0.2823	0.00000E+00	0.0000
6	0.0031			2.76419E-03	0.2364	4.09041E-03	0.2261	0.00000E+00	0.0000
7	0.0030			2.73257E-03	0.2262	4.42282E-03	0.2137	0.00000E+00	0.0000
8	0.0031			2.75610E-03	0.2574	7.30715E-03	0.2466	0.00000E+00	0.0000
9	0.0042			3.78961E-03	0.2784	1.23266E-02	0.2587	0.00000E+00	0.0000
10	0.0089			8.03017E-03	0.2766	1.82729E-02	0.2692	0.00000E+00	0.0000
11	0.0185			1.66439E-02	0.2746	3.14249E-02	0.2662	0.00000E+00	0.0000
12	0.0235			2.11756E-02	0.3049	3.62575E-02	0.2950	0.00000E+00	0.0000
13	0.0217			1.94941E-02	0.3292	3.66911E-02	0.3201	0.00000E+00	0.0000
14	0.0168			1.51088E-02	0.3171	5.15006E-02	0.3029	0.00000E+00	0.0000
15	0.0037			3.32288E-03	0.5420	1.15041E-02	0.6567	0.00000E+00	0.0000
16	0.0025			2.28572E-03	0.6776	7.34526E-03	0.8560	0.00000E+00	0.0000
17	0.0039			3.48490E-03	0.8972	4.92116E-03	0.9181	0.00000E+00	0.0000
18	0.0051			4.57111E-03	0.9436	4.97165E-03	0.9175	0.00000E+00	0.0000
19	0.0063			5.68670E-03	0.7516	8.07060E-03	0.7823	0.00000E+00	0.0000
20	0.0264			2.37973E-02	0.4217	3.12588E-02	0.4003	0.00000E+00	0.0000
21	0.0142			1.28140E-02	0.6658	1.33961E-02	0.5770	0.00000E+00	0.0000
22	0.0333			3.00187E-02	0.4619	2.98115E-02	0.3983	0.00000E+00	0.0000
23	0.1108			9.97854E-02	0.2626	1.06269E-01	0.2026	0.00000E+00	0.0000
24	0.2010			1.80941E-01	0.1919	1.86480E-01	0.1344	0.00000E+00	0.0000
25	0.1650			1.48576E-01	0.2257	1.47079E-01	0.1524	0.00000E+00	0.0000
26	0.1936			1.74246E-01	0.2282	1.66781E-01	0.1555	0.00000E+00	0.0000
27	0.0628			5.65633E-02	0.4168	5.29893E-02	0.2909	0.00000E+00	0.0000
SYSTEM TOTAL =				9.00251E-01	0.0811	1.00216E+00	0.0205	0.00000E+00	0.0000

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

                                FREQUENCY FOR GENERATIONS    4 TO 1003
0.8183 TO 0.8213     *
0.8213 TO 0.8243
0.8243 TO 0.8273
0.8273 TO 0.8303     *
0.8303 TO 0.8333     *
0.8333 TO 0.8363
0.8363 TO 0.8392     *
0.8392 TO 0.8422     *
0.8422 TO 0.8452     *
0.8452 TO 0.8482     *
0.8482 TO 0.8512     *******
0.8512 TO 0.8542     ********
0.8542 TO 0.8572     ********
0.8572 TO 0.8602     ******
0.8602 TO 0.8632     ****************
0.8632 TO 0.8662     ************************
0.8662 TO 0.8691     **********************
0.8691 TO 0.8721     ******************
0.8721 TO 0.8751     *************************
0.8751 TO 0.8781     ***************************
0.8781 TO 0.8811     ****************************************
0.8811 TO 0.8841     ************************************
0.8841 TO 0.8871     **************************************************
0.8871 TO 0.8901     ********************************************
0.8901 TO 0.8931     ************************************
0.8931 TO 0.8960     *************************************************************
0.8960 TO 0.8990     **************************************************
0.8990 TO 0.9020     *************************************
0.9020 TO 0.9050     ********************************************************
0.9050 TO 0.9080     **************************************************
0.9080 TO 0.9110     ************************************************
0.9110 TO 0.9140     **************************************************
0.9140 TO 0.9170     ***********************************************
0.9170 TO 0.9200     ********************************
0.9200 TO 0.9229     *****************************
0.9229 TO 0.9259     *****************************
0.9259 TO 0.9289     **********************
0.9289 TO 0.9319     *************************
0.9319 TO 0.9349     **********************
0.9349 TO 0.9379     **************
0.9379 TO 0.9409     ****************
0.9409 TO 0.9439     ***********
0.9439 TO 0.9469     ******
0.9469 TO 0.9499     *****
0.9499 TO 0.9528     ****
0.9528 TO 0.9558     ******
0.9558 TO 0.9588     **
0.9588 TO 0.9618     *
0.9618 TO 0.9648
0.9648 TO 0.9678     **
0.9678 TO 0.9708     *
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

                                FREQUENCY FOR GENERATIONS  254 TO 1003
0.8183 TO 0.8213     *
0.8213 TO 0.8243
0.8243 TO 0.8273
0.8273 TO 0.8303     *
0.8303 TO 0.8333     *
0.8333 TO 0.8363
0.8363 TO 0.8392     *
0.8392 TO 0.8422
0.8422 TO 0.8452     *
0.8452 TO 0.8482     *
0.8482 TO 0.8512     ******
0.8512 TO 0.8542     ******
0.8542 TO 0.8572     ******
0.8572 TO 0.8602     *****
0.8602 TO 0.8632     ************
0.8632 TO 0.8662     ******************
0.8662 TO 0.8691     *****************
0.8691 TO 0.8721     ***************
0.8721 TO 0.8751     *******************
0.8751 TO 0.8781     *******************
0.8781 TO 0.8811     **************************
0.8811 TO 0.8841     *************************
0.8841 TO 0.8871     ***************************************
0.8871 TO 0.8901     **********************************
0.8901 TO 0.8931     ****************************
0.8931 TO 0.8960     *********************************************
0.8960 TO 0.8990     **************************************
0.8990 TO 0.9020     ***************************
0.9020 TO 0.9050     ***************************************
0.9050 TO 0.9080     ****************************************
0.9080 TO 0.9110     ************************************
0.9110 TO 0.9140     *************************************
0.9140 TO 0.9170     **************************************
0.9170 TO 0.9200     ***********************
0.9200 TO 0.9229     **********************
0.9229 TO 0.9259     *********************
0.9259 TO 0.9289     ******************
0.9289 TO 0.9319     *******************
0.9319 TO 0.9349     ****************
0.9349 TO 0.9379     ***********
0.9379 TO 0.9409     ************
0.9409 TO 0.9439     ******
0.9439 TO 0.9469     *****
0.9469 TO 0.9499     ****
0.9499 TO 0.9528     ***
0.9528 TO 0.9558     ***
0.9558 TO 0.9588     **
0.9588 TO 0.9618     *
0.9618 TO 0.9648
0.9648 TO 0.9678     **
0.9678 TO 0.9708     *
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

                               FREQUENCY FOR GENERATIONS  504 TO 1003
0.8183 TO 0.8213     *
0.8213 TO 0.8243
0.8243 TO 0.8273
0.8273 TO 0.8303     *
0.8303 TO 0.8333     *
0.8333 TO 0.8363
0.8363 TO 0.8392
0.8392 TO 0.8422
0.8422 TO 0.8452     *
0.8452 TO 0.8482     *
0.8482 TO 0.8512     *****
0.8512 TO 0.8542     ***
0.8542 TO 0.8572     **
0.8572 TO 0.8602     ***
0.8602 TO 0.8632     ********
0.8632 TO 0.8662     **************
0.8662 TO 0.8691     *************
0.8691 TO 0.8721     *******
0.8721 TO 0.8751     **************
0.8751 TO 0.8781     **********
0.8781 TO 0.8811     ******************
0.8811 TO 0.8841     ******************
0.8841 TO 0.8871     *************************
0.8871 TO 0.8901     *******************
0.8901 TO 0.8931     *******************
0.8931 TO 0.8960     *************************
0.8960 TO 0.8990     *************************
0.8990 TO 0.9020     *******************
0.9020 TO 0.9050     ********************************
0.9050 TO 0.9080     **************************
0.9080 TO 0.9110     ************************
0.9110 TO 0.9140     **************************
0.9140 TO 0.9170     *************************
0.9170 TO 0.9200     ******************
0.9200 TO 0.9229     **********
0.9229 TO 0.9259     *********
0.9259 TO 0.9289     **************
0.9289 TO 0.9319     **************
0.9319 TO 0.9349     ***********
0.9349 TO 0.9379     *********
0.9379 TO 0.9409     **********
0.9409 TO 0.9439     ****
0.9439 TO 0.9469     ***
0.9469 TO 0.9499     ***
0.9499 TO 0.9528     *
0.9528 TO 0.9558     ***
0.9558 TO 0.9588     **
0.9588 TO 0.9618     *
0.9618 TO 0.9648
0.9648 TO 0.9678     **
0.9678 TO 0.9708     *
```

Figure 6.7-8 CSAS25 Input / Output for Enlarged Fuel Tube Model (continued)

```
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

                              FREQUENCY FOR GENERATIONS  754 TO 1003
0.8183 TO 0.8213     *
0.8213 TO 0.8243
0.8243 TO 0.8273
0.8273 TO 0.8303     *
0.8303 TO 0.8333     *
0.8333 TO 0.8363
0.8363 TO 0.8392
0.8392 TO 0.8422
0.8422 TO 0.8452
0.8452 TO 0.8482
0.8482 TO 0.8512     ****
0.8512 TO 0.8542     *
0.8542 TO 0.8572     *
0.8572 TO 0.8602
0.8602 TO 0.8632     ****
0.8632 TO 0.8662     ********
0.8662 TO 0.8691     **********
0.8691 TO 0.8721     ****
0.8721 TO 0.8751     ***
0.8751 TO 0.8781     ****
0.8781 TO 0.8811     ********
0.8811 TO 0.8841     *******
0.8841 TO 0.8871     **************
0.8871 TO 0.8901     ********
0.8901 TO 0.8931     ***********
0.8931 TO 0.8960     *******************
0.8960 TO 0.8990     *************
0.8990 TO 0.9020     *******
0.9020 TO 0.9050     *************
0.9050 TO 0.9080     **************
0.9080 TO 0.9110     ************
0.9110 TO 0.9140     *************
0.9140 TO 0.9170     ***********
0.9170 TO 0.9200     *********
0.9200 TO 0.9229     *****
0.9229 TO 0.9259     *****
0.9259 TO 0.9289     **********
0.9289 TO 0.9319     ******
0.9319 TO 0.9349     *****
0.9349 TO 0.9379     ****
0.9379 TO 0.9409     ****
0.9409 TO 0.9439     **
0.9439 TO 0.9469
0.9469 TO 0.9499     *
0.9499 TO 0.9528     *
0.9528 TO 0.9558     *
0.9558 TO 0.9588     **
0.9588 TO 0.9618     *
0.9618 TO 0.9648
0.9648 TO 0.9678     *
0.9678 TO 0.9708     *


*************************************************************************************************************************************

          CONGRATULATIONS!  YOU HAVE  SUCCESSFULLY TRAVERSED THE PERILOUS PATH THROUGH KENO V IN  20.77833 MINUTES

*************************************************************************************************************************************
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition

```
1
    AA      N     NN   SSSSSS   WW     WW  EEEEEEEE  RRRRRRR    SSSSSS             CCCCCC    OOOOOO   DDDDDDD    EEEEEEEE
   AAAA    NN     NN  SSSSSSSS  WW     WW  EEEEEEEE  RRRRRRRR  SSSSSSSS           CCCCCCCC  OOOOOOOO  DDDDDDDD   EEEEEEEE
  AA  AA   NNN    NN  SS        WW     WW  EE        RR     RR SS                 CC        OO    OO   DD    DD  EE
 AA    AA  NNNN   NN  SS        WW     WW  EE        RR     RR SS                 CC        OO    OO   DD    DD  EE
 AAAAAAAA  NN NN  NN  SSSSSSS   WW     WW  EEEEE     RRRRRRRR  SSSSSSS            CC        OO    OO   DD    DD  EEEEE
 AAAAAAAA  NN NN  NN   SSSSSSS  WW     WW  EEEEE     RRRRRRR    SSSSSSS           CC        OO    OO   DD    DD  EEEEE
 AA    AA  NN  NNNN         SS  WW WW  WW  EE        RR RR           SS           CC        OO    OO   DD    DD  EE
 AA    AA  NN   NNN         SS  WW WW  WW  EE        RR  RR          SS           CC        OO    OO   DD    DD  EE
 AA    AA  NN     NN  SSSSSSSS   WWWWWW    EEEEEEEE  RR     RR SSSSSSSS           CCCCCCCC  OOOOOOOO  DDDDDDDD   EEEEEEEE
 AA    AA  NN      N   SSSSSS     WW WW    EEEEEEEE  RR     RR  SSSSSS             CCCCCC    OOOOOO   DDDDDDD    EEEEEEEE

                          M      M   OOOOOO   N      NN  KK     KK          888888     AA
                          MM    MM  OOOOOOOO  NN     NN  KK    KK          88888888   AAAA
                          MMM  MMM  OO    OO  NNN    NN  KK   KK           88    88  AA  AA
                          MMMMMMMM  OO    OO  NNNN   NN  KK KK             88    88  AA    AA
                          MM MM MM  OO    OO  NN NN  NN  KKKK               888888   AAAAAAAA
                          MM    MM  OO    OO  NN NN  NN  KKKK               888888   AAAAAAAA
                          MM    MM  OO    OO  NN   NNNN  KK KK             88    88  AA    AA
                          MM    MM  OO    OO  NN    NNN  KK   KK           88    88  AA    AA
                          MM    MM  OOOOOOOO  NN     NN  KK    KK          88888888  AA    AA
                          MM    MM   OOOOOO   NN      N  KK     KK          888888   AA    AA

 Running on machine 57NST (Windows NT) ....
 Date and time of execution: 15/ 9/2000 -  17.34.12

            PPPPPPP    CCCCCC            WW     WW   IIIIII  N      NN           N      NN  TTTTTTTT
            PPPPPPPP  CCCCCCCC           WW     WW   IIIIII  NN     NN           NN     NN  TTTTTTTT
            PP    PP  CC                 WW     WW     II    NNN    NN           NNN    NN     TT
            PP    PP  CC                 WW     WW     II    NNNN   NN           NNNN   NN     TT
            PPPPPPPP  CC                 WW     WW     II    NN NN  NN           NN NN  NN     TT
            PPPPPPP   CC                 WW     WW     II    NN NN  NN           NN NN  NN     TT
            PP        CC                 WW WW  WW     II    NN   NNNN           NN   NNNN     TT
            PP        CC                 WW WW  WW     II    NN    NNN           NN    NNN     TT
            PP        CCCCCCCC            WWWWWW     IIIIII  NN     NN           NN     NN     TT
            PP         CCCCCC              WW WW     IIIIII  NN      N           NN      N     TT

 ********  This Computer Program is Supplied Under Licence by the AEA Technology ANSWERS Software Service  ********

*********************************************************
 *          Program MONK 8A - Release Update 1            *
 *          ---------------------------------             *
 *                                                        *
 *   This is the ANSWERS QA Set version of MONK. This     *
 * program has successfully executed the designated set   *
 * of test cases on the ANSWERS QA Set computer systems.  *
 *                                                        *
 * This is the first update release of MONK8A, known as   *
 * the RU1 release. It contains corrections to the errors *
 * reported in ANSWERS/CRIT/ERROR(98)28,30,31 and 33      *
 *                                                        *
 *  22 January 1999                                       *
 *********************************************************
 *********************************************************
 *     The MONK program is developed and maintained       *
 *   through a collaboration between AEA Technology PLC   *
 *            and British Nuclear Fuels PLC.              *
 *********************************************************

 *****************************************************************
 ***            ANSWERS Software Licensing Procedure           ***
 *****************************************************************

 *** The timelock password has been successfully verified.
 *** This password expires at midnight on 30/ 6/2001

 *** Successful authorisation achieved on system 57NST
 *** This system has the identification number  131008778

 *****************************************************************
  This is a licensed ANSWERS software product made available to
   NAC International.
  The use of this program is restricted within the terms of your
  licence agreement with AEA Technology.
  This copy is registered with version identifier - PCNT9
 *****************************************************************
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
*******************************************************************
         ***          End of ANSWERS Software Licensing Checks          ***
         *******************************************************************

1PRINT OF INPUT DATA SET
 ======================
 *                                         *
 * Connecticut Yankee STC Transfer Cask Model *
 *                                         *

 always convert
! Always converts intergers to real numbers

 *********************************************

 *********************************
 * Inserting TSC Parameters Here *
 *   *
 *********************************

 *********************************
 < FPF LABEL FUELPARAM
 < CPF LABEL TUBEPARAM
 < CPF LABEL BASKPARAM
 < CPF LABEL CANPARAM
 *********************************

 * The following parameters need to be updated

 *********************************************
 @tscMAT   = 15                                              ! Last material number of TSC going into cask
 @tscNUM   = 20                                              ! Last part number of TSC going into cask
 @fuelMAT  = 1                                               ! Material number of fuel from TSC model
 *********************************************

 * The remaining parameters should stay the same unless the drawings change.

 @cpi       = 2.54                                           ! Centimeters per inch
 @tscHT     = 151.75                                         ! Height of TSC going into cask = 151.75*2.54
 @tscOD     = 70.64                                          ! Outer diameter of TSC going into cask = 70.64*2.54

 @tfrOD     = 89.0                                           ! Transfer cask OD = 89.0*2.54

 @cavMAT    = 4                                              ! Cavity Material additive

 @btmplHT   = 1                                              ! Bottom plate height = 1.0*2.54
 @btmplMAT  = 1                                              ! Bottom plate material additive

 @inshlHT   = 150.0                                          ! Inner shell height  = 149.8*2.54
 @inshlID   = 71.5                                           ! Inner shell inner Diameter = 71.5*2.54
 @inshlTH   = 0.75                                           ! Inner shell thickness = 0.75*2.54
 @inshlMAT  = 1                                              ! Inner shell material additive

 @pbshlTH   = 4.0                                            ! Lead shell thickness = 4.0*2.54
 @pbshlMAT  = 2                                              ! Lead shell material additive

 @ns4frGAP  = 4                                              ! Gap above Lead filled w/ NS-4-FR = 3*2.54
 @n4shlMAT  = 3                                              ! NS-4-FR shell material additive

 @otshlTH   = 1.25                                           ! Outer shell thickness = 1.25*2.54
 @otshlMAT  = 1                                              ! Outer shell material additive

 @topplHT   = 2.0                                            ! Top plate height = 2.0*2.54
 @topplMAT  = 1                                              ! Top plate material additive

 @rtnrnHT   = 0.75                                           ! Retaining ring height = 0.75*2.54
 @rtnrnID   = 68.5                                           ! Retaining ring inner diameter = 68.5*2.54
 @rtnrnOD   = 80.8                                           ! Retaining ring outer diameter = 80.8*2.54
 @rtnrnMAT  = 1                                              ! Retaining ring material additive

 @shldrHT   = 9.50                                           ! Shield door height = 9.50*2.54
 @shldrMAT  = 1                                              ! Shield door material additive
 @drrailID  = 75.5                                           ! Shield door rail inner dimension  = 75.5*2.54
 @drrailWD  = 4.5                                            ! Shield door rail width = 4.5
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
 @trunzcor = 15.00                                ! Distance b/w origen of trunion cylinder and retaining ri
 @trunOD   = 10.00                                ! Diameter of trunions = 10*2.54
 @trunMAT  = 1                                    ! Trunion material additive

 ************************************************
 BEGIN MATERIAL SPECIFICATION
 ************************************************
NORMALISE

 *********************************
 < FMF LABEL FUELMIX
 *********************************

 NMATERIALS [@tscMAT + 5]

 *********************************
 * Inserting TSC Materials Here  *
 *                               *
 < FMF LABEL FUELMAT
 < CMF LABEL TUBEMAT
 < CMF LABEL BASKETMAT
 < CMF LABEL CANMAT
 *********************************

 WEIGHT
 MATERIAL [@tscMAT + 1]  STAINLESS 304L STEEL     !Steel components of Transfer Cask

 WEIGHT
 MATERIAL [@tscMAT + 2]  DENSITY 11.04            !LEAD
 PB     PROP 1.0000

 ATOMS
 MATERIAL [@tscMAT + 3]  DENSITY 0.0              !NS-4-FR
 B10    PROP 8.553E-5
 B11    PROP 3.422E-4
 AL27   PROP 7.796E-3
 H1     PROP 5.854E-2
 O16    PROP 2.609E-2
 C      PROP 2.264E-2
 N      PROP 1.394E-3

 ATOMS
 MATERIAL [@tscMAT + 4]  DENSITY 0.9982           ! Material (water) outside of Basket
 H1     PROP 2
 O16    PROP 1

 ATOMS
 MATERIAL [@tscMAT + 5]  DENSITY 0.9982           ! Additional water for future use
 H1     PROP 2
 O16    PROP 1
 END
************************************************
 BEGIN MATERIAL GEOMETRY
 ************************************************

 *********************************
 *  Inserting TSC Geometry Here  *
 *                               *
 < cgf Label BASKGEOM            *
 *********************************
 !234567890123456789012345678901234567890123456789012345678901234567890123456789012
 PART [@tscNUM + 1]
 ZROD 1 3*0  [@cpi*@tscOD/2] [@cpi*@tscHT]                        ! TSC
 ZROD 2 3*0  [@cpi*@inshlID/2] [@cpi*(@btmplHT+@inshlHT+@topplHT)]  ! Cask cavity
 ZROD 3 3*0  [@cpi*@tfrOD/2] [@cpi*@btmplHT]                      ! Bottom plate
 ZROD 4 2*0  [@cpi*@btmplHT] [@cpi*((@inshlID/2)+@inshlTH)]
             [@cpi*@inshlHT]                                      !            Inner          shell

 ZROD 5 2*0  [@cpi*@btmplHT] [@cpi*((@inshlID/2)+@inshlTH+@pbshlTH)]
             [@cpi*(@inshlHT-@ns4frGAP)]                          ! Lead shell
 ZROD 6 2*0  [@cpi*@btmplHT] [@cpi*((@tfrOD/2)-@otshlTH)]
             [@cpi*@inshlHT]                                      !           NS-4-FR         shell
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
ZROD 7 2*0  [@cpi*@btmplHT] [@cpi*(@tfrOD/2)] [@cpi*@inshlHT]            ! Outer shell
ZROD 8 2*0  [@cpi*(@btmplHT+@inshlHT)]  [@cpi*(@tfrOD/2)]
              [@cpi*@topplHT]                                  ! Top plate
ZROD 9 2*0  [@cpi*(@btmplHT+@inshlHT+@topplHT)] [@cpi*@rtnrnID/2]
              [@cpi*@rtnrnHT]                                  ! Area inside retaining ring
ZROD 10 2*0 [@cpi*(@btmplHT+@inshlHT+@topplHT)] [@cpi*@rtnrnOD/2]
              [@cpi*@rtnrnHT]                                  ! Retaining ring
ZROD 11 2*0 [-@shldrHT*@cpi] [@cpi*@tfrOD/2] [@cpi*@shldrHT]             ! Shield doors and
YP   12  [@cpi*((@drrailID/2)+@drrailWD)]                                 ! Y plane for shield door rail cu
YP   13  [-@cpi*((@drrailID/2)+@drrailWD)]                                ! Y plane for shield door rail c
XROD 14  [-@cpi*@tfrOD/2] 0
              [@cpi*(@btmplHT+@inshlHT+@topplHT - @trunzcor)]
              [@cpi*@trunOD/2]    [@cpi*@tfrOD]                            ! Trunions
ZROD 15 2*0 [-1 * @cpi*@shldrHT] [@cpi*@tfrOD/2]
              [@cpi*(@shldrHT+@btmplHT+@inshlHT+@topplHT+@rtnrnHT)]        ! Container

ZONES
P@tscNUM                  +1                                   ! TSC
M[@tscMAT + @cavMAT]      +2 -1                                ! Cask cavity
M[@tscMAT + @btmplMAT]    +3 -2                                ! Bottom plate
M[@tscMAT + @inshlMAT]    +4 -2 -14                            ! Inner shell
M[@tscMAT + @pbshlMAT]    +5 -4 -14                            ! Lead shell
M[@tscMAT + @n4shlMAT]    +6 -5 -4 -14                         ! NS-4-FR shell
M[@tscMAT + @otshlMAT]    +7 -6 -14                            ! Outer shell
M[@tscMAT + @topplMAT]    +8 -2                                ! Top plate
M[@tscMAT + @cavMAT]      +9                                   ! Area inside retaining ring
M[@tscMAT + @rtnrnMAT]    +10 -9                               ! Retaining ring
M[@tscMAT + @shldrMAT]    +11 -12 +13                          ! Shield doors and rails
M[@tscMAT + @cavMAT]      +11 +12                              ! Space outside of shield door
M[@tscMAT + @cavMAT]      +11 -13                              ! Space outside of shield door
M[@tscMAT + @trunMAT]     +14 +15 -2                           ! Trunions
M[@tscMAT + @cavMAT]      +15 -14 -11 -10 -8 -7 -3             ! Container of same material f

*************************************************

ALBEDO 1 1 1
PERIODIC

END

*************************************************
BEGIN HOLE DATA
*************************************************

********************************
* Inserting TSC Hole Data Here  *
*                               *
< FHF LABEL FUELHOLE
< CHF LABEL TUBEHOLE
< CHF LABEL BASKHOLE
********************************

END

*************************************************
BEGIN CONTROL DATA
*************************************************

*READ   ! read and check each independently
*SEEK MULTIPLE DEFINITIONS

SEEDS 54321 54321
STAGES -3 810 1000 STDV 0.0008

END

*************************************************
BEGIN SOURCE GEOMETRY
*************************************************

ZONEMAT
ALL / MATERIAL @fuelMAT

END
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
Changing  input to named channel:      FPF after reading
  15  lines from   named channel:    INPUT Total line count=   15
Real     parameter number    1:rpitch              =  1.442700E+00
Real     parameter number    2:lactfu              =  3.061970E+02
Real     parameter number    3:odpellet            =  9.307000E-01
Real     parameter number    4:odclad              =  1.066800E+00
Real     parameter number    5:cladth              =  5.660000E-02
Real     parameter number    6:odgt                =  1.346200E+00
Real     parameter number    7:gtth                =  3.300000E-02
Real     parameter number    8:odit                =  1.346200E+00
Real     parameter number    9:itth                =  3.300000E-02
Real     parameter number   10:lfu                 =  3.218688E+02
Real     parameter number   11:ltcap               =  1.739900E+00
Real     parameter number   12:lbcap               =  1.739900E+00
Real     parameter number   13:lfexpb              =  0.000000E+00
Real     parameter number   14:lattice             =  1.500000E+01
Real     parameter number   15:lassem              =  3.481324E+02
Real     parameter number   16:wfuel               =  2.164080E+01
Real     parameter number   17:lbnozz              =  8.097500E+00
Real     parameter number   18:ltnozz              =  1.724660E+01
Real     parameter number   19:fgapb               =  0.000000E+00
Real     parameter number   20:fuoffz              =  0.000000E+00
Returning input to named channel:    INPUT after reading
  33  lines from   named channel:      FPF Total line count=   45

Changing  input to named channel:      CPF after reading
  16  lines from   named channel:    INPUT Total line count=   46
Real     parameter number   21:wft                 =  2.222500E+01
Real     parameter number   22:ftth                =  1.219000E-01
Real     parameter number   23:lfutube             =  3.357880E+02
Real     parameter number   24:wfto                =  2.294130E+01
Integer parameter number   25:ftoffz              =          0
Real     parameter number   26:asoffx              =  5.842000E-01
Real     parameter number   27:asoffy              =  5.842000E-01
Real     parameter number   28:asoffyp             =  2.921000E-01
Real     parameter number   29:asoffxo             =  1.600200E+00
Real     parameter number   30:asoffyo             =  1.600200E+00
Real     parameter number   31:wbrl                =  2.025400E+01
Real     parameter number   32:blt                 =  1.905000E-01
Real     parameter number   33:blct                =  1.270000E-01
Real     parameter number   34:lboral              =  3.261360E+02
Real     parameter number   35:boffz               =  3.556000E-01
Integer parameter number   36:bshiftx             =          0
Integer parameter number   37:bshifty             =          0
Integer parameter number   38:bshiftyp            =          0
Real     parameter number   39:cvst                =  4.570000E-02
Real     parameter number   40:lcvs                =  3.284220E+02
Real     parameter number   41:cvoffz              =  2.032000E+00
Real     parameter number   42:tboffx              =  3.886000E-01
Real     parameter number   43:tboffy              =  3.886000E-01
Real     parameter number   44:tboffyp             =  1.943000E-01
Real     parameter number   45:overs               =  1.016000E+00
Returning input to named channel:    INPUT after reading
  47  lines from   named channel:      CPF Total line count=   87

Changing  input to named channel:      CPF after reading
  17  lines from   named channel:    INPUT Total line count=   88
Real     parameter number   46:diabw               =  1.752092E+02
Real     parameter number   47:lbw                 =  5.080000E+00
Real     parameter number   48:lbwd                =  1.270000E+00
Real     parameter number   49:lbws                =  1.038860E+01
Real     parameter number   50:diatpw              =  1.752092E+02
Real     parameter number   51:ltpw                =  1.727200E+01
Real     parameter number   52:ltpwd               =  1.270000E+00
Real     parameter number   53:lspring             =  1.473200E+01
Real     parameter number   54:thspring            =  1.270000E+00
Real     parameter number   55:opspd               =  2.332990E+01
Real     parameter number   56:diassp              =  1.756410E+02
Real     parameter number   57:tspd                =  1.270000E+00
Real     parameter number   58:wsspx1              =  1.353330E+01
Real     parameter number   59:wsspx2              =  3.961910E+01
Real     parameter number   60:wsspx3              =  6.545090E+01
Real     parameter number   61:tsspy1              =  2.708420E+01
Real     parameter number   62:tsspy2              =  5.926600E+01
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
Real    parameter number  63:wsspxo          =  4.012710E+01
Real    parameter number  64:tsspyo          =  5.405900E+01
Real    parameter number  65:diaht           =  1.749298E+02
Real    parameter number  66:thtd            =  1.270000E+00
Integer parameter number  67:nhtd            =        27
Real    parameter number  68:dsspht          =  4.559300E+00
Real    parameter number  69:lbasket         =  3.594100E+02
Real    parameter number  70:diskstack       =  3.160522E+02
Integer parameter number  71:baskoff         =         0
Returning input to named channel:     INPUT after reading
  96  lines from   named channel:       CPF Total line count=  133

Changing  input to named channel:       CPF after reading
  18  lines from   named channel:     INPUT Total line count=  134
Real    parameter number  72:canod           =  1.794256E+02
Real    parameter number  73:canth           =  1.587500E+00
Real    parameter number  74:canl            =  3.854450E+02
Real    parameter number  75:canbot          =  4.445000E+00
Real    parameter number  76:shieldl         =  1.270000E+01
Real    parameter number  77:structl         =  7.620000E+00
Real    parameter number  78:cavheight       =  3.606800E+02
Returning input to named channel:     INPUT after reading
 113  lines from   named channel:       CPF Total line count=  147
Integer parameter number  79:tscMAT          =        15
Integer parameter number  80:tscNUM          =        20
Integer parameter number  81:fuelMAT         =         1
Real    parameter number  82:cpi             =  2.540000E+00
Real    parameter number  83:tscHT           =  1.517500E+02
Real    parameter number  84:tscOD           =  7.064000E+01
Real    parameter number  85:tfrOD           =  8.900000E+01
Integer parameter number  86:cavMAT          =         4
Integer parameter number  87:btmplHT         =         1
Integer parameter number  88:btmplMAT        =         1
Real    parameter number  89:inshlHT         =  1.500000E+02
Real    parameter number  90:inshlID         =  7.150000E+01
Real    parameter number  91:inshlTH         =  7.500000E-01
Integer parameter number  92:inshlMAT        =         1
Real    parameter number  93:pbshlTH         =  4.000000E+00
Integer parameter number  94:pbshlMAT        =         2
Integer parameter number  95:ns4frGAP        =         4
Integer parameter number  96:n4shlMAT        =         3
Real    parameter number  97:otshlTH         =  1.250000E+00
Integer parameter number  98:otshlMAT        =         1
Real    parameter number  99:topplHT         =  2.000000E+00
Integer parameter number 100:topplMAT        =         1
Real    parameter number 101:rtnrnHT         =  7.500000E-01
Real    parameter number 102:rtnrnID         =  6.850000E+01
Real    parameter number 103:rtnrnOD         =  8.080000E+01
Integer parameter number 104:rtnrnMAT        =         1
Real    parameter number 105:shldrHT         =  9.500000E+00
Integer parameter number 106:shldrMAT        =         1
Real    parameter number 107:drrailID        =  7.550000E+01
Real    parameter number 108:drrailWD        =  4.500000E+00
Real    parameter number 109:trunzcor        =  1.500000E+01
Real    parameter number 110:trunOD          =  1.000000E+01
Integer parameter number 111:trunMAT         =         1

********************************************************
*    ENTERING UNIT  9 TO READ MATERIAL SPECIFICATION    *
********************************************************

    Free format reading told to echo all input lines      to channel  6

 NORMALISE
+++++FILE NAME KEY IS DICE96J2V5.DAT
DATABASE NAME IS  d:\answers\data_libraries\monk_matdbv2d.dat
 DATABASE HISTORY IS
         MONK MATERIAL SPECIFICATION MODULE DATABASE VERSION 2C, STRUCTURING :
         . DICEDAT1C.DAT
         . DICE96J2V4.DAT
         . OILDICE96V2.DAT
         . DICE97E6V1.DAT
         . DICEDAT1D.DAT
         . DICE97E6V2.DAT
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
     . DICE96J2V5.DAT .
     . DICE97E6V3.DAT
     ***************************************************
     * FOR USE WITH MONK, NOT FOR MCBEND AND RANKERN    *
     *                                                 *
     * If a requested nuclide is not present in the    *
     * nuclear data library, a warning message will be *
     * printed below and the nuclide will be omitted   *
     * from the material.                              *
     * CHECK CAREFULLY that this automatic correction  *
     * to the material composition is appropriate.     *
     ***************************************************

< FMF LABEL FUELMIX
    Changing  input to named channel:      FMF after reading
      80  lines from   named channel:    INPUT Total line count=  209

NMIXTURES 1
*************************************************

ATOMS
MIXTURE 1
H1 2
O16 1

< UP
    Returning input to named channel:    INPUT after reading
      10  lines from   named channel:      FMF Total line count=  218

NMATERIALS [@tscMAT + 5]
*********************************
    The input characters        : [@tscMAT + 5]
    have been replaced by       : +20.00000

< FMF LABEL FUELMAT

    Changing  input to named channel:      FMF after reading
      88  lines from   named channel:    INPUT Total line count=  226

WEIGHT
MATERIAL 1 DENSITY 10.412          ! 95% UO2 theoretical density 4.2 wt% 235U
*********************************
* Inserting TSC Materials Here  *
*                               *
U235  PROP 0.04063
U238  PROP 0.84080
O16   PROP 0.11856

WEIGHT
MATERIAL 2 ZIRCONIUM               ! Fuel pin cladding / End Caps
                   ++++MATERIAL <   2>: USES MIXTURE <ZIRCONIUM>

ATOMS
                   ++++MATERIAL <   2>: DEFAULT PROPORTION=1.0
MATERIAL 3 DENSITY 0.9982          ! Water In Lattice and Tube
H1    PROP 2
O16   PROP 1

ATOMS
MATERIAL 4 DENSITY 0.9982          ! Water In Fuel Rod Clad Gap
H1    PROP 2
O16   PROP 1

WEIGHT
MATERIAL 5 ZIRCONIUM               ! Guide tube material
                   ++++MATERIAL <   5>: USES MIXTURE <ZIRCONIUM>

WEIGHT
                   ++++MATERIAL <   5>: DEFAULT PROPORTION=1.0
MATERIAL 6 ZIRCONIUM               ! Instrument Tube Material
                   ++++MATERIAL <   6>: USES MIXTURE <ZIRCONIUM>

VOLUME
                   ++++MATERIAL <   6>: DEFAULT PROPORTION=1.0
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
MATERIAL 7
STAINLESS 304L STEEL PROP 0.3031
                   ++++MATERIAL <   7>: USES MIXTURE <STAINLESS 304L STEEL>
MIXTURE 1 DENSITY 0.9982 PROP 0.6969     ! Lower Nozzle Material

MATERIAL 8
STAINLESS 304L STEEL PROP 0.1720
                   ++++MATERIAL <   8>: USES MIXTURE <STAINLESS 304L STEEL>
MIXTURE 1 DENSITY 0.9982 PROP 0.8280     ! Upper Nozzle Material

< UP
    Returning input to named channel:     INPUT after reading
      48  lines from   named channel:       FMF Total line count=  262
< CMF LABEL TUBEMAT

    Changing  input to named channel:       CMF after reading
      89  lines from   named channel:     INPUT Total line count=  263

WEIGHT
MATERIAL  9  STAINLESS 304L STEEL    ! Tube wall and cover sheet
                   ++++MATERIAL <   9>: USES MIXTURE <STAINLESS 304L STEEL>

VOLUME
                   ++++MATERIAL <   9>: DEFAULT PROPORTION=1.0
MATERIAL 10                          ! BORAL core
AL27  DENSITY 2.6226 PROP 0.5738
B10   DENSITY 2.6226 PROP 0.0450
B11   DENSITY 2.6226 PROP 0.2735
C     DENSITY 2.6226 PROP 0.0926
VOID PROP 0.0150

WEIGHT
MATERIAL 11 ALUMINIUM                ! BORAL alumnimum clad

< UP
    Returning input to named channel:     INPUT after reading
      24  lines from   named channel:       CMF Total line count=  279
< CMF LABEL BASKETMAT

    Changing  input to named channel:       CMF after reading
      90  lines from   named channel:     INPUT Total line count=  280
WEIGHT
                   ++++MATERIAL <  11>: USES MIXTURE <ALUMINIUM>
                   ++++MATERIAL <  11>: DEFAULT PROPORTION=1.0
MATERIAL 12 STAINLESS 304L STEEL    ! Structural Disk Material
                   ++++MATERIAL <  12>: USES MIXTURE <STAINLESS 304L STEEL>

WEIGHT
                   ++++MATERIAL <  12>: DEFAULT PROPORTION=1.0
MATERIAL 13 STAINLESS 304L STEEL    ! Weldment Material
                   ++++MATERIAL <  13>: USES MIXTURE <STAINLESS 304L STEEL>

WEIGHT
                   ++++MATERIAL <  13>: DEFAULT PROPORTION=1.0
MATERIAL 14 ALUMINIUM               ! Heat Transfer Disk Material

< UP
    Returning input to named channel:     INPUT after reading
      41  lines from   named channel:       CMF Total line count=  291
< CMF LABEL CANMAT

    Changing  input to named channel:       CMF after reading
      91  lines from   named channel:     INPUT Total line count=  292

WEIGHT
                   ++++MATERIAL <  14>: USES MIXTURE <ALUMINIUM>
                   ++++MATERIAL <  14>: DEFAULT PROPORTION=1.0
MATERIAL 15 STAINLESS 304L STEEL    ! Canister Material
                   ++++MATERIAL <  15>: USES MIXTURE <STAINLESS 304L STEEL>

< UP
    Returning input to named channel:     INPUT after reading
      52  lines from   named channel:       CMF Total line count=  297
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
WEIGHT
                 ++++MATERIAL <  15>: DEFAULT PROPORTION=1.0
MATERIAL [@tscMAT + 1]  STAINLESS 304L STEEL            !Steel components of Transfer Cask
*********************************
    The input characters        : [@tscMAT + 1]
    have been replaced by       : +16.00000
                 ++++MATERIAL <  16>: USES MIXTURE <STAINLESS 304L STEEL>

WEIGHT
                 ++++MATERIAL <  16>: DEFAULT PROPORTION=1.0
MATERIAL [@tscMAT + 2]  DENSITY 11.04                   !LEAD
    The input characters        : [@tscMAT + 2]
    have been replaced by       : +17.00000
PB     PROP 1.0000
ATOMS
MATERIAL [@tscMAT + 3]  DENSITY 0.0                               !NS-4-FR
    The input characters        : [@tscMAT + 3]
    have been replaced by       : +18.00000
B10    PROP 8.553E-5
B11    PROP 3.422E-4
AL27   PROP 7.796E-3
H1     PROP 5.854E-2
O16    PROP 2.609E-2
C      PROP 2.264E-2
N      PROP 1.394E-3

ATOMS
MATERIAL [@tscMAT + 4]  DENSITY 0.9982                  ! Material (water) outside of Basket
    The input characters        : [@tscMAT + 4]
    have been replaced by       : +19.00000
H1     PROP 2
O16    PROP 1

ATOMS
MATERIAL [@tscMAT + 5]  DENSITY 0.9982                  ! Additional water for future use
    The input characters        : [@tscMAT + 5]
    have been replaced by       : +20.00000
H1     PROP 2
O16    PROP 1
END
=====================================================================================================
```

MATERIAL #		LIBRARY SUBSTANCE	DFN	MOULD	ALIAS	ATOM/B-CM	NADLIB /MEDLIB	DENSITY	MASS FRACTION	Z.A
MATERIAL	1	U235	9228	62	J2U235	1.08389E-03	U235	1.04120E+01	4.06304E-02	92.235
	1	U238	9237	63	J2U238	2.21469E-02	U238	1.04120E+01	8.40808E-01	92.238
	1	O16	825	33	J2O16	4.64778E-02	O	1.04120E+01	1.18561E-01	8.016
MATERIAL	2	ZR	4000	47	J2ZR	4.29096E-02	ZR	6.50000E+00	1.00000E+00	40.000
MATERIAL	3	H1	10293	64	J2HINH2O	6.67530E-02	H	9.98200E-01	1.11915E-01	1.001
	3	O16	825	33	J2O16	3.33765E-02	O	9.98200E-01	8.88085E-01	8.016
MATERIAL	4	H1	10293	64	J2HINH2O	6.67530E-02	H	9.98200E-01	1.11915E-01	1.001
	4	O16	825	33	J2O16	3.33765E-02	O	9.98200E-01	8.88085E-01	8.016
MATERIAL	5	ZR	4000	47	J2ZR	4.29096E-02	ZR	6.50000E+00	1.00000E+00	40.000
MATERIAL	6	ZR	4000	47	J2ZR	4.29096E-02	ZR	6.50000E+00	1.00000E+00	40.000
MATERIAL	7	FE54	2625	15	J2FE54	1.13160E-03	FE	3.09913E+00	3.27048E-02	26.054
	7	FE56	2631	66	J2FE56	1.75916E-02	FE	3.09913E+00	5.27228E-01	26.056
	7	FE57	2634	16	J2FE57	4.02773E-04	FE	3.09913E+00	1.22872E-02	26.057
	7	FE58	2637	17	J2FE58	5.37031E-05	FE	3.09913E+00	1.66701E-03	26.058
	7	CR50	2425	11	J2CR50	2.17721E-04	CR	3.09913E+00	5.82656E-03	24.050
	7	CR52	2431	53	J2CR52	4.19859E-03	CR	3.09913E+00	1.16848E-01	24.052
	7	CR53	2434	12	J2CR53	4.76031E-04	CR	3.09913E+00	1.35031E-02	24.053
	7	CR54	2437	13	J2CR54	1.18507E-04	CR	3.09913E+00	3.42495E-03	24.054
	7	NI58	2825	56	J2NI58	1.34311E-03	NI	3.09913E+00	4.16931E-02	28.058
	7	NI60	2831	57	J2NI60	5.17360E-04	NI	3.09913E+00	1.66132E-02	28.060
	7	NI61	2834	58	J2NI61	2.24913E-05	NI	3.09913E+00	7.34284E-04	28.061
	7	NI62	2837	59	J2NI62	7.16961E-05	NI	3.09913E+00	2.37900E-03	28.062
	7	NI64	2843	60	J2NI64	1.82693E-05	NI	3.09913E+00	6.25781E-04	28.064
	7	H1	10293	64	J2HINH2O	4.65202E-02	H	3.09913E+00	2.51210E-02	1.001
	7	O16	825	33	J2O16	2.32601E-02	O	3.09913E+00	1.99344E-01	8.016
MATERIAL	8	FE54	2625	15	J2FE54	6.42149E-04	FE	2.19041E+00	2.62583E-02	26.054
	8	FE56	2631	66	J2FE56	9.98270E-03	FE	2.19041E+00	4.23306E-01	26.056
	8	FE57	2634	16	J2FE57	2.28562E-04	FE	2.19041E+00	9.86528E-03	26.057
	8	FE58	2637	17	J2FE58	3.04749E-05	FE	2.19041E+00	1.33842E-03	26.058
	8	CR50	2425	11	J2CR50	1.23550E-04	CR	2.19041E+00	4.67809E-03	24.050
	8	CR52	2431	53	J2CR52	2.38257E-03	CR	2.19041E+00	9.38158E-02	24.052

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

	8	CR53	2434	12	J2CR53	2.70133E-04	CR	2.19041E+00	1.08415E-02	24.053
	8	CR54	2437	13	J2CR54	6.72489E-05	CR	2.19041E+00	2.74986E-03	24.054
	8	NI58	2825	56	J2NI58	7.62173E-04	NI	2.19041E+00	3.34750E-02	28.058
	8	NI60	2831	57	J2NI60	2.93586E-04	NI	2.19041E+00	1.33386E-02	28.060
	8	NI61	2834	58	J2NI61	1.27631E-05	NI	2.19041E+00	5.89549E-04	28.061
	8	NI62	2837	59	J2NI62	4.06853E-05	NI	2.19041E+00	1.91008E-03	28.062
	8	NI64	2843	60	J2NI64	1.03673E-05	NI	2.19041E+00	5.02433E-04	28.064
	8	H1	10293	64	J2HINH2O	5.52715E-02	H	2.19041E+00	4.22289E-02	1.001
	8	O16	825	33	J2O16	2.76358E-02	O	2.19041E+00	3.35102E-01	8.016
MATERIAL	9	FE54	2625	15	J2FE54	3.73343E-03	FE	7.92967E+00	4.21706E-02	26.054
	9	FE56	2631	66	J2FE56	5.80390E-02	FE	7.92967E+00	6.79825E-01	26.056
	9	FE57	2634	16	J2FE57	1.32885E-03	FE	7.92967E+00	1.58435E-02	26.057
	9	FE58	2637	17	J2FE58	1.77180E-04	FE	7.92967E+00	2.14949E-03	26.058
	9	CR50	2425	11	J2CR50	7.18316E-04	CR	7.92967E+00	7.51296E-03	24.050
	9	CR52	2431	53	J2CR52	1.38522E-02	CR	7.92967E+00	1.50667E-01	24.052
	9	CR53	2434	12	J2CR53	1.57054E-03	CR	7.92967E+00	1.74114E-02	24.053
	9	CR54	2437	13	J2CR54	3.90982E-04	CR	7.92967E+00	4.41624E-03	24.054
	9	NI58	2825	56	J2NI58	4.43124E-03	NI	7.92967E+00	5.37605E-02	28.058
	9	NI60	2831	57	J2NI60	1.70690E-03	NI	7.92967E+00	2.14216E-02	28.060
	9	NI61	2834	58	J2NI61	7.42043E-05	NI	7.92967E+00	9.46809E-04	28.061
	9	NI62	2837	59	J2NI62	2.36543E-04	NI	7.92967E+00	3.06756E-03	28.062
	9	NI64	2843	60	J2NI64	6.02748E-05	NI	7.92967E+00	8.06902E-04	28.064
MATERIAL	10	AL27	1325	1	J2AL27	3.35908E-02	AL	2.58326E+00	5.82597E-01	13.027
	10	B10	525	5	J2B10	7.09867E-03	B10	2.58326E+00	4.56899E-02	5.010
	10	B11	528	48	J2B11	3.92395E-02	B11	2.58326E+00	2.77693E-01	5.011
	10	C	600	6	J2C	1.21775E-02	C	2.58326E+00	9.40197E-02	6.000
MATERIAL	11	AL27	1325	1	J2AL27	6.02626E-02	AL	2.70000E+00	1.00000E+00	13.027
MATERIAL	12	FE54	2625	15	J2FE54	3.73343E-03	FE	7.92967E+00	4.21706E-02	26.054
	12	FE56	2631	66	J2FE56	5.80390E-02	FE	7.92967E+00	6.79825E-01	26.056
	12	FE57	2634	16	J2FE57	1.32885E-03	FE	7.92967E+00	1.58435E-02	26.057
	12	FE58	2637	17	J2FE58	1.77180E-04	FE	7.92967E+00	2.14949E-03	26.058
	12	CR50	2425	11	J2CR50	7.18316E-04	CR	7.92967E+00	7.51296E-03	24.050
	12	CR52	2431	53	J2CR52	1.38522E-02	CR	7.92967E+00	1.50667E-01	24.052
	12	CR53	2434	12	J2CR53	1.57054E-03	CR	7.92967E+00	1.74114E-02	24.053
	12	CR54	2437	13	J2CR54	3.90982E-04	CR	7.92967E+00	4.41624E-03	24.054
	12	NI58	2825	56	J2NI58	4.43124E-03	NI	7.92967E+00	5.37605E-02	28.058
	12	NI60	2831	57	J2NI60	1.70690E-03	NI	7.92967E+00	2.14216E-02	28.060
	12	NI61	2834	58	J2NI61	7.42043E-05	NI	7.92967E+00	9.46809E-04	28.061
	12	NI62	2837	59	J2NI62	2.36543E-04	NI	7.92967E+00	3.06756E-03	28.062
	12	NI64	2843	60	J2NI64	6.02748E-05	NI	7.92967E+00	8.06902E-04	28.064
MATERIAL	13	FE54	2625	15	J2FE54	3.73343E-03	FE	7.92967E+00	4.21706E-02	26.054
	13	FE56	2631	66	J2FE56	5.80390E-02	FE	7.92967E+00	6.79825E-01	26.056
	13	FE57	2634	16	J2FE57	1.32885E-03	FE	7.92967E+00	1.58435E-02	26.057
	13	FE58	2637	17	J2FE58	1.77180E-04	FE	7.92967E+00	2.14949E-03	26.058
	13	CR50	2425	11	J2CR50	7.18316E-04	CR	7.92967E+00	7.51296E-03	24.050
	13	CR52	2431	53	J2CR52	1.38522E-02	CR	7.92967E+00	1.50667E-01	24.052
	13	CR53	2434	12	J2CR53	1.57054E-03	CR	7.92967E+00	1.74114E-02	24.053
	13	CR54	2437	13	J2CR54	3.90982E-04	CR	7.92967E+00	4.41624E-03	24.054
	13	NI58	2825	56	J2NI58	4.43124E-03	NI	7.92967E+00	5.37605E-02	28.058
	13	NI60	2831	57	J2NI60	1.70690E-03	NI	7.92967E+00	2.14216E-02	28.060
	13	NI61	2834	58	J2NI61	7.42043E-05	NI	7.92967E+00	9.46809E-04	28.061
	13	NI62	2837	59	J2NI62	2.36543E-04	NI	7.92967E+00	3.06756E-03	28.062
	13	NI64	2843	60	J2NI64	6.02748E-05	NI	7.92967E+00	8.06902E-04	28.064
MATERIAL	14	AL27	1325	1	J2AL27	6.02626E-02	AL	2.70000E+00	1.00000E+00	13.027
MATERIAL	15	FE54	2625	15	J2FE54	3.73343E-03	FE	7.92967E+00	4.21706E-02	26.054
	15	FE56	2631	66	J2FE56	5.80390E-02	FE	7.92967E+00	6.79825E-01	26.056
	15	FE57	2634	16	J2FE57	1.32885E-03	FE	7.92967E+00	1.58435E-02	26.057
	15	FE58	2637	17	J2FE58	1.77180E-04	FE	7.92967E+00	2.14949E-03	26.058
	15	CR50	2425	11	J2CR50	7.18316E-04	CR	7.92967E+00	7.51296E-03	24.050
	15	CR52	2431	53	J2CR52	1.38522E-02	CR	7.92967E+00	1.50667E-01	24.052
	15	CR53	2434	12	J2CR53	1.57054E-03	CR	7.92967E+00	1.74114E-02	24.053
	15	CR54	2437	13	J2CR54	3.90982E-04	CR	7.92967E+00	4.41624E-03	24.054
	15	NI58	2825	56	J2NI58	4.43124E-03	NI	7.92967E+00	5.37605E-02	28.058
	15	NI60	2831	57	J2NI60	1.70690E-03	NI	7.92967E+00	2.14216E-02	28.060
	15	NI61	2834	58	J2NI61	7.42043E-05	NI	7.92967E+00	9.46809E-04	28.061
	15	NI62	2837	59	J2NI62	2.36543E-04	NI	7.92967E+00	3.06756E-03	28.062
	15	NI64	2843	60	J2NI64	6.02748E-05	NI	7.92967E+00	8.06902E-04	28.064
MATERIAL	16	FE54	2625	15	J2FE54	3.73343E-03	FE	7.92967E+00	4.21706E-02	26.054
	16	FE56	2631	66	J2FE56	5.80390E-02	FE	7.92967E+00	6.79825E-01	26.056
	16	FE57	2634	16	J2FE57	1.32885E-03	FE	7.92967E+00	1.58435E-02	26.057
	16	FE58	2637	17	J2FE58	1.77180E-04	FE	7.92967E+00	2.14949E-03	26.058
	16	CR50	2425	11	J2CR50	7.18316E-04	CR	7.92967E+00	7.51296E-03	24.050
	16	CR52	2431	53	J2CR52	1.38522E-02	CR	7.92967E+00	1.50667E-01	24.052
	16	CR53	2434	12	J2CR53	1.57054E-03	CR	7.92967E+00	1.74114E-02	24.053

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
         16  CR54     2437   13   J2CR54      3.90982E-04      CR 7.92967E+00 4.41624E-03 24.054
         16  NI58     2825   56   J2NI58      4.43124E-03      NI 7.92967E+00 5.37605E-02 28.058
         16  NI60     2831   57   J2NI60      1.70690E-03      NI 7.92967E+00 2.14216E-02 28.060
         16  NI61     2834   58   J2NI61      7.42043E-05      NI 7.92967E+00 9.46809E-04 28.061
         16  NI62     2837   59   J2NI62      2.36543E-04      NI 7.92967E+00 3.06756E-03 28.062
         16  NI64     2843   60   J2NI64      6.02748E-05      NI 7.92967E+00 8.06902E-04 28.064
MATERIAL 17  PB       8200   34   J2PB        3.20871E-02      PB 1.10400E+01 1.00000E+00 82.000
MATERIAL 18  B10       525    5   J2B10       8.55300E-05     B10 1.63187E+00 8.71455E-04  5.010
         18  B11       528   48   J2B11       3.42200E-04     B11 1.63187E+00 3.83359E-03  5.011
         18  AL27     1325    1   J2AL27      7.79600E-03      AL 1.63187E+00 2.14044E-01 13.027
         18  H1      10293   64   J2HINH2O    5.85400E-02       H 1.63187E+00 6.00348E-02  1.001
         18  O16       825   33   J2O16       2.60900E-02       O 1.63187E+00 4.24640E-01  8.016
         18  C         600    6   J2C         2.26400E-02       C 1.63187E+00 2.76707E-01  6.000
         18  N14       725   31   J2N14       1.38884E-03       N 1.63187E+00 1.97898E-02  7.014
         18  N15       728   32   J2N15       5.15780E-06       N 1.63187E+00 7.87271E-05  7.015
MATERIAL 19  H1      10293   64   J2HINH2O    6.67530E-02       H 9.98200E-01 1.11915E-01  1.001
         19  O16       825   33   J2O16       3.33765E-02       O 9.98200E-01 8.88085E-01  8.016
MATERIAL 20  H1      10293   64   J2HINH2O    6.67530E-02       H 9.98200E-01 1.11915E-01  1.001
         20  O16       825   33   J2O16       3.33765E-02       O 9.98200E-01 8.88085E-01  8.016
=========================================================================================================

 BEGIN MATERIAL GEOMETRY
 *************************************************
1
 *********************************************************
 *    ENTERING UNIT  2 TO READ MATERIAL GEOMETRY DATA.   *
 *********************************************************

     Changing  input to named channel:      CGF after reading
      129  lines from   named channel:     INPUT Total line count=  335

 qg  NOTES ON PRINTING OF INPUT GEOMETRY DATA
     ======================================
     Body and zone numbers in each part are local to that part.
     Abbreviations for body parameters:
     SPHERE     R = Radius
     BOX       XL = Length on X axis; YL = Length on Y axis ;  ZL = Length on Z axis
     (X)ROD     R = Radius          ;  H = Height of(X)axis.
     (X)CONE   RB = Radius of base  ; RT = Radius of top    ;    H = Height of(X)axis.
     TORUS     RB = Bigger radius   ; RS = Smaller radius.
     (X)REL     R = Radius          ; HH = Half hgt.(X)axis.
     (XY)PRISM  B = Length of(X)base;  H = Height of(Y)axis ;  L = Prism length (Z);
                Base angles         :  P = Origin end       ;  Q = Other end of base.
     (X)SEC    R1 = Inner radius    ; R2 = Outer radius     ;  H = Height of(X)axis;
                Angles from (Y) axis: T1 = lower theta      ; T2 = Upper theta.
     (X)HEMI   R = Radius
     (X)HEX    D = Half-width across the hexagonal X-section; Height of (X) axis
     RPP       XU = Upper X limit   ; YU = Upper Y limit    ; ZU = Upper Z limit
     All      [R] = Matrix of direction cosines for rotated bodies:
               Vx = new X axis      ; Vy = New Y axis       ; Vz = New Z axis
     ================================================================================


     PART   1 (NEST   ) Bodies in earlier parts=   0
     -----------------------------------------------
     Body definitions. Numbers are local to this part.

     shape  number     X0         Y0         Z0    Shape dependent parameters (see notes)
     BOX       1     0.0000     0.0000     0.0000 XL    21.6408 YL    21.6408 ZL   348.1324

     Zone  Name        Contents           Region     Volume   Description (local bodies)
       1               Body Hole     1     1     1.630E+05   +1
       2   Exterior  (Extra zone created by code)            -1


     PART   2 Was created by copying PART    1
     ----------------------------------------
     Bodies     2 to    2 copied from bodies    1 to    1
     Zones      3 to    4 copied from zones     1 to    2
     Regions    2 to    2 replace regions       1 to    1


     PART   3 (NEST   ) Bodies in earlier parts=   2
     -----------------------------------------------
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
Body definitions. Numbers are local to this part.

shape  number    X0          Y0          Z0    Shape dependent parameters (see notes)
BOX      1     0.0457      0.0000      0.3556 XL      0.1905 YL     20.2540 ZL    326.1360
The input characters          : [@blt+@cvst]
have been replaced by         : +.2362000
BOX      2     0.0457      0.0000      0.0000 XL      0.1905 YL     20.2540 ZL    328.4220
BOX      3     0.0000      0.0000      0.0000 XL      0.2362 YL     20.2540 ZL    328.4220

Zone  Name        Contents          Region     Volume    Description (local bodies)
  5               Body Hole     6      3     1.258E+03   +1
  6               Material      3      4     8.820E+00   +2   -1
  7               Material      9      5     3.040E+02   +3   -2
  8   Exterior   (Extra zone created by code)            -3


PART   4 (NEST    ) Bodies in earlier parts=   5
-----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0          Y0          Z0    Shape dependent parameters (see notes)
The input characters          : [@wbrl+@overs]
have been replaced by         : +21.27000
The input characters          : [@wbrl+@overs]
have been replaced by         : +21.27000
BOX      1     0.0457      0.0000      0.3556 XL      0.1905 YL     21.2700 ZL    326.1360
The input characters          : [@blt+@cvst]
have been replaced by         : +.2362000
The input characters          : [@wbrl+@overs]
have been replaced by         : +21.27000
BOX      2     0.0457      0.0000      0.0000 XL      0.1905 YL     21.2700 ZL    328.4220
BOX      3     0.0000      0.0000      0.0000 XL      0.2362 YL     21.2700 ZL    328.4220

Zone  Name        Contents          Region     Volume    Description (local bodies)
  9               Body Hole     6      6     1.321E+03   +1
 10               Material      3      7     9.263E+00   +2   -1
 11               Material      9      8     3.192E+02   +3   -2
 12   Exterior   (Extra zone created by code)            -3
The input characters          : [@ftth+@asoffx]
have been replaced by         : +.7061000
The input characters          : [@ftth+@asoffy]
have been replaced by         : +.7061000

PART   5 (FG PART) Bodies in earlier parts=   8
-----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0          Y0          Z0    Shape dependent parameters (see notes)
BOX      1     0.7061      0.7061      0.0000 XL     21.6408 YL     21.6408 ZL    348.1324
The input characters          : [@baskoff+@lbw+@ftoffz]
have been replaced by         : +5.080000
BOX      2     0.1219      0.1219      0.0000 XL     22.2250 YL     22.2250 ZL    360.6800
The input characters          : [@wft+2*@ftth]
have been replaced by         : +22.46880
The input characters          : [@wft+2*@ftth]
have been replaced by         : +22.46880
BOX      3     0.0000      0.0000      5.0800 XL     22.4688 YL     22.4688 ZL    335.7880
The input characters          : [@wft+2*@ftth]
have been replaced by         : +22.46880
The input characters          : [@wft+2*@ftth]
have been replaced by         : +22.46880
BOX      4     0.0000      0.0000      0.0000 XL     22.4688 YL     22.4688 ZL    360.6800

Zone  Name        Contents          Region  Code Vol.    Description (local bodies)
 13  FUEL ASSEM  Part No.      1      -     1.630E+05   +1
 14  SPACE IN T  Material      3      -     1.512E+04   +2   -1
 15  FUEL TUBE   Material      9      -    -8.637E+03   +3   -2
 16  CONTAINER   Material      3      -    -1.656E+05   +4   -3   -2
 17  Exterior   (Extra zone created by code)            -4

There is a one-to-one correspondence between regions and zones.
The code volumes (calculated from zone descriptions and body volumes) will be used.
Zones  13 to  16 map to regions   9 to   12
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
The input characters        : [@ftth+@asoffx]
have been replaced by       : +.7061000
The input characters        : [@ftth+@asoffyp]
have been replaced by       : +.4140000


PART   6 (FG PART) Bodies in earlier parts=  12
----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0         Y0         Z0    Shape dependent parameters (see notes)
BOX       1     0.7061     0.4140     0.0000 XL    21.6408 YL    21.6408 ZL   348.1324
The input characters        : [@baskoff+@lbw+@ftoffz]
have been replaced by       : +5.080000
BOX       2     0.1219     0.1219     0.0000 XL    22.2250 YL    22.2250 ZL   360.6800
The input characters        : [@wft+2*@ftth]
have been replaced by       : +22.46880
The input characters        : [@wft+2*@ftth]
have been replaced by       : +22.46880
BOX       3     0.0000     0.0000     5.0800 XL    22.4688 YL    22.4688 ZL   335.7880
The input characters        : [@wft+2*@ftth]
have been replaced by       : +22.46880
The input characters        : [@wft+2*@ftth]
have been replaced by       : +22.46880
BOX       4     0.0000     0.0000     0.0000 XL    22.4688 YL    22.4688 ZL   360.6800

Zone  Name       Contents          Region  Code Vol.   Description (local bodies)
 18  FUEL ASSEM  Part No.      1     -     1.630E+05   +1
 19  SPACE IN T  Material      3     -     1.512E+04   +2   -1
 20  FUEL TUBE   Material      9     -    -8.637E+03   +3   -2
 21  CONTAINER   Material      3     -    -1.656E+05   +4   -3   -2
 22  Exterior   (Extra zone created by code)           -4

There is a one-to-one correspondence between regions and zones.
The code volumes (calculated from zone descriptions and body volumes) will be used.
Zones  18 to  21 map to regions  13 to   16
The input characters        : [@ftth+@asoffxo]
have been replaced by       : +1.722100
The input characters        : [@ftth+@asoffyo]
have been replaced by       : +1.722100

PART   7 (FG PART) Bodies in earlier parts=  16
----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0         Y0         Z0    Shape dependent parameters (see notes)
BOX       1     1.7221     1.7221     0.0000 XL    21.6408 YL    21.6408 ZL   348.1324
The input characters        : [@wft+@overs]
have been replaced by       : +23.24100
The input characters        : [@wft+@overs]
have been replaced by       : +23.24100
The input characters        : [@baskoff+@lbw+@ftoffz]
have been replaced by       : +5.080000
BOX       2     0.1219     0.1219     0.0000 XL    23.2410 YL    23.2410 ZL   360.6800
The input characters        : [@wft+2*@ftth+@overs]
have been replaced by       : +23.48480
The input characters        : [@wft+2*@ftth+@overs]
have been replaced by       : +23.48480
BOX       3     0.0000     0.0000     5.0800 XL    23.4848 YL    23.4848 ZL   335.7880
The input characters        : [@wft+2*@ftth+@overs]
have been replaced by       : +23.48480
The input characters        : [@wft+2*@ftth+@overs]
have been replaced by       : +23.48480
BOX       4     0.0000     0.0000     0.0000 XL    23.4848 YL    23.4848 ZL   360.6800

Zone  Name       Contents          Region  Code Vol.   Description (local bodies)
 23  FUEL ASSEM  Part No.      2     -     1.630E+05   +1
 24  SPACE IN T  Material      3     -     3.178E+04   +2   -1
 25  FUEL TUBE   Material      9     -    -9.620E+03   +3   -2
 26  CONTAINER   Material      3     -    -1.811E+05   +4   -3   -2
 27  Exterior   (Extra zone created by code)           -4

There is a one-to-one correspondence between regions and zones.
The code volumes (calculated from zone descriptions and body volumes) will be used.
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
Zones  23 to  26 map to regions  17 to  20

PART   8 (CLUSTER) Bodies in earlier parts=  20
-----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0         Y0         Z0    Shape dependent parameters (see notes)
The input characters          : [@tboffx+@cvst+@blt]
have been replaced by         : +.6248000
The input characters          : [@tboffy+@cvst+@blt]
have been replaced by         : +.6248000
The input characters          : [@wft+2*@ftth]
have been replaced by         : +22.46880
The input characters          : [@wft+2*@ftth]
have been replaced by         : +22.46880
BOX       1     0.6248     0.6248     0.0000 XL    22.4688 YL    22.4688 ZL    360.6800
The input characters          : [@tboffy+(@wfto-@wbrl)/2.0+@bshifty]
have been replaced by         : +1.732250
The input characters          : [@baskoff+@lbw+@ftoffz+@cvoffz]
have been replaced by         : +7.112000
The input characters          : [@blt+@cvst]
have been replaced by         : +.2362000
The input characters          : [@tboffx+@wfto]
have been replaced by         : +23.32990
BOX       2     0.3886     1.7323     7.1120 XL     0.2362 YL    20.2540 ZL    328.4220
The input characters          : [@tboffy+(@wfto+@wbrl)/2.0+@bshifty]
have been replaced by         : +21.98625
The input characters          : [@baskoff+@lbw+@ftoffz+@cvoffz]
have been replaced by         : +7.112000
The input characters          : [@blt+@cvst]
have been replaced by         : +.2362000
BOX       3    23.3299    21.9862     7.1120 XL     0.2362 YL    20.2540 ZL    328.4220
        Vx   -1.00000    0.00000    0.00000
  [R]=  Vy    0.00000   -1.00000    0.00000
        Vz    0.00000    0.00000    1.00000
The input characters          : [@tboffx+(@wfto-@wbrl)/2.0+@bshiftx]
have been replaced by         : +1.732250
The input characters          : [@tboffy+@wfto]
have been replaced by         : +23.32990
The input characters          : [@baskoff+@lbw+@ftoffz+@cvoffz]
have been replaced by         : +7.112000
The input characters          : [@blt+@cvst]
have been replaced by         : +.2362000
BOX       4     1.7323    23.3299     7.1120 XL     0.2362 YL    20.2540 ZL    328.4220
        Vx    0.00000   -1.00000    0.00000
  [R]=  Vy    1.00000    0.00000    0.00000
        Vz    0.00000    0.00000    1.00000
The input characters          : [@tboffx+(@wfto+@wbrl)/2.0+@bshiftx]
have been replaced by         : +21.98625
The input characters          : [@baskoff+@lbw+@ftoffz+@cvoffz]
have been replaced by         : +7.112000
The input characters          : [@blt+@cvst]
have been replaced by         : +.2362000
BOX       5    21.9862     0.3886     7.1120 XL     0.2362 YL    20.2540 ZL    328.4220
        Vx    0.00000    1.00000    0.00000
  [R]=  Vy   -1.00000    0.00000    0.00000
        Vz    0.00000    0.00000    1.00000
BOX       6     0.0000     0.0000     0.0000 XL    23.3299 YL    23.3299 ZL    360.6800

Zone  Name       Contents         Region     Volume    Description (local bodies)
 28              Part No.      5    21     1.821E+05    +1
 29              Part No.      3    22     1.571E+03    +2
 30              Part No.      3    23     1.571E+03    +3
 31              Part No.      3    24     1.571E+03    +4
 32              Part No.      3    25     1.571E+03    +5
 33              Material      3    26     7.940E+03    +6    -1    -2    -3    -4    -5
 34   Exterior  (Extra zone created by code)            -6


PART   9 (CLUSTER) Bodies in earlier parts=  26
-----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0         Y0         Z0    Shape dependent parameters (see notes)
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
The input characters       : [@tboffx+@cvst+@blt]
have been replaced by      : +.6248000
The input characters       : [@tboffyp+@cvst+@blt]
have been replaced by      : +.4305000
The input characters       : [@wft+2*@ftth]
have been replaced by      : +22.46880
The input characters       : [@wft+2*@ftth]
have been replaced by      : +22.46880
BOX       1      0.6248     0.4305     0.0000 XL     22.4688 YL     22.4688 ZL    360.6800
The input characters       : [@tboffyp+(@wfto-@wbrl)/2.0+@bshiftyp]
have been replaced by      : +1.537950
The input characters       : [@baskoff+@lbw+@ftoffz+@cvoffz]
have been replaced by      : +7.112000
The input characters       : [@blt+@cvst]
have been replaced by      : +.2362000
The input characters       : [@tboffx+@wfto]
have been replaced by      : +23.32990
BOX       2      0.3886     1.5379     7.1120 XL      0.2362 YL     20.2540 ZL    328.4220
The input characters       : [@tboffyp+(@wfto+@wbrl)/2.0+@bshiftyp]
have been replaced by      : +21.79195
The input characters       : [@baskoff+@lbw+@ftoffz+@cvoffz]
have been replaced by      : +7.112000
The input characters       : [@blt+@cvst]
have been replaced by      : +.2362000
BOX       3     23.3299    21.7919     7.1120 XL      0.2362 YL     20.2540 ZL    328.4220
          Vx   -1.00000    0.00000    0.00000
  [R]=    Vy    0.00000   -1.00000    0.00000
          Vz    0.00000    0.00000    1.00000
The input characters       : [@tboffx+(@wfto-@wbrl)/2.0+@bshiftx]
have been replaced by      : +1.732250
The input characters       : [@tboffyp+@wfto]
have been replaced by      : +23.13560
The input characters       : [@baskoff+@lbw+@ftoffz+@cvoffz]
have been replaced by      : +7.112000
The input characters       : [@blt+@cvst]
have been replaced by      : +.2362000
BOX       4      1.7323    23.1356     7.1120 XL      0.2362 YL     20.2540 ZL    328.4220
          Vx    0.00000   -1.00000    0.00000
  [R]=    Vy    1.00000    0.00000    0.00000
          Vz    0.00000    0.00000    1.00000
The input characters       : [@tboffx+(@wfto+@wbrl)/2.0+@bshiftx]
have been replaced by      : +21.98625
The input characters       : [@baskoff+@lbw+@ftoffz+@cvoffz]
have been replaced by      : +7.112000
The input characters       : [@blt+@cvst]
have been replaced by      : +.2362000
BOX       5     21.9862     0.1943     7.1120 XL      0.2362 YL     20.2540 ZL    328.4220
          Vx    0.00000    1.00000    0.00000
  [R]=    Vy   -1.00000    0.00000    0.00000
          Vz    0.00000    0.00000    1.00000
BOX       6      0.0000     0.0000     0.0000 XL     23.3299 YL     23.3299 ZL    360.6800

Zone  Name       Contents         Region    Volume   Description (local bodies)
 35              Part No.      6    27     1.821E+05   +1
 36              Part No.      3    28     1.571E+03   +2
 37              Part No.      3    29     1.571E+03   +3
 38              Part No.      3    30     1.571E+03   +4
 39              Part No.      3    31     1.571E+03   +5
 40              Material      3    32     7.940E+03   +6   -1   -2   -3   -4   -5
 41   Exterior  (Extra zone created by code)           -6

PART  10 (CLUSTER) Bodies in earlier parts=  32
-----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0          Y0          Z0    Shape dependent parameters (see notes)
The input characters       : [@tboffx+@cvst+@blt]
have been replaced by      : +.6248000
The input characters       : [@tboffy+@cvst+@blt]
have been replaced by      : +.6248000
The input characters       : [@wft+2*@ftth+@overs]
have been replaced by      : +23.48480
The input characters       : [@wft+2*@ftth+@overs]
have been replaced by      : +23.48480
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
BOX        1     0.6248     0.6248     0.0000 XL     23.4848 YL     23.4848 ZL    360.6800
The input characters        : [@tboffy+(@wfto-@wbrl)/2.0+@bshifty]
have been replaced by       : +1.732250
The input characters        : [@baskoff+@lbw+@ftoffz+@cvoffz]
have been replaced by       : +7.112000
The input characters        : [@blt+@cvst]
have been replaced by       : +.2362000
The input characters        : [@wbrl+@overs]
have been replaced by       : +21.27000
The input characters        : [@tboffx+@wfto+@overs]
have been replaced by       : +24.34590
BOX        2     0.3886     1.7323     7.1120 XL      0.2362 YL     21.2700 ZL    328.4220
The input characters        : [@tboffy+(@wfto+@wbrl)/2.0+@overs+@bshifty]
have been replaced by       : +23.00225
The input characters        : [@baskoff+@lbw+@ftoffz+@cvoffz]
have been replaced by       : +7.112000
The input characters        : [@blt+@cvst]
have been replaced by       : +.2362000
The input characters        : [@wbrl+@overs]
have been replaced by       : +21.27000
BOX        3    24.3459    23.0023     7.1120 XL      0.2362 YL     21.2700 ZL    328.4220
             Vx   -1.00000    0.00000    0.00000
   [R]=      Vy    0.00000   -1.00000    0.00000
             Vz    0.00000    0.00000    1.00000
The input characters        : [@tboffx+(@wfto-@wbrl)/2.0+@bshiftx]
have been replaced by       : +1.732250
The input characters        : [@tboffy+@wfto+@overs]
have been replaced by       : +24.34590
The input characters        : [@baskoff+@lbw+@ftoffz+@cvoffz]
have been replaced by       : +7.112000
The input characters        : [@blt+@cvst]
have been replaced by       : +.2362000
The input characters        : [@wbrl+@overs]
have been replaced by       : +21.27000
BOX        4     1.7323    24.3459     7.1120 XL      0.2362 YL     21.2700 ZL    328.4220
             Vx    0.00000   -1.00000    0.00000
   [R]=      Vy    1.00000    0.00000    0.00000
             Vz    0.00000    0.00000    1.00000
The input characters        : [@tboffx+(@wfto+@wbrl)/2.0+@overs+@bshiftx]
have been replaced by       : +23.00225
The input characters        : [@baskoff+@lbw+@ftoffz+@cvoffz]
have been replaced by       : +7.112000
The input characters        : [@blt+@cvst]
have been replaced by       : +.2362000
The input characters        : [@wbrl+@overs]
have been replaced by       : +21.27000
BOX        5    23.0023     0.3886     7.1120 XL      0.2362 YL     21.2700 ZL    328.4220
             Vx    0.00000    1.00000    0.00000
   [R]=      Vy   -1.00000    0.00000    0.00000
             Vz    0.00000    0.00000    1.00000
The input characters        : [@opspd+@overs]
have been replaced by       : +24.34590
The input characters        : [@opspd+@overs]
have been replaced by       : +24.34590
BOX        6     0.0000     0.0000     0.0000 XL     24.3459 YL     24.3459 ZL    360.6800

Zone  Name         Contents          Region      Volume   Description (local bodies)
 42                Part No.      7     33     1.989E+05    +1
 43                Part No.      4     34     1.650E+03    +2
 44                Part No.      4     35     1.650E+03    +3
 45                Part No.      4     36     1.650E+03    +4
 46                Part No.      4     37     1.650E+03    +5
 47                Material      3     38     8.255E+03    +6    -1    -2    -3    -4    -5
 48   Exterior   (Extra zone created by code)              -6

PART  11 (CLUSTER) Bodies in earlier parts=  38
-----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number     X0          Y0          Z0     Shape dependent parameters (see notes)
The input characters        : [-1.0*(@wsspxo+(@opspd+@overs)/2.0)]
have been replaced by       : -52.30005
The input characters        : [@tsspyo-(@opspd+@overs)/2.0]
have been replaced by       : +41.88605
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [@opspd+@overs]
have been replaced by     : +24.34590
The input characters      : [@opspd+@overs]
have been replaced by     : +24.34590
The input characters      : [-1.0*(@wsspx1+@opspd/2.0)]
have been replaced by     : -25.19825
The input characters      : [@tsspy2-@opspd/2.0]
have been replaced by     : +47.60105
BOX       1   -52.3000    41.8860   -15.4686 XL    24.3459 YL    24.3459 ZL    360.6800
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [@wsspx1-@opspd/2.0]
have been replaced by     : +1.868350
The input characters      : [@tsspy2-@opspd/2.0]
have been replaced by     : +47.60105
BOX       2   -25.1983    47.6011   -15.4686 XL    23.3299 YL    23.3299 ZL    360.6800
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [@wsspxo-(@opspd+@overs)/2.0]
have been replaced by     : +27.95415
BOX       3     1.8683    47.6011   -15.4686 XL    23.3299 YL    23.3299 ZL    360.6800
The input characters      : [@tsspyo-(@opspd+@overs)/2.0]
have been replaced by     : +41.88605
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [@opspd+@overs]
have been replaced by     : +24.34590
The input characters      : [@opspd+@overs]
have been replaced by     : +24.34590
The input characters      : [-1.0*(@wsspx3+@opspd/2.0)]
have been replaced by     : -77.11584
The input characters      : [@tsspy1-@opspd/2.0]
have been replaced by     : +15.41925
BOX       4    27.9541    41.8860   -15.4686 XL    24.3459 YL    24.3459 ZL    360.6800
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [-1.0*(@wsspx2+@opspd/2.0)]
have been replaced by     : -51.28405
The input characters      : [@tsspy1-@opspd/2.0]
have been replaced by     : +15.41925
BOX       5   -77.1158    15.4192   -15.4686 XL    23.3299 YL    23.3299 ZL    360.6800
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [-1.0*(@wsspx1+@opspd/2.0)]
have been replaced by     : -25.19825
The input characters      : [@tsspy1-@opspd/2.0]
have been replaced by     : +15.41925
BOX       6   -51.2841    15.4192   -15.4686 XL    23.3299 YL    23.3299 ZL    360.6800
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [@wsspx1-@opspd/2.0]
have been replaced by     : +1.868350
The input characters      : [@tsspy1-@opspd/2.0]
have been replaced by     : +15.41925
BOX       7   -25.1983    15.4192   -15.4686 XL    23.3299 YL    23.3299 ZL    360.6800
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [@wsspx2-@opspd/2.0]
have been replaced by     : +27.95415
The input characters      : [@tsspy1-@opspd/2.0]
have been replaced by     : +15.41925
BOX       8     1.8683    15.4192   -15.4686 XL    23.3299 YL    23.3299 ZL    360.6800
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [@wsspx3-@opspd/2.0]
have been replaced by     : +53.78595
The input characters      : [@tsspy1-@opspd/2.0]
have been replaced by     : +15.41925
BOX       9    27.9541    15.4192   -15.4686 XL    23.3299 YL    23.3299 ZL    360.6800
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [-1.0*(@wsspx3+@opspd/2.0)]
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
have been replaced by          : -77.11584
The input characters           : [-1.0*@opspd/2.0]
have been replaced by          : -11.66495
BOX       10    53.7859    15.4192    -15.4686 XL     23.3299 YL     23.3299 ZL    360.6800
The input characters           : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by          : -15.46860
The input characters           : [-1.0*(@wsspx2+@opspd/2.0)]
have been replaced by          : -51.28405
The input characters           : [-1.0*@opspd/2.0]
have been replaced by          : -11.66495
BOX       11   -77.1158   -11.6649    -15.4686 XL     23.3299 YL     23.3299 ZL    360.6800
The input characters           : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by          : -15.46860
The input characters           : [-1.0*(@wsspx1+@opspd/2.0)]
have been replaced by          : -25.19825
The input characters           : [-1.0*@opspd/2.0]
have been replaced by          : -11.66495
BOX       12   -51.2841   -11.6649    -15.4686 XL     23.3299 YL     23.3299 ZL    360.6800
The input characters           : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by          : -15.46860
The input characters           : [@wsspx1-@opspd/2.0]
have been replaced by          : +1.868350
The input characters           : [-1.0*@opspd/2.0]
have been replaced by          : -11.66495
BOX       13   -25.1983   -11.6649    -15.4686 XL     23.3299 YL     23.3299 ZL    360.6800
The input characters           : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by          : -15.46860
The input characters           : [@wsspx2-@opspd/2.0]
have been replaced by          : +27.95415
The input characters           : [-1.0*@opspd/2.0]
have been replaced by          : -11.66495
BOX       14     1.8683   -11.6649    -15.4686 XL     23.3299 YL     23.3299 ZL    360.6800
The input characters           : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by          : -15.46860
The input characters           : [@wsspx3-@opspd/2.0]
have been replaced by          : +53.78595
The input characters           : [-1.0*@opspd/2.0]
have been replaced by          : -11.66495
BOX       15    27.9541   -11.6649    -15.4686 XL     23.3299 YL     23.3299 ZL    360.6800
The input characters           : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by          : -15.46860
The input characters           : [-1.0*(@wsspx3+@opspd/2.0)]
have been replaced by          : -77.11584
The input characters           : [-1.0*(@tsspy1+@opspd/2.0)]
have been replaced by          : -38.74915
BOX       16    53.7859   -11.6649    -15.4686 XL     23.3299 YL     23.3299 ZL    360.6800
The input characters           : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by          : -15.46860
The input characters           : [-1.0*(@wsspx2+@opspd/2.0)]
have been replaced by          : -51.28405
The input characters           : [-1.0*(@tsspy1+@opspd/2.0)]
have been replaced by          : -38.74915
BOX       17   -77.1158   -38.7492    -15.4686 XL     23.3299 YL     23.3299 ZL    360.6800
The input characters           : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by          : -15.46860
The input characters           : [-1.0*(@wsspx1+@opspd/2.0)]
have been replaced by          : -25.19825
The input characters           : [-1.0*(@tsspy1+@opspd/2.0)]
have been replaced by          : -38.74915
BOX       18   -51.2841   -38.7492    -15.4686 XL     23.3299 YL     23.3299 ZL    360.6800
The input characters           : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by          : -15.46860
The input characters           : [@wsspx1-@opspd/2.0]
have been replaced by          : +1.868350
The input characters           : [-1.0*(@tsspy1+@opspd/2.0)]
have been replaced by          : -38.74915
BOX       19   -25.1983   -38.7492    -15.4686 XL     23.3299 YL     23.3299 ZL    360.6800
The input characters           : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by          : -15.46860
The input characters           : [@wsspx2-@opspd/2.0]
have been replaced by          : +27.95415
The input characters           : [-1.0*(@tsspy1+@opspd/2.0)]
have been replaced by          : -38.74915
BOX       20     1.8683   -38.7492    -15.4686 XL     23.3299 YL     23.3299 ZL    360.6800
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [@wsspx3-@opspd/2.0]
have been replaced by     : +53.78595
The input characters      : [-1.0*(@tsspy1+@opspd/2.0)]
have been replaced by     : -38.74915
BOX      21    27.9541   -38.7492   -15.4686 XL    23.3299 YL    23.3299 ZL   360.6800
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [-1.0*(@wsspxo+(@opspd+@overs)/2.0)]
have been replaced by     : -52.30005
BOX      22    53.7859   -38.7492   -15.4686 XL    23.3299 YL    23.3299 ZL   360.6800
The input characters      : [-1.0*(@tsspyo+(@opspd+@overs)/2.0)]
have been replaced by     : -66.23195
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [@opspd+@overs]
have been replaced by     : +24.34590
The input characters      : [@opspd+@overs]
have been replaced by     : +24.34590
The input characters      : [-1.0*(@wsspx1+@opspd/2.0)]
have been replaced by     : -25.19825
The input characters      : [-1.0*(@tsspy2+@opspd/2.0)]
have been replaced by     : -70.93095
BOX      23   -52.3000   -66.2319   -15.4686 XL    24.3459 YL    24.3459 ZL   360.6800
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [@wsspx1-@opspd/2.0]
have been replaced by     : +1.868350
The input characters      : [-1.0*(@tsspy2+@opspd/2.0)]
have been replaced by     : -70.93095
BOX      24   -25.1983   -70.9309   -15.4686 XL    23.3299 YL    23.3299 ZL   360.6800
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [@wsspxo-(@opspd+@overs)/2.0]
have been replaced by     : +27.95415
BOX      25     1.8683   -70.9309   -15.4686 XL    23.3299 YL    23.3299 ZL   360.6800
The input characters      : [-1.0*(@tsspyo+(@opspd+@overs)/2.0)]
have been replaced by     : -66.23195
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
The input characters      : [@opspd+@overs]
have been replaced by     : +24.34590
The input characters      : [@opspd+@overs]
have been replaced by     : +24.34590
The input characters      : [-1.0*(@baskoff+@lbw+@lbws)]
have been replaced by     : -15.46860
BOX      26    27.9541   -66.2319   -15.4686 XL    24.3459 YL    24.3459 ZL   360.6800
The input characters      : [@diaht/2.0]
have been replaced by     : +87.46490
ZROD     27     0.0000     0.0000   -15.4686  R    87.4649  H   360.6800
```

Zone	Name	Contents		Region	Volume	Description (local bodies)
49		Part No.	16	39	2.138E+05	+1
50		Part No.	12	40	1.963E+05	+2
51		Part No.	13	41	1.963E+05	+3
52		Part No.	17	42	2.138E+05	+4
53		Part No.	12	43	1.963E+05	+5
54		Part No.	12	44	1.963E+05	+6
55		Part No.	12	45	1.963E+05	+7
56		Part No.	13	46	1.963E+05	+8
57		Part No.	13	47	1.963E+05	+9
58		Part No.	13	48	1.963E+05	+10
59		Part No.	9	49	1.963E+05	+11
60		Material	3	50	1.963E+05	+12
61		Part No.	9	51	1.963E+05	+13
62		Part No.	15	52	1.963E+05	+14
63		Material	3	53	1.963E+05	+15
64		Part No.	15	54	1.963E+05	+16
65		Part No.	8	55	1.963E+05	+17
66		Part No.	8	56	1.963E+05	+18
67		Part No.	8	57	1.963E+05	+19
68		Part No.	14	58	1.963E+05	+20
69		Part No.	14	59	1.963E+05	+21

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
 70             Part No.    14   60    1.963E+05  +22
 71             Part No.    10   61    2.138E+05  +23
 72             Part No.     8   62    1.963E+05  +24
 73             Part No.    14   63    1.963E+05  +25
 74             Part No.    18   64    2.138E+05  +26
 75             Hole Mat.    7   65    3.494E+06  +27   -1   -2   -3   -4   -5   -6
                                                   -7   -8   -9  -10  -11  -12  -13
                                                  -14  -15  -16  -17  -18  -19  -20
                                                  -21  -22  -23  -24  -25  -26
 76  Exterior  (Extra zone created by code)       -27

PART  12 (NEST   ) Bodies in earlier parts=  65
----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0        Y0        Z0    Shape dependent parameters (see notes)
BOX      1     0.0000   23.3299    0.0000 XL    23.3299 YL    23.3299 ZL   360.6800
        Vx    0.00000  -1.00000   0.00000
  [R]=  Vy    1.00000   0.00000   0.00000
        Vz    0.00000   0.00000   1.00000
BOX      2     0.0000    0.0000    0.0000 XL    23.3299 YL    23.3299 ZL   360.6800

Zone  Name      Contents         Region    Volume   Description (local bodies)
 77             Part No.     8   66    1.963E+05   +1
 78             Material     3   67    0.000E+00   +2   -1
 79  Exterior  (Extra zone created by code)        -2

PART  13 (NEST   ) Bodies in earlier parts=  67
----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0        Y0        Z0    Shape dependent parameters (see notes)
BOX      1    23.3299   23.3299    0.0000 XL    23.3299 YL    23.3299 ZL   360.6800
        Vx   -1.00000   0.00000   0.00000
  [R]=  Vy    0.00000  -1.00000   0.00000
        Vz    0.00000   0.00000   1.00000
BOX      2     0.0000    0.0000    0.0000 XL    23.3299 YL    23.3299 ZL   360.6800

Zone  Name      Contents         Region    Volume   Description (local bodies)
 80             Part No.     8   68    1.963E+05   +1
 81             Material     3   69    0.000E+00   +2   -1
 82  Exterior  (Extra zone created by code)        -2

PART  14 (NEST   ) Bodies in earlier parts=  69
----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0        Y0        Z0    Shape dependent parameters (see notes)
BOX      1    23.3299    0.0000    0.0000 XL    23.3299 YL    23.3299 ZL   360.6800
        Vx    0.00000   1.00000   0.00000
  [R]=  Vy   -1.00000   0.00000   0.00000
        Vz    0.00000   0.00000   1.00000
BOX      2     0.0000    0.0000    0.0000 XL    23.3299 YL    23.3299 ZL   360.6800

Zone  Name      Contents         Region    Volume   Description (local bodies)
 83             Part No.     8   70    1.963E+05   +1
 84             Material     3   71    0.000E+00   +2   -1
 85  Exterior  (Extra zone created by code)        -2

PART  15 (NEST   ) Bodies in earlier parts=  71
----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0        Y0        Z0    Shape dependent parameters (see notes)
BOX      1    23.3299   23.3299    0.0000 XL    23.3299 YL    23.3299 ZL   360.6800
        Vx   -1.00000   0.00000   0.00000
  [R]=  Vy    0.00000  -1.00000   0.00000
        Vz    0.00000   0.00000   1.00000
BOX      2     0.0000    0.0000    0.0000 XL    23.3299 YL    23.3299 ZL   360.6800

Zone  Name      Contents         Region    Volume   Description (local bodies)
 86             Part No.     9   72    1.963E+05   +1
 87             Material     3   73    0.000E+00   +2   -1
 88  Exterior  (Extra zone created by code)        -2
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
PART  16 (NEST   ) Bodies in earlier parts=  73
-----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number   X0         Y0         Z0    Shape dependent parameters (see notes)
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
BOX        1     0.0000    24.3459     0.0000 XL    24.3459 YL    24.3459 ZL   360.6800
          Vx    0.00000   -1.00000    0.00000
  [R]=    Vy    1.00000    0.00000    0.00000
          Vz    0.00000    0.00000    1.00000
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
BOX        2     0.0000     0.0000     0.0000 XL    24.3459 YL    24.3459 ZL   360.6800

Zone  Name       Contents          Region     Volume    Description (local bodies)
 89              Part No.    10     74     2.138E+05   +1
 90              Material     3     75     0.000E+00   +2   -1
 91   Exterior  (Extra zone created by code)           -2


PART  17 (NEST   ) Bodies in earlier parts=  75
-----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number   X0         Y0         Z0    Shape dependent parameters (see notes)
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
BOX        1    24.3459    24.3459     0.0000 XL    24.3459 YL    24.3459 ZL   360.6800
          Vx   -1.00000    0.00000    0.00000
  [R]=    Vy    0.00000   -1.00000    0.00000
          Vz    0.00000    0.00000    1.00000
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
BOX        2     0.0000     0.0000     0.0000 XL    24.3459 YL    24.3459 ZL   360.6800

Zone  Name       Contents          Region     Volume    Description (local bodies)
 92              Part No.    10     76     2.138E+05   +1
 93              Material     3     77     0.000E+00   +2   -1
 94   Exterior  (Extra zone created by code)           -2

PART  18 (NEST   ) Bodies in earlier parts=  77
-----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number   X0         Y0         Z0    Shape dependent parameters (see notes)
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
BOX        1    24.3459     0.0000     0.0000 XL    24.3459 YL    24.3459 ZL   360.6800
          Vx    0.00000    1.00000    0.00000
  [R]=    Vy   -1.00000    0.00000    0.00000
          Vz    0.00000    0.00000    1.00000
The input characters       : [@opspd+@overs]
have been replaced by      : +24.34590
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
The input characters        : [@opspd+@overs]
have been replaced by       : +24.34590
BOX       2     0.0000     0.0000     0.0000 XL     24.3459 YL     24.3459 ZL    360.6800

Zone  Name       Contents          Region     Volume   Description (local bodies)
 95              Part No.     10    78     2.138E+05   +1
 96              Material      3    79     0.000E+00   +2   -1
 97   Exterior  (Extra zone created by code)           -2


PART  19 (NEST   ) Bodies in earlier parts=  79
----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0         Y0         Z0    Shape dependent parameters (see notes)
The input characters        : [@diaht/2.0]
have been replaced by       : +87.46490
The input characters        : [@canod/2.0-@canth]
have been replaced by       : +88.12530
ZROD      1     0.0000     0.0000     0.0000  R     87.4649  H    360.6800
ZROD      2     0.0000     0.0000     0.0000  R     88.1253  H    360.6800

Zone  Name       Contents          Region     Volume   Description (local bodies)
 98              Part No.     11    80     8.668E+06   +1
 99              Material      3    81     1.314E+05   +2   -1
100   Exterior  (Extra zone created by code)           -2
The input characters        : [@canod/2.0-@canth]
have been replaced by       : +88.12530

PART  20 (FG PART) Bodies in earlier parts=  81
----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0         Y0         Z0    Shape dependent parameters (see notes)
The input characters        : [-1*@canbot]
have been replaced by       : -4.445000
The input characters        : [@canod/2.0]
have been replaced by       : +89.71280
ZROD      1     0.0000     0.0000     0.0000  R     88.1253  H    360.6800
The input characters        : [@canod/2.0-@canth]
have been replaced by       : +88.12530
ZROD      2     0.0000     0.0000    -4.4450  R     89.7128  H      4.4450
The input characters        : [@cavheight+@shieldl]
have been replaced by       : +3.7338000E+02
The input characters        : [@canod/2.0-@canth]
have been replaced by       : +88.12530
ZROD      3     0.0000     0.0000   360.6800  R     88.1253  H     12.7000
The input characters        : [@canod/2.0-@canth]
have been replaced by       : +88.12530
The input characters        : [@canl-@canbot]
have been replaced by       : +3.8100000E+02
ZROD      4     0.0000     0.0000   373.3800  R     88.1253  H      7.6200
The input characters        : [@canod/2.0]
have been replaced by       : +89.71280
The input characters        : [@canl-@canbot]
have been replaced by       : +3.8100000E+02
ZROD      5     0.0000     0.0000     0.0000  R     88.1253  H    381.0000
The input characters        : [-1.*@canbot]
have been replaced by       : -4.445000
The input characters        : [@canod/2.0]
have been replaced by       : +89.71280
ZROD      6     0.0000     0.0000     0.0000  R     89.7128  H    381.0000
ZROD      7     0.0000     0.0000    -4.4450  R     89.7128  H    385.4450

Zone  Name       Contents          Region  Code Vol.   Description (local bodies)
101  CAVITY     Part No.     19      -     8.800E+06   +1
102  BOTTOMPLAT Material     15      -     1.124E+05   +2
103  SHIELDLID  Material     15      -     3.099E+05   +3
104  STRUCTLID  Material     15      -     1.859E+05   +4
105  SHELL      Material     15      -     3.379E+05   +6   -5
Returning input to named channel:     INPUT after reading
 422  lines from   named channel:       CGF Total line count=  756
The input characters        : [@tscNUM + 1]
have been replaced by       : +21.00000
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
106  CANISTER   Material      0    -    -1.859E+05   +7   -6   -4   -2
107  Exterior   (Extra zone created by code)          -7

There is a one-to-one correspondence between regions and zones.
The code volumes (calculated from zone descriptions and body volumes) will be used.
Zones 101 to 106 map to regions  82 to  87
The input characters        : [@cpi*@tscOD/2]
have been replaced by       : +89.71280
The input characters        : [@cpi*@tscHT]
have been replaced by       : +3.854450E+02

PART  21 (FG PART) Bodies in earlier parts=  88
-----------------------------------------------
Body definitions. Numbers are local to this part.

shape  number    X0          Y0        Z0    Shape dependent parameters (see notes)
The input characters        : [@cpi*@inshlID/2]
have been replaced by       : +90.80500
The input characters        : [@cpi*(@btmplHT+@inshlHT+@topplHT)]
have been replaced by       : +3.8862000E+02
ZROD       1      0.0000     0.0000     0.0000  R     89.7128  H    385.4450
The input characters        : [@cpi*@tfrOD/2]
have been replaced by       : +1.1303000E+02
The input characters        : [@cpi*@btmplHT]
have been replaced by       : +2.540000
ZROD       2      0.0000     0.0000     0.0000  R     90.8050  H    388.6200
The input characters        : [@cpi*@btmplHT]
have been replaced by       : +2.540000
The input characters        : [@cpi*((@inshlID/2)+@inshlTH)]
have been replaced by       : +92.71000
ZROD       3      0.0000     0.0000     0.0000  R    113.0300  H      2.5400
The input characters        : [@cpi*@inshlHT]
have been replaced by       : +3.8100000E+02
The input characters        : [@cpi*@btmplHT]
have been replaced by       : +2.540000
The input characters        : [@cpi*((@inshlID/2)+@inshlTH+@pbshlTH)]
have been replaced by       : +1.0287000E+02
ZROD       4      0.0000     0.0000     2.5400  R     92.7100  H    381.0000
The input characters        : [@cpi*(@inshlHT-@ns4frGAP)]
have been replaced by       : +3.7084000E+02
The input characters        : [@cpi*@btmplHT]
have been replaced by       : +2.540000
The input characters        : [@cpi*((@tfrOD/2)-@otshlTH)]
have been replaced by       : +1.0985500E+02
ZROD       5      0.0000     0.0000     2.5400  R    102.8700  H    370.8400
The input characters        : [@cpi*@inshlHT]
have been replaced by       : +3.8100000E+02
The input characters        : [@cpi*@btmplHT]
have been replaced by       : +2.540000
The input characters        : [@cpi*(@tfrOD/2)]
have been replaced by       : +1.1303000E+02
The input characters        : [@cpi*@inshlHT]
have been replaced by       : +3.8100000E+02
ZROD       6      0.0000     0.0000     2.5400  R    109.8550  H    381.0000
The input characters        : [@cpi*(@btmplHT+@inshlHT)]
have been replaced by       : +3.8354001E+02
The input characters        : [@cpi*(@tfrOD/2)]
have been replaced by       : +1.1303000E+02
ZROD       7      0.0000     0.0000     2.5400  R    113.0300  H    381.0000
The input characters        : [@cpi*@topplHT]
have been replaced by       : +5.080000
The input characters        : [@cpi*(@btmplHT+@inshlHT+@topplHT)]
have been replaced by       : +3.8862000E+02
The input characters        : [@cpi*@rtnrnID/2]
have been replaced by       : +86.99500
ZROD       8      0.0000     0.0000   383.5400  R    113.0300  H      5.0800
The input characters        : [@cpi*@rtnrnHT]
have been replaced by       : +1.905000
The input characters        : [@cpi*(@btmplHT+@inshlHT+@topplHT)]
have been replaced by       : +3.8862000E+02
The input characters        : [@cpi*@rtnrnOD/2]
have been replaced by       : +1.0261600E+02
ZROD       9      0.0000     0.0000   388.6200  R     86.9950  H      1.9050
The input characters        : [@cpi*@rtnrnHT]
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
have been replaced by       : +1.905000
The input characters        : [-@shldrHT*@cpi]
have been replaced by       : -24.13000
The input characters        : [@cpi*@tfrOD/2]
have been replaced by       : +1.1303000E+02
The input characters        : [@cpi*@shldrHT]
have been replaced by       : +24.13000
ZROD     10     0.0000     0.0000   388.6200  R   102.6160  H     1.9050
The input characters        : [@cpi*((@drrailID/2)+@drrailWD)]
have been replaced by       : +1.0731499E+02
ZROD     11     0.0000     0.0000   -24.1300  R   113.0300  H    24.1300
The input characters        : [-@cpi*((@drrailID/2)+@drrailWD)]
have been replaced by       : -1.0731499E+02
YP       12                              At   107.3150
The input characters        : [-@cpi*@tfrOD/2]
have been replaced by       : -1.1303000E+02
YP       13                              At  -107.3150
The input characters        : [@cpi*(@btmplHT+@inshlHT+@topplHT - @trunzcor)]
have been replaced by       : +3.5051999E+02
The input characters        : [@cpi*@trunOD/2]
have been replaced by       : +12.70000
The input characters        : [@cpi*@tfrOD]
have been replaced by       : +2.260600E+02
The input characters        : [-1 * @cpi*@shldrHT]
have been replaced by       : -24.13000
The input characters        : [@cpi*@tfrOD/2]
have been replaced by       : +1.1303000E+02
XROD     14  -113.0300     0.0000   350.5200  R    12.7000  H   226.0600
The input characters        : [@cpi*(@shldrHT+@btmplHT+@inshlHT+@topplHT+@rtnrnHT)]
have been replaced by       : +4.1465500E+02
ZROD     15     0.0000     0.0000   -24.1300  R   113.0300  H   414.6550

Zone  Name       Contents          Region  Code Vol.   Description (local bodies)
The input characters        : [@tscMAT + @cavMAT]
have been replaced by       : +19.00000
108              Part No.     20     -     9.746E+06   +1
The input characters        : [@tscMAT + @btmplMAT]
have been replaced by       : +16.00000
109              Material     19     -     3.210E+05   +2   -1
The input characters        : [@tscMAT + @inshlMAT]
have been replaced by       : +16.00000
110              Material     16     -    -9.965E+06   +3   -2
The input characters        : [@tscMAT + @pbshlMAT]
have been replaced by       : +17.00000
111              Material     16     -     1.065E+05   +4   -2  -14
The input characters        : [@tscMAT + @n4shlMAT]
have been replaced by       : +18.00000
112              Material     17     -     1.926E+06   +5   -4  -14
The input characters        : [@tscMAT + @otshlMAT]
have been replaced by       : +16.00000
113              Material     18     -    -8.286E+06   +6   -5   -4  -14
The input characters        : [@tscMAT + @topplMAT]
have been replaced by       : +16.00000
114              Material     16     -     7.325E+05   +7   -6  -14
The input characters        : [@tscMAT + @cavMAT]
have been replaced by       : +19.00000
115              Material     16     -    -9.863E+06   +8   -2
The input characters        : [@tscMAT + @rtnrnMAT]
have been replaced by       : +16.00000
116              Material     19     -     4.529E+04   +9
The input characters        : [@tscMAT + @shldrMAT]
have been replaced by       : +16.00000
117              Material     16     -     1.773E+04  +10   -9
The input characters        : [@tscMAT + @cavMAT]
have been replaced by       : +19.00000
118              Material     16     -     9.685E+05  +11  -12  +13
The input characters        : [@tscMAT + @cavMAT]
have been replaced by       : +19.00000
119              Material     19     -     9.685E+05  +11  +12
The input characters        : [@tscMAT + @trunMAT]
have been replaced by       : +16.00000
120              Material     19     -     9.685E+05  +11  -13
The input characters        : [@tscMAT + @cavMAT]
have been replaced by       : +19.00000
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
121              Material     16     -     6.690E+06  +14  +15   -2
122              Material     19     -    -1.011E+05  +15  -14  -11  -10   -8   -7   -3
123  Exterior   (Extra zone created by code)          -15

There is a one-to-one correspondence between regions and zones.
The code volumes (calculated from zone descriptions and body volumes) will be used.
Zones 108 to 122 map to regions  88 to  102

The input data has been expanded into a global model in which each occurrence
of a part becomes unique. The parts and bodies in this expanded scheme are
renumbered and referred to as 'Assembled' parts and bodies

Summary of part structure
The global part is input part number          21
Map of part structure. Numbers are input parts.

   21 Contains:
        20 Contains:
             19 Contains:
                  11 Contains:
                       16 Contains:
                            10 Contains:
                                  7 Contains:
                                       2 s.p.
                                  4 s.p.
                                  4 s.p.
                                  4 s.p.
                                  4 s.p.
                       12 Contains:
                             8 Contains:
                                  5 Contains:
                                       1 s.p.
                                  3 s.p.
                                  3 s.p.
                                  3 s.p.
                                  3 s.p.
                       13 Contains:
                             8 etc.
                                  5 etc.
                       17 Contains:
                            10 etc.
                                  7 etc.
                       12 etc.
                             8 etc.
                                  5 etc.
                       12 etc.
                             8 etc.
                                  5 etc.
                       12 etc.
                             8 etc.
                                  5 etc.
                       13 etc.
                             8 etc.
                                  5 etc.
                       13 etc.
                             8 etc.
                                  5 etc.
                       13 etc.
                             8 etc.
                                  5 etc.
                        9 Contains:
                             6 Contains:
                                  1 s.p.
                             3 s.p.
                             3 s.p.
                             3 s.p.
                             3 s.p.
                        9 etc.
                             6 etc.
                       15 Contains:
                             9 etc.
                                  6 etc.
                       15 etc.
                             9 etc.
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
                        6 etc.
              8 etc.
                   5 etc.
              8 etc.
                   5 etc.
              8 etc.
                   5 etc.
             14 Contains:
                   8 etc.
                        5 etc.
             14 etc.
                   8 etc.
                        5 etc.
             14 etc.
                   8 etc.
                        5 etc.
             10 etc.
                   7 etc.
              8 etc.
                   5 etc.
             14 etc.
                   8 etc.
                        5 etc.
             18 Contains:
                  10 etc.
                        7 etc.

    Maximum level of nesting                   =   8
    Number of assembled parts                  = 189
    Number of assembled bodies                 = 637
    Number of uses of BODY HOLES               =   4
    Maximum HOLE material used                 =   7
    Number of uses of each input part:
       20    4   80   16   16    4    4   16    4    4
        1    4    4    4    2    1    1    1    1    1
        1

    Scoring region volumes have been multiplied by the number of uses of each part.

    External zone of global part is number  123 with definition:  -15

    The coordinate limits of the geometry are estimated to be:
    XMIN=  -113.030 XMAX=   113.030
    YMIN=  -113.030 YMAX=   113.030
    ZMIN=   -24.130 ZMAX=   390.525


    Albedo data for outer surface of global part   21
    Body number= 103 Shape number=  5
    The material number in the outside zone ( 123 ) has been reset to -4000

    Reflection coefficients for  3 surfaces are:
        1.0000    1.0000    1.0000
    A periodic boundary condition has been requested.


TIME TAKEN TO READ AND PROCESS GEOMETRY DATA=      1.563 SECS
STORAGE USED FOR GEOMETRY DATA (4BYTE WORDS)=     16814
MAXIMUM REAL MATERIAL NUMBER USED           =        19
MAXIMUM HOLE MATERIAL REFERENCED IN GEOMETRY=         7


*********************************************************
* SUCCESSFUL CONCLUSION TO UNIT  2 TO READ THE          *
* MATERIAL GEOMETRY DATA. NO ERRORS.                    *
*********************************************************

1

*********************************************************
*    ENTERING UNIT  3 TO READ HOLE DATA                 *
*********************************************************
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
    Changing  input to named channel:       FHF after reading
     189  lines from   named channel:     INPUT Total line count=  816


 HOLE  1      PLATE
 -------

           DIRECTION COSINES OF PLATE NORMAL = 0.0000 0.0000 1.0000
           NO. OF EXPLICIT PLATE BOUNDARIES =  2
    The input characters         : [@lassem-@ltnozz]
    have been replaced by        : +3.3088577E+02
    The input characters         : [@lbnozz]
    have been replaced by        : +8.097500

           PLATE BOUNDARY         MATERIAL NO.

                                       8
               330.8858
                                      -2
                 8.0975
                                       7


 HOLE  2      LATTICE
 -------
    The input characters         : [-(@rpitch/2.0)-(@wfuel-@lattice*@rpitch)/2.0]
    have been replaced by        : -.7214997
    The input characters         : [-(@rpitch/2.0)-(@wfuel-@lattice*@rpitch)/2.0]
    have been replaced by        : -.7214997
    The input characters         : [@odgt/2.0]
    have been replaced by        : +.6731000
    The input characters         : [@odgt/2.]
    have been replaced by        : +.6731000

           NO. OF PINS IN THE X-DIRECTION =  15     NO. OF PINS IN THE Y-DIRECTION =  15
           LATTICE PITCH IN THE X-DIRECTION =    1.4427     LATTICE PITCH IN THE Y-DIRECTION =    1.4427
           ORIGIN SHIFT (X0,Y0) =  -0.7215  -0.7215

           ALL PINS HAVE INNER RADIUS    0.6731 AND OUTER RADIUS    0.6731

           PINS   1 TO  32 CONTAIN ROD MATERIAL NO. =  -3
           PINS  33 TO  33 CONTAIN ROD MATERIAL NO. =  -4
           PINS  34 TO  35 CONTAIN ROD MATERIAL NO. =  -3
           PINS  36 TO  36 CONTAIN ROD MATERIAL NO. =  -4
           PINS  37 TO  39 CONTAIN ROD MATERIAL NO. =  -3
           PINS  40 TO  40 CONTAIN ROD MATERIAL NO. =  -4
           PINS  41 TO  42 CONTAIN ROD MATERIAL NO. =  -3
           PINS  43 TO  43 CONTAIN ROD MATERIAL NO. =  -4
           PINS  44 TO  52 CONTAIN ROD MATERIAL NO. =  -3
           PINS  53 TO  53 CONTAIN ROD MATERIAL NO. =  -4
           PINS  54 TO  64 CONTAIN ROD MATERIAL NO. =  -3
           PINS  65 TO  65 CONTAIN ROD MATERIAL NO. =  -4
           PINS  66 TO  70 CONTAIN ROD MATERIAL NO. =  -3
           PINS  71 TO  71 CONTAIN ROD MATERIAL NO. =  -4
           PINS  72 TO  77 CONTAIN ROD MATERIAL NO. =  -3
           PINS  78 TO  78 CONTAIN ROD MATERIAL NO. =  -4
           PINS  79 TO  87 CONTAIN ROD MATERIAL NO. =  -3
           PINS  88 TO  88 CONTAIN ROD MATERIAL NO. =  -4
           PINS  89 TO 108 CONTAIN ROD MATERIAL NO. =  -3
           PINS 109 TO 109 CONTAIN ROD MATERIAL NO. =  -4
           PINS 110 TO 112 CONTAIN ROD MATERIAL NO. =  -3
           PINS 113 TO 113 CONTAIN ROD MATERIAL NO. =  -5
           PINS 114 TO 116 CONTAIN ROD MATERIAL NO. =  -3
           PINS 117 TO 117 CONTAIN ROD MATERIAL NO. =  -4
           PINS 118 TO 137 CONTAIN ROD MATERIAL NO. =  -3
           PINS 138 TO 138 CONTAIN ROD MATERIAL NO. =  -4
           PINS 139 TO 147 CONTAIN ROD MATERIAL NO. =  -3
           PINS 148 TO 148 CONTAIN ROD MATERIAL NO. =  -4
           PINS 149 TO 154 CONTAIN ROD MATERIAL NO. =  -3
           PINS 155 TO 155 CONTAIN ROD MATERIAL NO. =  -4
           PINS 156 TO 160 CONTAIN ROD MATERIAL NO. =  -3
           PINS 161 TO 161 CONTAIN ROD MATERIAL NO. =  -4
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
          PINS 162 TO 172 CONTAIN ROD MATERIAL NO. =  -3
          PINS 173 TO 173 CONTAIN ROD MATERIAL NO. =  -4
          PINS 174 TO 182 CONTAIN ROD MATERIAL NO. =  -3
          PINS 183 TO 183 CONTAIN ROD MATERIAL NO. =  -4
          PINS 184 TO 185 CONTAIN ROD MATERIAL NO. =  -3
          PINS 186 TO 186 CONTAIN ROD MATERIAL NO. =  -4
          PINS 187 TO 189 CONTAIN ROD MATERIAL NO. =  -3
          PINS 190 TO 190 CONTAIN ROD MATERIAL NO. =  -4
          PINS 191 TO 192 CONTAIN ROD MATERIAL NO. =  -3
          PINS 193 TO 193 CONTAIN ROD MATERIAL NO. =  -4
          PINS 194 TO 225 CONTAIN ROD MATERIAL NO. =  -3

          ALL PINS HAVE CAN MATERIAL NO. =    3

          OTHERWISE MATERIAL NO. =    3


HOLE  3     RZMESH
-------
    The input characters        : [@odpellet/2.0]
    have been replaced by       : +.4653500
    The input characters        : [(@odclad/2.0)-@cladth]
    have been replaced by       : +.4768000
    The input characters        : [@odclad/2.0]
    have been replaced by       : +.5334000

             3 R-MESHES WITH BOUNDARIES LOCATED AT :
  4.65350E-01 4.76800E-01 5.33400E-01
    The input characters        : [@lbnozz+@fgapb]
    have been replaced by       : +8.097500
    The input characters        : [@lbnozz+@fgapb+@lbcap]
    have been replaced by       : +9.837399
    The input characters        : [@lbnozz+@fgapb+@lbcap+@lfexpb]
    have been replaced by       : +9.837399
    The input characters        : [@lbnozz+@fgapb+@lbcap+@lfexpb+@lactfu]
    have been replaced by       : +3.1603439E+02
    The input characters        : [@lbnozz+@fgapb+@lfu-@ltcap]
    have been replaced by       : +3.2822641E+02
    The input characters        : [@lbnozz+@fgapb+@lfu]
    have been replaced by       : +3.2996631E+02
    The input characters        : [@lassem-@ltnozz]
    have been replaced by       : +3.3088577E+02

             7 Z-MESHES WITH BOUNDARIES LOCATED AT :
  8.09750E+00 8.09750E+00 9.83740E+00 9.83740E+00 3.16034E+02 3.28226E+02 3.29966E+02 3.30886E+02


          MATERIAL MAP
          ------------

          Z-MESH   1 :
             3   3   3

          Z-MESH   2 :
             2   2   2

          Z-MESH   3 :
             4   4   2

          Z-MESH   4 :
             1   4   2

          Z-MESH   5 :
             4   4   2

          Z-MESH   6 :
             2   2   2

          Z-MESH   7 :
             3   3   3


          MATERIAL OUTSIDE DEFINED MESHES :   3
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
HOLE  4     RZMESH
-------
    The input characters        : [(@odgt/2.0) - @gtth]
    have been replaced by       : +.6401000
    The input characters        : [@odgt/2.0]
    have been replaced by       : +.6731000

               2 R-MESHES WITH BOUNDARIES LOCATED AT :
     6.40100E-01 6.73100E-01
    The input characters        : [@lassem - @ltnozz]
    have been replaced by       : +3.3088577E+02

               1 Z-MESHES WITH BOUNDARIES LOCATED AT :
     8.09750E+00 3.30886E+02


            MATERIAL MAP
            ------------

            Z-MESH   1 :
               3   5


            MATERIAL OUTSIDE DEFINED MESHES :    3


HOLE  5     RZMESH
-------
    The input characters        : [(@odit/2.0) - @itth]
    have been replaced by       : +.6401000
    The input characters        : [@odit/2.0]
    have been replaced by       : +.6731000

               2 R-MESHES WITH BOUNDARIES LOCATED AT :
     6.40100E-01 6.73100E-01
    The input characters        : [@lassem - @ltnozz]
    have been replaced by       : +3.3088577E+02

               1 Z-MESHES WITH BOUNDARIES LOCATED AT :
     8.09750E+00 3.30886E+02


            MATERIAL MAP
            ------------

            Z-MESH   1 :
               3   6


            MATERIAL OUTSIDE DEFINED MESHES :    3
    Returning input to named channel:     INPUT after reading
      93  lines from   named channel:       FHF Total line count=  905

    Changing  input to named channel:       CHF after reading
     190  lines from   named channel:     INPUT Total line count=  906


HOLE  6     PLATE
-------

            DIRECTION COSINES OF PLATE NORMAL = 1.0000 0.0000 0.0000
            NO. OF EXPLICIT PLATE BOUNDARIES =  2
    The input characters        : [(@blt+@blct)/2.0]
    have been replaced by       : +.1587500
    The input characters        : [(@blt-@blct)/2.0]
    have been replaced by       : +.0317500

            PLATE BOUNDARY          MATERIAL NO.

                                         11
                  0.1587
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
                                   10
            0.0318
                                   11

    Returning input to named channel:     INPUT after reading
      17  lines from    named channel:      CHF Total line count=  917

    Changing  input to named channel:       CHF after reading
     191  lines from    named channel:    INPUT Total line count=  918


HOLE  7      PLATE
-------

            DIRECTION COSINES OF PLATE NORMAL = 0.0000 0.0000 1.0000
            NO. OF EXPLICIT PLATE BOUNDARIES =  5
    The input characters         : [@lbasket-@lbws-@lbw]
    have been replaced by        : +3.4394141E+02
    The input characters         : [-1.0*(@lbw+@lbws)]
    have been replaced by        : -15.46860
    The input characters         : [-1.0*(@baskoff+@lbw+@lbws)]
    have been replaced by        : -15.46860

            PLATE BOUNDARY           MATERIAL NO.

                                     3
                343.9414
                                    -8
                316.0522
                                   -10
                  0.0000
                                    -9
                -15.4686
                                     3
                -15.4686
                                     3


HOLE  8      RZMESH
-------
    The input characters         : [@diatpw/2.0]
    have been replaced by        : +87.60460

               1 R-MESHES WITH BOUNDARIES LOCATED AT :
     8.76046E+01
    The input characters         : [@lbasket-@lbws-@lbw-@ltpw]
    have been replaced by        : +3.2666940E+02
    The input characters         : [@lbasket-@lbws-@lbw-@ltpw+@ltpwd]
    have been replaced by        : +3.2793939E+02

               1 Z-MESHES WITH BOUNDARIES LOCATED AT :
     3.26669E+02 3.27939E+02


            MATERIAL MAP
            ------------

            Z-MESH   1 :
              13


            MATERIAL OUTSIDE DEFINED MESHES :    3


HOLE  9      RZMESH
-------
    The input characters         : [@diabw/2.0]
    have been replaced by        : +87.60460

               1 R-MESHES WITH BOUNDARIES LOCATED AT :
     8.76046E+01
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
    The input characters        : [-1.0*(@lbws+@lbwd)]
    have been replaced by       : -11.65860
    The input characters        : [-1.0*@lbws]
    have been replaced by       : -10.38860

              1 Z-MESHES WITH BOUNDARIES LOCATED AT :
    -1.16586E+01-1.03886E+01


            MATERIAL MAP
            ------------

            Z-MESH   1 :
              13


            MATERIAL OUTSIDE DEFINED MESHES :    3



HOLE 10     PLATE
-------

            DIRECTION COSINES OF PLATE NORMAL = 0.0000 0.0000 1.0000
            NO. OF EXPLICIT PLATE BOUNDARIES =  4
    The input characters        : [@tspd+@dsspht+@thtd+@dsspht]
    have been replaced by       : +11.65860

            REPEATED CELL OF WIDTH 1.16586E+01
    The input characters        : [@tspd+@dsspht+@thtd+@dsspht]
    have been replaced by       : +11.65860
    The input characters        : [@tspd+@dsspht+@thtd]
    have been replaced by       : +7.099300
    The input characters        : [@tspd+@dsspht]
    have been replaced by       : +5.829300

            PLATE BOUNDARY          MATERIAL NO.

                                          3
                 11.6586
                                          3
                  7.0993
                                         14
                  5.8293
                                          3
                  1.2700
                                         12



HOLE   1 : NO. OF MATERIALS =   8   MATERIAL LIST =   8   7   3   2   4   1   5   6
HOLE   2 : NO. OF MATERIALS =   6   MATERIAL LIST =   3   2   4   1   5   6
HOLE   3 : NO. OF MATERIALS =   4   MATERIAL LIST =   3   2   4   1
HOLE   4 : NO. OF MATERIALS =   2   MATERIAL LIST =   3   5
HOLE   5 : NO. OF MATERIALS =   2   MATERIAL LIST =   3   6
HOLE   6 : NO. OF MATERIALS =   2   MATERIAL LIST =  11  10
HOLE   7 : NO. OF MATERIALS =   4   MATERIAL LIST =   3  13  14  12
HOLE   8 : NO. OF MATERIALS =   2   MATERIAL LIST =  13   3
HOLE   9 : NO. OF MATERIALS =   2   MATERIAL LIST =  13   3
HOLE  10 : NO. OF MATERIALS =   3   MATERIAL LIST =   3  14  12
    Returning input to named channel:     INPUT after reading
      74  lines from   named channel:       CHF Total line count=  971


*********************************************************
* SUCCESSFUL CONCLUSION TO UNIT  3 TO READ THE          *
* HOLE DATA                 NO ERRORS.                  *
*********************************************************

1

*********************************************************
*    ENTERING UNIT  4 TO READ PROBLEM CONTROL DATA.     *
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
*******************************************************

USER SUPPLIED RANDOM NUMBER SEEDS         =     54321
                                                54321
FOR A CRITICALITY CALCULATION :
NUMBER OF SUPER HISTORIES PER BATCH       =      1000
FIRST STAGE NUMBER                        =        -3
LAST  STAGE NUMBER                        =       810
MAXIMUM GENERATION NUMBER                 =        10
ESTIMATE OF NUFACTOR                      =     1.000
FINAL STANDARD DEVIATION ON K(THREE)      =  0.000800

SAMPLING TIME ( SECONDS )                 =  10000000
ERRORS PERMITTING, AN  EXECUTION OF THE  SUPPLIED
DATA WILL BE ATTEMPTED


*******************************************************
* SUCCESSFUL CONCLUSION TO UNIT  4 TO READ THE        *
* PROBLEM CONTROL DATA.   NO ERRORS.                  *
*******************************************************

1

*******************************************************
*    ENTERING UNIT  5 TO READ SOURCE GEOMETRY DATA.   *
*******************************************************


SOURCE GEOMETRY SUCCESSFULLY INPUT
SOURCE WILL BE SAMPLED FROM    1 REGIONS


*******************************************************
* SUCCESSFUL CONCLUSION TO UNIT  5 TO READ THE        *
* SOURCE GEOMETRY DATA.   NO ERRORS.                  *
*******************************************************

1

***********************QI******************************
* STATUS OF INPUT UNITS AT END OF STAGE ONE PROCESSING *
*******************************************************

               PROBLEM CONTROL DATA.       USED-OK
               MATERIAL GEOMETRY DATA.     USED-OK
               SOURCE GEOMETRY DATA.       USED-OK
               HOLE DATA                   USED-OK
               MATERIAL SPECIFICATION      USED-OK


*******************************************************
* ENTERING ROUTINE TO DISTRIBUTE THE INPUT DATA TO    *
* MODULE 25005 (FG TRACKING)                          *
*******************************************************


*******************************************************
* ENTERING ROUTINE TO DISTRIBUTE THE INPUT DATA TO    *
* MODULE 48321 (SCORING)                              *
*******************************************************

WARNING: Negative volumes have been found in the following regions:

    REGION          VOLUME
    ------          ------
       11         -1.382E+05
       12         -2.649E+06
       15         -3.455E+04
       16         -6.624E+05
       19         -3.848E+04
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
      20           -7.244E+05
      87           -1.859E+05
      90           -9.965E+06
      93           -8.286E+06
      95           -9.863E+06
     102           -1.011E+05

Inspect the FG printout to ensure that these do not correspond to scoring regions.

These negative volumes have been reset to 1.0


*********************************************************
* ENTERING ROUTINE TO DISTRIBUTE THE INPUT DATA TO      *
* MODULE 03435 (SIMPLE SOURCE)                          *
*********************************************************


SOURCE WILL BE SAMPLED FROM THE FOLLOWING ZONES:

----------------------------------------------------------------------------------------------
                    ENVELOPE                                              RESTRICTION
   XHI          XLO          YHI          YLO          ZHI          ZLO          FGZONES     MATERIAL
----------------------------------------------------------------------------------------------

 1.1303E+02 -1.1303E+02  1.1303E+02 -1.1303E+02  3.9052E+02 -2.4130E+01   108 122            1
----------------------------------------------------------------------------------------------



         *****************************************************************
                 ANSWERS Software Licensing Procedure for Modules
                             Module name - MONK-CRIT
         *****************************************************************


         *** The timelock password has been successfully verified.
         *** This password expires at midnight on 30/ 6/2001


         *** Successful authorisation achieved on system 57NST
         *** This system has the identification number  131008778


         *****************************************************************
          This module is part of the ANSWERS program - MONK8A

          The use of this module is restricted within the terms of your
          licence agreement with AEA Technology.
         *****************************************************************


         *****************************************************************
         ***          End of ANSWERS Software Licensing Checks          ***
         *****************************************************************



*********************************************************
* ENTERING ROUTINE TO DISTRIBUTE THE INPUT DATA TO      *
* MODULE 36882 (POINT NEUTRON)                          *
*********************************************************

1

  DICE MK. VII Sept 92 (BOUND-ATOM THERMAL TREATMENT FOR CERTAIN NUCLIDES),  LIBRARY FORMAT VERSION  3
  ====================================================================================================

                          NUCLEAR DATA READ FROM FILE: d:\answers\data_libraries\dice96j2v5.dat

THIS CASE IS BEING RUN FOR  20 MATERIAL(S) WITH 13193 CROSS-SECTION  ENERGY GROUPS FROM 1.50000E+01 MEV TO 1.00000E-11 MEV
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
                    THERMAL DATA READ FOR FOLLOWING NUCLIDES
                    ========================================
NUCLIDE ID NO                   COMMENTS
-------------                   --------
    10293            Data for hydrogen in H2O processed from JEF file JAN 92 by
                    D.E.Bendall using 3% fitting error and .1% integration error



                    ===================================================
                    THE THERMAL DATA OCCUPIES  14611 LOCATIONS;
                    THE TOTAL NUCLEAR DATA OCCUPIES 3618571 LOCATIONS;
                    THE DATA TOOK    4.1 SECS OF CPU TO PROCESS
                    ===================================================


SUMMARY OF MATERIAL DATA
========================


MATERIAL  1   DENSITY 1.04120E+01 GRMS/CC     NUMBER OF NUCLIDES  3     TEMPERATURE 293.0 DEGREES KELVIN
-----------
              NUCLIDE NO.         NAME        ATOMIC NO.     ATOMIC WT   PROP BY NUCLIDE      DFN         LIBRARY NO.
              -----------         ----        ----------     ---------   ---------------      ---         -----------

                   1             J2U235           92           235.04      1.5546E-02        9228b            62
                   2             J2U238           92           238.05      3.1765E-01        9237b            63
                   3              J2O16            8            15.99      6.6681E-01         825b            33

MATERIAL  2   DENSITY 6.50000E+00 GRMS/CC     NUMBER OF NUCLIDES  1     TEMPERATURE 293.0 DEGREES KELVIN
-----------
              NUCLIDE NO.         NAME        ATOMIC NO.     ATOMIC WT   PROP BY NUCLIDE      DFN         LIBRARY NO.
              -----------         ----        ----------     ---------   ---------------      ---         -----------

                   1               J2ZR           40            91.22      1.0000E+00        4000b            47

MATERIAL  3   DENSITY 9.98200E-01 GRMS/CC     NUMBER OF NUCLIDES  2     TEMPERATURE 293.0 DEGREES KELVIN
-----------
              NUCLIDE NO.         NAME        ATOMIC NO.     ATOMIC WT   PROP BY NUCLIDE      DFN         LIBRARY NO.
              -----------         ----        ----------     ---------   ---------------      ---         -----------

                   1            J2HINH2O           1             1.01      6.6661E-01       10293             64
                   2              J2O16            8            15.99      3.3339E-01         825b            33

MATERIAL  4   DENSITY 9.98200E-01 GRMS/CC     NUMBER OF NUCLIDES  2     TEMPERATURE 293.0 DEGREES KELVIN
-----------
              NUCLIDE NO.         NAME        ATOMIC NO.     ATOMIC WT   PROP BY NUCLIDE      DFN         LIBRARY NO.
              -----------         ----        ----------     ---------   ---------------      ---         -----------

                   1            J2HINH2O           1             1.01      6.6661E-01       10293             64
                   2              J2O16            8            15.99      3.3339E-01         825b            33

MATERIAL  5   DENSITY 6.50000E+00 GRMS/CC     NUMBER OF NUCLIDES  1     TEMPERATURE 293.0 DEGREES KELVIN
-----------
              NUCLIDE NO.         NAME        ATOMIC NO.     ATOMIC WT   PROP BY NUCLIDE      DFN         LIBRARY NO.
              -----------         ----        ----------     ---------   ---------------      ---         -----------

                   1               J2ZR           40            91.22      1.0000E+00        4000b            47

MATERIAL  6   DENSITY 6.50000E+00 GRMS/CC     NUMBER OF NUCLIDES  1     TEMPERATURE 293.0 DEGREES KELVIN
-----------
              NUCLIDE NO.         NAME        ATOMIC NO.     ATOMIC WT   PROP BY NUCLIDE      DFN         LIBRARY NO.
              -----------         ----        ----------     ---------   ---------------      ---         -----------
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

1	J2ZR	40	91.22	1.0000E+00	4000b	47

MATERIAL 7 DENSITY 3.09913E+00 GRMS/CC NUMBER OF NUCLIDES 15 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2FE54	26	53.94	1.1794E-02	2625b	15
2	J2FE56	26	55.94	1.8334E-01	2631b	66
3	J2FE57	26	56.94	4.1978E-03	2634b	16
4	J2FE58	26	57.93	5.5970E-04	2637b	17
5	J2CR50	24	49.95	2.2691E-03	2425b	11
6	J2CR52	24	51.94	4.3759E-02	2431b	53
7	J2CR53	24	52.94	4.9613E-03	2434b	12
8	J2CR54	24	53.94	1.2351E-03	2437b	13
9	J2NI58	28	57.94	1.3998E-02	2825b	56
10	J2NI60	28	59.93	5.3920E-03	2831b	57
11	J2NI61	28	60.93	2.3441E-04	2834b	58
12	J2NI62	28	61.93	7.4723E-04	2837b	59
13	J2NI64	28	63.93	1.9040E-04	2843b	60
14	J2HINH2O	1	1.01	4.8484E-01	10293	64
15	J2O16	8	15.99	2.4249E-01	825b	33

MATERIAL 8 DENSITY 2.19041E+00 GRMS/CC NUMBER OF NUCLIDES 15 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2FE54	26	53.94	6.5686E-03	2625b	15
2	J2FE56	26	55.94	1.0211E-01	2631b	66
3	J2FE57	26	56.94	2.3380E-03	2634b	16
4	J2FE58	26	57.93	3.1172E-04	2637b	17
5	J2CR50	24	49.95	1.2638E-03	2425b	11
6	J2CR52	24	51.94	2.4371E-02	2431b	53
7	J2CR53	24	52.94	2.7632E-03	2434b	12
8	J2CR54	24	53.94	6.8789E-04	2437b	13
9	J2NI58	28	57.94	7.7962E-03	2825b	56
10	J2NI60	28	59.93	3.0031E-03	2831b	57
11	J2NI61	28	60.93	1.3055E-04	2834b	58
12	J2NI62	28	61.93	4.1617E-04	2837b	59
13	J2NI64	28	63.93	1.0605E-04	2843b	60
14	J2HINH2O	1	1.01	5.6537E-01	10293	64
15	J2O16	8	15.99	2.8276E-01	825b	33

MATERIAL 9 DENSITY 7.92967E+00 GRMS/CC NUMBER OF NUCLIDES 13 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2FE54	26	53.94	4.3251E-02	2625b	15
2	J2FE56	26	55.94	6.7237E-01	2631b	66
3	J2FE57	26	56.94	1.5395E-02	2634b	16
4	J2FE58	26	57.93	2.0526E-03	2637b	17
5	J2CR50	24	49.95	8.3216E-03	2425b	11
6	J2CR52	24	51.94	1.6048E-01	2431b	53
7	J2CR53	24	52.94	1.8195E-02	2434b	12
8	J2CR54	24	53.94	4.5295E-03	2437b	13
9	J2NI58	28	57.94	5.1335E-02	2825b	56
10	J2NI60	28	59.93	1.9774E-02	2831b	57
11	J2NI61	28	60.93	8.5964E-04	2834b	58
12	J2NI62	28	61.93	2.7403E-03	2837b	59
13	J2NI64	28	63.93	6.9827E-04	2843b	60

MATERIAL 10 DENSITY 2.58326E+00 GRMS/CC NUMBER OF NUCLIDES 4 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2AL27	13	26.98	3.6469E-01	1325b	1

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

2	J2B10	5	10.01	7.7071E-02	525b	5
3	J2B11	5	11.01	4.2603E-01	528b	48
4	J2C	6	12.01	1.3221E-01	600b	6

MATERIAL 11 DENSITY 2.70000E+00 GRMS/CC NUMBER OF NUCLIDES 1 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2AL27	13	26.98	1.0000E+00	1325b	1

MATERIAL 12 DENSITY 7.92967E+00 GRMS/CC NUMBER OF NUCLIDES 13 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2FE54	26	53.94	4.3251E-02	2625b	15
2	J2FE56	26	55.94	6.7237E-01	2631b	66
3	J2FE57	26	56.94	1.5395E-02	2634b	16
4	J2FE58	26	57.93	2.0526E-03	2637b	17
5	J2CR50	24	49.95	8.3216E-03	2425b	11
6	J2CR52	24	51.94	1.6048E-01	2431b	53
7	J2CR53	24	52.94	1.8195E-02	2434b	12
8	J2CR54	24	53.94	4.5295E-03	2437b	13
9	J2NI58	28	57.94	5.1335E-02	2825b	56
10	J2NI60	28	59.93	1.9774E-02	2831b	57
11	J2NI61	28	60.93	8.5964E-04	2834b	58
12	J2NI62	28	61.93	2.7403E-03	2837b	59
13	J2NI64	28	63.93	6.9827E-04	2843b	60

MATERIAL 13 DENSITY 7.92967E+00 GRMS/CC NUMBER OF NUCLIDES 13 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2FE54	26	53.94	4.3251E-02	2625b	15
2	J2FE56	26	55.94	6.7237E-01	2631b	66
3	J2FE57	26	56.94	1.5395E-02	2634b	16
4	J2FE58	26	57.93	2.0526E-03	2637b	17
5	J2CR50	24	49.95	8.3216E-03	2425b	11
6	J2CR52	24	51.94	1.6048E-01	2431b	53
7	J2CR53	24	52.94	1.8195E-02	2434b	12
8	J2CR54	24	53.94	4.5295E-03	2437b	13
9	J2NI58	28	57.94	5.1335E-02	2825b	56
10	J2NI60	28	59.93	1.9774E-02	2831b	57
11	J2NI61	28	60.93	8.5964E-04	2834b	58
12	J2NI62	28	61.93	2.7403E-03	2837b	59
13	J2NI64	28	63.93	6.9827E-04	2843b	60

MATERIAL 14 DENSITY 2.70000E+00 GRMS/CC NUMBER OF NUCLIDES 1 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2AL27	13	26.98	1.0000E+00	1325b	1

MATERIAL 15 DENSITY 7.92967E+00 GRMS/CC NUMBER OF NUCLIDES 13 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2FE54	26	53.94	4.3251E-02	2625b	15
2	J2FE56	26	55.94	6.7237E-01	2631b	66
3	J2FE57	26	56.94	1.5395E-02	2634b	16
4	J2FE58	26	57.93	2.0526E-03	2637b	17
5	J2CR50	24	49.95	8.3216E-03	2425b	11
6	J2CR52	24	51.94	1.6048E-01	2431b	53
7	J2CR53	24	52.94	1.8195E-02	2434b	12
8	J2CR54	24	53.94	4.5295E-03	2437b	13
9	J2NI58	28	57.94	5.1335E-02	2825b	56

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

10	J2NI60	28	59.93	1.9774E-02	2831b	57
11	J2NI61	28	60.93	8.5964E-04	2834b	58
12	J2NI62	28	61.93	2.7403E-03	2837b	59
13	J2NI64	28	63.93	6.9827E-04	2843b	60

MATERIAL 16 DENSITY 7.92967E+00 GRMS/CC NUMBER OF NUCLIDES 13 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2FE54	26	53.94	4.3251E-02	2625b	15
2	J2FE56	26	55.94	6.7237E-01	2631b	66
3	J2FE57	26	56.94	1.5395E-02	2634b	16
4	J2FE58	26	57.93	2.0526E-03	2637b	17
5	J2CR50	24	49.95	8.3216E-03	2425b	11
6	J2CR52	24	51.94	1.6048E-01	2431b	53
7	J2CR53	24	52.94	1.8195E-02	2434b	12
8	J2CR54	24	53.94	4.5295E-03	2437b	13
9	J2NI58	28	57.94	5.1335E-02	2825b	56
10	J2NI60	28	59.93	1.9774E-02	2831b	57
11	J2NI61	28	60.93	8.5964E-04	2834b	58
12	J2NI62	28	61.93	2.7403E-03	2837b	59
13	J2NI64	28	63.93	6.9827E-04	2843b	60

MATERIAL 17 DENSITY 1.10400E+01 GRMS/CC NUMBER OF NUCLIDES 1 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2PB	82	207.21	1.0000E+00	8200b	34

MATERIAL 18 DENSITY 1.63187E+00 GRMS/CC NUMBER OF NUCLIDES 8 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2B10	5	10.01	7.3169E-04	525b	5
2	J2B11	5	11.01	2.9274E-03	528b	48
3	J2AL27	13	26.98	6.6692E-02	1325b	1
4	J2HINH2O	1	1.01	5.0079E-01	10293	64
5	J2O16	8	15.99	2.2325E-01	825b	33
6	J2C	6	12.01	1.9368E-01	600b	6
7	J2N14	7	14.00	1.1881E-02	725b	31
8	J2N15	7	15.00	4.4123E-05	728b	32

MATERIAL 19 DENSITY 9.98200E-01 GRMS/CC NUMBER OF NUCLIDES 2 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2HINH2O	1	1.01	6.6661E-01	10293	64
2	J2O16	8	15.99	3.3339E-01	825b	33

MATERIAL 20 DENSITY 9.98200E-01 GRMS/CC NUMBER OF NUCLIDES 2 TEMPERATURE 293.0 DEGREES KELVIN

NUCLIDE NO.	NAME	ATOMIC NO.	ATOMIC WT	PROP BY NUCLIDE	DFN	LIBRARY NO.
1	J2HINH2O	1	1.01	6.6661E-01	10293	64
2	J2O16	8	15.99	3.3339E-01	825b	33

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
*******************************************************
* ENTERING ROUTINE TO DISTRIBUTE THE INPUT DATA TO     *
* MODULE 37371 (HOLE MODULE)                           *
*******************************************************


NO. OF HOLES REFERENCED IN THE GEOMETRY DATA =        7
TOTAL NUMBER OF HOLES                        =       10
TOTAL NUMBER OF MATERIALS                    =       19


*******************************************************
* ENTERING ROUTINE TO DISTRIBUTE THE INPUT DATA TO     *
* MODULE 16724 (ACTION TALLIES)                        *
*******************************************************


THE FOLLOWING SCORES WILL BE TALLIED AND PRINTED:
    SOURCE DISTRIBUTION COUNTS
    BOUNDARY CROSSING COUNTS
    MATERIAL ACTION COUNTS
    REGION ACTION COUNTS
    NEUTRON PARAMETERS
    SYSTEM CATEGORISATION
    FLUXES
    SAMPLING GUIDANCE
    ACTION TALLIES WILL BE NORMALISED TO 10000 SAMPLES


********************Q2*************************
*      END OF STAGE TWO PROCESSING            *
***********************************************


AT THE START OF THE TRACKING PROCESS THERE IS OVER A WEEK OF CPU TIME AVAILABLE


A TIME OF    30.000 SECS WILL BE ALLOWED FOR CREATING DUMP AND OUTPUT FILES


STAGE  -3 COMPLETED AFTER       0.31 MIN - K(THREE)= 0.9072 ( 0.0106)
 STAGE  -2 COMPLETED AFTER       0.69 MIN - K(THREE)= 0.9167 ( 0.0068)
 STAGE  -1 COMPLETED AFTER       1.05 MIN - K(THREE)= 0.9240 ( 0.0054)
 STAGE   0 COMPLETED AFTER       1.42 MIN - K(THREE)= 0.9222 ( 0.0048)
 STAGE   1 COMPLETED AFTER       1.83 MIN - K(THREE)= 0.9087 ( 0.0096)
 STAGE   2 COMPLETED AFTER       2.28 MIN - K(THREE)= 0.9278 ( 0.0063)
 STAGE   3 COMPLETED AFTER       2.73 MIN - K(THREE)= 0.9303 ( 0.0052)
 STAGE   4 COMPLETED AFTER       3.15 MIN - K(THREE)= 0.9329 ( 0.0047)
 STAGE   5 COMPLETED AFTER       3.54 MIN - K(THREE)= 0.9295 ( 0.0042)
 STAGE   6 COMPLETED AFTER       3.98 MIN - K(THREE)= 0.9308 ( 0.0039)
 STAGE   7 COMPLETED AFTER       4.41 MIN - K(THREE)= 0.9309 ( 0.0036)
 STAGE   8 COMPLETED AFTER       4.82 MIN - K(THREE)= 0.9316 ( 0.0034)
 STAGE   9 COMPLETED AFTER       5.23 MIN - K(THREE)= 0.9308 ( 0.0032)
 STAGE  10 COMPLETED AFTER       5.62 MIN - K(THREE)= 0.9291 ( 0.0030)
 STAGE  11 COMPLETED AFTER       6.05 MIN - K(THREE)= 0.9295 ( 0.0029)
 STAGE  12 COMPLETED AFTER       6.47 MIN - K(THREE)= 0.9289 ( 0.0028)
 STAGE  13 COMPLETED AFTER       6.86 MIN - K(THREE)= 0.9279 ( 0.0027)
 STAGE  14 COMPLETED AFTER       7.26 MIN - K(THREE)= 0.9279 ( 0.0025)
 STAGE  15 COMPLETED AFTER       7.65 MIN - K(THREE)= 0.9271 ( 0.0025)
 STAGE  16 COMPLETED AFTER       8.13 MIN - K(THREE)= 0.9280 ( 0.0024)
 STAGE  17 COMPLETED AFTER       8.60 MIN - K(THREE)= 0.9286 ( 0.0023)
 STAGE  18 COMPLETED AFTER       9.02 MIN - K(THREE)= 0.9284 ( 0.0022)
 STAGE  19 COMPLETED AFTER       9.54 MIN - K(THREE)= 0.9298 ( 0.0022)
 STAGE  20 COMPLETED AFTER       9.98 MIN - K(THREE)= 0.9300 ( 0.0021)
 STAGE  21 COMPLETED AFTER      10.43 MIN - K(THREE)= 0.9302 ( 0.0020)
 STAGE  22 COMPLETED AFTER      10.89 MIN - K(THREE)= 0.9305 ( 0.0020)
 STAGE  23 COMPLETED AFTER      11.33 MIN - K(THREE)= 0.9309 ( 0.0020)
 STAGE  24 COMPLETED AFTER      11.75 MIN - K(THREE)= 0.9314 ( 0.0019)
 STAGE  25 COMPLETED AFTER      12.20 MIN - K(THREE)= 0.9315 ( 0.0019)
 STAGE  26 COMPLETED AFTER      12.61 MIN - K(THREE)= 0.9313 ( 0.0019)
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
STAGE  27 COMPLETED AFTER    13.03 MIN - K(THREE)= 0.9310 ( 0.0018)
STAGE  28 COMPLETED AFTER    13.44 MIN - K(THREE)= 0.9311 ( 0.0018)
STAGE  29 COMPLETED AFTER    13.85 MIN - K(THREE)= 0.9311 ( 0.0018)
STAGE  30 COMPLETED AFTER    14.32 MIN - K(THREE)= 0.9311 ( 0.0017)
STAGE  31 COMPLETED AFTER    14.78 MIN - K(THREE)= 0.9315 ( 0.0017)
STAGE  32 COMPLETED AFTER    15.18 MIN - K(THREE)= 0.9317 ( 0.0017)
STAGE  33 COMPLETED AFTER    15.61 MIN - K(THREE)= 0.9319 ( 0.0017)
STAGE  34 COMPLETED AFTER    16.03 MIN - K(THREE)= 0.9319 ( 0.0016)
STAGE  35 COMPLETED AFTER    16.44 MIN - K(THREE)= 0.9316 ( 0.0016)
STAGE  36 COMPLETED AFTER    16.89 MIN - K(THREE)= 0.9318 ( 0.0016)
STAGE  37 COMPLETED AFTER    17.40 MIN - K(THREE)= 0.9320 ( 0.0016)
STAGE  38 COMPLETED AFTER    17.82 MIN - K(THREE)= 0.9316 ( 0.0015)
STAGE  39 COMPLETED AFTER    18.28 MIN - K(THREE)= 0.9318 ( 0.0015)
STAGE  40 COMPLETED AFTER    18.74 MIN - K(THREE)= 0.9315 ( 0.0015)
STAGE  41 COMPLETED AFTER    19.28 MIN - K(THREE)= 0.9319 ( 0.0015)
STAGE  42 COMPLETED AFTER    19.76 MIN - K(THREE)= 0.9321 ( 0.0015)
STAGE  43 COMPLETED AFTER    20.22 MIN - K(THREE)= 0.9318 ( 0.0014)
STAGE  44 COMPLETED AFTER    20.75 MIN - K(THREE)= 0.9320 ( 0.0014)
STAGE  45 COMPLETED AFTER    21.24 MIN - K(THREE)= 0.9322 ( 0.0014)
STAGE  46 COMPLETED AFTER    21.67 MIN - K(THREE)= 0.9321 ( 0.0014)
STAGE  47 COMPLETED AFTER    22.11 MIN - K(THREE)= 0.9319 ( 0.0014)
STAGE  48 COMPLETED AFTER    22.54 MIN - K(THREE)= 0.9317 ( 0.0014)
STAGE  49 COMPLETED AFTER    23.01 MIN - K(THREE)= 0.9316 ( 0.0013)
STAGE  50 COMPLETED AFTER    23.51 MIN - K(THREE)= 0.9320 ( 0.0013)
STAGE  51 COMPLETED AFTER    23.95 MIN - K(THREE)= 0.9320 ( 0.0013)
STAGE  52 COMPLETED AFTER    24.45 MIN - K(THREE)= 0.9322 ( 0.0013)
STAGE  53 COMPLETED AFTER    24.91 MIN - K(THREE)= 0.9322 ( 0.0013)
STAGE  54 COMPLETED AFTER    25.35 MIN - K(THREE)= 0.9320 ( 0.0013)
STAGE  55 COMPLETED AFTER    25.81 MIN - K(THREE)= 0.9320 ( 0.0013)
STAGE  56 COMPLETED AFTER    26.24 MIN - K(THREE)= 0.9318 ( 0.0013)
STAGE  57 COMPLETED AFTER    26.77 MIN - K(THREE)= 0.9321 ( 0.0012)
STAGE  58 COMPLETED AFTER    27.32 MIN - K(THREE)= 0.9324 ( 0.0012)
STAGE  59 COMPLETED AFTER    27.78 MIN - K(THREE)= 0.9324 ( 0.0012)
STAGE  60 COMPLETED AFTER    28.27 MIN - K(THREE)= 0.9326 ( 0.0012)
STAGE  61 COMPLETED AFTER    28.73 MIN - K(THREE)= 0.9326 ( 0.0012)
STAGE  62 COMPLETED AFTER    29.18 MIN - K(THREE)= 0.9325 ( 0.0012)
STAGE  63 COMPLETED AFTER    29.65 MIN - K(THREE)= 0.9324 ( 0.0012)
STAGE  64 COMPLETED AFTER    30.11 MIN - K(THREE)= 0.9323 ( 0.0012)
STAGE  65 COMPLETED AFTER    30.59 MIN - K(THREE)= 0.9323 ( 0.0012)
STAGE  66 COMPLETED AFTER    31.06 MIN - K(THREE)= 0.9323 ( 0.0012)
STAGE  67 COMPLETED AFTER    31.55 MIN - K(THREE)= 0.9324 ( 0.0011)
STAGE  68 COMPLETED AFTER    32.02 MIN - K(THREE)= 0.9326 ( 0.0011)
STAGE  69 COMPLETED AFTER    32.48 MIN - K(THREE)= 0.9326 ( 0.0011)
STAGE  70 COMPLETED AFTER    32.92 MIN - K(THREE)= 0.9328 ( 0.0011)
STAGE  71 COMPLETED AFTER    33.36 MIN - K(THREE)= 0.9328 ( 0.0011)
STAGE  72 COMPLETED AFTER    33.83 MIN - K(THREE)= 0.9330 ( 0.0011)
STAGE  73 COMPLETED AFTER    34.25 MIN - K(THREE)= 0.9327 ( 0.0011)
STAGE  74 COMPLETED AFTER    34.69 MIN - K(THREE)= 0.9326 ( 0.0011)
STAGE  75 COMPLETED AFTER    35.16 MIN - K(THREE)= 0.9327 ( 0.0011)
STAGE  76 COMPLETED AFTER    35.64 MIN - K(THREE)= 0.9327 ( 0.0011)
STAGE  77 COMPLETED AFTER    36.07 MIN - K(THREE)= 0.9325 ( 0.0011)
STAGE  78 COMPLETED AFTER    36.56 MIN - K(THREE)= 0.9325 ( 0.0011)
STAGE  79 COMPLETED AFTER    37.02 MIN - K(THREE)= 0.9324 ( 0.0011)
STAGE  80 COMPLETED AFTER    37.50 MIN - K(THREE)= 0.9326 ( 0.0011)
STAGE  81 COMPLETED AFTER    38.00 MIN - K(THREE)= 0.9326 ( 0.0010)
STAGE  82 COMPLETED AFTER    38.42 MIN - K(THREE)= 0.9327 ( 0.0010)
STAGE  83 COMPLETED AFTER    38.90 MIN - K(THREE)= 0.9327 ( 0.0010)
STAGE  84 COMPLETED AFTER    39.36 MIN - K(THREE)= 0.9326 ( 0.0010)
STAGE  85 COMPLETED AFTER    39.85 MIN - K(THREE)= 0.9326 ( 0.0010)
STAGE  86 COMPLETED AFTER    40.28 MIN - K(THREE)= 0.9324 ( 0.0010)
STAGE  87 COMPLETED AFTER    40.70 MIN - K(THREE)= 0.9323 ( 0.0010)
STAGE  88 COMPLETED AFTER    41.16 MIN - K(THREE)= 0.9322 ( 0.0010)
STAGE  89 COMPLETED AFTER    41.62 MIN - K(THREE)= 0.9321 ( 0.0010)
STAGE  90 COMPLETED AFTER    42.06 MIN - K(THREE)= 0.9320 ( 0.0010)
STAGE  91 COMPLETED AFTER    42.52 MIN - K(THREE)= 0.9321 ( 0.0010)
STAGE  92 COMPLETED AFTER    42.97 MIN - K(THREE)= 0.9320 ( 0.0010)
STAGE  93 COMPLETED AFTER    43.47 MIN - K(THREE)= 0.9321 ( 0.0010)
STAGE  94 COMPLETED AFTER    43.94 MIN - K(THREE)= 0.9322 ( 0.0010)
STAGE  95 COMPLETED AFTER    44.41 MIN - K(THREE)= 0.9322 ( 0.0010)
STAGE  96 COMPLETED AFTER    44.84 MIN - K(THREE)= 0.9322 ( 0.0010)
STAGE  97 COMPLETED AFTER    45.25 MIN - K(THREE)= 0.9321 ( 0.0010)
STAGE  98 COMPLETED AFTER    45.75 MIN - K(THREE)= 0.9322 ( 0.0010)
STAGE  99 COMPLETED AFTER    46.21 MIN - K(THREE)= 0.9320 ( 0.0010)
STAGE 100 COMPLETED AFTER    46.75 MIN - K(THREE)= 0.9322 ( 0.0009)
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
STAGE 101 COMPLETED AFTER     47.24 MIN - K(THREE)= 0.9321 ( 0.0009)
STAGE 102 COMPLETED AFTER     47.76 MIN - K(THREE)= 0.9319 ( 0.0009)
STAGE 103 COMPLETED AFTER     48.20 MIN - K(THREE)= 0.9319 ( 0.0009)
STAGE 104 COMPLETED AFTER     48.65 MIN - K(THREE)= 0.9319 ( 0.0009)
STAGE 105 COMPLETED AFTER     49.12 MIN - K(THREE)= 0.9319 ( 0.0009)
STAGE 106 COMPLETED AFTER     49.52 MIN - K(THREE)= 0.9316 ( 0.0009)
STAGE 107 COMPLETED AFTER     50.02 MIN - K(THREE)= 0.9317 ( 0.0009)
STAGE 108 COMPLETED AFTER     50.43 MIN - K(THREE)= 0.9316 ( 0.0009)
STAGE 109 COMPLETED AFTER     50.88 MIN - K(THREE)= 0.9315 ( 0.0009)
STAGE 110 COMPLETED AFTER     51.35 MIN - K(THREE)= 0.9315 ( 0.0009)
STAGE 111 COMPLETED AFTER     51.80 MIN - K(THREE)= 0.9314 ( 0.0009)
STAGE 112 COMPLETED AFTER     52.26 MIN - K(THREE)= 0.9313 ( 0.0009)
STAGE 113 COMPLETED AFTER     52.71 MIN - K(THREE)= 0.9311 ( 0.0009)
STAGE 114 COMPLETED AFTER     53.14 MIN - K(THREE)= 0.9310 ( 0.0009)
STAGE 115 COMPLETED AFTER     53.63 MIN - K(THREE)= 0.9310 ( 0.0009)
STAGE 116 COMPLETED AFTER     54.08 MIN - K(THREE)= 0.9310 ( 0.0009)
STAGE 117 COMPLETED AFTER     54.52 MIN - K(THREE)= 0.9309 ( 0.0009)
STAGE 118 COMPLETED AFTER     54.99 MIN - K(THREE)= 0.9309 ( 0.0009)
STAGE 119 COMPLETED AFTER     55.47 MIN - K(THREE)= 0.9309 ( 0.0009)
STAGE 120 COMPLETED AFTER     55.92 MIN - K(THREE)= 0.9309 ( 0.0009)
STAGE 121 COMPLETED AFTER     56.42 MIN - K(THREE)= 0.9310 ( 0.0009)
STAGE 122 COMPLETED AFTER     56.89 MIN - K(THREE)= 0.9310 ( 0.0009)
STAGE 123 COMPLETED AFTER     57.32 MIN - K(THREE)= 0.9310 ( 0.0009)
STAGE 124 COMPLETED AFTER     57.77 MIN - K(THREE)= 0.9310 ( 0.0009)
STAGE 125 COMPLETED AFTER     58.23 MIN - K(THREE)= 0.9311 ( 0.0009)
STAGE 126 COMPLETED AFTER     58.72 MIN - K(THREE)= 0.9311 ( 0.0008)
STAGE 127 COMPLETED AFTER     59.18 MIN - K(THREE)= 0.9310 ( 0.0008)
STAGE 128 COMPLETED AFTER     59.61 MIN - K(THREE)= 0.9310 ( 0.0008)
STAGE 129 COMPLETED AFTER     60.06 MIN - K(THREE)= 0.9310 ( 0.0008)
STAGE 130 COMPLETED AFTER     60.56 MIN - K(THREE)= 0.9310 ( 0.0008)
STAGE 131 COMPLETED AFTER     61.03 MIN - K(THREE)= 0.9311 ( 0.0008)
STAGE 132 COMPLETED AFTER     61.49 MIN - K(THREE)= 0.9311 ( 0.0008)
STAGE 133 COMPLETED AFTER     61.94 MIN - K(THREE)= 0.9310 ( 0.0008)
STAGE 134 COMPLETED AFTER     62.40 MIN - K(THREE)= 0.9309 ( 0.0008)
STAGE 135 COMPLETED AFTER     62.90 MIN - K(THREE)= 0.9309 ( 0.0008)
STAGE 136 COMPLETED AFTER     63.43 MIN - K(THREE)= 0.9310 ( 0.0008)
STAGE 137 COMPLETED AFTER     63.94 MIN - K(THREE)= 0.9312 ( 0.0008)
STAGE 138 COMPLETED AFTER     64.47 MIN - K(THREE)= 0.9312 ( 0.0008)
STAGE 139 COMPLETED AFTER     64.97 MIN - K(THREE)= 0.9313 ( 0.0008)
STAGE 140 COMPLETED AFTER     65.39 MIN - K(THREE)= 0.9313 ( 0.0008)
STAGE 141 COMPLETED AFTER     65.84 MIN - K(THREE)= 0.9313 ( 0.0008)
STAGE 142 COMPLETED AFTER     66.30 MIN - K(THREE)= 0.9313 ( 0.0008)

*********************************************************
* REQUIRED ACCURACY (SD=  0.000800) REACHED BY K(THREE) *
* EXECUTION ENDS AFTER STAGE   142                      *
*********************************************************

OUTPUT FROM MONK8A (1/2/1998) AT 18.40.37 ON 15/ 9/2000
=====================QO===============================

NUMBER OF SUPERHISTORIES POST-SETTLING  =      142000
NUMBER OF SAMPLES POST-SETTLING         =     1426292
FIRST STAGE RUN                         =          -3
FINAL STAGE COMPLETED                   =         142
TOTAL C.P.U. TIME (SECONDS )            =    3977.996
AVERAGE TIME PER SAMPLE(SECONDS )       =       0.027
AVERAGE TIME PER STAGE(SECONDS )        =      27.247
AVERAGE SAMPLES PER SECONDS             =          36
NUMBER OF RANDOM NUMBERS USED           =   569634827
AFTER SEEDING WITH VALUES               =       54321       54321
TRAJECTORIES TRACKED THIS RUN           =    58521395
NUMBER OF COLLISIONS THIS RUN           =    75810555
ZONE SEARCH LOCATIONS USED(PAIRS)       =         350
1*************************************************************************************************************************
 *************************************    CUMULATIVE    K-EFFECTIVE    ESTIMATORS    **********************************
 ************************************************************************************************************************
 *  STAGE     K(COLL)   STDV      K(SCORE)  STDV      A(SCORE)  STDV      ALPHA     BETA          K(THREE)  STDV      *
 ************************************************************************************************************************
 *                                                                                                                      *
 *    1       0.9195    0.0129    0.9050    0.0124    0.9973    0.0077    0.0841    0.9162        0.9087    0.0096    *
 *    2       0.9291    0.0086    0.9292    0.0088    1.0014    0.0052    0.1753    0.9592        0.9278    0.0063    *
 *    3       0.9334    0.0068    0.9298    0.0074    1.0003    0.0044    0.2089    0.9211        0.9303    0.0052    *
 *    4       0.9352    0.0060    0.9307    0.0065    0.9985    0.0038    0.2063    0.9112        0.9329    0.0047    *
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

*	5	0.9306	0.0054	0.9263	0.0060	0.9975	0.0034	0.2220	0.9323	0.9295	0.0042	*
*	6	0.9319	0.0049	0.9287	0.0056	0.9985	0.0032	0.2460	0.9143	0.9308	0.0039	*
*	7	0.9315	0.0045	0.9285	0.0052	0.9982	0.0030	0.2426	0.9183	0.9309	0.0036	*
*	8	0.9310	0.0043	0.9298	0.0049	0.9984	0.0028	0.2473	0.9013	0.9316	0.0034	*
*	9	0.9288	0.0040	0.9300	0.0045	0.9987	0.0027	0.2675	0.8580	0.9308	0.0032	*
*	10	0.9277	0.0039	0.9277	0.0043	0.9983	0.0026	0.2520	0.8649	0.9291	0.0030	*
*	11	0.9286	0.0037	0.9282	0.0041	0.9987	0.0025	0.2552	0.8648	0.9295	0.0029	*
*	12	0.9290	0.0035	0.9269	0.0040	0.9983	0.0024	0.2499	0.8760	0.9289	0.0028	*
*	13	0.9281	0.0034	0.9267	0.0038	0.9990	0.0023	0.2468	0.8830	0.9279	0.0027	*
*	14	0.9276	0.0033	0.9288	0.0037	1.0007	0.0022	0.2587	0.8642	0.9279	0.0025	*
*	15	0.9270	0.0032	0.9280	0.0036	1.0007	0.0021	0.2613	0.8652	0.9271	0.0025	*
*	16	0.9286	0.0030	0.9285	0.0034	1.0006	0.0020	0.2649	0.8676	0.9280	0.0024	*
*	17	0.9293	0.0029	0.9292	0.0033	1.0008	0.0020	0.2717	0.8546	0.9286	0.0023	*
*	18	0.9291	0.0029	0.9293	0.0032	1.0010	0.0019	0.2718	0.8564	0.9284	0.0022	*
*	19	0.9304	0.0028	0.9308	0.0031	1.0010	0.0018	0.2718	0.8519	0.9298	0.0022	*
*	20	0.9303	0.0027	0.9309	0.0030	1.0009	0.0018	0.2773	0.8525	0.9300	0.0021	*
*	21	0.9305	0.0026	0.9308	0.0030	1.0006	0.0017	0.2762	0.8594	0.9302	0.0020	*
*	22	0.9312	0.0026	0.9312	0.0029	1.0008	0.0017	0.2659	0.8723	0.9305	0.0020	*
*	23	0.9319	0.0025	0.9309	0.0028	1.0003	0.0017	0.2538	0.8826	0.9309	0.0020	*
*	24	0.9320	0.0025	0.9318	0.0028	1.0004	0.0016	0.2604	0.8793	0.9314	0.0019	*
*	25	0.9324	0.0024	0.9319	0.0027	1.0006	0.0016	0.2609	0.8816	0.9315	0.0019	*
*	26	0.9320	0.0024	0.9319	0.0027	1.0007	0.0016	0.2635	0.8757	0.9313	0.0019	*
*	27	0.9317	0.0023	0.9319	0.0026	1.0010	0.0015	0.2681	0.8707	0.9310	0.0018	*
*	28	0.9317	0.0023	0.9314	0.0026	1.0004	0.0015	0.2700	0.8676	0.9311	0.0018	*
*	29	0.9315	0.0022	0.9313	0.0025	1.0004	0.0015	0.2730	0.8701	0.9311	0.0018	*
*	30	0.9319	0.0022	0.9310	0.0025	1.0001	0.0014	0.2682	0.8695	0.9311	0.0017	*
*	31	0.9325	0.0022	0.9318	0.0024	1.0006	0.0014	0.2705	0.8697	0.9315	0.0017	*
*	32	0.9324	0.0021	0.9321	0.0024	1.0005	0.0014	0.2685	0.8785	0.9317	0.0017	*
*	33	0.9325	0.0021	0.9323	0.0024	1.0004	0.0014	0.2634	0.8817	0.9319	0.0017	*
*	34	0.9326	0.0021	0.9321	0.0023	1.0004	0.0014	0.2595	0.8862	0.9319	0.0016	*
*	35	0.9325	0.0020	0.9323	0.0023	1.0008	0.0013	0.2596	0.8896	0.9316	0.0016	*
*	36	0.9327	0.0020	0.9322	0.0023	1.0006	0.0013	0.2576	0.8974	0.9318	0.0016	*
*	37	0.9334	0.0020	0.9327	0.0022	1.0010	0.0013	0.2574	0.8996	0.9320	0.0016	*
*	38	0.9329	0.0020	0.9323	0.0022	1.0010	0.0013	0.2579	0.8990	0.9316	0.0015	*
*	39	0.9330	0.0019	0.9323	0.0022	1.0008	0.0013	0.2579	0.8980	0.9318	0.0015	*
*	40	0.9326	0.0019	0.9320	0.0022	1.0007	0.0013	0.2617	0.8943	0.9315	0.0015	*
*	41	0.9331	0.0019	0.9328	0.0021	1.0012	0.0012	0.2630	0.8960	0.9319	0.0015	*
*	42	0.9333	0.0019	0.9331	0.0021	1.0011	0.0012	0.2665	0.8916	0.9321	0.0015	*
*	43	0.9331	0.0018	0.9326	0.0021	1.0010	0.0012	0.2654	0.8908	0.9318	0.0014	*
*	44	0.9334	0.0018	0.9330	0.0021	1.0012	0.0012	0.2649	0.8900	0.9320	0.0014	*
*	45	0.9337	0.0018	0.9331	0.0020	1.0012	0.0012	0.2643	0.8919	0.9322	0.0014	*
*	46	0.9332	0.0018	0.9330	0.0020	1.0011	0.0012	0.2651	0.8927	0.9321	0.0014	*
*	47	0.9330	0.0018	0.9331	0.0020	1.0013	0.0012	0.2635	0.8964	0.9319	0.0014	*
*	48	0.9327	0.0017	0.9329	0.0020	1.0013	0.0011	0.2621	0.8966	0.9317	0.0014	*
*	49	0.9329	0.0017	0.9331	0.0020	1.0015	0.0011	0.2630	0.8949	0.9316	0.0013	*
*	50	0.9332	0.0017	0.9333	0.0019	1.0015	0.0011	0.2629	0.8946	0.9320	0.0013	*
*	51	0.9332	0.0017	0.9335	0.0019	1.0016	0.0011	0.2630	0.8947	0.9320	0.0013	*
*	52	0.9335	0.0017	0.9338	0.0019	1.0017	0.0011	0.2640	0.8956	0.9322	0.0013	*
*	53	0.9334	0.0017	0.9336	0.0019	1.0015	0.0011	0.2635	0.8952	0.9322	0.0013	*
*	54	0.9332	0.0016	0.9332	0.0019	1.0013	0.0011	0.2644	0.8939	0.9320	0.0013	*
*	55	0.9332	0.0016	0.9330	0.0019	1.0011	0.0011	0.2623	0.8962	0.9320	0.0013	*
*	56	0.9330	0.0016	0.9326	0.0018	1.0009	0.0011	0.2621	0.8976	0.9318	0.0013	*
*	57	0.9331	0.0016	0.9329	0.0018	1.0010	0.0011	0.2645	0.8948	0.9321	0.0012	*
*	58	0.9337	0.0016	0.9333	0.0018	1.0011	0.0011	0.2625	0.8972	0.9324	0.0012	*
*	59	0.9335	0.0016	0.9330	0.0018	1.0008	0.0010	0.2640	0.8949	0.9324	0.0012	*
*	60	0.9339	0.0016	0.9333	0.0018	1.0010	0.0010	0.2622	0.8942	0.9326	0.0012	*
*	61	0.9338	0.0015	0.9333	0.0018	1.0009	0.0010	0.2616	0.8951	0.9326	0.0012	*
*	62	0.9337	0.0015	0.9332	0.0017	1.0009	0.0010	0.2615	0.8935	0.9325	0.0012	*
*	63	0.9338	0.0015	0.9331	0.0017	1.0010	0.0010	0.2614	0.8938	0.9324	0.0012	*
*	64	0.9336	0.0015	0.9334	0.0017	1.0013	0.0010	0.2650	0.8914	0.9323	0.0012	*
*	65	0.9335	0.0015	0.9331	0.0017	1.0011	0.0010	0.2622	0.8940	0.9323	0.0012	*
*	66	0.9336	0.0015	0.9331	0.0017	1.0010	0.0010	0.2599	0.8965	0.9323	0.0012	*
*	67	0.9338	0.0015	0.9333	0.0017	1.0012	0.0010	0.2592	0.8984	0.9324	0.0011	*
*	68	0.9340	0.0015	0.9335	0.0017	1.0012	0.0010	0.2604	0.8981	0.9326	0.0011	*
*	69	0.9339	0.0015	0.9334	0.0017	1.0010	0.0010	0.2611	0.8974	0.9326	0.0011	*
*	70	0.9341	0.0014	0.9333	0.0016	1.0008	0.0010	0.2565	0.9018	0.9328	0.0011	*
*	71	0.9339	0.0014	0.9336	0.0016	1.0010	0.0010	0.2567	0.9052	0.9328	0.0011	*
*	72	0.9341	0.0014	0.9337	0.0016	1.0009	0.0010	0.2537	0.9092	0.9330	0.0011	*
*	73	0.9338	0.0014	0.9333	0.0016	1.0007	0.0009	0.2533	0.9070	0.9327	0.0011	*
*	74	0.9337	0.0014	0.9330	0.0016	1.0006	0.0009	0.2533	0.9056	0.9326	0.0011	*
*	75	0.9338	0.0014	0.9332	0.0016	1.0008	0.0009	0.2546	0.9057	0.9327	0.0011	*
*	76	0.9339	0.0014	0.9333	0.0016	1.0009	0.0009	0.2551	0.9055	0.9327	0.0011	*
*	77	0.9335	0.0014	0.9332	0.0016	1.0009	0.0009	0.2577	0.9037	0.9325	0.0011	*
*	78	0.9336	0.0014	0.9333	0.0016	1.0009	0.0009	0.2576	0.9038	0.9325	0.0011	*

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

79	0.9335	0.0014	0.9334	0.0016	1.0011	0.0009	0.2589	0.9023	0.9324	0.0011
80	0.9336	0.0014	0.9334	0.0015	1.0009	0.0009	0.2587	0.9021	0.9326	0.0011
81	0.9336	0.0013	0.9334	0.0015	1.0010	0.0009	0.2594	0.9025	0.9326	0.0010
82	0.9336	0.0013	0.9335	0.0015	1.0009	0.0009	0.2589	0.9052	0.9327	0.0010
83	0.9337	0.0013	0.9333	0.0015	1.0008	0.0009	0.2555	0.9085	0.9327	0.0010
84	0.9335	0.0013	0.9332	0.0015	1.0008	0.0009	0.2576	0.9064	0.9326	0.0010
85	0.9336	0.0013	0.9332	0.0015	1.0008	0.0009	0.2571	0.9071	0.9326	0.0010
86	0.9334	0.0013	0.9330	0.0015	1.0008	0.0009	0.2567	0.9072	0.9324	0.0010
87	0.9333	0.0013	0.9328	0.0015	1.0007	0.0009	0.2563	0.9070	0.9323	0.0010
88	0.9332	0.0013	0.9329	0.0015	1.0009	0.0009	0.2575	0.9058	0.9322	0.0010
89	0.9330	0.0013	0.9327	0.0015	1.0007	0.0009	0.2572	0.9039	0.9321	0.0010
90	0.9329	0.0013	0.9324	0.0015	1.0005	0.0008	0.2558	0.9041	0.9320	0.0010
91	0.9329	0.0013	0.9326	0.0014	1.0006	0.0008	0.2577	0.9042	0.9321	0.0010
92	0.9329	0.0013	0.9324	0.0014	1.0005	0.0008	0.2572	0.9042	0.9320	0.0010
93	0.9330	0.0013	0.9324	0.0014	1.0006	0.0008	0.2576	0.9038	0.9321	0.0010
94	0.9330	0.0013	0.9326	0.0014	1.0006	0.0008	0.2580	0.9040	0.9322	0.0010
95	0.9330	0.0012	0.9324	0.0014	1.0004	0.0008	0.2567	0.9043	0.9322	0.0010
96	0.9329	0.0012	0.9324	0.0014	1.0004	0.0008	0.2568	0.9041	0.9322	0.0010
97	0.9327	0.0012	0.9324	0.0014	1.0004	0.0008	0.2582	0.9024	0.9321	0.0010
98	0.9328	0.0012	0.9324	0.0014	1.0004	0.0008	0.2586	0.9018	0.9322	0.0010
99	0.9326	0.0012	0.9324	0.0014	1.0004	0.0008	0.2599	0.9000	0.9320	0.0010
100	0.9329	0.0012	0.9324	0.0014	1.0004	0.0008	0.2585	0.9017	0.9322	0.0009
101	0.9329	0.0012	0.9324	0.0014	1.0004	0.0008	0.2583	0.9031	0.9321	0.0009
102	0.9328	0.0012	0.9321	0.0014	1.0004	0.0008	0.2571	0.9031	0.9319	0.0009
103	0.9328	0.0012	0.9319	0.0014	1.0002	0.0008	0.2560	0.9032	0.9319	0.0009
104	0.9327	0.0012	0.9319	0.0014	1.0002	0.0008	0.2566	0.9045	0.9319	0.0009
105	0.9326	0.0012	0.9317	0.0013	1.0001	0.0008	0.2560	0.9041	0.9319	0.0009
106	0.9324	0.0012	0.9316	0.0013	1.0002	0.0008	0.2571	0.9028	0.9316	0.0009
107	0.9325	0.0012	0.9316	0.0013	1.0002	0.0008	0.2577	0.9028	0.9317	0.0009
108	0.9323	0.0012	0.9315	0.0013	1.0002	0.0008	0.2579	0.9011	0.9316	0.0009
109	0.9322	0.0012	0.9313	0.0013	1.0001	0.0008	0.2585	0.8998	0.9315	0.0009
110	0.9321	0.0012	0.9312	0.0013	1.0000	0.0008	0.2591	0.8989	0.9315	0.0009
111	0.9320	0.0012	0.9311	0.0013	1.0000	0.0008	0.2591	0.8987	0.9314	0.0009
112	0.9319	0.0012	0.9308	0.0013	0.9998	0.0008	0.2581	0.8979	0.9313	0.0009
113	0.9318	0.0011	0.9305	0.0013	0.9997	0.0008	0.2580	0.8973	0.9311	0.0009
114	0.9317	0.0011	0.9303	0.0013	0.9996	0.0008	0.2576	0.8956	0.9310	0.0009
115	0.9316	0.0011	0.9303	0.0013	0.9996	0.0008	0.2583	0.8943	0.9310	0.0009
116	0.9315	0.0011	0.9302	0.0013	0.9996	0.0007	0.2585	0.8944	0.9310	0.0009
117	0.9315	0.0011	0.9301	0.0013	0.9995	0.0007	0.2575	0.8960	0.9309	0.0009
118	0.9314	0.0011	0.9302	0.0013	0.9995	0.0007	0.2583	0.8941	0.9309	0.0009
119	0.9314	0.0011	0.9302	0.0013	0.9996	0.0007	0.2595	0.8925	0.9309	0.0009
120	0.9315	0.0011	0.9303	0.0013	0.9997	0.0007	0.2603	0.8925	0.9309	0.0009
121	0.9315	0.0011	0.9305	0.0013	0.9998	0.0007	0.2613	0.8919	0.9310	0.0009
122	0.9316	0.0011	0.9306	0.0013	0.9999	0.0007	0.2622	0.8911	0.9310	0.0009
123	0.9315	0.0011	0.9306	0.0012	0.9999	0.0007	0.2626	0.8916	0.9310	0.0009
124	0.9315	0.0011	0.9307	0.0012	0.9999	0.0007	0.2621	0.8914	0.9310	0.0009
125	0.9316	0.0011	0.9307	0.0012	0.9999	0.0007	0.2615	0.8913	0.9311	0.0009
126	0.9316	0.0011	0.9308	0.0012	0.9999	0.0007	0.2611	0.8921	0.9311	0.0008
127	0.9315	0.0011	0.9307	0.0012	0.9999	0.0007	0.2618	0.8908	0.9310	0.0008
128	0.9314	0.0011	0.9307	0.0012	0.9999	0.0007	0.2619	0.8903	0.9310	0.0008
129	0.9314	0.0011	0.9308	0.0012	1.0000	0.0007	0.2626	0.8898	0.9310	0.0008
130	0.9314	0.0011	0.9309	0.0012	1.0000	0.0007	0.2640	0.8893	0.9310	0.0008
131	0.9314	0.0011	0.9310	0.0012	1.0000	0.0007	0.2639	0.8902	0.9311	0.0008
132	0.9313	0.0011	0.9310	0.0012	1.0000	0.0007	0.2639	0.8897	0.9311	0.0008
133	0.9312	0.0011	0.9309	0.0012	1.0000	0.0007	0.2637	0.8900	0.9310	0.0008
134	0.9313	0.0011	0.9308	0.0012	1.0000	0.0007	0.2632	0.8913	0.9309	0.0008
135	0.9313	0.0010	0.9308	0.0012	1.0000	0.0007	0.2634	0.8914	0.9309	0.0008
136	0.9315	0.0010	0.9308	0.0012	1.0000	0.0007	0.2627	0.8926	0.9310	0.0008
137	0.9317	0.0010	0.9311	0.0012	1.0000	0.0007	0.2636	0.8924	0.9312	0.0008
138	0.9318	0.0010	0.9312	0.0012	1.0001	0.0007	0.2649	0.8915	0.9312	0.0008
139	0.9319	0.0010	0.9311	0.0012	1.0000	0.0007	0.2639	0.8922	0.9313	0.0008
140	0.9318	0.0010	0.9311	0.0012	1.0000	0.0007	0.2646	0.8914	0.9313	0.0008
141	0.9317	0.0010	0.9311	0.0012	1.0000	0.0007	0.2653	0.8897	0.9313	0.0008
142	0.9317	0.0010	0.9311	0.0012	1.0000	0.0007	0.2660	0.8886	0.9313	0.0008

INDIVIDUAL STAGE K-EFFECTIVE ESTIMATORS

STAGE	K(COLL)	STDV	K(SCORE)	STDV	A(SCORE)	STDV	ALPHA	BETA	K(THREE)	STDV
-3	0.8951	0.0140	0.9146	0.0159	1.0005	0.0087	0.3553	0.8636	0.9072	0.0106
-2	0.9166	0.0117	0.9278	0.0135	1.0003	0.0078	0.3260	0.8554	0.9239	0.0089
-1	0.9376	0.0131	0.9669	0.0144	1.0226	0.0086	0.2679	0.9749	0.9370	0.0089
0	0.9135	0.0130	0.9359	0.0169	1.0096	0.0095	0.4350	0.9297	0.9172	0.0096

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

*	1	0.9195	0.0129	0.9050	0.0124	0.9973	0.0077	0.0841	0.9162	0.9087	0.0096	*
*	2	0.9373	0.0114	0.9497	0.0121	1.0049	0.0071	0.2484	0.9644	0.9419	0.0081	*
*	3	0.9419	0.0113	0.9311	0.0137	0.9979	0.0081	0.2730	0.8389	0.9358	0.0093	*
*	4	0.9406	0.0125	0.9333	0.0131	0.9933	0.0072	0.2029	0.8754	0.9406	0.0099	*
*	5	0.9097	0.0120	0.9065	0.0157	0.9931	0.0084	0.3116	0.9744	0.9142	0.0100	*
*	6	0.9386	0.0119	0.9402	0.0148	1.0032	0.0086	0.3587	0.8313	0.9370	0.0099	*
*	7	0.9290	0.0121	0.9276	0.0139	0.9960	0.0083	0.2208	0.9440	0.9317	0.0095	*
*	8	0.9271	0.0123	0.9395	0.0135	0.9998	0.0086	0.2760	0.7975	0.9362	0.0091	*
*	9	0.9102	0.0120	0.9310	0.0125	1.0014	0.0077	0.4306	0.4924	0.9214	0.0092	*
*	10	0.9168	0.0133	0.9049	0.0150	0.9950	0.0105	0.0862	0.9637	0.9108	0.0101	*
*	11	0.9376	0.0113	0.9333	0.0129	1.0018	0.0077	0.2868	0.8682	0.9329	0.0086	*
*	12	0.9334	0.0119	0.9122	0.0150	0.9948	0.0093	0.1896	0.9959	0.9214	0.0098	*
*	13	0.9161	0.0139	0.9245	0.0140	1.0079	0.0075	0.2063	0.9937	0.9149	0.0102	*
*	14	0.9207	0.0124	0.9584	0.0127	1.0239	0.0081	0.4102	0.6152	0.9282	0.0088	*
*	15	0.9181	0.0135	0.9149	0.0154	1.0003	0.0078	0.2993	0.8925	0.9156	0.0115	*
*	16	0.9488	0.0105	0.9357	0.0130	0.9992	0.0074	0.3042	0.9064	0.9403	0.0084	*
*	17	0.9397	0.0108	0.9396	0.0126	1.0040	0.0079	0.3529	0.6970	0.9369	0.0085	*
*	18	0.9261	0.0129	0.9312	0.0146	1.0049	0.0085	0.2770	0.8820	0.9255	0.0103	*
*	19	0.9484	0.0099	0.9517	0.0108	1.0016	0.0068	0.2643	0.7812	0.9495	0.0074	*
*	20	0.9295	0.0123	0.9330	0.0146	0.9973	0.0073	0.3696	0.8931	0.9342	0.0101	*
*	21	0.9335	0.0107	0.9290	0.0134	0.9961	0.0080	0.2522	0.9922	0.9340	0.0081	*
*	22	0.9440	0.0135	0.9399	0.0141	1.0039	0.0078	0.0907	1.1192	0.9359	0.0102	*
*	23	0.9477	0.0134	0.9225	0.0133	0.9894	0.0073	0.0439	1.0775	0.9350	0.0104	*
*	24	0.9342	0.0112	0.9528	0.0135	1.0049	0.0076	0.4250	0.7931	0.9410	0.0087	*
*	25	0.9410	0.0114	0.9344	0.0134	1.0040	0.0073	0.2731	0.9427	0.9325	0.0093	*
*	26	0.9221	0.0129	0.9326	0.0139	1.0031	0.0082	0.3336	0.7299	0.9268	0.0104	*
*	27	0.9222	0.0110	0.9335	0.0133	1.0104	0.0078	0.3901	0.7173	0.9217	0.0082	*
*	28	0.9335	0.0124	0.9159	0.0150	0.9825	0.0075	0.3440	0.7236	0.9346	0.0116	*
*	29	0.9258	0.0118	0.9297	0.0152	1.0003	0.0082	0.3601	0.9382	0.9280	0.0095	*
*	30	0.9423	0.0120	0.9212	0.0125	0.9925	0.0073	0.1544	0.8211	0.9307	0.0099	*
*	31	0.9483	0.0104	0.9557	0.0124	1.0144	0.0078	0.3563	0.8204	0.9412	0.0078	*
*	32	0.9296	0.0142	0.9404	0.0157	0.9976	0.0080	0.1896	1.1882	0.9413	0.0109	*
*	33	0.9338	0.0133	0.9392	0.0130	0.9987	0.0081	0.1250	0.9802	0.9398	0.0091	*
*	34	0.9374	0.0123	0.9251	0.0138	0.9984	0.0086	0.1225	1.0395	0.9282	0.0094	*
*	35	0.9300	0.0122	0.9397	0.0144	1.0165	0.0085	0.2715	0.9898	0.9207	0.0089	*
*	36	0.9388	0.0115	0.9287	0.0139	0.9939	0.0076	0.1855	1.1751	0.9378	0.0089	*
*	37	0.9552	0.0112	0.9497	0.0127	1.0125	0.0073	0.2650	0.9421	0.9394	0.0085	*
*	38	0.9140	0.0136	0.9137	0.0159	1.0013	0.0090	0.2889	0.8661	0.9127	0.0114	*
*	39	0.9345	0.0125	0.9339	0.0140	0.9944	0.0080	0.2600	0.8631	0.9389	0.0100	*
*	40	0.9164	0.0104	0.9199	0.0142	0.9971	0.0086	0.4411	0.7032	0.9204	0.0085	*
*	41	0.9526	0.0103	0.9599	0.0119	1.0159	0.0075	0.3193	0.9036	0.9432	0.0072	*
*	42	0.9415	0.0111	0.9433	0.0139	1.0001	0.0082	0.4005	0.7294	0.9425	0.0093	*
*	43	0.9216	0.0113	0.9127	0.0131	0.9975	0.0088	0.2044	0.8667	0.9167	0.0086	*
*	44	0.9477	0.0117	0.9487	0.0124	1.0088	0.0072	0.2652	0.8369	0.9411	0.0089	*
*	45	0.9445	0.0116	0.9374	0.0136	1.0010	0.0077	0.2367	0.9730	0.9381	0.0089	*
*	46	0.9095	0.0124	0.9296	0.0143	0.9967	0.0079	0.3229	0.9268	0.9262	0.0093	*
*	47	0.9237	0.0144	0.9377	0.0146	1.0105	0.0081	0.1930	1.0598	0.9239	0.0102	*
*	48	0.9161	0.0141	0.9220	0.0142	1.0011	0.0084	0.1812	0.9084	0.9199	0.0105	*
*	49	0.9393	0.0116	0.9402	0.0142	1.0117	0.0089	0.3101	0.8215	0.9303	0.0092	*
*	50	0.9483	0.0113	0.9462	0.0137	1.0004	0.0083	0.2685	0.8802	0.9464	0.0084	*
*	51	0.9358	0.0129	0.9446	0.0143	1.0082	0.0087	0.2670	0.8964	0.9348	0.0094	*
*	52	0.9449	0.0114	0.9438	0.0143	1.0031	0.0081	0.3121	0.9253	0.9414	0.0090	*
*	53	0.9304	0.0117	0.9238	0.0135	0.9927	0.0082	0.2366	0.8668	0.9316	0.0096	*
*	54	0.9184	0.0114	0.9110	0.0144	0.9934	0.0087	0.3229	0.7995	0.9187	0.0094	*
*	55	0.9354	0.0116	0.9227	0.0134	0.9889	0.0081	0.1331	1.0369	0.9359	0.0090	*
*	56	0.9199	0.0124	0.9086	0.0150	0.9902	0.0081	0.2520	0.9731	0.9210	0.0106	*
*	57	0.9409	0.0110	0.9491	0.0136	1.0022	0.0081	0.3756	0.7595	0.9443	0.0084	*
*	58	0.9604	0.0110	0.9504	0.0125	1.0055	0.0077	0.2011	0.9601	0.9472	0.0081	*
*	59	0.9239	0.0110	0.9149	0.0151	0.9883	0.0090	0.4070	0.7126	0.9269	0.0102	*
*	60	0.9529	0.0132	0.9523	0.0129	1.0079	0.0076	0.1793	0.8312	0.9458	0.0100	*
*	61	0.9295	0.0124	0.9329	0.0145	0.9973	0.0089	0.2198	0.9589	0.9347	0.0093	*
*	62	0.9310	0.0122	0.9256	0.0133	1.0024	0.0081	0.2517	0.7817	0.9251	0.0096	*
*	63	0.9349	0.0119	0.9291	0.0130	1.0030	0.0075	0.2553	0.9134	0.9278	0.0087	*
*	64	0.9205	0.0127	0.9553	0.0145	1.0231	0.0076	0.5181	0.7500	0.9199	0.0093	*
*	65	0.9313	0.0125	0.9155	0.0131	0.9893	0.0079	0.1116	1.0426	0.9284	0.0091	*
*	66	0.9395	0.0122	0.9276	0.0135	0.9968	0.0082	0.1073	1.0772	0.9324	0.0090	*
*	67	0.9483	0.0121	0.9458	0.0142	1.0087	0.0087	0.2338	0.9858	0.9378	0.0086	*
*	68	0.9431	0.0114	0.9478	0.0139	1.0027	0.0080	0.3315	0.8804	0.9439	0.0085	*
*	69	0.9268	0.0122	0.9272	0.0148	0.9916	0.0084	0.3204	0.8270	0.9340	0.0102	*
*	70	0.9480	0.0141	0.9246	0.0134	0.9835	0.0074	-0.0515	1.1876	0.9430	0.0105	*
*	71	0.9232	0.0151	0.9569	0.0167	1.0130	0.0094	0.2734	1.0548	0.9339	0.0103	*
*	72	0.9485	0.0138	0.9395	0.0138	0.9961	0.0082	0.1036	1.0984	0.9447	0.0095	*
*	73	0.9090	0.0134	0.9005	0.0145	0.9871	0.0088	0.2461	0.6694	0.9112	0.0115	*
*	74	0.9260	0.0118	0.9145	0.0135	0.9924	0.0082	0.2623	0.7693	0.9233	0.0096	*

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
*   75   0.9413  0.0122   0.9493  0.0137   1.0110  0.0080   0.3276  0.9196     0.9366  0.0079   *
*   76   0.9354  0.0115   0.9396  0.0139   1.0078  0.0084   0.2986  0.8857     0.9314  0.0088   *
*   77   0.9041  0.0117   0.9268  0.0151   1.0064  0.0086   0.4818  0.7575     0.9110  0.0085   *
*   78   0.9415  0.0115   0.9378  0.0135   1.0029  0.0083   0.2484  0.9104     0.9361  0.0090   *
*   79   0.9196  0.0118   0.9378  0.0136   1.0114  0.0083   0.3701  0.7806     0.9221  0.0088   *
*   80   0.9435  0.0113   0.9359  0.0125   0.9909  0.0073   0.2476  0.8885     0.9459  0.0087   *
*   81   0.9347  0.0107   0.9340  0.0139   1.0022  0.0081   0.3262  0.9097     0.9322  0.0087   *
*   82   0.9365  0.0144   0.9436  0.0154   0.9996  0.0076   0.2178  1.1815     0.9426  0.0105   *
*   83   0.9421  0.0129   0.9194  0.0126   0.9890  0.0076   0.0021  1.1353     0.9319  0.0092   *
*   84   0.9146  0.0115   0.9237  0.0149   1.0040  0.0082   0.4612  0.6578     0.9169  0.0094   *
*   85   0.9398  0.0112   0.9279  0.0127   0.9951  0.0071   0.2039  0.9628     0.9350  0.0094   *
*   86   0.9150  0.0128   0.9168  0.0140   1.0002  0.0081   0.2267  0.9265     0.9162  0.0098   *
*   87   0.9268  0.0150   0.9115  0.0148   0.9989  0.0075   0.1963  0.8652     0.9155  0.0122   *
*   88   0.9180  0.0120   0.9453  0.0132   1.0130  0.0078   0.3842  0.7888     0.9246  0.0086   *
*   89   0.9184  0.0124   0.9101  0.0125   0.9840  0.0071   0.2519  0.5945     0.9217  0.0104   *
*   90   0.9233  0.0127   0.9025  0.0134   0.9860  0.0075   0.1304  0.8784     0.9176  0.0108   *
*   91   0.9359  0.0119   0.9516  0.0148   1.0093  0.0080   0.4398  0.8921     0.9364  0.0090   *
*   92   0.9292  0.0121   0.9159  0.0132   0.9910  0.0077   0.2073  0.8861     0.9266  0.0096   *
*   93   0.9402  0.0115   0.9378  0.0128   1.0032  0.0073   0.2851  0.8707     0.9356  0.0090   *
*   94   0.9344  0.0115   0.9456  0.0140   1.0019  0.0084   0.2832  0.9231     0.9407  0.0087   *
*   95   0.9352  0.0127   0.9147  0.0138   0.9806  0.0079   0.1366  0.9134     0.9352  0.0107   *
*   96   0.9209  0.0134   0.9376  0.0141   1.0049  0.0084   0.2687  0.8925     0.9288  0.0092   *
*   97   0.9067  0.0135   0.9307  0.0160   1.0037  0.0092   0.4413  0.6620     0.9176  0.0106   *
*   98   0.9432  0.0123   0.9302  0.0145   0.9960  0.0079   0.2927  0.8608     0.9375  0.0105   *
*   99   0.9137  0.0107   0.9312  0.0138   1.0076  0.0088   0.4137  0.6576     0.9190  0.0077   *
*  100   0.9559  0.0113   0.9338  0.0126   0.9956  0.0069   0.1557  1.0458     0.9418  0.0091   *
*  101   0.9339  0.0118   0.9306  0.0134   1.0022  0.0074   0.2474  1.0442     0.9291  0.0089   *
*  102   0.9241  0.0118   0.9016  0.0130   0.9956  0.0086   0.1404  0.9052     0.9088  0.0090   *
*  103   0.9315  0.0134   0.9111  0.0136   0.9858  0.0079   0.1678  0.8515     0.9266  0.0102   *
*  104   0.9267  0.0123   0.9345  0.0154   0.9979  0.0086   0.3170  1.0249     0.9342  0.0092   *
*  105   0.9236  0.0126   0.9151  0.0138   0.9893  0.0083   0.1919  0.8749     0.9261  0.0102   *
*  106   0.8991  0.0132   0.9148  0.0149   1.0113  0.0084   0.4125  0.7450     0.8999  0.0102   *
*  107   0.9428  0.0120   0.9316  0.0147   0.9993  0.0083   0.3054  0.9145     0.9357  0.0097   *
*  108   0.9094  0.0144   0.9176  0.0151   0.9984  0.0093   0.2898  0.6919     0.9163  0.0114   *
*  109   0.9160  0.0120   0.9115  0.0142   0.9881  0.0080   0.3568  0.6876     0.9213  0.0105   *
*  110   0.9255  0.0120   0.9211  0.0146   0.9904  0.0080   0.3496  0.7460     0.9298  0.0107   *
*  111   0.9192  0.0119   0.9181  0.0138   0.9975  0.0079   0.2709  0.8695     0.9206  0.0095   *
*  112   0.9267  0.0119   0.8961  0.0119   0.9845  0.0073   0.1318  0.7111     0.9111  0.0099   *
*  113   0.9184  0.0119   0.8985  0.0133   0.9914  0.0080   0.2282  0.8004     0.9099  0.0100   *
*  114   0.9122  0.0130   0.9051  0.0130   0.9876  0.0083   0.2296  0.6337     0.9146  0.0101   *
*  115   0.9277  0.0115   0.9261  0.0134   0.9941  0.0075   0.3419  0.7219     0.9309  0.0096   *
*  116   0.9214  0.0118   0.9231  0.0137   0.9949  0.0075   0.2997  0.8945     0.9272  0.0095   *
*  117   0.9255  0.0133   0.9084  0.0145   0.9920  0.0083   0.1307  1.0806     0.9193  0.0104   *
*  118   0.9252  0.0117   0.9424  0.0122   1.0027  0.0071   0.3654  0.6279     0.9344  0.0087   *
*  119   0.9307  0.0110   0.9285  0.0137   1.0047  0.0081   0.3850  0.7430     0.9259  0.0089   *
*  120   0.9355  0.0132   0.9535  0.0150   1.0122  0.0085   0.3537  0.8683     0.9366  0.0098   *
*  121   0.9358  0.0112   0.9449  0.0136   1.0093  0.0075   0.3685  0.8108     0.9340  0.0087   *
*  122   0.9386  0.0116   0.9469  0.0136   1.0124  0.0081   0.3579  0.8001     0.9340  0.0087   *
*  123   0.9213  0.0129   0.9337  0.0153   1.0036  0.0087   0.3232  0.9504     0.9262  0.0097   *
*  124   0.9313  0.0132   0.9391  0.0138   1.0028  0.0085   0.2088  0.8743     0.9350  0.0098   *
*  125   0.9413  0.0131   0.9357  0.0137   0.9972  0.0081   0.1981  0.8731     0.9392  0.0099   *
*  126   0.9356  0.0113   0.9377  0.0124   0.9980  0.0074   0.2058  0.9977     0.9392  0.0081   *
*  127   0.9185  0.0112   0.9212  0.0135   1.0087  0.0084   0.3678  0.7453     0.9137  0.0090   *
*  128   0.9142  0.0131   0.9229  0.0139   0.9912  0.0079   0.2869  0.7784     0.9272  0.0100   *
*  129   0.9295  0.0118   0.9479  0.0141   1.0103  0.0086   0.3769  0.8090     0.9326  0.0089   *
*  130   0.9336  0.0104   0.9432  0.0139   1.0059  0.0080   0.4195  0.8109     0.9344  0.0079   *
*  131   0.9355  0.0123   0.9379  0.0137   1.0003  0.0072   0.2500  1.0264     0.9371  0.0095   *
*  132   0.9218  0.0126   0.9409  0.0123   1.0009  0.0076   0.2611  0.8039     0.9352  0.0084   *
*  133   0.9184  0.0125   0.9196  0.0147   1.0002  0.0091   0.2331  0.9375     0.9191  0.0093   *
*  134   0.9341  0.0120   0.9178  0.0140   0.9991  0.0074   0.1709  1.1236     0.9215  0.0097   *
*  135   0.9394  0.0105   0.9188  0.0138   0.9926  0.0080   0.2821  0.8896     0.9312  0.0092   *
*  136   0.9556  0.0107   0.9384  0.0133   1.0045  0.0081   0.1978  1.0134     0.9372  0.0085   *
*  137   0.9500  0.0113   0.9603  0.0133   1.0033  0.0074   0.3475  0.8754     0.9538  0.0087   *
*  138   0.9476  0.0107   0.9420  0.0138   1.0096  0.0077   0.4184  0.7942     0.9367  0.0092   *
*  139   0.9485  0.0120   0.9310  0.0130   0.9931  0.0074   0.1376  0.9936     0.9402  0.0097   *
*  140   0.9101  0.0132   0.9243  0.0150   0.9927  0.0085   0.3846  0.7448     0.9243  0.0106   *
*  141   0.9222  0.0119   0.9245  0.0134   0.9932  0.0076   0.3820  0.6121     0.9278  0.0099   *
*  142   0.9271  0.0111   0.9417  0.0134   1.0027  0.0084   0.3761  0.6994     0.9343  0.0084   *
*                                                                                                *
1***************************************************************************************************
*********************************************  NEUTRON  BALANCE  SUMMARY  *************************************************
*        ************ INDIVIDUAL STAGE COUNTS ************  *  **************** CUMULATIVE COUNTS ****************   *
*  STAGE  SAMPLE SCATTER CAPTURE FISSION CHILDREN N,2N ESCAPE  *  SAMPLE  SCATTER  CAPTURE FISSION CHILDREN N,2N ESCAPE  *
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Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

*	-3	7709	303968	4900	2812	6900	3	0	*									*
*	-2	9933	388745	6234	3708	9105	8	0	*									*
*	-1	9450	371158	5851	3609	8860	10	0	*									*
*	0	9614	378133	6041	3580	8783	7	0	*									*
*	1	9536	370098	5970	3574	8769	8	0	*	9536	370098	5970	3574	8769	8	0		*
*	2	11231	423892	6952	4288	10527	9	0	*	20767	793990	12922	7862	19295	17	0		*
*	3	10377	411650	6410	3978	9774	11	0	*	31144	1205640	19332	11840	29069	28	0		*
*	4	10321	396951	6381	3952	9708	12	0	*	41465	1602591	25713	15792	38777	40	0		*
*	5	9184	358888	5789	3402	8354	7	0	*	50649	1961479	31502	19194	47131	47	0		*
*	6	10490	404280	6490	4008	9846	8	0	*	61139	2365759	37992	23202	56977	55	0		*
*	7	10082	395128	6281	3811	9366	10	0	*	71221	2760887	44273	27013	66343	65	0		*
*	8	9689	377504	6046	3653	8982	10	0	*	80910	3138391	50319	30666	75326	75	0		*
*	9	9379	374832	5915	3475	8537	11	0	*	90289	3513223	56234	34141	83862	86	0		*
*	10	9104	356214	5713	3399	8347	8	0	*	99393	3869437	61947	37540	92209	94	0		*
*	11	10159	397342	6299	3874	9525	14	0	*	109552	4266779	68246	41414	101734	108	0		*
*	12	9897	382650	6143	3761	9238	7	0	*	119449	4649429	74389	45175	110972	115	0		*
*	13	9091	357957	5714	3389	8328	12	0	*	128540	5007386	80103	48564	119300	127	0		*
*	14	9295	369206	5816	3484	8558	5	0	*	137835	5376592	85919	52048	127857	132	0		*
*	15	9193	362142	5766	3435	8440	8	0	*	147028	5738734	91685	55483	136297	140	0		*
*	16	11400	442837	7008	4402	10816	10	0	*	158428	6181571	98693	59885	147113	150	0		*
*	17	11079	439274	6847	4238	10411	6	0	*	169507	6620845	105540	64123	157524	156	0		*
*	18	9655	387133	6016	3643	8942	4	0	*	179162	7007978	111556	67766	166466	160	0		*
*	19	12256	479280	7532	4732	11624	8	0	*	191418	7487258	119088	72498	178089	168	0		*
*	20	10435	413150	6501	3944	9699	10	0	*	201853	7900408	125589	76442	187789	178	0		*
*	21	10596	408462	6580	4028	9891	12	0	*	212449	8308870	132169	80470	197680	190	0		*
*	22	11059	429889	6817	4251	10440	9	0	*	223508	8738759	138986	84721	208120	199	0		*
*	23	10692	410293	6581	4125	10133	14	0	*	234200	9149052	145567	88846	218253	213	0		*
*	24	10046	387383	6230	3820	9384	4	0	*	244246	9536435	151797	92666	227637	217	0		*
*	25	10651	414808	6578	4081	10023	8	0	*	254897	9951243	158375	96747	237660	225	0		*
*	26	9471	375338	5926	3556	8733	11	0	*	264368	10326581	164301	100303	246394	236	0		*
*	27	9755	385220	6096	3665	8996	6	0	*	274123	10711801	170397	103968	255390	242	0		*
*	28	9954	381461	6187	3781	9292	14	0	*	284077	11093262	176584	107749	264682	256	0		*
*	29	9731	374928	6072	3670	9009	11	0	*	293808	11468190	182656	111419	273691	267	0		*
*	30	11135	441523	6874	4270	10493	9	0	*	304943	11909713	189530	115689	284184	276	0		*
*	31	10997	424271	6759	4248	10428	10	0	*	315940	12333984	196289	119937	294612	286	0		*
*	32	9548	366071	5941	3610	8876	3	0	*	325488	12700055	202230	123547	303487	289	0		*
*	33	10246	399032	6361	3893	9568	8	0	*	335734	13099087	208591	127440	313055	297	0		*
*	34	9957	385519	6159	3801	9334	3	0	*	345691	13484606	214750	131241	322389	300	0		*
*	35	9793	386211	6088	3711	9107	6	0	*	355484	13870817	220838	134952	331496	306	0		*
*	36	10613	409387	6560	4060	9964	7	0	*	366097	14280204	227398	139012	341460	313	0		*
*	37	10977	433629	6717	4269	10486	9	0	*	377074	14713833	234115	143281	351946	322	0		*
*	38	8678	342907	5462	3224	7932	8	0	*	385752	15056740	239577	146505	359878	330	0		*
*	39	10165	392203	6301	3866	9499	2	0	*	395917	15448943	245878	150371	369377	332	0		*
*	40	9784	379996	6146	3649	8966	11	0	*	405701	15828939	252024	154020	378343	343	0		*
*	41	11756	454332	7202	4564	11198	10	0	*	417457	16283271	259226	158584	389541	353	0		*
*	42	10567	411971	6523	4052	9949	8	0	*	428024	16695242	265749	162636	399490	361	0		*
*	43	9802	382644	6130	3679	9034	7	0	*	437826	17077886	271879	166315	408524	368	0		*
*	44	11285	447123	6933	4359	10695	7	0	*	449111	17525009	278812	170674	419218	375	0		*
*	45	10776	420644	6637	4147	10178	8	0	*	459887	17945653	285449	174821	429396	383	0		*
*	46	9187	355157	5795	3400	8355	8	0	*	469074	18300810	291244	178221	437752	391	0		*
*	47	9320	369224	5820	3507	8609	7	0	*	478394	18670034	297064	181728	446361	398	0		*
*	48	9125	358547	5732	3404	8360	11	0	*	487519	19028581	302796	185132	454720	409	0		*
*	49	9833	387945	6084	3757	9236	8	0	*	497352	19416526	308880	188889	463956	417	0		*
*	50	10863	424013	6680	4192	10302	9	0	*	508215	19840539	315560	193081	474258	426	0		*
*	51	9265	365015	5743	3528	8670	6	0	*	517480	20205554	321303	196609	482928	432	0		*
*	52	10751	422652	6629	4130	10159	8	0	*	528231	20628206	327932	200739	493087	440	0		*
*	53	10044	383143	6247	3803	9345	6	0	*	538275	21011349	334179	204542	502432	446	0		*
*	54	9340	364276	5853	3493	8578	6	0	*	547615	21375625	340032	208035	511010	452	0		*
*	55	10180	387203	6310	3878	9522	8	0	*	557795	21762828	346342	211913	520532	460	0		*
*	56	9401	360928	5889	3519	8648	7	0	*	567196	22123756	352231	215432	529180	467	0		*
*	57	11368	445909	7026	4350	10697	8	0	*	578564	22569665	359257	219782	539876	475	0		*
*	58	11943	467670	7282	4669	11469	8	0	*	590507	23037335	366539	224451	551346	483	0		*
*	59	10103	387518	6305	3802	9335	4	0	*	600610	23424853	372844	228253	560680	487	0		*
*	60	10551	413239	6465	4094	10054	8	0	*	611161	23838092	379309	232347	570735	495	0		*
*	61	9750	377179	6063	3691	9062	4	0	*	620911	24215271	385372	236038	579797	499	0		*
*	62	9538	373044	5928	3614	8880	4	0	*	630449	24588315	391300	239652	588677	503	0		*
*	63	10320	401207	6396	3930	9648	6	0	*	640769	24989522	397696	243582	598325	509	0		*
*	64	9653	381037	6045	3616	8886	8	0	*	650422	25370559	403741	247198	607210	517	0		*
*	65	10529	403921	6550	3992	9805	13	0	*	660951	25774480	410291	251190	617016	530	0		*
*	66	10152	389189	6284	3881	9538	12	0	*	671103	26163669	416575	255071	626554	542	0		*
*	67	10415	415196	6401	4017	9876	3	0	*	681518	26578865	422976	259088	636430	545	0		*
*	68	10299	395590	6355	3954	9713	10	0	*	691817	26974455	429331	263042	646144	555	0		*
*	69	9721	376525	6063	3668	9009	10	0	*	701538	27350980	435394	266710	655153	565	0		*
*	70	9747	373318	5996	3762	9240	11	0	*	711285	27724298	441390	270472	664393	576	0		*

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

*	71	9406	364063	5878	3534	8683	6	0	*	720691	28088361	447268	274006	673077	582	0	*
*	72	10157	390441	6241	3923	9634	7	0	*	730848	28478802	453509	277929	682710	589	0	*
*	73	8831	342957	5571	3271	8028	11	0	*	739679	28821759	459080	281200	690738	600	0	*
*	74	9587	365668	5976	3618	8878	7	0	*	749266	29187427	465056	284818	699616	607	0	*
*	75	10106	393760	6241	3874	9512	9	0	*	759372	29581187	471297	288692	709128	616	0	*
*	76	10476	407282	6505	3984	9799	13	0	*	769848	29988469	477802	292676	718927	629	0	*
*	77	8945	349689	5657	3292	8088	4	0	*	778793	30338158	483459	295968	727015	633	0	*
*	78	10529	409877	6503	4034	9913	8	0	*	789322	30748035	489962	300002	736928	641	0	*
*	79	9755	381335	6116	3651	8971	12	0	*	799077	31129370	496078	303653	745899	653	0	*
*	80	10691	402590	6590	4106	10087	5	0	*	809768	31531960	502668	307759	755986	658	0	*
*	81	10775	421272	6680	4097	10072	2	0	*	820543	31953232	509348	311856	766058	660	0	*
*	82	9152	353106	5666	3489	8570	3	0	*	829695	32306338	515014	315345	774628	663	0	*
*	83	10506	405308	6492	4028	9897	14	0	*	840201	32711646	521506	319373	784525	677	0	*
*	84	9627	376797	6047	3588	8804	8	0	*	849828	33088443	527553	322961	793330	685	0	*
*	85	10743	418817	6642	4110	10096	9	0	*	860571	33507260	534195	327071	803426	694	0	*
*	86	9061	353704	5692	3372	8291	3	0	*	869632	33860964	539887	330443	811717	697	0	*
*	87	8808	344454	5495	3325	8164	12	0	*	878440	34205418	545382	333768	819881	709	0	*
*	88	9702	386274	6084	3628	8906	10	0	*	888142	34591692	551466	337396	828787	719	0	*
*	89	9882	383794	6206	3691	9076	15	0	*	898024	34975486	557672	341087	837863	734	0	*
*	90	9375	368735	5859	3522	8656	6	0	*	907399	35344221	563531	344609	846519	740	0	*
*	91	9937	381849	6159	3789	9300	11	0	*	917336	35726070	569690	348398	855818	751	0	*
*	92	9655	375033	6013	3651	8972	9	0	*	926991	36101103	575703	352049	864790	760	0	*
*	93	10470	414806	6471	4010	9844	10	0	*	937461	36515909	582174	356059	874634	770	0	*
*	94	10145	395351	6292	3863	9479	10	0	*	947606	36911260	588466	359922	884113	780	0	*
*	95	10141	396303	6290	3858	9484	6	0	*	957747	37307563	594756	363780	893597	786	0	*
*	96	9144	354763	5726	3428	8420	10	0	*	966891	37662326	600482	367208	902017	796	0	*
*	97	8700	339068	5497	3213	7888	10	0	*	975591	38001394	605979	370421	909905	806	0	*
*	98	10503	419408	6479	4034	9907	10	0	*	986094	38420802	612458	374455	919812	816	0	*
*	99	9490	373098	5968	3532	8671	10	0	*	995584	38793900	618426	377987	928482	826	0	*
*	100	11597	457272	7099	4513	11085	15	0	*	1007181	39251172	625525	382500	939567	841	0	*
*	101	10223	401422	6348	3886	9548	11	0	*	1017404	39652594	631873	386386	949115	852	0	*
*	102	10794	428171	6739	4062	9974	7	0	*	1028198	40080765	638612	390448	959089	859	0	*
*	103	9424	366423	5856	3575	8778	7	0	*	1037622	40447188	644468	394023	967868	866	0	*
*	104	9613	379999	6000	3625	8909	12	0	*	1047235	40827187	650468	397648	976776	878	0	*
*	105	10085	394389	6299	3794	9314	8	0	*	1057320	41221576	656767	401442	986091	886	0	*
*	106	8326	331291	5288	3046	7486	8	0	*	1065646	41552867	662055	404488	993577	894	0	*
*	107	10726	420214	6620	4121	10112	14	0	*	1076372	41973081	668675	408609	1003689	908	0	*
*	108	8329	334121	5251	3083	7574	5	0	*	1084701	42307202	673926	411692	1011263	913	0	*
*	109	9668	376839	6074	3604	8855	10	0	*	1094369	42684041	680000	415296	1020119	923	0	*
*	110	10170	391351	6344	3832	9412	6	0	*	1104539	43075392	686344	419128	1029531	929	0	*
*	111	9621	377706	6028	3598	8844	5	0	*	1114160	43453098	692372	422726	1038375	934	0	*
*	112	9806	385311	6112	3700	9087	6	0	*	1123966	43838409	698484	426426	1047462	940	0	*
*	113	9480	377829	5944	3547	8706	11	0	*	1133446	44216238	704428	429973	1056168	951	0	*
*	114	9165	357364	5771	3400	8360	6	0	*	1142611	44573602	710199	433373	1064528	957	0	*
*	115	10419	413664	6491	3939	9666	11	0	*	1153030	44987266	716690	437312	1074193	968	0	*
*	116	9795	375112	6126	3676	9025	7	0	*	1162825	45362378	722816	440988	1083218	975	0	*
*	117	9341	360925	5831	3519	8645	9	0	*	1172166	45723303	728647	444507	1091864	984	0	*
*	118	10422	398939	6501	3929	9643	8	0	*	1182588	46122242	735148	448436	1101506	992	0	*
*	119	10291	405633	6398	3902	9578	9	0	*	1192879	46527875	741546	452338	1111084	1001	0	*
*	120	9525	371059	5900	3630	8911	5	0	*	1202404	46898934	747446	455968	1119995	1006	0	*
*	121	10765	415781	6673	4101	10074	9	0	*	1213169	47314715	754119	460069	1130068	1015	0	*
*	122	10070	393674	6224	3851	9452	5	0	*	1223239	47708389	760343	463920	1139520	1020	0	*
*	123	9285	357912	5816	3484	8555	14	0	*	1232524	48066301	766159	467404	1148075	1034	0	*
*	124	9810	378858	6099	3718	9136	7	0	*	1242334	48445159	772258	471122	1157211	1041	0	*
*	125	9798	382815	6052	3754	9222	7	0	*	1252132	48827974	778310	474876	1166433	1048	0	*
*	126	10566	402549	6547	4028	9886	9	0	*	1262698	49230523	784857	478904	1176319	1057	0	*
*	127	9934	388706	6228	3717	9125	11	0	*	1272632	49619229	791085	482621	1185444	1068	0	*
*	128	9068	354462	5701	3373	8290	6	0	*	1281700	49973691	796786	485994	1193733	1074	0	*
*	129	9682	381840	6028	3662	9000	8	0	*	1291382	50355531	802814	489656	1202733	1082	0	*
*	130	10651	414819	6614	4049	9944	12	0	*	1302033	50770350	809428	493705	1212677	1094	0	*
*	131	10541	405168	6531	4018	9861	8	0	*	1312574	51175518	815959	497723	1222538	1102	0	*
*	132	9645	380049	6028	3623	8891	5	0	*	1322219	51555567	821987	501346	1231429	1107	0	*
*	133	9425	370050	5905	3527	8656	7	0	*	1331644	51925617	827892	504873	1240084	1114	0	*
*	134	10136	388817	6293	3853	9468	10	0	*	1341780	52314434	834185	508726	1249553	1124	0	*
*	135	10866	422519	6718	4154	10208	6	0	*	1352646	52736953	840903	512880	1259760	1130	0	*
*	136	11492	450746	7026	4475	10982	9	0	*	1364138	53187699	847929	517355	1270742	1139	0	*
*	137	11319	433364	6960	4375	10753	16	0	*	1375457	53621063	854889	521730	1281495	1155	0	*
*	138	11593	443518	7123	4475	10985	5	0	*	1387050	54064581	862012	526205	1292481	1160	0	*
*	139	10690	422102	6568	4127	10139	5	0	*	1397740	54486683	868580	530332	1302620	1165	0	*
*	140	9075	349495	5723	3360	8259	8	0	*	1406815	54836178	874303	533692	1310879	1173	0	*
*	141	9566	368040	5986	3591	8822	11	0	*	1416381	55204218	880289	537283	1319701	1184	0	*
*	142	9911	386935	6173	3745	9188	7	0	*	1426292	55591153	886462	541028	1328889	1191	0	*

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1PLOT OF CUMULATIVE K(THREE) ESTIMATOR AGAINST STAGE NUMBER

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
0.900     0.905     0.910     0.915     0.920     0.925     0.930     0.935     0.940     0.945     0.950     0.955     0.960
   I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I
 1 -----------------X------------------I
 2                                            I------------X------------I
 3                                                    I---------X---------I
 4                                                          I--------X--------I
 5                                                    I-------X-------I
 6                                                       I-------X-------I
 7                                                        I------X------I
 8                                                         I------X------I
 9                                                         I-----X-----I
10                                                     I-----X-----I
11                                                      I-----X-----I
12                                                     I-----X-----I
13                                                    I----X----I
14                                                    I----X----I
15                                                  I----X----I
16                                                    I----X----I
17                                                     I----X----I
18                                                      I---X---I
19                                                         I---X---I
20                                                         I---X---I
21                                                         I---X---I
22                                                          I---X---I
23                                                           I---X---I
24                                                            I---X---I
25                                                            I---X---I
26                                                            I---X---I
27                                                           I---X---I
28                                                           I---X---I
29                                                           I---X---I
30                                                            I--X--I
31                                                             I--X--I
32                                                             I--X--I
33                                                              I--X--I
34                                                              I--X--I
35                                                             I--X--I
36                                                              I--X--I
37                                                              I--X--I
38                                                             I--X--I
39                                                              I--X--I
40                                                             I--X--I
41                                                              I--X--I
42                                                              I--X--I
43                                                              I--X--I
44                                                              I--X--I
45                                                              I--X--I
46                                                              I--X--I
47                                                              I--X--I
48                                                             I--X--I
49                                                             I--X--I
50                                                              I--X--I
51                                                              I--X--I
52                                                              I--X--I
53                                                              I--X--I
54                                                              I--X--I
55                                                              I--X--I
56                                                              I--X--I
57                                                               I-X-I
58                                                                I-X-I
59                                                                I-X-I
60                                                                I-X-I
61                                                                I-X-I
62                                                                I-X-I
63                                                                I-X-I
64                                                                I-X-I
65                                                                I-X-I
66                                                                I-X-I
67                                                                I-X-I
68                                                                I-X-I
69                                                                I-X-I
70                                                                 I-X-I
71                                                                 I-X-I
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
 72                                                                 I-X-I
 73                                                                I-X-I
 74                                                                I-X-I
 75                                                                I-X-I
 76                                                                I-X-I
 77                                                                I-X-I
 78                                                                I-X-I
 79                                                                I-X-I
 80                                                                I-X-I
 81                                                                I-X-I
 82                                                                I-X-I
 83                                                                I-X-I
 84                                                                I-X-I
 85                                                                I-X-I
 86                                                                I-X-I
 87                                                                I-X-I
 88                                                               I-X-I
 89                                                               I-X-I
 90                                                               I-X-I
 91                                                               I-X-I
 92                                                               I-X-I
 93                                                               I-X-I
 94                                                               I-X-I
 95                                                               I-X-I
 96                                                               I-X-I
 97                                                               I-X-I
 98                                                               I-X-I
 99                                                               I-X-I
100                                                               I-X-I
101                                                               I-X-I
102                                                               I-X-I
103                                                               I-X-I
104                                                               I-X-I
105                                                               I-X-I
106                                                              I-X-I
107                                                              I-X-I
108                                                              I-X-I
109                                                              I-X-I
110                                                              I-X-I
111                                                              I-X-I
112                                                              I-X-I
113                                                             I-X-I
114                                                             I-X-I
115                                                             I-X-I
116                                                             I-X-I
117                                                             I-X-I
118                                                             I-X-I
119                                                             I-X-I
120                                                             I-X-I
121                                                             I-X-I
122                                                             I-X-I
123                                                             I-X-I
124                                                             I-X-I
125                                                             I-X-I
126                                                             I-X-I
127                                                             I-X-I
128                                                             I-X-I
129                                                             I-X-I
130                                                             I-X-I
131                                                             I-X-I
132                                                             I-X-I
133                                                             I-X-I
134                                                             I-X-I
135                                                             I-X-I
136                                                             I-X-I
137                                                             I-X-I
138                                                             I-X-I
139                                                              I-X-I
140                                                              I-X-I
141                                                              I-X-I
142                                                              I-X-I
    I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I----I
  0.900     0.905     0.910     0.915     0.920     0.925     0.930     0.935     0.940     0.945     0.950     0.955     0.960
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

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******************************************************************************
******************************************************************************
**..........................................................................**
**.......                                                            .......**
**.......     FINAL VALUE OF K(THREE)  =  0.9313    ( STDV    = 0.0008 )  .......**
**.......                                                            .......**
**..........................................................................**
******************************************************************************
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MATERIAL 1	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	24697	2031	3793	1934	8	0	32463
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	4.61608E-01	6.94569E-02	1.70799E-01	1.94914E+00	8.60120E+00	1.34114E+01	4.93664E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	2.80124E-03	4.55603E-06	2.96161E-07	1.40450E+00	8.48512E+00	1.33863E+01	9.33308E-04

MATERIAL 2	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	5351	33	0	165	1	0	5550
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	4.64942E-01	1.40058E-01	0.00000E+00	3.43412E+00	1.03403E+01	0.00000E+00	5.52029E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	4.80826E-03	2.44472E-05	0.00000E+00	3.09289E+00	1.02145E+01	0.00000E+00	5.65020E-03

MATERIAL 3	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	340381	1136	0	10	0	0	341527
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	1.13264E-01	1.32774E-01	0.00000E+00	8.38188E+00	0.00000E+00	0.00000E+00	1.13561E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	5.27875E-06	6.37601E-08	0.00000E+00	8.28618E+00	0.00000E+00	0.00000E+00	5.20383E-06

MATERIAL 4	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	4228	10	0	0	0	0	4238
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	1.77507E-01	2.89506E-01	0.00000E+00	8.40470E+00	0.00000E+00	0.00000E+00	1.78119E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	4.27597E-05	1.70817E-07	0.00000E+00	8.32974E+00	0.00000E+00	0.00000E+00	4.22101E-05

MATERIAL 5	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	445	4	0	12	0	0	461
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	4.07169E-01	9.98868E-02	0.00000E+00	3.41218E+00	1.11034E+01	0.00000E+00	4.84884E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	1.89588E-03	1.00722E-05	0.00000E+00	3.07082E+00	1.09153E+01	0.00000E+00	2.21200E-03

MATERIAL 6	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	28	0	0	1	0	0	29
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	4.22067E-01	2.36067E-03	0.00000E+00	3.25322E+00	0.00000E+00	0.00000E+00	4.92761E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	2.30975E-03	3.47591E-06	0.00000E+00	2.92416E+00	0.00000E+00	0.00000E+00	2.65788E-03

MATERIAL 7	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	371	7	0	1	0	0	379
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	7.18499E-02	5.57958E-03	0.00000E+00	3.09424E+00	0.00000E+00	0.00000E+00	7.65652E-02
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	1.55491E-06	4.41302E-08	0.00000E+00	2.61663E+00	0.00000E+00	0.00000E+00	1.50181E-06

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

MATERIAL 8	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	78	1	0	0	0	0	79
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	3.76073E-02	9.91264E-08	0.00000E+00	4.26081E+00	0.00000E+00	0.00000E+00	4.11879E-02
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	2.21942E-07	2.81823E-08	0.00000E+00	3.62755E+00	0.00000E+00	0.00000E+00	2.19275E-07

MATERIAL 9	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	2178	74	0	72	0	0	2324
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	2.99537E-01	1.04150E-01	0.00000E+00	2.99848E+00	9.20106E+00	0.00000E+00	3.76362E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	5.48850E-04	1.79516E-07	0.00000E+00	2.47153E+00	9.20106E+00	0.00000E+00	5.50012E-04

MATERIAL 10	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	804	2438	0	11	0	0	3253
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	5.28858E-01	3.13167E-03	0.00000E+00	3.61397E+00	0.00000E+00	0.00000E+00	1.44993E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	1.35957E-02	2.73188E-07	0.00000E+00	3.17318E+00	0.00000E+00	0.00000E+00	4.17480E-06

MATERIAL 11	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	236	2	0	9	0	0	247
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	6.70501E-01	5.22666E-01	0.00000E+00	3.37984E+00	0.00000E+00	0.00000E+00	7.64902E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	5.68548E-02	8.69063E-07	0.00000E+00	2.97044E+00	0.00000E+00	0.00000E+00	6.10537E-02

MATERIAL 12	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	4414	348	0	97	0	0	4859
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	1.99235E-01	2.66845E-02	0.00000E+00	2.96924E+00	1.28827E+01	0.00000E+00	2.42245E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	3.51658E-05	6.17651E-08	0.00000E+00	2.43490E+00	1.28708E+01	0.00000E+00	2.78969E-05

MATERIAL 13	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	10	1	0	0	0	0	11
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	1.48663E-01	2.90288E-07	0.00000E+00	2.78299E+00	0.00000E+00	0.00000E+00	1.72410E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	6.69739E-06	4.38876E-08	0.00000E+00	2.03083E+00	0.00000E+00	0.00000E+00	5.06549E-06

MATERIAL 14	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	1178	37	0	33	0	0	1248
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	5.24631E-01	8.37436E-02	0.00000E+00	3.42078E+00	0.00000E+00	0.00000E+00	5.88168E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	2.18188E-03	5.05591E-08	0.00000E+00	3.02060E+00	0.00000E+00	0.00000E+00	1.92676E-03

MATERIAL 15	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	535	46	0	9	0	0	590
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	1.60907E-01	1.80555E-02	0.00000E+00	2.96621E+00	0.00000E+00	0.00000E+00	1.91034E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	1.85183E-05	6.07273E-08	0.00000E+00	2.33399E+00	0.00000E+00	0.00000E+00	1.41039E-05

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

MATERIAL 16	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	489	19	0	10	0	0	518
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	1.99776E-01	5.03783E-02	0.00000E+00	2.57752E+00	8.44186E+00	0.00000E+00	2.39550E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	2.61709E-04	1.68898E-07	0.00000E+00	1.98260E+00	8.44186E+00	0.00000E+00	2.35646E-04

MATERIAL 17	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	605	1	0	9	0	0	615
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	3.19062E-01	3.37821E-02	0.00000E+00	3.16794E+00	9.51841E+00	0.00000E+00	3.61278E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	8.12752E-04	2.93113E-07	0.00000E+00	2.67219E+00	9.44834E+00	0.00000E+00	9.01029E-04

MATERIAL 18	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	627	24	0	0	0	0	651
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	1.03265E-01	1.20080E-02	0.00000E+00	3.68962E+00	0.00000E+00	0.00000E+00	1.01454E-01
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	2.68269E-05	7.99855E-08	0.00000E+00	2.95077E+00	0.00000E+00	0.00000E+00	2.18204E-05

MATERIAL 19	ELASTIC	CAPTURE	FISSION	(N,N*)	(N,2N)	(N,3N)	TOTAL
TOTAL NO. OF EVENTS	733	3	0	0	0	0	736
MEAN ENERGY OF NEUTRONS CAUSING EVENTS (MEV)	7.83762E-02	8.00542E-02	0.00000E+00	7.67502E+00	0.00000E+00	0.00000E+00	7.85274E-02
MEAN LOG(ENERGY) OF NEUTRONS CAUSING EVENTS (MEV)	3.08455E-06	5.90435E-08	0.00000E+00	7.67253E+00	0.00000E+00	0.00000E+00	3.03881E-06

```
1CASE CATEGORISATION
==================

 THERE ARE 972 CATEGORIES SPLIT AS FOLLOWS :   A=1:URANIUM SYSTEMS.............   1 - 324
 *****************************************     A=2:PLUTONIUM SYSTEMS............ 325 - 648
                                               A=3:OTHER SYSTEMS................ 649 - 972

           WITHIN EACH 324 NUMBER SEGMENT :    B=1:LOW NON-FUEL ABSORPTION......   1 - 108
           ------------------------------      B=2:MEDIUM NON-FUEL ABSORPTION... 109 - 216
                                               B=3:HIGH NON-FUEL ABSORPTION..... 217 - 324

           WITHIN EACH 108 NUMBER SEGMENT :    C=1:LOW ASSEMBLIES...............   1 -  36
           ------------------------------      C=2:MEDIUM LEAKAGE SYSTEMS........ 37 -  72
                                               C=3:HIGH LEAKAGE SYSTEMS.......... 73 - 108

            WITHIN EACH 36 NUMBER SEGMENT :    D=1:LOW RESONANCE ABSORPTION......  1 - 12
            -----------------------------      D=2:MEDIUM RESONANCE ABSORPTION... 13 - 24
                                               D=3:HIGH RESONANCE ABSORPTION..... 25 - 36

            WITHIN EACH 12 NUMBER SEGMENT :    E=1:LOW FAST FISSION.............. 1 -  4
            -----------------------------      E=2:MEDIUM FAST FISSION........... 5 -  8
                                               E=3:HIGH FAST FISSION............. 9 - 12

             WITHIN EACH 4 NUMBER SEGMENT :    F=1:NO HYDROGEN................... 1
             ----------------------------      F=2:LOW HYDROGEN CONTENT........... 2
                                               F=3:MEDIUM HYDROGEN CONTENT........ 3
                                               F=4:HIGH HYDROGEN CONTENT.......... 4

 TYPE OF SYSTEM .................. A = 1        FRACTION OF FISSIONS IN URANIUM AND PLUTONIUM = 1.0000 0.0000

 NON-FUEL ABSORPTION ............. B = 2        FRACTION OF TOTAL ABSORPTIONS IN FUEL = 0.5805

 LEAKAGE ......................... C = 1        FRACTION OF NEUTRONS LEAKING = 0.0000

 RESONANCE ABSORPTION ............ D = 3        FRACTION OF ABSORPTIONS IN RESONANCE PARTITION = 0.2563

 FAST FISSION .................... E = 1        MEASURE OF FAST FISSION = 0.0284

 FUEL HYDROGEN CONTENT ........... F = 1        MEASURE OF HYDROGEN CONTENT =    0.0000
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
                    *********************************************
                    * THIS CASE FALLS INTO CATEGORY NUMBER  133 *
                    *********************************************

THE CATEGORY NUMBER IS NOT A GUARANTEED INDICATOR OF THE BIAS TO BE EXPECTED ON THE FINAL VALUE OF K-EFFECTIVE
IT SHOULD BE USED WITH CAUTION SINCE MANY OTHER FACTORS ARE INVOLVED (E.G. UNUSUAL/EXOTIC MATERIALS AND NUCLIDES)

1SAMPLING GUIDANCE
=================

  1.   NO PARTICLE TRACKS IN ZONE   6 FOR    46 STAGES

            The first  20 stages that this occurred are:

              -1    2    3    4    5    6   10   11   29   30   31   32   33   34   49   52   57   58   60

       NO PARTICLE TRACKS IN ZONE   10 FOR   115 STAGES

            The first  20 stages that this occurred are:

              -1    0    1    2    3    4    5    7    8   10   11   13   14   15   19   20   21   22   23

       NO PARTICLE TRACKS IN ZONE   16 FOR    26 STAGES

            The first  20 stages that this occurred are:

               7    8   15   27   30   32   52   59   60   77  112  114  115  116  117  118  124  128  130

       NO PARTICLE TRACKS IN ZONE   21 FOR    68 STAGES

            The first  20 stages that this occurred are:

              -1    0    2    3    4    5   11   13   15   24   25   26   27   28   29   30   31   32   33

       NO PARTICLE TRACKS IN ZONE   26 FOR    86 STAGES

            The first  20 stages that this occurred are:

              -2    0    1    2    5    7   13   15   16   21   22   24   25   27   28   30   31   33   34

       NO PARTICLE TRACKS IN ZONE   78 FOR   146 STAGES

            The first  20 stages that this occurred are:

              -3   -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15

       NO PARTICLE TRACKS IN ZONE   81 FOR   146 STAGES

            The first  20 stages that this occurred are:

              -3   -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15

       NO PARTICLE TRACKS IN ZONE   84 FOR   146 STAGES

            The first  20 stages that this occurred are:

              -3   -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15

       NO PARTICLE TRACKS IN ZONE   87 FOR   146 STAGES

            The first  20 stages that this occurred are:

              -3   -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15

       NO PARTICLE TRACKS IN ZONE   90 FOR   146 STAGES

            The first  20 stages that this occurred are:

              -3   -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15

       NO PARTICLE TRACKS IN ZONE   93 FOR   146 STAGES
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
      The first  20 stages that this occurred are:

        -3   -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15

  NO PARTICLE TRACKS IN ZONE   96 FOR   146 STAGES

      The first  20 stages that this occurred are:

        -3   -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15

  NO PARTICLE TRACKS IN ZONE  102 FOR STAGES:
        56   59   77  118  122  128  129  130  131  132  134  135  137  140

  NO PARTICLE TRACKS IN ZONE  103 FOR   138 STAGES

      The first  20 stages that this occurred are:

        -3   -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   15   16

  NO PARTICLE TRACKS IN ZONE  104 FOR   119 STAGES

      The first  20 stages that this occurred are:

        -3   -1    0    2    4    5    6    7    8    9   11   12   13   15   16   18   19   20   21

  NO PARTICLE TRACKS IN ZONE  110 FOR   119 STAGES

      The first  20 stages that this occurred are:

        -3   -2    0    1    2    3    4    5    6    7    8   10   12   13   14   15   17   19   20

  NO PARTICLE TRACKS IN ZONE  115 FOR   139 STAGES

      The first  20 stages that this occurred are:

        -3   -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15

  NO PARTICLE TRACKS IN ZONE  116 FOR    95 STAGES

      The first  20 stages that this occurred are:

        -1    0    2    4    5    7    8    9   11   16   18   19   20   21   22   24   25   26   29

  NO PARTICLE TRACKS IN ZONE  117 FOR   138 STAGES

      The first  20 stages that this occurred are:

        -3   -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15

  NO PARTICLE TRACKS IN ZONE  118 FOR    28 STAGES

      The first  20 stages that this occurred are:

         2    4    5    7   32   52   55   56   58   61   74   76   77   81  117  118  120  122  128

  NO PARTICLE TRACKS IN ZONE  119 FOR   146 STAGES

      The first  20 stages that this occurred are:

        -3   -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15

  NO PARTICLE TRACKS IN ZONE  120 FOR   146 STAGES

      The first  20 stages that this occurred are:

        -3   -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15

  NO PARTICLE TRACKS IN ZONE  121 FOR   145 STAGES

      The first  20 stages that this occurred are:

        -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16

  NO PARTICLE TRACKS IN ZONE  122 FOR   141 STAGES
```

Figure 6.7-9 MONK8a Output Summary for Connecticut Yankee Fuel Maximum Reactivity Condition (continued)

```
    The first  20 stages that this occurred are:

      -3   -2   -1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15

2.  SOURCE PARTICLES STARTED FROM ALL FISSILE ZONES IN ALL STAGES

3.  CONSISTENCY OF ESTIMATORS

    Individual stage values of K(COLL) and K(SCORE) agree for all stages
    Difference between individual stage value of  A(SCORE) and 1.0 is  greater than 3 SD
    Stage                :    64
    A(SCORE)             :   1.02
    Difference in SD units:   3.05

4.  TEST FOR NORMALITY OF INDIVIDUAL STAGE ESTIMATORS
    (Level of significance > 1% for pass)

    K(COLL)        PASSED  Level of significance = 34.79%
    K(SCORE)       PASSED  Level of significance =  8.65%
    K(THREE)       PASSED  Level of significance =  5.57%

5.  CHI-SQUARED TEST FOR ADEQUATE SETTLING

              No. of            Chi squared per         Probability
              Settling stages   degree of freedom
    K(COLL)      4                   1.088               0.3551       PASSED
    K(SCORE)     4                   1.325               0.1546       PASSED
    K(THREE)     4                   1.653               0.0364       PASSED


    FINAL VALUE OF K(THREE)   =  0.9313     ( STDV      = 0.0008 )

    K(THREE) + (3 x STDV)     =  0.9337

    *********************************************************
    * MONK PROCESSING COMPLETED TO STAGE      3              *
    *********************************************************
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel

```
PRIMARY MODULE ACCESS AND INPUT RECORD ( SCALE DRIVER - 95/03/29 - 09:06:37 )
   MODULE CSAS25   WILL BE CALLED
     NAC-STC Directly Loaded; Wet Fuel-Pellet Gap; 100% Fuel Geometry Offset; 0 Enric
      ' Interior Water Density 1 g/cc, Exterior Water Density 0.00001 g/cc
     27GROUPNDF4 LATTICECELL
     'FUEL
     UO2 1 0.95 293 92235 4.5 92238 95.5 END
     'CLAD
     ZIRCALLOY 2 1 293 END
     'H2O CASK INTERIOR
     H2O 3 1 293 END
     'AL DISK
     AL 4 1 293 END
     'CASK / DISK STEEL
     SS304 5 1 293 END
     'BORAL SHEETS
     AL 6 DEN=2.6226 0.5738 293 END
     B-10 6 DEN=2.6226 0.045 293 END
     B-11 6 DEN=2.6226 0.2735 293 END
     C 6 DEN=2.6226 0.0926 293 END
     'LEAD SHIELD
     PB 7 1 293.0 END
     'NS4FR SHIELD
     B-10 8 0 8.553-5 293 END
     B-11 8 0 3.422-4 293 END
     AL 8 0 7.763-3 293 END
     H 8 0 5.854-2 293 END
     O 8 0 2.609-2 293 END
     C 8 0 2.264-2 293 END
     N 8 0 1.394-3 293 END
     'CASK EXTERIOR WATER
     H2O 9 0.00001 293 END
     'PELLET CLAD GAP WATER
     H2O 10 1 293 END
     END COMP
     SQUAREPITCH 1.2728 0.8204 1 3 0.9434 2 0.8398 10 END
     NAC-STC Directly Loaded; Wet Fuel-Pellet Gap; 100% Fuel Geometry Offset; 0 Enric
     READ PARAM RUN=YES PLT=NO TME=5000 GEN=803 NPG=1000 END PARAM
     READ GEOM
     UNIT 1
     COM='FUEL PIN CELL - FOR WATER ELEVATION'
     CYLINDER 1 1 0.4102 2P2.3749
     CYLINDER 10 1 0.4199 2P2.3749
     CYLINDER 2 1 0.4717 2P2.3749
     CUBOID 3 1 4P0.6364 2P2.3749
     UNIT 2
     COM='GUIDE/INSTRUMENT TUBE CELL - FOR WATER ELEVATION'
     CYLINDER 3 1 0.5644 2P2.3749
     CYLINDER 2 1 0.5992 2P2.3749
     CUBOID 3 1 4P0.6364 2P2.3749
     UNIT 3
     COM='FUEL PIN CELL - FOR STEEL DISK ELEVATION'
     CYLINDER 1 1 0.4102 2P0.6350
     CYLINDER 10 1 0.4199 2P0.6350
     CYLINDER 2 1 0.4717 2P0.6350
     CUBOID 3 1 4P0.6364 2P0.6350
     UNIT 4
     COM='GUIDE/INSTRUMENT TUBE CELL - FOR STEEL DISK ELEVATION'
     CYLINDER 3 1 0.5644 2P0.6350
     CYLINDER 2 1 0.5992 2P0.6350
     CUBOID 3 1 4P0.6364 2P0.6350
     UNIT 5
     COM='FUEL PIN CELL - FOR AL DISK ELEVATION'
     CYLINDER 1 1 0.4102 2P0.7938
     CYLINDER 10 1 0.4199 2P0.7938
     CYLINDER 2 1 0.4717 2P0.7938
     CUBOID 3 1 4P0.6364 2P0.7938
     UNIT 6
     COM='GUIDE/INSTRUMENT TUBE CELL - FOR AL DISK ELEVATION'
     CYLINDER 3 1 0.5644 2P0.7938
     CYLINDER 2 1 0.5992 2P0.7938
     CUBOID 3 1 4P0.6364 2P0.7938
     UNIT 21
     COM='ASSEMBLY - FOR WATER ELEVATION'
     ARRAY 1 -10.8188 -10.8188 -2.3749
     UNIT 22
     COM='ASSEMBLY - FOR STEEL DISK ELEVATION'
     ARRAY 2 -10.8188 -10.8188 -0.635
     UNIT 23
     COM='ASSEMBLY - FOR AL DISK ELEVATION'
     ARRAY 3 -10.8188 -10.8188 -0.7938
     UNIT 31
     COM='X-X BORAL SHEET - FOR WATER ELEVATION'
     CUBOID 6 1 2P10.3886 2P0.0635 2P2.3749
     CUBOID 4 1 2P10.3886 2P0.0951 2P2.3749
     UNIT 32
     COM='Y-Y BORAL SHEET - FOR WATER ELEVATION'
     CUBOID 6 1 2P0.0635 2P10.3886 2P2.3749
     CUBOID 4 1 2P0.0951 2P10.3886 2P2.3749
     UNIT 33
     COM='X-X BORAL SHEET - FOR STEEL DISK ELEVATION'
     CUBOID 6 1 2P10.3886 2P0.0635 2P0.6350
     CUBOID 4 1 2P10.3886 2P0.0951 2P0.6350
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
UNIT 34
COM='Y-Y BORAL SHEET - FOR STEEL DISK ELEVATION'
CUBOID 6 1 2P0.0635 2P10.3886 2P0.6350
CUBOID 4 1 2P0.0951 2P10.3886 2P0.6350
UNIT 35
COM='X-X BORAL SHEET - FOR AL DISK ELEVATION'
CUBOID 6 1 2P10.3886 2P0.0635 2P0.7938
CUBOID 4 1 2P10.3886 2P0.0951 2P0.7938
UNIT 36
COM='Y-Y BORAL SHEET - FOR AL DISK ELEVATION'
CUBOID 6 1 2P0.0635 2P10.3886 2P0.7938
CUBOID 4 1 2P0.0951 2P10.3886 2P0.7938
UNIT 40
COM='FUEL TUBE - FOR WATER ELEVATION (B)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE 21 0 -0.3698 0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0 11.4054 0
HOLE 31 0 -11.4054 0
HOLE 32 11.4054 0 0
HOLE 32 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 41
COM='FUEL TUBE - FOR WATER ELEVATION (T)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE 21 0 0.3698 0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0 11.4054 0
HOLE 31 0 -11.4054 0
HOLE 32 11.4054 0 0
HOLE 32 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 42
COM='FUEL TUBE - FOR WATER ELEVATION (BL)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE 21 -0.3698 -0.3698 0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0 11.4054 0
HOLE 31 0 -11.4054 0
HOLE 32 11.4054 0 0
HOLE 32 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 43
COM='FUEL TUBE - FOR WATER ELEVATION (BR)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE 21 0.3698 -0.3698 0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0 11.4054 0
HOLE 31 0 -11.4054 0
HOLE 32 11.4054 0 0
HOLE 32 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 44
COM='FUEL TUBE - FOR WATER ELEVATION (TL)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE 21 -0.3698 0.3698 0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0 11.4054 0
HOLE 31 0 -11.4054 0
HOLE 32 11.4054 0 0
HOLE 32 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 45
COM='FUEL TUBE - FOR WATER ELEVATION (TR)'
CUBOID 3 1 4P11.1887 2P2.3749
HOLE 21 0.3698 0.3698 0
CUBOID 5 1 4P11.3101 2P2.3749
CUBOID 3 1 4P11.5006 2P2.3749
HOLE 31 0 11.4054 0
HOLE 31 0 -11.4054 0
HOLE 32 11.4054 0 0
HOLE 32 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P2.3749
UNIT 50
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (B)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE 22 0 -0.3698 0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0 11.4054 0
HOLE 33 0 -11.4054 0
HOLE 34 11.4054 0 0
HOLE 34 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 51
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (T)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE 22 0 0.3698 0
CUBOID 5 1 4P11.3101 2P0.6350
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0 11.4054 0
HOLE 33 0 -11.4054 0
HOLE 34 11.4054 0 0
HOLE 34 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 52
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (BL)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE 22 -0.3698 -0.3698 0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0 11.4054 0
HOLE 33 0 -11.4054 0
HOLE 34 11.4054 0 0
HOLE 34 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 53
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (BR)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE 22 0.3698 -0.3698 0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0 11.4054 0
HOLE 33 0 -11.4054 0
HOLE 34 11.4054 0 0
HOLE 34 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 54
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (TL)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE 22 -0.3698 0.3698 0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0 11.4054 0
HOLE 33 0 -11.4054 0
HOLE 34 11.4054 0 0
HOLE 34 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 55
COM='FUEL TUBE - FOR STEEL DISK ELEVATION (TR)'
CUBOID 3 1 4P11.1887 2P0.6350
HOLE 22 0.3698 0.3698 0
CUBOID 5 1 4P11.3101 2P0.6350
CUBOID 3 1 4P11.5006 2P0.6350
HOLE 33 0 11.4054 0
HOLE 33 0 -11.4054 0
HOLE 34 11.4054 0 0
HOLE 34 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P0.6350
UNIT 60
COM='FUEL TUBE - FOR AL DISK ELEVATION (B)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE 23 0 -0.3698 0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0 11.4054 0
HOLE 35 0 -11.4054 0
HOLE 36 11.4054 0 0
HOLE 36 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 61
COM='FUEL TUBE - FOR AL DISK ELEVATION (T)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE 23 0 0.3698 0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0 11.4054 0
HOLE 35 0 -11.4054 0
HOLE 36 11.4054 0 0
HOLE 36 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 62
COM='FUEL TUBE - FOR AL DISK ELEVATION (BL)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE 23 -0.3698 -0.3698 0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0 11.4054 0
HOLE 35 0 -11.4054 0
HOLE 36 11.4054 0 0
HOLE 36 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 63
COM='FUEL TUBE - FOR AL DISK ELEVATION (BR)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE 23 0.3698 -0.3698 0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0 11.4054 0
HOLE 35 0 -11.4054 0
HOLE 36 11.4054 0 0
HOLE 36 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 64
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
COM='FUEL TUBE - FOR AL DISK ELEVATION (TL)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE 23 -0.3698 0.3698 0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0 11.4054 0
HOLE 35 0 -11.4054 0
HOLE 36 11.4054 0 0
HOLE 36 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 65
COM='FUEL TUBE - FOR AL DISK ELEVATION (TR)'
CUBOID 3 1 4P11.1887 2P0.7938
HOLE 23 0.3698 0.3698 0
CUBOID 5 1 4P11.3101 2P0.7938
CUBOID 3 1 4P11.5006 2P0.7938
HOLE 35 0 11.4054 0
HOLE 35 0 -11.4054 0
HOLE 36 11.4054 0 0
HOLE 36 -11.4054 0 0
CUBOID 5 1 4P11.5461 2P0.7938
UNIT 70
COM='DISK OPENING - FOR WATER ELEVATION (B)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 40 0 -0.181 0
UNIT 71
COM='DISK OPENING - FOR WATER ELEVATION (T)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 41 0 0.181 0
UNIT 72
COM='DISK OPENING - FOR WATER ELEVATION (BL)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 42 -0.181 -0.181 0
UNIT 73
COM='DISK OPENING - FOR WATER ELEVATION (BR)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 43 0.181 -0.181 0
UNIT 74
COM='DISK OPENING - FOR WATER ELEVATION (TL)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 44 -0.181 0.181 0
UNIT 75
COM='DISK OPENING - FOR WATER ELEVATION (TR)'
CUBOID 3 1 4P11.7272 2P2.3749
HOLE 45 0.181 0.181 0
UNIT 80
COM='DISK OPENING - FOR STEEL DISK ELEVATION (B)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 50 0 -0.181 0
UNIT 81
COM='DISK OPENING - FOR STEEL DISK ELEVATION (T)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 51 0 0.181 0
UNIT 82
COM='DISK OPENING - FOR STEEL DISK ELEVATION (BL)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 52 -0.181 -0.181 0
UNIT 83
COM='DISK OPENING - FOR STEEL DISK ELEVATION (BR)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 53 0.181 -0.181 0
UNIT 84
COM='DISK OPENING - FOR STEEL DISK ELEVATION (TL)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 54 -0.181 0.181 0
UNIT 85
COM='DISK OPENING - FOR STEEL DISK ELEVATION (TR)'
CUBOID 3 1 4P11.7272 2P0.6350
HOLE 55 0.181 0.181 0
UNIT 90
COM='DISK OPENING - FOR AL DISK ELEVATION (B)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 60 0 -0.181 0
UNIT 91
COM='DISK OPENING - FOR AL DISK ELEVATION (T)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 61 0 0.181 0
UNIT 92
COM='DISK OPENING - FOR AL DISK ELEVATION (BL)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 62 -0.181 -0.181 0
UNIT 93
COM='DISK OPENING - FOR AL DISK ELEVATION (BR)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 63 0.181 -0.181 0
UNIT 94
COM='DISK OPENING - FOR AL DISK ELEVATION (TL)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 64 -0.181 0.181 0
UNIT 95
COM='DISK OPENING - FOR AL DISK ELEVATION (TR)'
CUBOID 3 1 4P11.7272 2P0.7938
HOLE 65 0.181 0.181 0
UNIT 101
COM='BASKET STRUCTURE IN TRANPORT CASK - WATER ELEVATION'
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
CYLINDER 3 1 90.17 2P2.3749
HOLE 75 -58.9864 -40.7822 0
HOLE 75 -58.9864 -13.5941 0
HOLE 73 -58.9864 13.5941 0
HOLE 73 -58.9864 40.7822 0
HOLE 75 -27.1882 -67.9704 0
HOLE 75 -27.1882 -40.7822 0
HOLE 75 -27.1882 -13.5941 0
HOLE 73 -27.1882 13.5941 0
HOLE 73 -27.1882 40.7822 0
HOLE 73 -27.1882 67.9704 0
HOLE 71 0 -67.9704 0
HOLE 71 0 -40.7822 0
HOLE 71 0 -13.5941 0
HOLE 70 0 13.5941 0
HOLE 70 0 40.7822 0
HOLE 70 0 67.9704 0
HOLE 74 27.1882 -67.9704 0
HOLE 74 27.1882 -40.7822 0
HOLE 74 27.1882 -13.5941 0
HOLE 72 27.1882 13.5941 0
HOLE 72 27.1882 40.7822 0
HOLE 72 27.1882 67.9704 0
HOLE 74 58.9864 -40.7822 0
HOLE 74 58.9864 -13.5941 0
HOLE 72 58.9864 13.5941 0
HOLE 72 58.9864 40.7822 0
CYLINDER 5 1 93.98 2P2.3749
CYLINDER 7 1 103.43 2P2.3749
CYLINDER 5 1 110.11 2P2.3749
CYLINDER 9 1 124.12 2P2.3749
CYLINDER 9 1 124.44 2P2.3749
CYLINDER 5 1 125.07 2P2.3749
CUBOID 9 1 4P125.07 2P2.3749
UNIT 102
COM='BASKET STRUCTURE IN TRANPORT CASK - ST DISK ELEVATION'
CYLINDER 5 1 89.99 2P0.6350
HOLE 85 -58.9864 -40.7822 0
HOLE 85 -58.9864 -13.5941 0
HOLE 83 -58.9864 13.5941 0
HOLE 83 -58.9864 40.7822 0
HOLE 85 -27.1882 -67.9704 0
HOLE 85 -27.1882 -40.7822 0
HOLE 85 -27.1882 -13.5941 0
HOLE 83 -27.1882 13.5941 0
HOLE 83 -27.1882 40.7822 0
HOLE 83 -27.1882 67.9704 0
HOLE 81 0 -67.9704 0
HOLE 81 0 -40.7822 0
HOLE 81 0 -13.5941 0
HOLE 80 0 13.5941 0
HOLE 80 0 40.7822 0
HOLE 80 0 67.9704 0
HOLE 84 27.1882 -67.9704 0
HOLE 84 27.1882 -40.7822 0
HOLE 84 27.1882 -13.5941 0
HOLE 82 27.1882 13.5941 0
HOLE 82 27.1882 40.7822 0
HOLE 82 27.1882 67.9704 0
HOLE 84 58.9864 -40.7822 0
HOLE 84 58.9864 -13.5941 0
HOLE 82 58.9864 13.5941 0
HOLE 82 58.9864 40.7822 0
CYLINDER 3 1 90.17 2P0.6350
CYLINDER 5 1 93.98 2P0.6350
CYLINDER 7 1 103.43 2P0.6350
CYLINDER 5 1 110.11 2P0.6350
CYLINDER 9 1 124.12 2P0.6350
CYLINDER 9 1 124.44 2P0.6350
CYLINDER 5 1 125.07 2P0.6350
CUBOID 9 1 4P125.07 2P0.6350
UNIT 103
COM='BASKET STRUCTURE IN TRANPORT CASK - AL DISK ELEVATION'
CYLINDER 4 1 89.73 2P0.7938
HOLE 95 -58.9864 -40.7822 0
HOLE 95 -58.9864 -13.5941 0
HOLE 93 -58.9864 13.5941 0
HOLE 93 -58.9864 40.7822 0
HOLE 95 -27.1882 -67.9704 0
HOLE 95 -27.1882 -40.7822 0
HOLE 95 -27.1882 -13.5941 0
HOLE 93 -27.1882 13.5941 0
HOLE 93 -27.1882 40.7822 0
HOLE 93 -27.1882 67.9704 0
HOLE 91 0 -67.9704 0
HOLE 91 0 -40.7822 0
HOLE 91 0 -13.5941 0
HOLE 90 0 13.5941 0
HOLE 90 0 40.7822 0
HOLE 90 0 67.9704 0
HOLE 94 27.1882 -67.9704 0
HOLE 94 27.1882 -40.7822 0
HOLE 94 27.1882 -13.5941 0
HOLE 92 27.1882 13.5941 0
HOLE 92 27.1882 40.7822 0
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
HOLE 92 27.1882 67.9704 0
HOLE 94 58.9864 -40.7822 0
HOLE 94 58.9864 -13.5941 0
HOLE 92 58.9864 13.5941 0
HOLE 92 58.9864 40.7822 0
CYLINDER 3 1 90.17 2P0.7938
CYLINDER 5 1 93.98 2P0.7938
CYLINDER 7 1 103.43 2P0.7938
CYLINDER 5 1 110.11 2P0.7938
CYLINDER 9 1 124.12 2P0.7938
CYLINDER 9 1 124.44 2P0.7938
CYLINDER 5 1 125.07 2P0.7938
CUBOID 9 1 4P125.07 2P0.7938
GLOBAL UNIT 104
COM='DISK SLICE STACK'
ARRAY 4 -125.07 -125.07 0
CUBOID 9 1 4P125.08 12.3573 0
END GEOM
READ ARRAY
ARA=1 NUX=17 NUY=17 NUZ=1 FILL
 34R1
 5R1 2 2R1 2 2R1 2 5R1
 3R1 2 9R1 2 3R1
 17R1
2R1 2 2R1 2 2R1 2 2R1 2 2R1 2 2R1
 34R1
2R1 2 2R1 2 2R1 2 2R1 2 2R1 2 2R1
 34R1
2R1 2 2R1 2 2R1 2 2R1 2 2R1 2 2R1
 17R1
 3R1 2 9R1 2 3R1
 5R1 2 2R1 2 2R1 2 5R1
 34R1
END FILL
ARA=2 NUX=17 NUY=17 NUZ=1 FILL
 34R3
 5R3 4 2R3 4 2R3 4 5R3
 3R3 4 9R3 4 3R3
 17R3
2R3 4 2R3 4 2R3 4 2R3 4 2R3 4 2R3
 34R3
2R3 4 2R3 4 2R3 4 2R3 4 2R3 4 2R3
 34R3
2R3 4 2R3 4 2R3 4 2R3 4 2R3 4 2R3
 17R3
 3R3 4 9R3 4 3R3
 5R3 4 2R3 4 2R3 4 5R3
 34R3
END FILL
ARA=3 NUX=17 NUY=17 NUZ=1 FILL
 34R5
 5R5 6 2R5 6 2R5 6 5R5
 3R5 6 9R5 6 3R5
 17R5
2R5 6 2R5 6 2R5 6 2R5 6 2R5 6 2R5
 34R5
2R5 6 2R5 6 2R5 6 2R5 6 2R5 6 2R5
 34R5
2R5 6 2R5 6 2R5 6 2R5 6 2R5 6 2R5
 17R5
 3R5 6 9R5 6 3R5
 5R5 6 2R5 6 2R5 6 5R5
 34R5
END FILL
ARA=4 NUX=1 NUY=1 NUZ=4 FILL 101 102 101 103 END FILL
END ARRAY
READ BOUNDS ZFC=PER YXF=MIRROR END BOUNDS
READ PLOT
TTL='XY SLICE OF CASK - ST DISK ELEVATION'
SCR=YES PIC=MAT LPI=10
XUL=-120.0 YUL=120.0 ZUL=5.5 XLR=120.0 YLR=-120.0 ZLR=5.5
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='XY SLICE CASK CENTER AREA ST DISK ELEVATION'
SCR=YES PIC=MAT LPI=10
XUL=-27.0 YUL=27.0 ZUL=5.5 XLR=27.0 YLR=-27.0 ZLR=5.5
UAX=1.0 VDN=-1.0 NAX=1500 END
END PLOT
END DATA

  SECONDARY MODULE 000008   HAS BEEN CALLED.

  MODULE 000008   IS FINISHED. COMPLETION CODE     0. CPU TIME USED     1.37 (SECONDS).

  SECONDARY MODULE 000002   HAS BEEN CALLED.

  MODULE 000002   IS FINISHED. COMPLETION CODE     0. CPU TIME USED     6.49 (SECONDS).

  SECONDARY MODULE 000009   HAS BEEN CALLED.

  MODULE 000009   IS FINISHED. COMPLETION CODE     0. CPU TIME USED   672.94 (SECONDS).

  MODULE CSAS25   IS FINISHED. COMPLETION CODE     0. CPU TIME USED   686.79 (SECONDS).

THE FOLLOWING DATA CARDS PRECEDE AN = CARD
  EXECUTION TERMINATED DUE TO ERRORS
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
    NAC-STC DIRECTLY LOADED; WET FUEL-PELLET GAP; 100% FUEL GEOMETRY OFFSET; 0 ENRIC

    **** PROBLEM PARAMETERS ****

    LIB 27GROUPNDF4  LIBRARY
    MXX            10 MIXTURES
    MSC            19 COMPOSITION SPECIFICATIONS
    IZM             4 MATERIAL ZONES
    GE  LATTICECELL  GEOMETRY
    MORE            0 0/1 DO NOT READ/READ OPTIONAL PARAMETER DATA
    MSLN            0 FUEL SOLUTIONS

    **** PROBLEM COMPOSITION DESCRIPTION ****

    SC  UO2          STANDARD COMPOSITION
    MX              1 MIXTURE NO.
    VF         0.9500 VOLUME FRACTION
    ROTH      10.9600 THEORETICAL DENSITY
    NEL             2 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
              92000       1.00 ATOM/MOLECULE
                                92235     4.500 WT%
                                92238    95.500 WT%
               8016       2.00 ATOMS/MOLECULE
'CLAD
    END

    SC  ZIRCALLOY    STANDARD COMPOSITION
    MX              2 MIXTURE NO.
    VF         1.0000 VOLUME FRACTION
    ROTH       6.5600 THEORETICAL DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
              40302       1.00 ATOM/MOLECULE
'H2O CASK INTERIOR
    END

    SC  H2O          STANDARD COMPOSITION
    MX              3 MIXTURE NO.
    VF         1.0000 VOLUME FRACTION
    ROTH       0.9982 THEORETICAL DENSITY
    NEL             2 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
               1001       2.00 ATOMS/MOLECULE
               8016       1.00 ATOM/MOLECULE
'AL DISK
    END

    SC  AL           STANDARD COMPOSITION
    MX              4 MIXTURE NO.
    VF         1.0000 VOLUME FRACTION
    ROTH       2.7020 THEORETICAL DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
              13027       1.00 ATOM/MOLECULE
'CASK / DISK STEEL
    END

    SC  SS304        STANDARD COMPOSITION
    MX              5 MIXTURE NO.
    VF         1.0000 VOLUME FRACTION
    ROTH       7.9200 THEORETICAL DENSITY
    NEL             4 NO. ELEMENTS
    ICP             0 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
              24304    19.000 WT%
              25055     2.000 WT%
              26304    69.500 WT%
              28304     9.500 WT%
'BORAL SHEETS
    END

    SC  AL           STANDARD COMPOSITION
    MX              6 MIXTURE NO.
    VF         0.5738 VOLUME FRACTION
    ROTH       2.6226 SPECIFIED DENSITY
    NEL             1 NO. ELEMENTS
    ICP             1 0/1 MIXTURE/COMPOUND
    TEMP        293.0 DEG KELVIN
              13027       1.00 ATOM/MOLECULE
    END

    SC  B-10         STANDARD COMPOSITION
    MX              6 MIXTURE NO.
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
    VF        0.0450 VOLUME FRACTION
    ROTH      2.6226 SPECIFIED DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                5010      1.00 ATOM/MOLECULE
    END

    SC  B-11          STANDARD COMPOSITION
    MX             6 MIXTURE NO.
    VF        0.2735 VOLUME FRACTION
    ROTH      2.6226 SPECIFIED DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                5011      1.00 ATOM/MOLECULE
    END

    SC  C             STANDARD COMPOSITION
    MX             6 MIXTURE NO.
    VF        0.0926 VOLUME FRACTION
    ROTH      2.6226 SPECIFIED DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                6012      1.00 ATOM/MOLECULE

'LEAD SHIELD
    END

    SC  PB            STANDARD COMPOSITION
    MX             7 MIXTURE NO.
    VF        1.0000 VOLUME FRACTION
    ROTH     11.3440 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
               82000      1.00 ATOM/MOLECULE

'NS4FR SHIELD
    END

    SC  B-10          STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   8.5530E-05 ATOMIC DENSITY
    ROTH      1.0000 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                5010      1.00 ATOM/MOLECULE
    END

    SC  B-11          STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   3.4220E-04 ATOMIC DENSITY
    ROTH      1.0000 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                5011      1.00 ATOM/MOLECULE
    END

    SC  AL            STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   7.7630E-03 ATOMIC DENSITY
    ROTH      2.7020 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
               13027      1.00 ATOM/MOLECULE
    END

    SC  H             STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   5.8540E-02 ATOMIC DENSITY
    ROTH      1.0000 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                1001      1.00 ATOM/MOLECULE
    END

    SC  O             STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   2.6090E-02 ATOMIC DENSITY
    ROTH      1.0000 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                8016      1.00 ATOM/MOLECULE
    END

    SC  C             STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   2.2640E-02 ATOMIC DENSITY
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
    ROTH      2.1000 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN

                6012       1.00 ATOM/MOLECULE
    END

    SC  N              STANDARD COMPOSITION
    MX             8 MIXTURE NO.
    DEN   1.3940E-03 ATOMIC DENSITY
    ROTH      1.0000 THEORETICAL DENSITY
    NEL            1 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                7014       1.00 ATOM/MOLECULE

'CASK EXTERIOR WATER
    END

    SC  H2O            STANDARD COMPOSITION
    MX             9 MIXTURE NO.
    VF        0.0000 VOLUME FRACTION
    ROTH      0.9982 THEORETICAL DENSITY
    NEL            2 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                1001       2.00 ATOMS/MOLECULE
                8016       1.00 ATOM/MOLECULE

'PELLET CLAD GAP WATER
    END

    SC  H2O            STANDARD COMPOSITION
    MX            10 MIXTURE NO.
    VF        1.0000 VOLUME FRACTION
    ROTH      0.9982 THEORETICAL DENSITY
    NEL            2 NO. ELEMENTS
    ICP            1 0/1 MIXTURE/COMPOUND
    TEMP       293.0 DEG KELVIN
                1001       2.00 ATOMS/MOLECULE
                8016       1.00 ATOM/MOLECULE
    END

    **** PROBLEM GEOMETRY ****

    CTP SQUAREPITCH  CELL TYPE
    PITCH     1.2728 CM CENTER TO CENTER SPACING
    FUELOD    0.8204 CM FUEL DIAMETER OR SLAB THICKNESS
    MFUEL          1 MIXTURE NO. OF FUEL
    MMOD           3 MIXTURE NO. OF MODERATOR
    CLADOD    0.9434 CM CLAD OUTER DIAMETER
    MCLAD          2 MIXTURE NO. OF CLAD
    GAPOD     0.8398 CM GAP OUTER DIAMETER
    MGAP          10 MIXTURE NO. OF GAP

    ZONE SPECIFICATIONS FOR LATTICECELL GEOMETRY

                   ZONE  1 IS FUEL
                   ZONE  2 IS GAP
                   ZONE  3 IS CLAD
                   ZONE  4 IS MOD

LOGICAL ASSIGNMENTS

MASTER LIBRARY   11
WORKING LIBRARY   0
SCRATCH FILE     18
NEW LIBRARY       1

P R O B L E M   D E S C R I P T I O N

IGR--GEOMETRY (0/1/2/3--INF MED/SLAB/CYL/SPHERE              2

IZM--NUMBER OF ZONES OR MATERIAL REGIONS                    10

MS--MIXING TABLE LENGTH                                     27

IBL--SHIELDED CROSS SECTION EDIT OPTION (0/1--NO/YES)        0

IBR--BONDARENKO FACTOR EDIT OPTION (0/1--NO/YES)             0

ISSOPT--DANCOFF FACTOR OPTION                                0

CONVERGENCE CRITERION    1.00000E-03

GEOMETRY CORRECTION FACTOR FOR WIGNER RATIONAL APPROXIMATION  1.350E+00

        3Q ARRAY HAS     27 ENTRIES.

        4Q ARRAY HAS     27 ENTRIES.

        5Q ARRAY HAS     27 ENTRIES.
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
        6Q ARRAY HAS     10 ENTRIES.
        7Q ARRAY HAS     10 ENTRIES.
        8Q ARRAY HAS     10 ENTRIES.
        9Q ARRAY HAS     10 ENTRIES.
       10Q ARRAY HAS     27 ENTRIES.
       11Q ARRAY HAS     10 ENTRIES.
M I X I N G   T A B L E
ENTRY   MIXTURE   ISOTOPE   NUMBER DENSITY   NEW IDENTIFIER
  1        1       92235     1.05821E-03         1092235
  2        1       92238     2.21739E-02         1092238
  3        1        8016     4.64643E-02         1008016
  4        3        8016     3.33846E-02         3008016
  5        8        8016     2.60900E-02         8008016
  6        9        8016     3.33846E-07         9008016
  7       10        8016     3.33846E-02        10008016
  8        2       40302     4.33078E-02         2040302
  9        3        1001     6.67692E-02         3001001
 10        8        1001     5.85400E-02         8001001
 11        9        1001     6.67692E-07         9001001
 12       10        1001     6.67692E-02        10001001
 13        4       13027     6.03066E-02         4013027
 14        6       13027     3.35871E-02         6013027
 15        8       13027     7.76300E-03         8013027
 16        5       24304     1.74286E-02         5024304
 17        5       25055     1.73633E-03         5025055
 18        5       26304     5.93579E-02         5026304
 19        5       28304     7.72070E-03         5028304
 20        6        5010     7.09799E-03         6005010
 21        8        5010     8.55300E-05         8005010
 22        6        5011     3.92356E-02         6005011
 23        8        5011     3.42200E-04         8005011
 24        6        6012     1.21874E-02         6006012
 25        8        6012     2.26400E-02         8006012
 26        7       82000     3.29690E-02         7082000
 27        8        7014     1.39400E-03         8007014
GEOMETRY AND MATERIAL DESCRIPTION
ZONE   MIXTURE   OUTER DIMENSION   TEMPERATURE      EXTRA XS    TYPE (0/1--FUEL/MOD)
  1       1        4.10200E-01     2.93000E+02    1.23440E+00          0
  2      10        4.19900E-01     2.93000E+02    0.00000E+00          0
  3       2        4.71700E-01     2.93000E+02    6.63851E+00          0
  4       3        7.18100E-01     2.93000E+02    0.00000E+00          0
  5       4        5.71810E+00     2.93000E+02    0.00000E+00          0
  6       5        1.07181E+01     2.93000E+02    0.00000E+00          0
  7       6        1.57181E+01     2.93000E+02    0.00000E+00          0
  8       7        2.07181E+01     2.93000E+02    0.00000E+00          0
  9       8        2.57181E+01     2.93000E+02    0.00000E+00          0
 10       9        3.07181E+01     2.93000E+02    0.00000E+00          0
*************************************************************************************************************
***                                NAC-STC DIRECTLY LOADED; WET FUEL-PELLET GAP; 100% FUEL GEOMETRY OFFSET; 0 ENRIC***
*************************************************************************************************************
***                                ******        NUMERIC PARAMETERS        ******                          ***
***                                                                                                        ***
***                TME        MAXIMUM PROBLEM TIME (MIN)                           ******                  ***
***                                                                                                        ***
***                TBA        TIME PER GENERATION (MIN)                              0.50                  ***
***                                                                                                        ***
***                GEN        NUMBER OF GENERATIONS                                   803                  ***
***                                                                                                        ***
***                NPG        NUMBER PER GENERATION                                  1000                  ***
***                                                                                                        ***
***                NSK        NUMBER OF GENERATIONS TO BE SKIPPED                       3                  ***
***                                                                                                        ***
***                BEG        BEGINNING GENERATION NUMBER                               1                  ***
***                                                                                                        ***
***                RES        GENERATIONS BETWEEN CHECKPOINTS                           0                  ***
***                                                                                                        ***
***                X1D        NUMBER OF EXTRA 1-D CROSS SECTIONS                        1                  ***
***                                                                                                        ***
***                NBK        NEUTRON BANK SIZE                                      1025                  ***
***                                                                                                        ***
***                XNB        EXTRA POSITIONS IN NEUTRON BANK                           0                  ***
***                                                                                                        ***
***                NFB        FISSION BANK SIZE                                      1000                  ***
***                                                                                                        ***
***                XFB        EXTRA POSITIONS IN FISSION BANK                           0                  ***
***                                                                                                        ***
***                WTA        DEFAULT VALUE OF WEIGHT AVERAGE                      0.5000                  ***
***                                                                                                        ***
***                WTH        WEIGHT HIGH FOR SPLITTING                            3.0000                  ***
***                                                                                                        ***
***                WTL        WEIGHT LOW FOR RUSSIAN ROULETTE                      0.3333                  ***
***                                                                                                        ***
***                RND        STARTING RANDOM NUMBER                          BB827100001                  ***
***                                                                                                        ***
***                NB8        NUMBER OF D.A. BLOCKS ON UNIT  8                        200                  ***
***                                                                                                        ***
***                NL8        LENGTH OF D.A. BLOCKS ON UNIT  8                        512                  ***
***                                                                                                        ***
***                ADJ        MODE OF CALCULATION                                 FORWARD                  ***
***                                                                                                        ***
***                           INPUT DATA WRITTEN ON RESTART UNIT                       NO                  ***
***                                                                                                        ***
***                           BINARY DATA INTERFACE                                   YES                  ***
*************************************************************************************************************
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
**********************************************************************************************************
**********************************************************************************************************
***                                                                                                    ***
***                        NAC-STC DIRECTLY LOADED; WET FUEL-PELLET GAP; 100% FUEL GEOMETRY OFFSET; 0 ENRIC***
***                                                                                                    ***
**********************************************************************************************************
***                                ******     LOGICAL PARAMETERS        ******                         ***
***                                                                                                    ***
***  RUN  EXECUTE PROBLEM AFTER CHECKING DATA    YES          PLT  PLOT PICTURE MAP(S)              NO ***
***                                                                                                    ***
***  FLX  COMPUTE FLUX                            NO          FDN  COMPUTE FISSION DENSITIES        NO ***
***                                                                                                    ***
***  SMU  COMPUTE AVG UNIT SELF-MULTIPLICATION   NO           NUB  COMPUTE NU-BAR & AVG FISSION GROUP  YES ***
***                                                                                                    ***
***  MKU  COMPUTE MATRIX K-EFF BY UNIT NUMBER    NO           MKP  COMPUTE MATRIX K-EFF BY UNIT LOCATION   NO ***
***                                                                                                    ***
***  CKU  COMPUTE COFACTOR K-EFF BY UNIT NUMBER  NO           CKP  COMPUTE COFACTOR K-EFF BY UNIT LOCATION  NO ***
***                                                                                                    ***
***  FMU  PRINT FISS PROD MATRIX BY UNIT NUMBER  NO           FMP  PRINT FISS PROD MATRIX BY UNIT LOCATION  NO ***
***                                                                                                    ***
***  MKH  COMPUTE MATRIX K-EFF BY HOLE NUMBER    NO           MKA  COMPUTE MATRIX K-EFF BY ARRAY NUMBER   NO ***
***                                                                                                    ***
***  CKH  COMPUTE COFACTOR K-EFF BY HOLE NUMBER  NO           CKA  COMPUTE COFACTOR K-EFF BY ARRAY NUMBER  NO ***
***                                                                                                    ***
***  FMH  PRINT FISS PROD MATRIX BY HOLE NUMBER  NO           FMA  PRINT FISS PROD MATRIX BY ARRAY NUMBER  NO ***
***                                                                                                    ***
***  HHL  COLLECT MATRIX BY HIGHEST HOLE LEVEL   NO           HAL  COLLECT MATRIX BY HIGHEST ARRAY LEVEL   NO ***
***                                                                                                    ***
***  AMX  PRINT ALL MIXED CROSS SECTIONS         NO           FAR  PRINT FIS. AND ABS. BY REGION     NO ***
***                                                                                                    ***
***  XS1  PRINT 1-D MIXTURE X-SECTIONS           NO           GAS  PRINT FAR BY GROUP               NO ***
***                                                                                                    ***
***  XS2  PRINT 2-D MIXTURE X-SECTIONS           NO           PAX  PRINT XSEC-ALBEDO CORRELATION TABLES   NO ***
***                                                                                                    ***
***  XAP  PRINT MIXTURE ANGLES & PROBABILITIES   NO           PWT  PRINT WEIGHT AVERAGE ARRAY       NO ***
***                                                                                                    ***
***  PKI  PRINT FISSION SPECTRUM                 NO           PGM  PRINT INPUT GEOMETRY             NO ***
***                                                                                                    ***
***  P1D  PRINT EXTRA 1-D CROSS SECTIONS         NO           BUG  PRINT DEBUG INFORMATION          NO ***
***                                                                                                    ***
***                                                           TRK  PRINT TRACKING INFORMATION       NO ***
***                                                                                                    ***
***                                                                                                    ***
**********************************************************************************************************
**********************************************************************************************************
**********************************************************************************************************
                                        PARAMETER INPUT COMPLETED

                             ........    0 IO'S WERE USED READING THE PARAMETER DATA      ........

                            *************** DATA READING COMPLETED ***************
                                  NAC-STC DIRECTLY LOADED; WET FUEL-PELLET GAP; 100% FUEL GEOMETRY OFFSET; 0 ENRIC

                                                MIXING TABLE

                                      NUMBER OF SCATTERING ANGLES =  2
                                    CROSS SECTION MESSAGE THRESHOLD =3.0E-05


MIXTURE =     1          DENSITY(G/CC) =  10.412
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA        AWT                NUCLIDE TITLE
   1008016  4.64643E-02  1.18493E-01    8016     15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                         UPDATED
08/12/94
   1092235  1.05821E-03  3.96678E-02   92235    235.0441      URANIUM-235     ENDF/B-IV MAT 1261                         UPDATED
08/12/94
   1092238  2.21739E-02  8.41839E-01   92238    238.0510      URANIUM-238     ENDF/B-IV MAT 1262                         UPDATED
08/12/94

MIXTURE =     2          DENSITY(G/CC) =  6.5600
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA        AWT                NUCLIDE TITLE
   2040302  4.33078E-02  1.00000E+00   40000     91.2196      ZIRCALLOY       ENDF/B-IV MAT 1284                         UPDATED
08/12/94

MIXTURE =     3          DENSITY(G/CC) = 0.99817
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA        AWT                NUCLIDE TITLE
   3001001  6.67692E-02  1.11927E-01    1001      1.0077      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002                UPDATED
08/12/94
   3008016  3.33846E-02  8.88074E-01    8016     15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                         UPDATED
08/12/94

MIXTURE =     4          DENSITY(G/CC) =  2.7020
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA        AWT                NUCLIDE TITLE
   4013027  6.03066E-02  1.00000E+00   13027     26.9818     AL-27 1193 218 GP 040375(5)                                 UPDATED
08/12/94

MIXTURE =     5          DENSITY(G/CC) =  7.9200
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA        AWT                NUCLIDE TITLE
   5024304  1.74286E-02  1.90000E-01   24000     51.9957     CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'            UPDATED
08/12/94
   5025055  1.73633E-03  1.99999E-02   25055     54.9379      MANGANESE-55    ENDF/B-IV MAT 1197                         UPDATED
08/12/94
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
   5026304  5.93579E-02  6.95000E-01   26000     55.8447     FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED
08/12/94
   5028304  7.72070E-03  9.50001E-02   28000     58.6872     NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'         UPDATED
08/12/94

MIXTURE =      6          DENSITY(G/CC) =  2.5830
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT                 NUCLIDE TITLE
   6005010  7.09799E-03  4.56901E-02    5010     10.0130     B-10 1273 218NGP 042375 P-3 293K                         UPDATED
08/12/94
   6005011  3.92356E-02  2.77698E-01    5011     11.0096      BORON-11        ENDF/B-IV MAT 1160                      UPDATED
08/12/94
   6006012  1.21874E-02  9.40196E-02    6000     12.0001      CARBON-12       ENDF/B-IV MAT 1274/THRM1065             UPDATED
08/12/94
   6013027  3.35871E-02  5.82592E-01   13027     26.9818     AL-27 1193 218 GP 040375(5)                              UPDATED
08/12/94

MIXTURE =      7          DENSITY(G/CC) =  11.344
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT                 NUCLIDE TITLE
   7082000  3.29690E-02  1.00000E+00   82000    207.2100     PB   1288 218NGP 042375 P-3 293K                         UPDATED
08/12/94

MIXTURE =      8          DENSITY(G/CC) =  1.6298
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT                 NUCLIDE TITLE
   8001001  5.85400E-02  6.01023E-02    1001      1.0077      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002             UPDATED
08/12/94
   8005010  8.55300E-05  8.72589E-04    5010     10.0130     B-10 1273 218NGP 042375 P-3 293K                         UPDATED
08/12/94
   8005011  3.42200E-04  3.83863E-03    5011     11.0096      BORON-11        ENDF/B-IV MAT 1160                      UPDATED
08/12/94
   8006012  2.26400E-02  2.76813E-01    6000     12.0001      CARBON-12       ENDF/B-IV MAT 1274/THRM1065             UPDATED
08/12/94
   8007014  1.39400E-03  1.98893E-02    7014     14.0033      NITROGEN-14     ENDF/B-IV MAT 1275                      UPDATED
08/12/94
   8008016  2.60900E-02  4.25068E-01    8016     15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                      UPDATED
08/12/94
   8013027  7.76300E-03  2.13416E-01   13027     26.9818     AL-27 1193 218 GP 040375(5)                              UPDATED
08/12/94

MIXTURE =      9          DENSITY(G/CC) = 0.99817E-05
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT                 NUCLIDE TITLE
   9001001  6.67692E-07  1.11927E-01    1001      1.0077      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002             UPDATED
08/12/94
   9008016  3.33846E-07  8.88073E-01    8016     15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                      UPDATED
08/12/94

MIXTURE =     10          DENSITY(G/CC) = 0.99817
   NUCLIDE   ATOM-DENS.   WGT. FRAC.     ZA       AWT                 NUCLIDE TITLE
  10001001  6.67692E-02  1.11927E-01    1001      1.0077      HYDROGEN        ENDF/B-IV MAT 1269/THRM1002             UPDATED
08/12/94
  10008016  3.33846E-02  8.88074E-01    8016     15.9904      OXYGEN-16       ENDF/B-IV MAT 1276                      UPDATED
08/12/94


                           3001001     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002            UPDATED 08/12/94
                           8001001     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002            UPDATED 08/12/94
                           9001001     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002            UPDATED 08/12/94

                          10001001     HYDROGEN       ENDF/B-IV MAT 1269/THRM1002            UPDATED 08/12/94
                           6005010    B-10 1273 218NGP 042375 P-3 293K                       UPDATED 08/12/94
                           8005010    B-10 1273 218NGP 042375 P-3 293K                       UPDATED 08/12/94
                           6005011     BORON-11       ENDF/B-IV MAT 1160                     UPDATED 08/12/94
                           8005011     BORON-11       ENDF/B-IV MAT 1160                     UPDATED 08/12/94
                           6006012     CARBON-12      ENDF/B-IV MAT 1274/THRM1065            UPDATED 08/12/94
                           8006012     CARBON-12      ENDF/B-IV MAT 1274/THRM1065            UPDATED 08/12/94
                           8007014     NITROGEN-14    ENDF/B-IV MAT 1275                     UPDATED 08/12/94
                           1008016     OXYGEN-16      ENDF/B-IV MAT 1276                     UPDATED 08/12/94
                           3008016     OXYGEN-16      ENDF/B-IV MAT 1276                     UPDATED 08/12/94
                           8008016     OXYGEN-16      ENDF/B-IV MAT 1276                     UPDATED 08/12/94
                           9008016     OXYGEN-16      ENDF/B-IV MAT 1276                     UPDATED 08/12/94
                          10008016     OXYGEN-16      ENDF/B-IV MAT 1276                     UPDATED 08/12/94
                           4013027    AL-27 1193 218 GP 040375(5)                            UPDATED 08/12/94
                           6013027    AL-27 1193 218 GP 040375(5)                            UPDATED 08/12/94
                           8013027    AL-27 1193 218 GP 040375(5)                            UPDATED 08/12/94
                           5024304    CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94
                           5025055     MANGANESE-55   ENDF/B-IV MAT 1197                     UPDATED 08/12/94
                           5026304    FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94
                           5028304    NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'       UPDATED 08/12/94
                           2040302     ZIRCALLOY      ENDF/B-IV MAT 1284                     UPDATED 08/12/94
                           7082000    PB   1288 218NGP 042375 P-3 293K                       UPDATED 08/12/94
                           1092235     URANIUM-235    ENDF/B-IV MAT 1261                     UPDATED 08/12/94
                           1092238     URANIUM-238    ENDF/B-IV MAT 1262                     UPDATED 08/12/94

KENO MESSAGE NUMBER K5-222       1 TRANSFERS FOR MIXTURE     3 WERE CORRECTED FOR BAD MOMENTS.

KENO MESSAGE NUMBER K5-222       2 TRANSFERS FOR MIXTURE     9 WERE CORRECTED FOR BAD MOMENTS.

KENO MESSAGE NUMBER K5-222       1 TRANSFERS FOR MIXTURE    10 WERE CORRECTED FOR BAD MOMENTS.

                             ........    0 IO'S WERE USED MIXING CROSS-SECTIONS       ........

                              1-D CROSS SECTION ARRAY ID NUMBERS
                                 1  2002  1452    27    18  1018

                             ........    0 IO'S WERE USED PREPARING THE CROSS SECTIONS    ........
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
*******************************************************************************************
***                                                                                     ***
***       NAC-STC DIRECTLY LOADED; WET FUEL-PELLET GAP; 100% FUEL GEOMETRY OFFSET; 0 ENRIC  ***
***                                                                                     ***
*******************************************************************************************
*******************************************************************************************
***                                                                                     ***
***                          ****** ADDITIONAL INFORMATION ******                       ***
***                                                                                     ***
***  NUMBER OF ENERGY GROUPS                27       USE LATTICE GEOMETRY          YES  ***
***                                                                                     ***
***  NO. OF FISSION SPECTRUM SOURCE GROUP  1         GLOBAL ARRAY NUMBER              4  ***
***                                                                                     ***
***  NO. OF SCATTERING ANGLES IN XSECS     2         NUMBER OF UNITS IN THE GLOBAL X DIR.  1  ***
***                                                                                     ***
***  ENTRIES/NEUTRON IN THE NEUTRON BANK  25         NUMBER OF UNITS IN THE GLOBAL Y DIR.  1  ***
***                                                                                     ***
***  ENTRIES/NEUTRON IN THE FISSION BANK  18         NUMBER OF UNITS IN THE GLOBAL Z DIR.  4  ***
***                                                                                     ***
***  NUMBER OF MIXTURES USED                9        USE A GLOBAL REFLECTOR         YES  ***
***                                                                                     ***
***  NUMBER OF BIAS ID'S USED               1        USE NESTED HOLES               YES  ***
***                                                                                     ***
***  NUMBER OF DIFFERENTIAL ALBEDOS USED    0        NUMBER OF HOLES                186  ***
***                                                                                     ***
***  TOTAL INPUT GEOMETRY REGIONS         154        MAXIMUM HOLE NESTING LEVEL       3  ***
***                                                                                     ***
***  NUMBER OF GEOMETRY REGIONS USED      154        USE NESTED ARRAYS              YES  ***
***                                                                                     ***
***  LARGEST GEOMETRY UNIT NUMBER         104        NUMBER OF ARRAYS USED            4  ***
***                                                                                     ***
***  LARGEST ARRAY NUMBER                   4        MAXIMUM ARRAY NESTING LEVEL      2  ***
***                                                                                     ***
***                                                                                     ***
***  +X BOUNDARY CONDITION             MIRROR        -X BOUNDARY CONDITION       MIRROR  ***
***                                                                                     ***
***  +Y BOUNDARY CONDITION             MIRROR        -Y BOUNDARY CONDITION       MIRROR  ***
***                                                                                     ***
***  +Z BOUNDARY CONDITION                PER        -Z BOUNDARY CONDITION          PER  ***
***                                                                                     ***
*******************************************************************************************
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
*******************************************************************************************
***                                                                                     ***
***        NAC-STC DIRECTLY LOADED; WET FUEL-PELLET GAP; 100% FUEL GEOMETRY OFFSET; 0 ENR***
***                                                                                     ***
*******************************************************************************************
*******************************************************************************************
***                                                                                     ***
***                  ****** SPACE AND SUPERGROUP INFORMATION ******                     ***
***                                                                                     ***
***      100000 WORDS IS THE TOTAL SPACE AVAILABLE.                                     ***
***                                                                                     ***
***       53021 WORDS WERE USED FOR NON-SUPERGROUP STORAGE.                             ***
***                                                                                     ***
***       46979 WORDS OF STORAGE ARE AVAILABLE FOR SUPERGROUPED DATA.                   ***
***                                                                                     ***
***       99620 WORDS OF STORAGE ARE AVAILABLE FOR CONSTRUCTING THE SUPERGROUPS.        ***
***                                                                                     ***
***       46919 WORDS OF STORAGE ARE AVAILABLE TO EACH SUPERGROUP.                      ***
***                                                                                     ***
***        1180 WORDS ARE NEEDED FOR THE LARGEST GROUP.                                 ***
***                                                                                     ***
***       54417 WORDS OF STORAGE IS SUFFICIENT TO RUN THIS PROBLEM.                     ***
***                                                                                     ***
***       65927 WORDS OF STORAGE WILL ALLOW THE PROBLEM TO RUN WITH ONE SUPERGROUP.     ***
***                                                                                     ***
***       66208 WORDS OF STORAGE WILL BE USED TO RUN THIS PROBLEM.                      ***
***                                                                                     ***
*******************************************************************************************
*******************************************************************************************
***                                                                                     ***
***                   STARTING      ENDING      XSEC       ALBEDO      TOTAL            ***
***   SUPERGROUP       GROUP        GROUP      LENGTH      LENGTH      LENGTH           ***
***                                                                                     ***
***                                                                                     ***
***        1              1           27        2523          0        12846            ***
***                                                                                     ***
*******************************************************************************************

            ........    0 IO'S WERE USED IN SUPERGROUPING    ........

            ************************************************************
            **                                                        **
            **   ARRAY     UNITS IN   UNITS IN   UNITS IN   NESTING   **
            **   NUMBER     X DIR.     Y DIR.     Z DIR.     LEVEL    **
            **                                                        **
            **     1          17         17         1          2      **
            **                                                        **
            **     2          17         17         1          2      **
            **                                                        **
            **     3          17         17         1          2      **
            **                                                        **
            **     4 GLOBAL    1          1         4          1      **
            **                                                        **
            ************************************************************

            ........    0 IO'S WERE USED LOADING THE DATA    ........
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

NAC-STC DIRECTLY LOADED; WET FUEL-PELLET GAP; 100% FUEL GEOMETRY OFFSET; 0 ENRIC

GENERATION	GENERATION K-EFFECTIVE	ELAPSED TIME MINUTES	AVERAGE K-EFFECTIVE	AVG K-EFF DEVIATION	MATRIX K-EFFECTIVE	MATRIX K-EFF DEVIATION
KENO MESSAGE NUMBER K5-132		WARNING....ONLY	922 INDEPENDENT	FISSION POINTS WERE	GENERATED	
1	8.42775E-01	4.89833E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
KENO MESSAGE NUMBER K5-132		WARNING....ONLY	973 INDEPENDENT	FISSION POINTS WERE	GENERATED	
2	8.59256E-01	5.03500E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	9.81674E-01	5.17333E-01	9.81674E-01	0.00000E+00	0.00000E+00	0.00000E+00
4	9.36266E-01	5.32000E-01	9.58970E-01	2.27041E-02	0.00000E+00	0.00000E+00
5	9.32953E-01	5.46500E-01	9.50297E-01	1.57173E-02	0.00000E+00	0.00000E+00
6	9.22000E-01	5.60333E-01	9.43223E-01	1.31743E-02	0.00000E+00	0.00000E+00
7	8.90982E-01	5.75000E-01	9.32775E-01	1.46049E-02	0.00000E+00	0.00000E+00
8	9.58241E-01	5.88667E-01	9.37019E-01	1.26576E-02	0.00000E+00	0.00000E+00
9	9.58604E-01	6.02333E-01	9.40103E-01	1.11332E-02	0.00000E+00	0.00000E+00
10	9.31171E-01	6.16167E-01	9.38986E-01	9.70606E-03	0.00000E+00	0.00000E+00
11	9.14921E-01	6.29833E-01	9.36312E-01	8.96786E-03	0.00000E+00	0.00000E+00
12	8.89081E-01	6.43667E-01	9.31589E-01	9.30837E-03	0.00000E+00	0.00000E+00
13	8.96803E-01	6.58333E-01	9.28427E-01	8.99403E-03	0.00000E+00	0.00000E+00
14	9.29014E-01	6.72000E-01	9.28476E-01	8.21053E-03	0.00000E+00	0.00000E+00
15	9.17850E-01	6.85667E-01	9.27658E-01	7.59669E-03	0.00000E+00	0.00000E+00
16	9.67038E-01	6.99500E-01	9.30471E-01	7.57478E-03	0.00000E+00	0.00000E+00
17	9.04308E-01	7.13167E-01	9.28727E-01	7.26425E-03	0.00000E+00	0.00000E+00
18	8.82455E-01	7.26833E-01	9.25835E-01	7.38491E-03	0.00000E+00	0.00000E+00
19	9.23019E-01	7.40667E-01	9.25669E-01	6.93889E-03	0.00000E+00	0.00000E+00
20	9.26944E-01	7.54333E-01	9.25740E-01	6.54243E-03	0.00000E+00	0.00000E+00
21	9.26825E-01	7.68167E-01	9.25797E-01	6.18878E-03	0.00000E+00	0.00000E+00
22	9.51700E-01	7.81833E-01	9.27092E-01	6.01235E-03	0.00000E+00	0.00000E+00
23	9.31857E-01	7.95500E-01	9.27319E-01	5.72338E-03	0.00000E+00	0.00000E+00
24	9.45504E-01	8.08333E-01	9.28146E-01	5.51927E-03	0.00000E+00	0.00000E+00
25	9.48368E-01	8.23000E-01	9.29025E-01	5.34664E-03	0.00000E+00	0.00000E+00
26	9.29654E-01	8.36833E-01	9.29051E-01	5.11908E-03	0.00000E+00	0.00000E+00
27	8.95124E-01	8.50500E-01	9.27694E-01	5.09414E-03	0.00000E+00	0.00000E+00
28	9.51964E-01	8.63333E-01	9.28628E-01	4.98251E-03	0.00000E+00	0.00000E+00
29	9.46722E-01	8.77000E-01	9.29298E-01	4.84104E-03	0.00000E+00	0.00000E+00
30	9.07429E-01	8.89833E-01	9.28517E-01	4.72987E-03	0.00000E+00	0.00000E+00
31	9.19008E-01	9.03667E-01	9.28189E-01	4.57562E-03	0.00000E+00	0.00000E+00
32	9.23612E-01	9.16333E-01	9.28036E-01	4.42310E-03	0.00000E+00	0.00000E+00
33	9.32488E-01	9.31000E-01	9.28180E-01	4.28045E-03	0.00000E+00	0.00000E+00
34	9.03881E-01	9.43833E-01	9.27421E-01	4.21352E-03	0.00000E+00	0.00000E+00
35	9.62378E-01	9.56667E-01	9.28480E-01	4.21899E-03	0.00000E+00	0.00000E+00
36	8.97305E-01	9.70333E-01	9.27563E-01	4.19447E-03	0.00000E+00	0.00000E+00
37	9.73499E-01	9.83167E-01	9.28875E-01	4.27911E-03	0.00000E+00	0.00000E+00
38	9.15334E-01	9.97000E-01	9.28499E-01	4.17552E-03	0.00000E+00	0.00000E+00
39	9.46079E-01	1.01067E+00	9.28974E-01	4.08880E-03	0.00000E+00	0.00000E+00
40	9.66997E-01	1.02450E+00	9.29975E-01	4.10360E-03	0.00000E+00	0.00000E+00
41	9.39366E-01	1.03717E+00	9.30216E-01	4.00424E-03	0.00000E+00	0.00000E+00
42	9.67038E-01	1.05000E+00	9.31136E-01	4.00995E-03	0.00000E+00	0.00000E+00
			⋮			
768	9.46328E-01	1.07178E+01	9.33891E-01	8.50544E-04	0.00000E+00	0.00000E+00
769	9.59888E-01	1.07317E+01	9.33925E-01	8.50111E-04	0.00000E+00	0.00000E+00
770	9.59446E-01	1.07462E+01	9.33958E-01	8.49653E-04	0.00000E+00	0.00000E+00
771	9.79919E-01	1.07600E+01	9.34018E-01	8.50650E-04	0.00000E+00	0.00000E+00
772	9.06141E-01	1.07728E+01	9.33981E-01	8.50315E-04	0.00000E+00	0.00000E+00
773	9.42108E-01	1.07865E+01	9.33992E-01	8.49277E-04	0.00000E+00	0.00000E+00
774	9.46554E-01	1.07993E+01	9.34008E-01	8.48332E-04	0.00000E+00	0.00000E+00
775	9.31532E-01	1.08122E+01	9.34005E-01	8.47240E-04	0.00000E+00	0.00000E+00
776	9.55431E-01	1.08258E+01	9.34033E-01	8.46598E-04	0.00000E+00	0.00000E+00
777	9.00955E-01	1.08387E+01	9.33990E-01	8.46581E-04	0.00000E+00	0.00000E+00
778	9.18847E-01	1.08525E+01	9.33970E-01	8.45715E-04	0.00000E+00	0.00000E+00
779	9.18019E-01	1.08652E+01	9.33950E-01	8.44875E-04	0.00000E+00	0.00000E+00
780	9.58540E-01	1.08780E+01	9.33981E-01	8.44380E-04	0.00000E+00	0.00000E+00
781	9.33157E-01	1.08900E+01	9.33980E-01	8.43296E-04	0.00000E+00	0.00000E+00
782	9.41474E-01	1.09037E+01	9.33990E-01	8.42269E-04	0.00000E+00	0.00000E+00
783	9.81031E-01	1.09157E+01	9.34050E-01	8.43344E-04	0.00000E+00	0.00000E+00
784	9.34474E-01	1.09302E+01	9.34051E-01	8.42265E-04	0.00000E+00	0.00000E+00
785	9.61076E-01	1.09430E+01	9.34085E-01	8.41896E-04	0.00000E+00	0.00000E+00
786	9.36456E-01	1.09568E+01	9.34088E-01	8.40827E-04	0.00000E+00	0.00000E+00
787	9.33709E-01	1.09705E+01	9.34088E-01	8.39755E-04	0.00000E+00	0.00000E+00
788	9.36210E-01	1.09842E+01	9.34091E-01	8.38690E-04	0.00000E+00	0.00000E+00
789	9.18046E-01	1.09980E+01	9.34070E-01	8.37872E-04	0.00000E+00	0.00000E+00
790	9.03295E-01	1.10117E+01	9.34031E-01	8.37719E-04	0.00000E+00	0.00000E+00
791	9.24554E-01	1.10255E+01	9.34019E-01	8.36743E-04	0.00000E+00	0.00000E+00
792	9.63797E-01	1.10392E+01	9.34057E-01	8.36533E-04	0.00000E+00	0.00000E+00
793	9.54726E-01	1.10520E+01	9.34083E-01	8.35883E-04	0.00000E+00	0.00000E+00
794	9.23635E-01	1.10657E+01	9.34070E-01	8.34931E-04	0.00000E+00	0.00000E+00
795	9.41438E-01	1.10785E+01	9.34079E-01	8.33929E-04	0.00000E+00	0.00000E+00
796	8.87331E-01	1.10932E+01	9.34020E-01	8.34957E-04	0.00000E+00	0.00000E+00
797	9.41992E-01	1.11060E+01	9.34030E-01	8.33966E-04	0.00000E+00	0.00000E+00
798	9.52630E-01	1.11197E+01	9.34054E-01	8.33246E-04	0.00000E+00	0.00000E+00
799	9.12950E-01	1.11343E+01	9.34027E-01	8.32621E-04	0.00000E+00	0.00000E+00
800	9.10958E-01	1.11482E+01	9.33998E-01	8.32079E-04	0.00000E+00	0.00000E+00
801	9.14560E-01	1.11610E+01	9.33974E-01	8.31393E-04	0.00000E+00	0.00000E+00
802	9.42908E-01	1.11747E+01	9.33985E-01	8.30428E-04	0.00000E+00	0.00000E+00
803	8.95273E-01	1.11883E+01	9.33937E-01	8.30798E-04	0.00000E+00	0.00000E+00

KENO MESSAGE NUMBER K5-123 EXECUTION TERMINATED DUE TO COMPLETION OF THE SPECIFIED NUMBER OF GENERATIONS.

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

NAC-STC DIRECTLY LOADED; WET FUEL-PELLET GAP; 100% FUEL GEOMETRY OFFSET; 0 ENRIC

```
LIFETIME =  3.80463E-05 + OR -  7.45568E-08             GENERATION TIME =  2.68138E-05 + OR -  3.95380E-08
NU BAR   =  2.43935E+00 + OR -  6.92015E-05        AVERAGE FISSION GROUP =  2.19694E+01 + OR -  4.03476E-03
                     ENERGY(EV) OF THE AVERAGE LETHARGY CAUSING FISSION =  2.33262E-01 + OR -  7.60910E-04
```

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
3	0.93388	+ OR - 0.00083	0.93305 TO 0.93471	0.93222 TO 0.93554	0.93139 TO 0.93637	800000
4	0.93387	+ OR - 0.00083	0.93304 TO 0.93470	0.93221 TO 0.93554	0.93138 TO 0.93637	799000
5	0.93388	+ OR - 0.00083	0.93304 TO 0.93471	0.93221 TO 0.93554	0.93138 TO 0.93637	798000
6	0.93389	+ OR - 0.00083	0.93306 TO 0.93472	0.93222 TO 0.93556	0.93139 TO 0.93639	797000
7	0.93394	+ OR - 0.00083	0.93311 TO 0.93478	0.93228 TO 0.93561	0.93145 TO 0.93644	796000
8	0.93391	+ OR - 0.00083	0.93308 TO 0.93475	0.93225 TO 0.93558	0.93142 TO 0.93641	795000
9	0.93388	+ OR - 0.00083	0.93305 TO 0.93472	0.93222 TO 0.93555	0.93138 TO 0.93638	794000
10	0.93389	+ OR - 0.00083	0.93305 TO 0.93472	0.93222 TO 0.93555	0.93138 TO 0.93639	793000
11	0.93391	+ OR - 0.00083	0.93308 TO 0.93474	0.93224 TO 0.93558	0.93141 TO 0.93641	792000
12	0.93397	+ OR - 0.00083	0.93313 TO 0.93480	0.93230 TO 0.93563	0.93146 TO 0.93647	791000
17	0.93404	+ OR - 0.00084	0.93320 TO 0.93487	0.93236 TO 0.93571	0.93153 TO 0.93654	786000
22	0.93411	+ OR - 0.00084	0.93327 TO 0.93495	0.93244 TO 0.93579	0.93160 TO 0.93663	781000
27	0.93414	+ OR - 0.00084	0.93330 TO 0.93498	0.93246 TO 0.93582	0.93161 TO 0.93666	776000
.			.			
.			.			
.			.			
772	0.93283	+ OR - 0.00390	0.92893 TO 0.93673	0.92503 TO 0.94062	0.92114 TO 0.94452	31000
777	0.93235	+ OR - 0.00435	0.92800 TO 0.93670	0.92364 TO 0.94106	0.91929 TO 0.94541	26000
782	0.93195	+ OR - 0.00515	0.92680 TO 0.93711	0.92165 TO 0.94226	0.91649 TO 0.94742	21000
787	0.92652	+ OR - 0.00555	0.92097 TO 0.93207	0.91542 TO 0.93762	0.90986 TO 0.94317	16000
792	0.92531	+ OR - 0.00693	0.91838 TO 0.93224	0.91145 TO 0.93917	0.90452 TO 0.94610	11000
797	0.92155	+ OR - 0.00885	0.91270 TO 0.93039	0.90385 TO 0.93924	0.89501 TO 0.94808	6000

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

NAC-STC DIRECTLY LOADED; WET FUEL-PELLET GAP; 100% FUEL GEOMETRY OFFSET; 0 ENRIC

PLOT OF AVERAGE K-EFFECTIVE BY GENERATION RUN.
THE LINE REPRESENTS K-EFF = 0.9339 + OR - 0.0008 WHICH OCCURS FOR 803 GENERATIONS RUN.

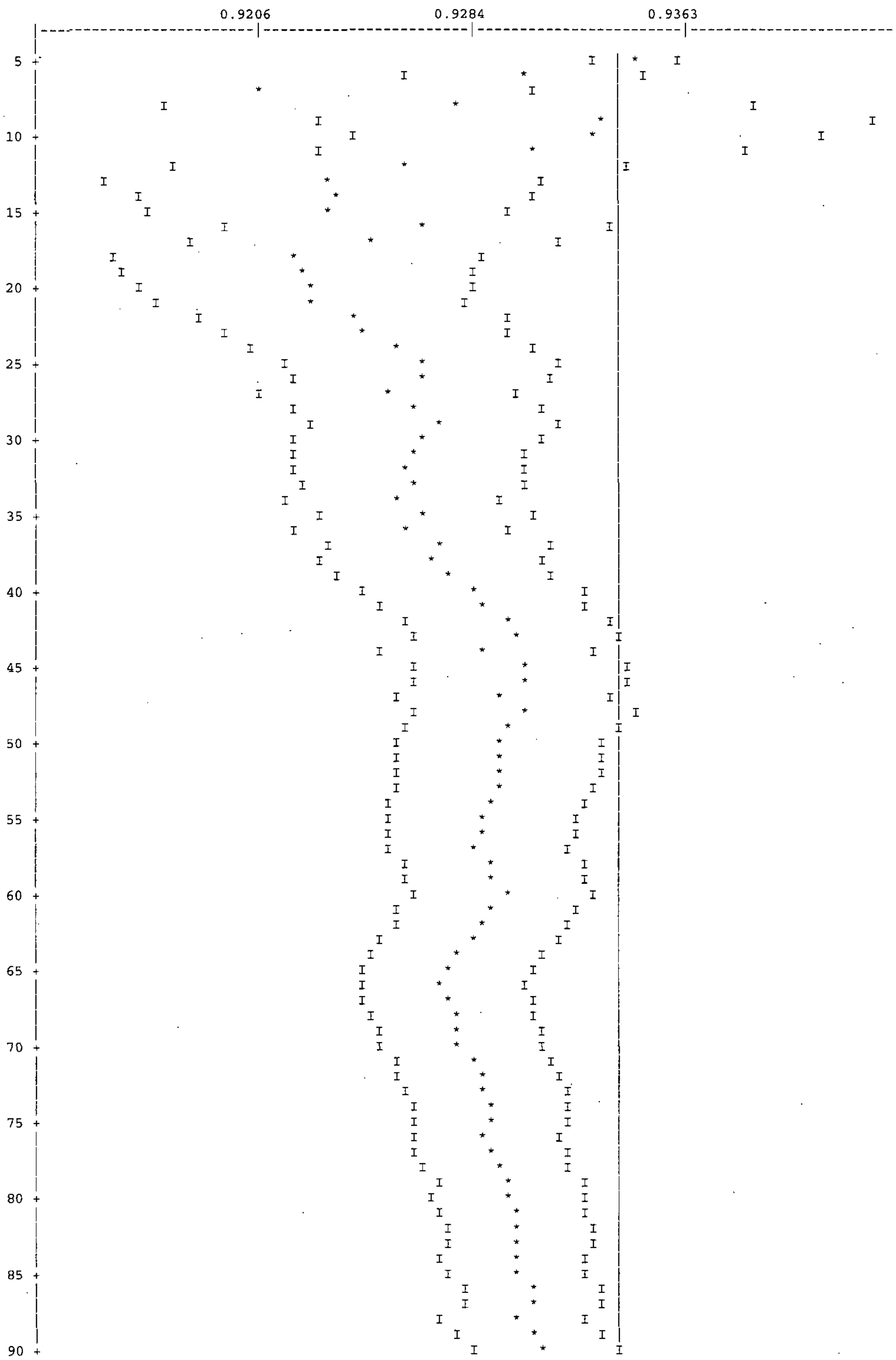

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

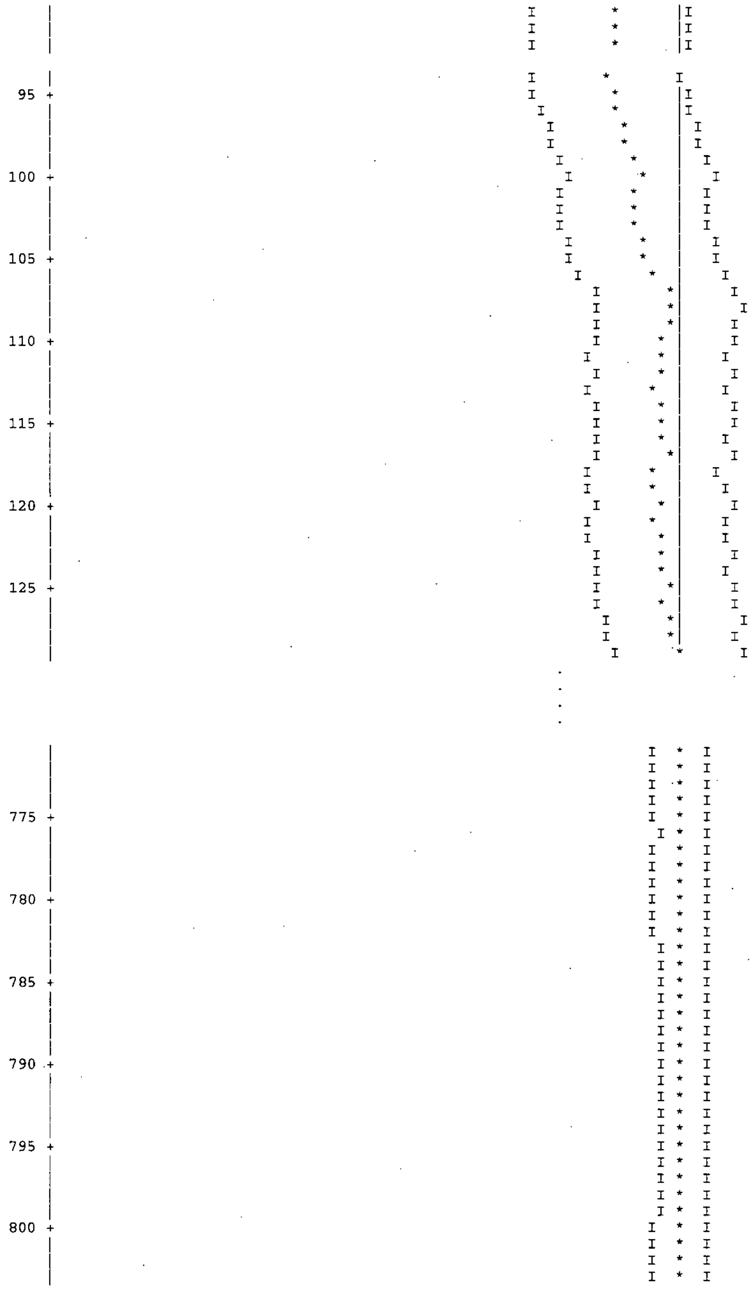

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
            NAC-STC DIRECTLY LOADED; WET FUEL-PELLET GAP; 100% FUEL GEOMETRY OFFSET; 0 ENRIC

                             FREQUENCY FOR GENERATIONS    4 TO  803
0.8689 TO 0.8733      ***
0.8733 TO 0.8776      ***
0.8776 TO 0.8820      ****
0.8820 TO 0.8864      *******
0:8864 TO 0.8907      ************
0.8907 TO 0.8951      *********
0.8951 TO 0.8995      ***************
0.8995 TO 0.9038      ************************
0.9038 TO 0.9082      ******************************
0.9082 TO 0.9125      *******************************
0.9125 TO 0.9169      **************************************************
0.9169 TO 0.9213      *********************************************
0.9213 TO 0.9256      *************************************************************
0.9256 TO 0.9300      ***************************************************************
0.9300 TO 0.9344      ***********************************************************
0.9344 TO 0.9387      ***************************************************
0.9387 TO 0.9431      ***********************************************************
0.9431 TO 0.9475      **********************************************************
0.9475 TO 0.9518      ******************************************
0.9518 TO 0.9562      ******************************************
0.9562 TO 0.9605      **************************
0.9605 TO 0.9649      *************************
0.9649 TO 0.9693      ****************************
0.9693 TO 0.9736      *****************
0.9736 TO 0.9780      ********
0.9780 TO 0.9824      ***********
0.9824 TO 0.9867      *****
0.9867 TO 0.9911      ******
0.9911 TO 0.9955      **
0.9955 TO 0.9998
0.9998 TO 1.0042      **
1.0042 TO 1.0086      **

NAC-STC DIRECTLY LOADED; WET FUEL-PELLET GAP; 100% FUEL GEOMETRY OFFSET; 0 ENRIC

                             FREQUENCY FOR GENERATIONS  204 TO  803
0.8689 TO 0.8733      ***
0.8733 TO 0.8776      *
0.8776 TO 0.8820      ***
0.8820 TO 0.8864      ****
0.8864 TO 0.8907      *********
0.8907 TO 0.8951      ******
0.8951 TO 0.8995      *******
0.8995 TO 0.9038      ********************
0.9038 TO 0.9082      ***********************
0.9082 TO 0.9125      **************************
0.9125 TO 0.9169      ************************************
0.9169 TO 0.9213      *************************************
0.9213 TO 0.9256      ****************************************************
0.9256 TO 0.9300      ******************************************
0.9300 TO 0.9344      ***********************************************
0.9344 TO 0.9387      *************************************
0.9387 TO 0.9431      ***********************************************
0.9431 TO 0.9475      *******************************************
0.9475 TO 0.9518      *****************************
0.9518 TO 0.9562      **********************************
0.9562 TO 0.9605      *********************
0.9605 TO 0.9649      ******************
0.9649 TO 0.9693      ******************
0.9693 TO 0.9736      ************
0.9736 TO 0.9780      ****
0.9780 TO 0.9824      ********
0.9824 TO 0.9867      ***
0.9867 TO 0.9911      ****
0.9911 TO 0.9955      **
0.9955 TO 0.9998
0.9998 TO 1.0042      **
1.0042 TO 1.0086      **
```

Figure 6.7-10 CSAS25 Input/Output for Framatome-Cogema AFA Fuel (continued)

```
NAC-STC DIRECTLY LOADED; WET FUEL-PELLET GAP; 100% FUEL GEOMETRY OFFSET; 0 ENRIC

                                   FREQUENCY FOR GENERATIONS  404 TO  803
0.8689 TO 0.8733     ***
0.8733 TO 0.8776
0.8776 TO 0.8820     ***
0.8820 TO 0.8864     ***
0.8864 TO 0.8907     ******
0.8907 TO 0.8951     ****
0.8951 TO 0.8995     ***
0.8995 TO 0.9038     ************
0.9038 TO 0.9082     ****************
0.9082 TO 0.9125     **************
0.9125 TO 0.9169     **********************
0.9169 TO 0.9213     ***********************
0.9213 TO 0.9256     ************************************
0.9256 TO 0.9300     ************************
0.9300 TO 0.9344     ********************************
0.9344 TO 0.9387     *************************
0.9387 TO 0.9431     ***********************************
0.9431 TO 0.9475     *******************************
0.9475 TO 0.9518     *********************
0.9518 TO 0.9562     ********************
0.9562 TO 0.9605     **************
0.9605 TO 0.9649     ************
0.9649 TO 0.9693     *************
0.9693 TO 0.9736     ******
0.9736 TO 0.9780     ****
0.9780 TO 0.9824     *******
0.9824 TO 0.9867     ***
0.9867 TO 0.9911     ****
0.9911 TO 0.9955     *
0.9955 TO 0.9998
0.9998 TO 1.0042     *
1.0042 TO 1.0086     **
```

```
NAC-STC DIRECTLY LOADED; WET FUEL-PELLET GAP; 100% FUEL GEOMETRY OFFSET; 0 ENRIC

                                   FREQUENCY FOR GENERATIONS  604 TO  803
0.8689 TO 0.8733     *
0.8733 TO 0.8776
0.8776 TO 0.8820     *
0.8820 TO 0.8864     *
0.8864 TO 0.8907     ****
0.8907 TO 0.8951     *
0.8951 TO 0.8995     ***
0.8995 TO 0.9038     *******
0.9038 TO 0.9082     ******
0.9082 TO 0.9125     ***********
0.9125 TO 0.9169     **************
0.9169 TO 0.9213     ****************
0.9213 TO 0.9256     **************
0.9256 TO 0.9300     **************
0.9300 TO 0.9344     ************
0.9344 TO 0.9387     *********
0.9387 TO 0.9431     *****************
0.9431 TO 0.9475     ************
0.9475 TO 0.9518     ************
0.9518 TO 0.9562     ***********
0.9562 TO 0.9605     **********
0.9605 TO 0.9649     *****
0.9649 TO 0.9693     *******
0.9693 TO 0.9736     ***
0.9736 TO 0.9780     **
0.9780 TO 0.9824     *****
0.9824 TO 0.9867     *
0.9867 TO 0.9911
0.9911 TO 0.9955     *
0.9955 TO 0.9998
0.9998 TO 1.0042
1.0042 TO 1.0086
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions

```
     PRIMARY MODULE ACCESS AND INPUT RECORD ( SCALE DRIVER - 95/03/29 - 09:06:37 )
MODULE CSAS25   WILL BE CALLED
  TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 cm) (IVF = 1.0) (EVF = 1.0
  '
  '      THIS IS A MODEL OF THE YNPS NAC-MPC BASKET
  '  LOADED WITH 36 UNITED NUCLEAR TYPE A ASSEMBLIES
  '                    WITH MODIFIED TUBE ASSEMBLY 98
  '
  '           PRODUCED FOR THE YANKEE ROWE
  '              STC LICENSE AMENDMENT
  '
  '      INTERIOR MODERATOR VOLUME FRACTION = 1.0
  '      EXTERIOR MODERATOR VOLUME FRACTION = 1.0
  '          CASK TO CASK PITCH = 300 cm
  '              FLOODED PELLET CLAD GAP
  '              NEUTRON SHIELD REMOVED
  '
  27GROUPNDF4 LATTICECELL
  UO2         1             0.95    293.0 92235 4.0 92238 96.0 END
  ZIRCALLOY   2             1.0     293.0                      END
  H2O         3             1.0     293.0                      END
  AL          4             1.0     293.0                      END
  SS304       5             1.0     293.0                      END
  B-10        6  DEN=2.6226 0.0450  293.0                      END
  B-11        6  DEN=2.6226 0.2736  293.0                      END
  C           6  DEN=2.6226 0.0927  293.0                      END
  AL          6  DEN=2.6226 0.5737  293.0                      END
  PB          7             1.0     293.0                      END
  H           8  DEN=1.6291 0.060   293.0                      END
  O           8  DEN=1.6291 0.425   293.0                      END
  C           8  DEN=1.6291 0.277   293.0                      END
  N           8  DEN=1.6291 0.020   293.0                      END
  AL          8  DEN=1.6291 0.214   293.0                      END
  B-10        8  DEN=1.6291 0.001   293.0                      END
  B-11        8  DEN=1.6291 0.004   293.0                      END
  H2O         9             1.0     293.0                      END
  H2O         10            1.0     293.0                      END
  END COMP
  SQUAREPITCH  1.1887 0.7887 1 3 0.9271 2 0.8052 10 END
  TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 cm) (IVF = 1.0) (EVF = 1.0
  READ PARAM RUN=YES PLT=YES GEN=1003 NPG=1000 TBA=15 RND=321 END PARAM
  READ GEOM
  '
  '  WATER LEVEL UNIT CELLS
  '
  UNIT  1
  COM='FUEL PIN CELL - BETWEEN DISKS'
  CYLINDER  1 1  0.3943    2P2.1400
  CYLINDER 10 1  0.4026    2P2.1400
  CYLINDER  2 1  0.4635    2P2.1400
  CUBOID    3 1  4P0.5944  2P2.1400
  UNIT  2
  COM='WATER CELL - BETWEEN DISKS'
  CUBOID    3 1  4P0.5944  2P2.1400
  UNIT  3
  COM='DISPLACEMENT CELL - BETWEEN DISKS'
  CYLINDER  2 1  0.4635    2P2.1400
  CUBOID    3 1  4P0.5944  2P2.1400
  UNIT  4
  COM='INSTRUMENT TUBE CELL - BETWEEN DISKS'
  CYLINDER  3 1  0.4998    2P2.1400
  CYLINDER  5 1  0.5442    2P2.1400
  CUBOID    3 1  4P0.5944  2P2.1400
  '
  '  DISK LEVEL UNIT CELLS (BOTH SS AND AL)
  '
  UNIT  5
  COM='FUEL PIN CELL - WITH SS DISK'
  CYLINDER  1 1  0.3943    2P0.6604
  CYLINDER 10 1  0.4026    2P0.6604
  CYLINDER  2 1  0.4635    2P0.6604
  CUBOID    3 1  4P0.5944 2P0.6604
  UNIT  6
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
COM='WATER CELL - WITH SS DISK'
CUBOID    3 1  4P0.5944 2P0.6604
UNIT  7
COM='DISPLACEMENT CELL - WITH SS DISK'
CYLINDER  2 1  0.4635   2P0.6604
CUBOID    3 1  4P0.5944 2P0.6604
UNIT  8
COM='INSTRUMENT TUBE CELL - WITH SS DISK'
CYLINDER  3 1  0.4998   2P0.6604
CYLINDER  5 1  0.5442   2P0.6604
CUBOID    3 1  4P0.5944 2P0.6604
'
'  WATER LEVEL BORAL SHEETS
'
UNIT 14
COM='X-X BORAL SHEET BETWEEN DISKS'
CUBOID 6 1 2P9.144 2P0.0318 2P2.1400
CUBOID 4 1 2P9.144 2P0.0953 2P2.1400
UNIT 15
COM='Y-Y BORAL SHEET BETWEEN DISKS'
CUBOID 6 1 2P0.0318 2P9.144 2P2.1400
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
CUBOID 4 1 2P0.0953 2P9.144 2P2.1400
'
'  DISK LEVEL BORAL SHEETS (AL AND SS)
'
UNIT 16
COM='X-X BORAL SHEET WITH SS DISK'
CUBOID 6 1 2P9.144 2P0.0318 2P0.6604
CUBOID 4 1 2P9.144 2P0.0953 2P0.6604
UNIT 17
COM='Y-Y BORAL SHEET WITH SS DISK'
CUBOID 6 1 2P0.0318 2P9.144 2P0.6604
CUBOID 4 1 2P0.0953 2P9.144 2P0.6604
'
' WATER LEVEL WEB MATERIAL
'
UNIT 20
COM='WATER LEVEL WEB MATERIAL (SMALL) X-X'
CUBOID    3 1 2P10.4635 2P0.9716 2P2.1400
UNIT 21
COM='WATER LEVEL WEB MATERIAL (MEDIUM) X-X'
CUBOID    3 1 2P10.4635 2P1.0478 2P2.1400
UNIT 22
COM='WATER LEVEL WEB MATERIAL (LARGE) X-X'
CUBOID    3 1 2P10.4635 2P1.1208 2P2.1400
UNIT 23
COM='WATER LEVEL WEB MATERIAL (LONG) Y-Y'
CUBOID    3 1 2P1.1208 2P79.5249 2P2.1400
'
'  SUPPORT DISK WEB MATERIAL
'
UNIT 30
COM='SUPPORT DISK WEB MATERIAL (SMALL) X-X'
CUBOID    5 1 2P10.4635 2P0.9716 2P0.6604
UNIT 31
COM='SUPPORT DISK WEB MATERIAL (MEDIUM) X-X'
CUBOID    5 1 2P10.4635 2P1.0478 2P0.6604
UNIT 32
COM='SUPPORT DISK WEB MATERIAL (LARGE) X-X'
CUBOID    5 1 2P10.4635 2P1.1208 2P0.6604
UNIT 33
COM='SUPPORT DISK WEB MATERIAL (LONG) Y-Y'
CUBOID    5 1 2P1.1208 2P79.5249 2P0.6604
'
'  HEAT TRANSFER DISK WEB MATERIAL
'
UNIT 40
COM='HEAT TRANSFER DISK WEB MATERIAL (SMALL) X-X'
CUBOID    4 1 2P10.4635 2P0.9716 2P0.6604
UNIT 41
COM='HEAT TRANSFER DISK WEB MATERIAL (MEDIUM) X-X'
CUBOID    4 1 2P10.4635 2P1.0478 2P0.6604
UNIT 42
COM='HEAT TRANSFER DISK WEB MATERIAL (LARGE) X-X'
CUBOID    4 1 2P10.4635 2P1.1208 2P0.6604
UNIT 43
COM='HEAT TRANSFER DISK WEB MATERIAL (LONG) Y-Y'
CUBOID    4 1 2P1.1208 2P79.5249 2P0.6604
'
'  WATER LEVEL ASSEMBLY ARRAYS
'
UNIT 50
COM='FUEL TUBE AND ASSEMBLY - WATER LEVEL'
ARRAY  1  -9.0768 -9.0768 -2.1400
CUBOID 3 1 4P9.9441                         2P2.1400
CUBOID 5 1 4P10.0661                        2P2.1400
CUBOID 3 1 4P10.25681                       2P2.1400
HOLE  14   0.0       10.1615  0.0
HOLE  14   0.0      -10.1615  0.0
HOLE  15   10.1615   0.0      0.0
HOLE  15  -10.1615   0.0      0.0
CUBOID 5 1 4P10.3051                        2P2.1400


UNIT 350
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
COM='FUEL TUBE AND ASSEMBLY - WATER LEVEL LR'
ARRAY  301  -9.9440 -9.0768 -2.1400
CUBOID 3 1 4P9.9441                          2P2.1400
CUBOID 5 1 4P10.0661                         2P2.1400
CUBOID 3 1 4P10.25681                        2P2.1400
HOLE  14   0.0      10.1615  0.0
HOLE  14   0.0     -10.1615 0.0
HOLE  15   10.1615  0.0      0.0
HOLE  15   -10.1615 0.0      0.0
CUBOID 5 1 4P10.3051                         2P2.1400

UNIT 550
COM='FUEL TUBE AND ASSEMBLY - WATER LEVEL UR'
ARRAY  501  -9.9440 -9.9440 -2.1400
CUBOID 3 1 4P9.9441                          2P2.1400
CUBOID 5 1 4P10.0661                         2P2.1400
CUBOID 3 1 4P10.25681                        2P2.1400
HOLE  14   0.0      10.1615  0.0
HOLE  14   0.0     -10.1615 0.0
HOLE  15   10.1615  0.0      0.0
HOLE  15   -10.1615 0.0      0.0
CUBOID 5 1 4P10.3051                         2P2.1400

UNIT 750
COM='FUEL TUBE AND ASSEMBLY - WATER LEVEL UL'
ARRAY  701  -9.0768 -9.9440 -2.1400
CUBOID 3 1 4P9.9441                          2P2.1400
CUBOID 5 1 4P10.0661                         2P2.1400
CUBOID 3 1 4P10.25681                        2P2.1400
HOLE  14   0.0      10.1615  0.0
HOLE  14   0.0     -10.1615 0.0
HOLE  15   10.1615  0.0      0.0
HOLE  15   -10.1615 0.0      0.0
CUBOID 5 1 4P10.3051                         2P2.1400


UNIT 51
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -Y'
CUBOID 3 1 4P10.4635                         2P2.1400
HOLE  750   0.0      -0.1584      0.0
UNIT 52
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS Y'
CUBOID 3 1 4P10.4635                         2P2.1400
HOLE  50   0.0      0.1584       0.0
UNIT 53
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X'
CUBOID 3 1 4P10.4635                         2P2.1400
HOLE  550   -0.1584   0.0          0.0
UNIT 54
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X'
CUBOID 3 1 4P10.4635                         2P2.1400
HOLE  750   0.1584   0.0          0.0
UNIT 55
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X Y'
CUBOID 3 1 4P10.4635                         2P2.1400
HOLE  50   0.1584   0.1584       0.0
UNIT 56
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X Y'
CUBOID 3 1 4P10.4635                         2P2.1400
HOLE  350   -0.1584   0.1584       0.0
UNIT 57
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X -Y'
CUBOID 3 1 4P10.4635                         2P2.1400
HOLE  750   0.1584   -0.1584       0.0
UNIT 58
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X -Y'
CUBOID 3 1 4P10.4635                         2P2.1400
HOLE  550   -0.1584   -0.1584       0.0
UNIT 59
COM='CENTRAL HOLE'
CUBOID 3 1 4P10.4636                         2P2.1400
'
'   DISK LEVEL ASSEMBLY ARRAYS
'
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
UNIT 60
COM='FUEL TUBE AND ASSEMBLY - DISK LEVEL'
ARRAY  2  -9.0768 -9.0768 -0.6604
CUBOID 3 1 4P9.9441                              2P0.6604
CUBOID 5 1 4P10.0661                             2P0.6604
CUBOID 3 1 4P10.25681                            2P0.6604
HOLE  16   0.0      10.1615  0.0
HOLE  16   0.0     -10.1615 0.0
HOLE  17   10.1615  0.0      0.0
HOLE  17   -10.1615 0.0      0.0
CUBOID 5 1 4P10.3051                             2P0.6604


UNIT 360
COM='FUEL TUBE AND ASSEMBLY - SUPPORT DISK LEVEL LR'
ARRAY  302  -9.9440 -9.0768 -0.6604
CUBOID 3 1 4P9.9441                              2P0.6604
CUBOID 5 1 4P10.0661                             2P0.6604
CUBOID 3 1 4P10.25681                            2P0.6604
HOLE  16   0.0      10.1615  0.0
HOLE  16   0.0     -10.1615 0.0
HOLE  17   10.1615  0.0      0.0
HOLE  17   -10.1615 0.0      0.0
CUBOID 5 1 4P10.3051                             2P0.6604

UNIT 560
COM='FUEL TUBE AND ASSEMBLY - SUPPORT DISK LEVEL UR'
ARRAY  502  -9.9440 -9.9440 -0.6604
CUBOID 3 1 4P9.9441                              2P0.6604
CUBOID 5 1 4P10.0661                             2P0.6604
CUBOID 3 1 4P10.25681                            2P0.6604
HOLE  16   0.0      10.1615  0.0
HOLE  16   0.0     -10.1615 0.0
HOLE  17   10.1615  0.0      0.0
HOLE  17   -10.1615 0.0      0.0
CUBOID 5 1 4P10.3051                             2P0.6604

UNIT 760
COM='FUEL TUBE AND ASSEMBLY - SUPPORT DISK LEVEL UL'
ARRAY  702  -9.0768 -9.9440 -0.6604
CUBOID 3 1 4P9.9441                              2P0.6604
CUBOID 5 1 4P10.0661                             2P0.6604
CUBOID 3 1 4P10.25681                            2P0.6604
HOLE  16   0.0      10.1615  0.0
HOLE  16   0.0     -10.1615 0.0
HOLE  17   10.1615  0.0      0.0
HOLE  17   -10.1615 0.0      0.0
CUBOID 5 1 4P10.3051                             2P0.6604


UNIT 61
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -Y'
CUBOID 3 1 4P10.4635                             2P0.6604
HOLE  760   0.0      -0.1584      0.0
UNIT 62
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS Y'
CUBOID 3 1 4P10.4635                             2P0.6604
HOLE  60   0.0      0.1584       0.0
UNIT 63
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X'
CUBOID 3 1 4P10.4635                             2P0.6604
HOLE  560   -0.1584  0.0          0.0
UNIT 64
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X'
CUBOID 3 1 4P10.4635                             2P0.6604
HOLE  760   0.1584   0.0          0.0
UNIT 65
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X Y'
CUBOID 3 1 4P10.4635                             2P0.6604
HOLE  60   0.1584   0.1584       0.0
UNIT 66
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X Y'
CUBOID 3 1 4P10.4635                             2P0.6604
HOLE  360   -0.1584  0.1584       0.0
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
UNIT 67
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS X -Y'
CUBOID 3 1 4P10.4635                          2P0.6604
HOLE  760   0.1584   -0.1584       0.0
UNIT 68
COM='ASSEMBLY CELL WITH 4 BORAL SHEETS -X -Y'
CUBOID 3 1 4P10.4635                          2P0.6604
HOLE  560   -0.1584   -0.1584       0.0
UNIT 69
COM='CENTRAL HOLE'
CUBOID 3 1 4P10.4636   2P0.6604
'
'  WATER LEVEL BASKET ARRAYS
'
UNIT 80
COM='5X1 WATER LEVEL ARRAY (SMALL ARRAY -X)'
ARRAY 20 -10.4636 -33.6323 -2.1400
UNIT 81
COM='5X1 WATER LEVEL ARRAY (SMALL ARRAY X)'
ARRAY 21 -10.4636 -33.6323 -2.1400
UNIT 82
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY -X)'
ARRAY 22 -10.4636 -56.6549 -2.1400
UNIT 83
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY X)'
ARRAY 23 -10.4636 -56.6549 -2.1400
UNIT 84
COM='13X1 WATER LEVEL ARRAY (LARGE ARRAY-X)'
ARRAY 24 -10.4636 -79.5251 -2.1400
UNIT 85
COM='13X1 WATER LEVEL ARRAY (MIDDLE LARGE ARRAY)'
ARRAY 25 -10.4636 -79.5251 -2.1400
UNIT 86
COM='13X1 WATER LEVEL ARRAY (LARGE ARRAY X)'
ARRAY 26 -10.4636 -79.5251 -2.1400
'
'  SUPPORT DISK LEVEL BASKET ARRAYS
'
UNIT 90
COM='5X1 SUPPORT DISK LEVEL ARRAY (SMALL ARRAY -X)'
ARRAY 30 -10.4636 -33.6323 -0.6604
UNIT 91
COM='5X1 SUPPORT DISK LEVEL ARRAY (SMALL ARRAY  X)'
ARRAY 31 -10.4636 -33.6323 -0.6604
UNIT 92
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY -X)'
ARRAY 32 -10.4636 -56.6549 -0.6604
UNIT 93
COM='9X1 WATER LEVEL ARRAY (MEDIUM ARRAY X)'
ARRAY 33 -10.4636 -56.6549 -0.6604
UNIT 94
COM='13X1 SUPPORT DISK LEVEL ARRAY (LARGE ARRAY -X)'
ARRAY 34 -10.4636 -79.5251 -0.6604
UNIT 95
COM='13X1 SUPPORT DISK LEVEL ARRAY (MIDDLE LARGE ARRAY)'
ARRAY 35 -10.4636 -79.5251 -0.6604
UNIT 96
COM='13X1 SUPPORT DISK LEVEL ARRAY (LARGE ARRAY -X)'
ARRAY 36 -10.4636 -79.5251 -0.6604
'
'  HEAT TRANSFER DISK LEVEL BASKET ARRAYS
'
UNIT 100
COM='5X1 HEAT TRANSFER DISK LEVEL ARRAY (SMALL ARRAY -X)'
ARRAY 40 -10.4636 -33.6323 -0.6604
UNIT 101
COM='5X1 HEAT TRANSFER DISK LEVEL ARRAY (SMALL ARRAY X)'
ARRAY 41 -10.4636 -33.6323 -0.6604
UNIT 102
COM='9X1 HEAT TRANSFER DISK LEVEL ARRAY (MEDIUM ARRAY -X)'
ARRAY 42 -10.4636 -56.6549 -0.6604
UNIT 103
COM='9X1 HEAT TRANSFER DISK LEVEL ARRAY (MEDIUM ARRAY  X)'
ARRAY 43 -10.4636 -56.6549 -0.6604
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
UNIT 104
COM='13X1 HEAT TRANSFER DISK LEVEL ARRAY (LARGE ARRAY -X)'
ARRAY 44 -10.4636 -79.5251 -0.6604
UNIT 105
COM='13X1 HEAT TRANSFER DISK LEVEL ARRAY (MIDDLE LARGE ARRAY)'
ARRAY 45 -10.4636 -79.5251 -0.6604
UNIT 106
COM='13X1 HEAT TRANSFER DISK LEVEL ARRAY (LARGE ARRAY X)'
ARRAY 46 -10.4636 -79.5251 -0.6604
'
'  BASKET ARRAY IN TRANSPORT CASK OVERPACK (LEVEL CONSTRUCTION)
'
UNIT 110
COM='BASKET ARRAY IN TRANSPORT CASK OVERPACK - WATER LEVEL'
ARRAY 50 -33.6323 -79.5251 -2.1400
CYLINDER 3 1 88.1253      2P2.1400
HOLE 80     -69.0614 0.0 0.0
HOLE 82     -46.1912 0.0 0.0
HOLE 81      69.0614 0.0 0.0
HOLE 83      46.1912 0.0 0.0
CYLINDER 5 1 89.7128      2P2.1400
CYLINDER 3 1 90.170       2P2.1400
CYLINDER 5 1 93.98        2P2.1400
CYLINDER 7 1 103.4288     2P2.1400
CYLINDER 5 1 110.109      2P2.1400
CYLINDER 9 1 124.714      2P2.1400
CYLINDER 9 1 125.349      2P2.1400
CUBOID   9 1 4P150        2P2.1400
UNIT 111
COM='BASKET ARRAY IN TRANSPORT CASK OVERPACK - SUPPORT DISK LEVEL'
ARRAY 51 -33.6323 -79.5251 -0.6604
CYLINDER 5 1 87.6046      2P0.6604
HOLE 90     -69.0614 0.0 0.0
HOLE 92     -46.1912 0.0 0.0
HOLE 91      69.0614 0.0 0.0
HOLE 93      46.1912 0.0 0.0
CYLINDER 3 1 88.1253      2P0.6604
CYLINDER 5 1 89.7128      2P0.6604
CYLINDER 3 1 90.170       2P0.6604
CYLINDER 5 1 93.98        2P0.6604
CYLINDER 7 1 103.4288     2P0.6604
CYLINDER 5 1 110.109      2P0.6604
CYLINDER 9 1 124.714      2P0.6604
CYLINDER 9 1 125.349      2P0.6604
CUBOID   9 1 4P150        2P0.6604
UNIT 112
COM='BASKET ARRAY IN TRANSPORT CASK OVERPACK - HEAT TRANSFER DISK LEVEL'
ARRAY 52 -33.6323 -79.5251 -0.6604
CYLINDER 4 1 87.2490      2P0.6604
HOLE 100    -69.0614 0.0 0.0
HOLE 102    -46.1912 0.0 0.0
HOLE 101     69.0614 0.0 0.0
HOLE 103     46.1912 0.0 0.0
CYLINDER 3 1 88.1253      2P0.6604
CYLINDER 5 1 89.7128      2P0.6604
CYLINDER 3 1 90.170       2P0.6604
CYLINDER 5 1 93.98        2P0.6604
CYLINDER 7 1 103.4288     2P0.6604
CYLINDER 5 1 110.109      2P0.6604
CYLINDER 9 1 124.714      2P0.6604
CYLINDER 9 1 125.349      2P0.6604
CUBOID   9 1 4P150        2P0.6604
'
UNIT 130
COM='OVERSIZED FUEL TUBE AND ASSEMBLY 98- WATER LEVEL'
ARRAY  3  -8.8736 -8.8736 -2.1400
CUBOID 3 1 4P10.1473                      2P2.1400
CUBOID 5 1 4P10.26922                     2P2.1400
CUBOID 3 1 4P10.3051                      2P2.1400


UNIT 330
COM='OVERSIZED FUEL TUBE AND ASSEMBLY 98- WATER LEVEL LR'
ARRAY  303  -10.1472 -8.8736 -2.1400
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
CUBOID 3 1 4P10.1473                        2P2.1400
CUBOID 5 1 4P10.26922                       2P2.1400
CUBOID 3 1 4P10.3051                        2P2.1400

UNIT 530
COM='OVERSIZED FUEL TUBE AND ASSEMBLY 98- WATER LEVEL UR'
ARRAY  503  -10.1472 -10.1472 -2.1400
CUBOID 3 1 4P10.1473                        2P2.1400
CUBOID 5 1 4P10.26922                       2P2.1400
CUBOID 3 1 4P10.3051                        2P2.1400

UNIT 730
COM='OVERSIZED FUEL TUBE AND ASSEMBLY 98- WATER LEVEL UL'
ARRAY  703  -8.8736 -10.1472 -2.1400
CUBOID 3 1 4P10.1473                        2P2.1400
CUBOID 5 1 4P10.26922                       2P2.1400
CUBOID 3 1 4P10.3051                        2P2.1400


UNIT 131
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - WATER LEVEL +X +Y'
CUBOID 3 1 4P10.4635                        2P2.1400
HOLE  130   0.1584   0.1584       0.0
UNIT 132
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - WATER LEVEL -X +Y'
CUBOID 3 1 4P10.4635                        2P2.1400
HOLE  330   -0.1584   0.1584       0.0
UNIT 133
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - WATER LEVEL +X -Y'
CUBOID 3 1 4P10.4635                        2P2.1400
HOLE  730   0.1584   -0.1584       0.0
UNIT 134
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - WATER LEVEL -X -Y'
CUBOID 3 1 4P10.4635                        2P2.1400
HOLE  530   -0.1584   -0.1584       0.0

UNIT 140
COM='OVERSIZED FUEL TUBE AND ASSEMBLY 98- DISK LEVEL'
ARRAY  4  -8.8736 -8.8736 -0.6604
CUBOID 3 1 4P10.1473                        2P0.6604
CUBOID 5 1 4P10.26922                       2P0.6604
CUBOID 3 1 4P10.3051                        2P0.6604


UNIT 340
COM='OVERSIZED FUEL TUBE AND ASSEMBLY 98- DISK LEVEL LR'
ARRAY  304  -10.1472 -8.8736 -0.6604
CUBOID 3 1 4P10.1473                        2P0.6604
CUBOID 5 1 4P10.26922                       2P0.6604
CUBOID 3 1 4P10.3051                        2P0.6604

UNIT 540
COM='OVERSIZED FUEL TUBE AND ASSEMBLY 98- DISK LEVEL UR'
ARRAY  504  -10.1472 -10.1472 -0.6604
CUBOID 3 1 4P10.1473                        2P0.6604
CUBOID 5 1 4P10.26922                       2P0.6604
CUBOID 3 1 4P10.3051                        2P0.6604

UNIT 740
COM='OVERSIZED FUEL TUBE AND ASSEMBLY 98- DISK LEVEL UL'
ARRAY  704  -8.8736 -10.1472 -0.6604
CUBOID 3 1 4P10.1473                        2P0.6604
CUBOID 5 1 4P10.26922                       2P0.6604
CUBOID 3 1 4P10.3051                        2P0.6604


UNIT 141
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - DISK LEVEL +X +Y'
CUBOID 3 1 4P10.4635                        2P0.6604
HOLE  140   0.1584   0.1584       0.0
UNIT 142
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - DISK LEVEL -X +Y'
CUBOID 3 1 4P10.4635                        2P0.6604
HOLE  340   -0.1584   0.1584       0.0
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
UNIT 143
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - DISK LEVEL +X -Y'
CUBOID 3 1 4P10.4635                          2P0.6604
HOLE  740   0.1584   -0.1584       0.0
UNIT 144
COM='OVERSIZED FUEL TUBE AND ASSEMBLY - DISK LEVEL -X -Y'
CUBOID 3 1 4P10.4635                          2P0.6604
HOLE  540   -0.1584   -0.1584       0.0
'
'  GLOBAL UNIT
'
GLOBAL UNIT 120
ARRAY 60 -175.349 -175.349 0.0
END GEOM
READ ARRAY
ARA=1 NUX=16 NUY=16 NUZ=1  FILL
1 1 1 1 1 1 1 3 2 2 2 2 2 2 2 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 4 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
END FILL
ARA=2 NUX=16 NUY=16 NUZ=1  FILL
5 5 5 5 5 5 5 7 6 6 6 6 6 6 6 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
7 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 8 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
END FILL
ARA=3 NUX=16 NUY=16 NUZ=1  FILL
1 1 1 1 1 1 1 3 2 2 2 2 2 2 2 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1
1 1 1 1 1 1 1 2 1 2 1 1 1 1 1 1
1 1 1 1 1 1 2 1 1 1 2 1 1 1 1 1
3 1 1 1 1 2 1 2 1 2 1 2 1 1 1 1
2 1 1 1 2 1 1 1 4 1 1 1 2 1 1 1
2 1 1 1 1 2 1 2 1 2 1 2 1 1 1 1
2 1 1 1 1 1 2 1 1 1 2 1 1 1 1 1
2 1 1 1 1 1 1 2 1 2 1 1 1 1 1 1
2 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
END FILL
ARA=4 NUX=16 NUY=16 NUZ=1  FILL
5 5 5 5 5 5 5 7 6 6 6 6 6 6 6 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
5 5 5 5 5 5 5 5 6 5 5 5 5 5 5 5
5 5 5 5 5 5 5 6 5 6 5 5 5 5 5 5
5 5 5 5 5 5 6 5 5 5 6 5 5 5 5 5
7 5 5 5 5 6 5 6 5 6 5 6 5 5 5 5
6 5 5 5 6 5 5 5 8 5 5 5 6 5 5 5
6 5 5 5 5 6 5 6 5 6 5 6 5 5 5 5
6 5 5 5 5 5 6 5 5 5 6 5 5 5 5 5
6 5 5 5 5 5 5 6 5 6 5 5 5 5 5 5
6 5 5 5 5 5 5 5 6 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
END FILL
ARA=301 NUX=16 NUY=16 NUZ=1  FILL
2 2 2 2 2 2 2 2 3 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3
1 1 1 1 1 1 1 4 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
END FILL
ARA=302 NUX=16 NUY=16 NUZ=1  FILL
6 6 6 6 6 6 6 6 7 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 7
5 5 5 5 5 5 5 8 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
END FILL
ARA=303 NUX=16 NUY=16 NUZ=1  FILL
2 2 2 2 2 2 2 2 3 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1
1 1 1 1 1 1 2 1 2 1 1 1 1 1 1 1
1 1 1 1 1 2 1 1 1 2 1 1 1 1 1 1
1 1 1 1 2 1 2 1 2 1 2 1 1 1 1 3
1 1 1 2 1 1 1 4 1 1 1 2 1 1 1 2
1 1 1 1 2 1 2 1 2 1 2 1 1 1 1 2
1 1 1 1 1 2 1 1 1 2 1 1 1 1 1 2
1 1 1 1 1 1 2 1 2 1 1 1 1 1 1 2
1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
END FILL
ARA=304 NUX=16 NUY=16 NUZ=1  FILL
6 6 6 6 6 6 6 6 7 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 6 5 5 5 5 5 5 5 5
5 5 5 5 5 5 6 5 6 5 5 5 5 5 5 5
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
5 5 5 5 5 6 5 5 5 6 5 5 5 5 5 5
5 5 5 5 6 5 6 5 6 5 6 5 5 5 5 7
5 5 5 6 5 5 5 8 5 5 5 6 5 5 5 6
5 5 5 5 6 5 6 5 6 5 6 5 5 5 5 6
5 5 5 5 5 6 5 5 5 6 5 5 5 5 5 6
5 5 5 5 5 5 6 5 6 5 5 5 5 5 5 6
5 5 5 5 5 5 5 6 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
END FILL
ARA=501 NUX=16 NUY=16 NUZ=1  FILL
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 4 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 2 2 2 2 2 2 2 3 1 1 1 1 1 1 1
END FILL
ARA=502 NUX=16 NUY=16 NUZ=1  FILL
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 8 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 7
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 6 6 6 6 6 6 6 7 5 5 5 5 5 5 5
END FILL
ARA=503 NUX=16 NUY=16 NUZ=1  FILL
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 2
1 1 1 1 1 1 2 1 2 1 1 1 1 1 1 2
1 1 1 1 1 2 1 1 1 2 1 1 1 1 1 2
1 1 1 1 2 1 2 1 2 1 2 1 1 1 1 2
1 1 1 2 1 1 1 4 1 1 1 2 1 1 1 2
1 1 1 1 2 1 2 1 2 1 2 1 1 1 1 3
1 1 1 1 1 2 1 1 1 2 1 1 1 1 1 1
1 1 1 1 1 1 2 1 2 1 1 1 1 1 1 1
1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 2 2 2 2 2 2 2 3 1 1 1 1 1 1 1
END FILL
ARA=504 NUX=16 NUY=16 NUZ=1  FILL
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6
5 5 5 5 5 5 5 6 5 5 5 5 5 5 5 6
5 5 5 5 5 5 6 5 6 5 5 5 5 5 5 6
5 5 5 5 5 6 5 5 5 6 5 5 5 5 5 6
5 5 5 5 6 5 6 5 6 5 6 5 5 5 5 6
5 5 5 6 5 5 5 8 5 5 5 6 5 5 5 6
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
5 5 5 5 6 5 6 5 6 5 6 5 5 5 5 7
5 5 5 5 5 6 5 5 5 6 5 5 5 5 5 5
5 5 5 5 5 5 6 5 6 5 5 5 5 5 5 5
5 5 5 5 5 5 5 6 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 6 6 6 6 6 6 6 7 5 5 5 5 5 5 5
END FILL
ARA=701 NUX=16 NUY=16 NUZ=1  FILL
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 4 1 1 1 1 1 1 1
3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 3 2 2 2 2 2 2 2 2
END FILL
ARA=702 NUX=16 NUY=16 NUZ=1  FILL
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 8 5 5 5 5 5 5 5
7 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 7 6 6 6 6 6 6 6 6
END FILL
ARA=703 NUX=16 NUY=16 NUZ=1  FILL
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1
2 1 1 1 1 1 1 2 1 2 1 1 1 1 1 1
2 1 1 1 1 1 2 1 1 1 2 1 1 1 1 1
2 1 1 1 1 2 1 2 1 2 1 2 1 1 1 1
2 1 1 1 2 1 1 1 4 1 1 1 2 1 1 1
3 1 1 1 1 2 1 2 1 2 1 2 1 1 1 1
1 1 1 1 1 1 2 1 1 1 2 1 1 1 1 1
1 1 1 1 1 1 1 2 1 2 1 1 1 1 1 1
1 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 3 2 2 2 2 2 2 2 2
END FILL
ARA=704 NUX=16 NUY=16 NUZ=1  FILL
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
6 5 5 5 5 5 5 5 6 5 5 5 5 5 5 5
6 5 5 5 5 5 5 6 5 6 5 5 5 5 5 5
6 5 5 5 5 5 6 5 5 5 6 5 5 5 5 5
6 5 5 5 5 6 5 6 5 6 5 6 5 5 5 5
6 5 5 5 6 5 5 5 8 5 5 5 6 5 5 5
7 5 5 5 5 6 5 6 5 6 5 6 5 5 5 5
5 5 5 5 5 5 6 5 5 5 6 5 5 5 5 5
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
5 5 5 5 5 5 5 6 5 6 5 5 5 5 5 5
5 5 5 5 5 5 5 5 6 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 7 6 6 6 6 6 6 6 6
END FILL
'
'  WATER LEVEL ARRAYS
'
ARA=20  NUX=1 NUY=5 NUZ=1
FILL
57
22
57
22
55
END FILL
ARA=21  NUX=1 NUY=5 NUZ=1
FILL
58
22
56
22
56
END FILL
ARA=22  NUX=1 NUY=9 NUZ=1
FILL
131
21
57
22
57
22
55
21
133
END FILL
ARA=23  NUX=1 NUY=9 NUZ=1
FILL
132
21
58
22
56
22
56
21
134
END FILL
ARA=24  NUX=1 NUY=13 NUZ=1
FILL
55
20
55
21
57
22
55
22
55
21
57
20
57
END FILL
ARA=25  NUX=1 NUY=13 NUZ=1
FILL
56
20
56
21
58
22
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
59
22
55
21
57
20
57
END FILL
ARA=26  NUX=1 NUY=13 NUZ=1
FILL
56
20
56
21
58
22
58
22
56
21
58
20
58
END FILL
'
'  SUPPOR DISK LEVEL ARRAYS
'
ARA=30  NUX=1 NUY=5 NUZ=1
FILL
67
32
67
32
65
END FILL
ARA=31  NUX=1 NUY=5 NUZ=1
FILL
68
32
66
32
66
END FILL
ARA=32  NUX=1 NUY=9 NUZ=1
FILL
141
31
67
32
67
32
65
31
143
END FILL
ARA=33  NUX=1 NUY=9 NUZ=1
FILL
142
31
68
32
66
32
66
31
144
END FILL
ARA=34  NUX=1 NUY=13 NUZ=1
FILL
65
30
65
31
67
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
32
65
32
65
31
67
30
67
END FILL
ARA=35  NUX=1 NUY=13 NUZ=1
FILL
66
30
66
31
68
32
69
32
65
31
67
30
67
END FILL
ARA=36  NUX=1 NUY=13 NUZ=1
FILL
66
30
66
31
68
32
68
32
66
31
68
30
68
END FILL
'
'  HEAT TRANSFER DISK LEVEL ARRAYS
'
ARA=40  NUX=1 NUY=5 NUZ=1
FILL
67
42
67
42
65
END FILL
ARA=41  NUX=1 NUY=5 NUZ=1
FILL
68
42
66
42
66
END FILL
ARA=42  NUX=1 NUY=9 NUZ=1
FILL
141
41
67
42
67
42
65
41
143
END FILL
ARA=43  NUX=1 NUY=9 NUZ=1
FILL
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
142
41
68
42
66
42
66
41
144
END FILL
ARA=44  NUX=1 NUY=13 NUZ=1
FILL
65
40
65
41
67
42
65
42
65
41
67
40
67
END FILL
ARA=45  NUX=1 NUY=13 NUZ=1
FILL
66
40
66
41
68
42
69
42
65
41
67
40
67
END FILL
ARA=46  NUX=1 NUY=13 NUZ=1
FILL
66
40
66
41
68
42
68
42
66
41
68
40
68
END FILL
'
'  MAJOR ARRAYS
'
ARA=50 NUX=5 NUY=1 NUZ=1
FILL
86 23 85 23 84
END FILL
ARA=51 NUX=5 NUY=1 NUZ=1
FILL
96 33 95 33 94
END FILL
ARA=52 NUX=5 NUY=1 NUZ=1
FILL
106 43 105 43 104
END FILL
'
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
'  GLOBAL ARRAY
'
ARA=60 NUX=1 NUY=1 NUZ=4
FILL
112
110
111
110
END FILL
END ARRAY
READ BOUNDS ZFC=PER YXF=MIR END BOUNDS
READ PLOT
SCR=YES PIC=MAT LPI=10
UAX=1.0 VDN=-1.0 NAX=1500
'
' WHOLE BASKET HORIZONTAL SLICES
'
TTL='BASKET X-Y CROSS SECTION AT Z= 0.635 HEAT TRANSFER DISK LEVEL'
XUL=  -130 YUL=  130  ZUL= 0.635
XLR=   130 YLR= -130  ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y CROSS SECTION AT Z= 3.44 WATER LEVEL'
XUL=  -130 YUL=  130  ZUL= 3.44
XLR=   130 YLR= -130  ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y CROSS SECTION AT Z= 6.236 SS DISK LEVEL'
XUL=  -130 YUL=  130  ZUL= 6.236
XLR=   130 YLR= -130  ZLR= 6.236
UAX=1.0 VDN=-1.0 NAX=1500 END
'
' HEAT TRANSFER DISK LEVEL BASKET QUADRANTS
'
TTL='BASKET X-Y QUADRANTD I HEAT TRANSFER DISK'
XUL=  12.   YUL= 80     ZUL= 0.635
XLR=  80.0  YLR= 12.0   ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT II HEAT TRANSFER DISK'
XUL=  12.0 YUL= -12.0   ZUL= 0.635
XLR=  80   YLR= -80     ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT III HEAT TRANSFER DISK'
XUL= -80.0  YUL= -12.0  ZUL= 0.635
XLR= -12.0  YLR= -80.0  ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT IV HEAT TRANSFER DISK'
XUL= -80.0  YUL= 80.0   ZUL= 0.635
XLR= -12.0  YLR= 12.0   ZLR= 0.635
UAX=1.0 VDN=-1.0 NAX=1500 END
'
' WATER LEVEL BASKET QUADRANTS
'
TTL='BASKET X-Y QUADRANT I WATER LEVEL'
XUL=  12.     YUL=  80     ZUL= 3.44
XLR=  80.0    YLR=  12.0   ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT II WATER LEVEL'
XUL=  12.0    YUL= -12.0   ZUL= 3.44
XLR=  80      YLR= -80     ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT III WATER LEVEL'
XUL= -80.0    YUL= -12.0   ZUL= 3.44
XLR= -12.0    YLR= -80.0   ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
TTL='BASKET X-Y QUADRANT IV WATER LEVEL'
XUL= -80.0    YUL= 80.0    ZUL= 3.44
XLR= -12.0    YLR= 12.0    ZLR= 3.44
UAX=1.0 VDN=-1.0 NAX=1500 END
'
'  VERTICAL SLICES
'
TTL='BASKET X-Z CROSS SECTION ALUMINUM LEVEL (MIDDLE OF FUEL PIN)'
XUL= -90  YUL=0.4   ZUL= 1.27
XLR=  90  YLR=0.4   ZLR= -.1
UAX=1.0 WDN=-1.0 NAX=1500 END
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
  TTL='BASKET X-Z CROSS SECTION WATER LEVEL (MIDDLE OF FUEL PIN)'
  XUL= -90  YUL=0.4   ZUL= 4.318
  XLR=  90  YLR=0.4   ZLR= 1.27
  UAX=1.0 WDN=-1.0 NAX=1500 END
  TTL='BASKET X-Z CROSS SECTION SS LEVEL (MIDDLE OF FUEL PIN)'
  XUL= -90  YUL=0.4   ZUL= 6.858
  XLR=  90  YLR=0.4   ZLR= 5.588
  UAX=1.0 WDN=-1.0 NAX=1500 END
  TTL='BASKET X-Z CROSS SECTION ENTIRE MODEL (MIDDLE OF FUEL PIN)'
  XUL= -90  YUL=0.4   ZUL= 12
  XLR=  90  YLR=0.4   ZLR= 0
  UAX=1.0 WDN=-1.0 NAX=1500 END
  END PLOT
  END DATA

SECONDARY MODULE 000008   HAS BEEN CALLED.

MODULE 000008   IS FINISHED. COMPLETION CODE     0. CPU TIME USED     0.44 (SECONDS).

SECONDARY MODULE 000002   HAS BEEN CALLED.

MODULE 000002   IS FINISHED. COMPLETION CODE     0. CPU TIME USED     3.07 (SECONDS).

SECONDARY MODULE 000009   HAS BEEN CALLED.

MODULE 000009   IS FINISHED. COMPLETION CODE     0. CPU TIME USED   697.72 (SECONDS).

MODULE CSAS25   IS FINISHED. COMPLETION CODE     0. CPU TIME USED   703.54 (SECONDS).
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
  ccccccccccc     sssssssssss      AAAAAAAAA      sssssssssss     22222222222    5555555555555
 ccccccccccccc   sssssssssssss    AAAAAAAAAAA    sssssssssssss   2222222222222   5555555555555
 cc         cc   ss         ss   AA         AA   ss         ss   22         22   55
 cc              ss              AA         AA   ss                         22   55
 cc              ss              AA         AA   ss                         22   55
 cc              ssssssssssss    AAAAAAAAAAAAA   ssssssssssss              22    555555555555
 cc               ssssssssssss   AAAAAAAAAAAAA    ssssssssssss           22      5555555555555
 cc                         ss   AA         AA              ss         22                   55
 cc                         ss   AA         AA              ss       22                     55
 cc         cc   ss         ss   AA         AA   ss         ss     22            55         55
 ccccccccccccc   sssssssssssss   AA         AA   sssssssssssss   2222222222222   5555555555555
  ccccccccccc     sssssssssss    AA         AA    sssssssssss    2222222222222    55555555555


  sssssssssss     ccccccccccc      AAAAAAAAA     LL              EEEEEEEEEEEEE                   PPPPPPPPPPPP     ccccccccccc
 sssssssssssss   ccccccccccccc    AAAAAAAAAAA    LL              EEEEEEEEEEEEE                   PPPPPPPPPPPPP   ccccccccccccc
 ss         ss   cc         cc   AA         AA   LL              EE                              PP         PP   cc         cc
 ss              cc              AA         AA   LL              EE                              PP         PP   cc
 ss              cc              AA         AA   LL              EE                              PP         PP   cc
 ssssssssssss    cc              AAAAAAAAAAAAA   LL              EEEEEEEEE       -------------   PPPPPPPPPPPPP   cc
  ssssssssssss   cc              AAAAAAAAAAAAA   LL              EEEEEEEEE       -------------   PPPPPPPPPPPP    cc
            ss   cc              AA         AA   LL              EE                              PP              cc
            ss   cc              AA         AA   LL              EE                              PP              cc
 ss         ss   cc         cc   AA         AA   LL              EE                              PP              cc         cc
 sssssssssssss   ccccccccccccc   AA         AA   LLLLLLLLLLLLL   EEEEEEEEEEEEE                   PP              ccccccccccccc
  sssssssssss     ccccccccccc    AA         AA   LLLLLLLLLLLLL   EEEEEEEEEEEEE                   PP               ccccccccccc


   0000000        33333333333            //     22222222222     5555555555555            //     0000000        22222222222
  000000000      3333333333333          //     2222222222222    5555555555555           //     000000000      2222222222222
 00       00     33         33         //      22         22    55                     //     00       00     22         22
 00       00                33        //                  22    55                    //      00       00                22
 00       00                33       //                   22    55                   //       00       00                22
 00       00              333       //                  22      555555555555        //        00       00              22
 00       00              333      //                 22        5555555555555      //         00       00            22
 00       00                33    //                22                     55     //          00       00          22
 00       00                33   //               22                       55    //           00       00        22
 00       00     33         33  //              22              55         55   //            00       00      22
  000000000      3333333333333 //              2222222222222    5555555555555  //              000000000     2222222222222
   0000000        33333333333 //               2222222222222     55555555555  //                0000000      2222222222222


      11          33333333333                    0000000         11                          22222222222     22222222222
     111         3333333333333                  000000000       111                         2222222222222   2222222222222
    1111         33         33      :::        00       00     1111             :::         22         22   22         22
      11                    33      :::        00       00       11             :::                    22              22
      11                    33      :::        00       00       11             :::                    22              22
      11                  333                  00       00       11                                  22              22
      11                  333                  00       00       11                                22              22
      11                    33      :::        00       00       11             :::              22              22
      11                    33      :::        00       00       11             :::            22              22
      11         33         33      :::        00       00       11             :::          22              22
   11111111      3333333333333                  000000000     11111111                      2222222222222   2222222222222
   11111111       33333333333                    0000000      11111111                      2222222222222   2222222222222
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
**** PROBLEM PARAMETERS ****

LIB 27GROUPNDF4  LIBRARY
MXX           10 MIXTURES
MSC           19 COMPOSITION SPECIFICATIONS
IZM            4 MATERIAL ZONES
GE  LATTICECELL  GEOMETRY
MORE           0 0/1 DO NOT READ/READ OPTIONAL PARAMETER DATA
MSLN           0 FUEL SOLUTIONS


**** PROBLEM COMPOSITION DESCRIPTION ****

SC  UO2          STANDARD COMPOSITION
MX             1 MIXTURE NO.
VF        0.9500 VOLUME FRACTION
ROTH     10.9600 THEORETICAL DENSITY
NEL            2 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           92000      1.00 ATOM/MOLECULE
                                92235     4.000 WT%
                                92238    96.000 WT%
            8016      2.00 ATOMS/MOLECULE
END

SC  ZIRCALLOY    STANDARD COMPOSITION
MX             2 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      6.5600 THEORETICAL DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           40302      1.00 ATOM/MOLECULE
END

SC  H2O          STANDARD COMPOSITION
MX             3 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      0.9982 THEORETICAL DENSITY
NEL            2 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            1001      2.00 ATOMS/MOLECULE
            8016      1.00 ATOM/MOLECULE
END

SC  AL           STANDARD COMPOSITION
MX             4 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      2.7020 THEORETICAL DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           13027      1.00 ATOM/MOLECULE
END

SC  SS304        STANDARD COMPOSITION
MX             5 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH      7.9200 THEORETICAL DENSITY
NEL            4 NO. ELEMENTS
ICP            0 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           24304    19.000 WT%
           25055     2.000 WT%
           26304    69.500 WT%
           28304     9.500 WT%
END

SC  B-10         STANDARD COMPOSITION
MX             6 MIXTURE NO.
VF        0.0450 VOLUME FRACTION
ROTH      2.6226 SPECIFIED DENSITY
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            5010       1.00 ATOM/MOLECULE
END

SC  B-11         STANDARD COMPOSITION
MX             6 MIXTURE NO.
VF        0.2736 VOLUME FRACTION
ROTH      2.6226 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            5011       1.00 ATOM/MOLECULE
END

SC  C            STANDARD COMPOSITION
MX             6 MIXTURE NO.
VF        0.0927 VOLUME FRACTION
ROTH      2.6226 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            6012       1.00 ATOM/MOLECULE
END

SC  AL           STANDARD COMPOSITION
MX             6 MIXTURE NO.
VF        0.5737 VOLUME FRACTION
ROTH      2.6226 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           13027       1.00 ATOM/MOLECULE
END

SC  PB           STANDARD COMPOSITION
MX             7 MIXTURE NO.
VF        1.0000 VOLUME FRACTION
ROTH     11.3440 THEORETICAL DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
           82000       1.00 ATOM/MOLECULE
END

SC  H            STANDARD COMPOSITION
MX             8 MIXTURE NO.
VF        0.0600 VOLUME FRACTION
ROTH      1.6291 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            1001       1.00 ATOM/MOLECULE
END

SC  O            STANDARD COMPOSITION
MX             8 MIXTURE NO.
VF        0.4250 VOLUME FRACTION
ROTH      1.6291 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            8016       1.00 ATOM/MOLECULE
END

SC  C            STANDARD COMPOSITION
MX             8 MIXTURE NO.
VF        0.2770 VOLUME FRACTION
ROTH      1.6291 SPECIFIED DENSITY
NEL            1 NO. ELEMENTS
ICP            1 0/1 MIXTURE/COMPOUND
TEMP       293.0 DEG KELVIN
            6012       1.00 ATOM/MOLECULE
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
END

SC  N            STANDARD COMPOSITION
MX            8 MIXTURE NO.
VF       0.0200 VOLUME FRACTION
ROTH     1.6291 SPECIFIED DENSITY
NEL           1 NO. ELEMENTS
ICP           1 0/1 MIXTURE/COMPOUND
TEMP      293.0 DEG KELVIN
           7014       1.00 ATOM/MOLECULE
END

SC  AL           STANDARD COMPOSITION
MX            8 MIXTURE NO.
VF       0.2140 VOLUME FRACTION
ROTH     1.6291 SPECIFIED DENSITY
NEL           1 NO. ELEMENTS
ICP           1 0/1 MIXTURE/COMPOUND
TEMP      293.0 DEG KELVIN
          13027       1.00 ATOM/MOLECULE
END

SC  B-10         STANDARD COMPOSITION
MX            8 MIXTURE NO.
VF       0.0010 VOLUME FRACTION
ROTH     1.6291 SPECIFIED DENSITY
NEL           1 NO. ELEMENTS
ICP           1 0/1 MIXTURE/COMPOUND
TEMP      293.0 DEG KELVIN
           5010       1.00 ATOM/MOLECULE
END

SC  B-11         STANDARD COMPOSITION
MX            8 MIXTURE NO.
VF       0.0040 VOLUME FRACTION
ROTH     1.6291 SPECIFIED DENSITY
NEL           1 NO. ELEMENTS
ICP           1 0/1 MIXTURE/COMPOUND
TEMP      293.0 DEG KELVIN
           5011       1.00 ATOM/MOLECULE
END

SC  H2O          STANDARD COMPOSITION
MX            9 MIXTURE NO.
VF       1.0000 VOLUME FRACTION
ROTH     0.9982 THEORETICAL DENSITY
NEL           2 NO. ELEMENTS
ICP           1 0/1 MIXTURE/COMPOUND
TEMP      293.0 DEG KELVIN
           1001       2.00 ATOMS/MOLECULE
           8016       1.00 ATOM/MOLECULE
END

SC  H2O          STANDARD COMPOSITION
MX           10 MIXTURE NO.
VF       1.0000 VOLUME FRACTION
ROTH     0.9982 THEORETICAL DENSITY
NEL           2 NO. ELEMENTS
ICP           1 0/1 MIXTURE/COMPOUND
TEMP      293.0 DEG KELVIN
           1001       2.00 ATOMS/MOLECULE
           8016       1.00 ATOM/MOLECULE
END


**** PROBLEM GEOMETRY ****

CTP SQUAREPITCH  CELL TYPE
PITCH    1.1887 CM CENTER TO CENTER SPACING
FUELOD   0.7887 CM FUEL DIAMETER OR SLAB THICKNESS
MFUEL         1 MIXTURE NO. OF FUEL
MMOD          3 MIXTURE NO. OF MODERATOR
CLADOD   0.9271 CM CLAD OUTER DIAMETER
MCLAD         2 MIXTURE NO. OF CLAD
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
GAPOD      0.8052 CM GAP OUTER DIAMETER
MGAP           10 MIXTURE NO. OF GAP


ZONE SPECIFICATIONS FOR LATTICECELL GEOMETRY

              ZONE  1 IS FUEL
              ZONE  2 IS GAP
              ZONE  3 IS CLAD
              ZONE  4 IS MOD
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
*******************************************************************************************************************
***                                                                                                             ***
***                    TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0***
***                                                                                                             ***
*******************************************************************************************************************
*******************************************************************************************************************
***                                                                                                             ***
***                            ********** DATA LIBRARY INFORMATION **********                                   ***
***                                                                                                             ***
***        UNIT                                                 VOLUME                                          ***
***        NUMBER             DATA SET NAME                     NAME          UNIT FUNCTION                     ***
***        ------             -------------                     ----          -------------                     ***
***                                                                                                             ***
***          89    M:\scale43\DATALIB\FT89F001                                STANDARD COMPOSITION LIBRARY      ***
***                                                                                                             ***
***          82    M:\scale43\DATALIB\FT82F001                                CROSS SECTION LIBRARY             ***
***                                                                                                             ***
***          11    D:\Projects\YAEC\5501\Runs\reflected_disk_st               SHORT CROSS SECTION LIBRARY       ***
***                                                                                                             ***
***          90    D:\Projects\YAEC\5501\Runs\reflected_disk_st               INPUT DATA DIRECT ACCESS          ***
***                                                                                                             ***
*******************************************************************************************************************
*******************************************************************************************************************
***                                                                                                             ***
***                                                                                                             ***
***                                 STANDARD COMPOSITION LIBRARY DATA                                           ***
***                                 ---------------------------------                                           ***
***                                                                                                             ***
***            UNIT NUMBER  :  89                                                                               ***
***                                                                                                             ***
***            DATASET NAME :  M:\scale43\DATALIB\FT89F001                                                      ***
***                                                                                                             ***
***            LIBRARY TITLE:  SCALE-4 STANDARD COMPOSITION LIBRARY                                             ***
***                            637 STANDARD COMPOSITIONS, 490 NUCLIDES                                          ***
***                            90 ELEMENTS WITH VARIABLE ISOTOPIC DISTRBUTIONS.                                 ***
***                                                                                                             ***
***            CREATION DATE:   6/30/95                                                                         ***
***                                                                                                             ***
***                                                                                                             ***
***                                                                                                             ***
***                                     CROSS SECTION LIBRARY DATA                                              ***
***                                     ---------------------------                                             ***
***                                                                                                             ***
***            UNIT NUMBER  :  82                                                                               ***
***                                                                                                             ***
***            DATASET NAME :  M:\scale43\DATALIB\FT82F001                                                      ***
***                                                                                                             ***
***            LIBRARY TITLE:  SCALE 4.2 - 27 GROUP NEUTRON GROUP LIBRARY                                       ***
***                               BASED ON ENDF-B VERSION 4 DATA                                                ***
***                                  COMPILED FOR NRC      1/27/89                                              ***
***                                     LAST UPDATED                                           08/12/94         ***
***                                        L.M.PETRIE    -    ORNL                                              ***
***                                                                                                             ***
***                                                                                                             ***
***                                                                                                             ***
***                                                                                                             ***
*******************************************************************************************************************
*******************************************************************************************************************

                    ........    0 IO'S WERE USED BEFORE READING KENO V DATA     ........

                    ........    0 IO'S WERE USED READING THE KENO V PARAMETER DATA      ........
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
               KK        KK EEEEEEEEEEEEE NN        NN  00000000000                VV          VV
               KK       KK  EEEEEEEEEEEEE NNN       NN 0000000000000               VV          VV
               KK      KK   EE            NNNN      NN OO         OO               VV          VV
               KK     KK    EE            NN NN     NN OO         OO               VV          VV
               KK    KK     EE            NN  NN    NN OO         OO               VV          VV
               KKKKKKKK     EEEEEEEEE     NN   NN   NN OO         OO -------------  VV         VV
               KKKKKKKK     EEEEEEEEE     NN    NN  NN OO         OO -------------   VV       VV
               KK    KK     EE            NN     NN NN OO         OO                  VV     VV
               KK     KK    EE            NN      NNNN OO         OO                   VV   VV
               KK      KK   EE            NN       NNN OO         OO                    VV VV
               KK       KK  EEEEEEEEEEEEE NN       NNN 0000000000000                     VVV
               KK        KK EEEEEEEEEEEEE NN        NN  00000000000                       V


  SSSSSSSSSSS   CCCCCCCCCCC     AAAAAAAAA   LL            EEEEEEEEEEEEE                PPPPPPPPPPPP   CCCCCCCCCCC
 SSSSSSSSSSSSS CCCCCCCCCCCCC   AAAAAAAAAAA  LL            EEEEEEEEEEEEE                PPPPPPPPPPPPP CCCCCCCCCCCCC
 SS         SS CC         CC AA         AA  LL            EE                           PP         PP CC         CC
 SS            CC            AA         AA  LL            EE                           PP         PP CC
 SS            CC            AA         AA  LL            EE                           PP         PP CC
 SSSSSSSSSSSS  CC            AAAAAAAAAAAAA  LL            EEEEEEEEE    -------------   PPPPPPPPPPPPP CC
  SSSSSSSSSSSS CC            AAAAAAAAAAAAA  LL            EEEEEEEEE    -------------   PPPPPPPPPPPP  CC
            SS CC            AA         AA  LL            EE                           PP            CC
            SS CC            AA         AA  LL            EE                           PP            CC
 SS         SS CC         CC AA         AA  LL            EE                           PP            CC         CC
 SSSSSSSSSSSSS CCCCCCCCCCCCC AA         AA  LLLLLLLLLLLLL EEEEEEEEEEEEE                PP            CCCCCCCCCCCCC
  SSSSSSSSSSS   CCCCCCCCCCC  AA         AA  LLLLLLLLLLLLL EEEEEEEEEEEEE                PP             CCCCCCCCCCC


    0000000     33333333333           //  22222222222   5555555555555          //    0000000     22222222222
   000000000   3333333333333         //  2222222222222  5555555555555         //    000000000   2222222222222
  00     00    33         33        //   22         22  55                   //    00     00    22         22
 00       00              33       //               22  55                  //    00       00              22
 00       00              33      //                22  55                 //     00       00              22
 00       00            333      //                22   555555555555      //      00       00            22
 00       00            333     //               22     5555555555555    //       00       00          22
 00       00              33   //              22                  55   //        00       00        22
 00       00              33  //             22                    55  //         00       00      22
  00     00    33         33 //            22           55         55 //           00     00     22
   000000000   3333333333333 //           2222222222222 5555555555555 //            000000000   2222222222222
    0000000     33333333333 //            2222222222222  55555555555 //              0000000    2222222222222


       11       33333333333              0000000        11              22222222222  7777777777777
      111      3333333333333            000000000      111             2222222222222 777777777777
     1111      33         33   :::     00       00    1111     :::     22         22 77         77
       11                 33   :::     00       00      11     :::                22           77
       11                 33   :::     00       00      11     :::                22          77
       11               333            00       00      11                      22           77
       11               333            00       00      11                    22            77
       11                 33   :::     00       00      11     :::          22             77
       11                 33   :::     00       00      11     :::        22              77
       11      33         33   :::     00       00      11     :::       22               77
   11111111    3333333333333            000000000    11111111           2222222222222     77
   11111111     33333333333              0000000     11111111           2222222222222     77
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
  SSSSSSSSSSS    CCCCCCCCCCC     AAAAAAAAA    LL              EEEEEEEEEEEEE                  PPPPPPPPPPPP    CCCCCCCCCCC
 SSSSSSSSSSSSS  CCCCCCCCCCCCC   AAAAAAAAAAA   LL              EEEEEEEEEEEEE                  PPPPPPPPPPPPP  CCCCCCCCCCCCC
 SS         SS  CC         CC  AA         AA  LL              EE                             PP         PP  CC         CC
 SS             CC             AA         AA  LL              EE                             PP         PP  CC
 SS             CC             AA         AA  LL              EE                             PP         PP  CC
 SSSSSSSSSSSS   CC             AAAAAAAAAAAAA  LL              EEEEEEEEE      -------------   PPPPPPPPPPPPP  CC
  SSSSSSSSSSSS  CC             AAAAAAAAAAAAA  LL              EEEEEEEEE      -------------   PPPPPPPPPPPP   CC
            SS  CC             AA         AA  LL              EE                             PP             CC
            SS  CC             AA         AA  LL              EE                             PP             CC
 SS         SS  CC         CC  AA         AA  LL              EE                             PP             CC         CC
 SSSSSSSSSSSSS  CCCCCCCCCCCCC  AA         AA  LLLLLLLLLLLLL   EEEEEEEEEEEEE                  PP             CCCCCCCCCCCCC
  SSSSSSSSSSS    CCCCCCCCCCC   AA         AA  LLLLLLLLLLLLL   EEEEEEEEEEEEE                  PP              CCCCCCCCCCC
```

```
*******************************************************************************
*******************************************************************************
*******************************************************************************
*****                                                                     *****
*****                 PROGRAM VERIFICATION INFORMATION                    *****
*****                                                                     *****
*****             CODE SYSTEM:  SCALE-PC VERSION:  4.3                    *****
*****                                                                     *****
*******************************************************************************
*******************************************************************************
*****                                                                     *****
*****                                                                     *****
*****                PROGRAM:  000009                                     *****
*****                                                                     *****
*****          CREATION DATE:  03/08/96                                   *****
*****                                                                     *****
*****                 VOLUME:  Eng                                        *****
*****                                                                     *****
*****                LIBRARY:  M:\SCALE43\WIN_NT\EXE                      *****
*****                                                                     *****
*****                                                                     *****
*****        PRODUCTION CODE:  KENOVA                                     *****
*****                                                                     *****
*****                VERSION:  3.1                                        *****
*****                                                                     *****
*****                JOBNAME:  SCALE-PC                                   *****
*****                                                                     *****
*****      DATE OF EXECUTION:  03/25/02                                   *****
*****                                                                     *****
*****      TIME OF EXECUTION:  13:01:27                                   *****
*****                                                                     *****
*****                                                                     *****
*******************************************************************************
*******************************************************************************
*******************************************************************************
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
*******************************************************************************************************************
***                                                                                                             ***
***                                TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0***
***                                                                                                             ***
*******************************************************************************************************************
***                                  ******       NUMERIC PARAMETERS       ******                               ***
***                                                                                                             ***
***                                                                                                             ***
***              TME       MAXIMUM PROBLEM TIME (MIN)                       30.00                               ***
***                                                                                                             ***
***              TBA       TIME PER GENERATION (MIN)                        15.00                               ***
***                                                                                                             ***
***              GEN       NUMBER OF GENERATIONS                             1003                               ***
***                                                                                                             ***
***              NPG       NUMBER PER GENERATION                             1000                               ***
***                                                                                                             ***
***              NSK       NUMBER OF GENERATIONS TO BE SKIPPED                  3                               ***
***                                                                                                             ***
***              BEG       BEGINNING GENERATION NUMBER                          1                               ***
***                                                                                                             ***
***              RES       GENERATIONS BETWEEN CHECKPOINTS                      0                               ***
***                                                                                                             ***
***              X1D       NUMBER OF EXTRA 1-D CROSS SECTIONS                   1                               ***
***                                                                                                             ***
***              NBK       NEUTRON BANK SIZE                                 1025                               ***
***                                                                                                             ***
***              XNB       EXTRA POSITIONS IN NEUTRON BANK                      0                               ***
***                                                                                                             ***
***              NFB       FISSION BANK SIZE                                 1000                               ***
***                                                                                                             ***
***              XFB       EXTRA POSITIONS IN FISSION BANK                      0                               ***
***                                                                                                             ***
***              WTA       DEFAULT VALUE OF WEIGHT AVERAGE                 0.5000                               ***
***                                                                                                             ***
***              WTH       WEIGHT HIGH FOR SPLITTING                       3.0000                               ***
***                                                                                                             ***
***              WTL       WEIGHT LOW FOR RUSSIAN ROULETTE                 0.3333                               ***
***                                                                                                             ***
***              RND       STARTING RANDOM NUMBER                             321                               ***
***                                                                                                             ***
***              NB8       NUMBER OF D.A. BLOCKS ON UNIT  8                   200                               ***
***                                                                                                             ***
***              NL8       LENGTH OF D.A. BLOCKS ON UNIT  8                   512                               ***
***                                                                                                             ***
***              ADJ       MODE OF CALCULATION                            FORWARD                               ***
***                                                                                                             ***
***                        INPUT DATA WRITTEN ON RESTART UNIT                  NO                               ***
***                                                                                                             ***
***                        BINARY DATA INTERFACE                              YES                               ***
***                                                                                                             ***
***                                                                                                             ***
*******************************************************************************************************************
*******************************************************************************************************************
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
*******************************************************************************************************
*******************************************************************************************************
***                                                                                                 ***
***                  TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0***
***                                                                                                 ***
*******************************************************************************************************
***                              ******    LOGICAL PARAMETERS      ******                           ***
***                                                                                                 ***
***  RUN  EXECUTE PROBLEM AFTER CHECKING DATA    YES       PLT  PLOT PICTURE MAP(S)             YES ***
***                                                                                                 ***
***  FLX  COMPUTE FLUX                           NO        FDN  COMPUTE FISSION DENSITIES        NO ***
***                                                                                                 ***
***  SMU  COMPUTE AVG UNIT SELF-MULTIPLICATION   NO        NUB  COMPUTE NU-BAR & AVG FISSION GROUP YES ***
***                                                                                                 ***
***  MKU  COMPUTE MATRIX K-EFF BY UNIT NUMBER    NO        MKP  COMPUTE MATRIX K-EFF BY UNIT LOCATION   NO ***
***                                                                                                 ***
***  CKU  COMPUTE COFACTOR K-EFF BY UNIT NUMBER  NO        CKP  COMPUTE COFACTOR K-EFF BY UNIT LOCATION NO ***
***                                                                                                 ***
***  FMU  PRINT FISS PROD MATRIX BY UNIT NUMBER  NO        FMP  PRINT FISS PROD MATRIX BY UNIT LOCATION NO ***
***                                                                                                 ***
***  MKH  COMPUTE MATRIX K-EFF BY HOLE NUMBER    NO        MKA  COMPUTE MATRIX K-EFF BY ARRAY NUMBER    NO ***
***                                                                                                 ***
***  CKH  COMPUTE COFACTOR K-EFF BY HOLE NUMBER  NO        CKA  COMPUTE COFACTOR K-EFF BY ARRAY NUMBER  NO ***
***                                                                                                 ***
***  FMH  PRINT FISS PROD MATRIX BY HOLE NUMBER  NO        FMA  PRINT FISS PROD MATRIX BY ARRAY NUMBER  NO ***
***                                                                                                 ***
***  HHL  COLLECT MATRIX BY HIGHEST HOLE LEVEL   NO        HAL  COLLECT MATRIX BY HIGHEST ARRAY LEVEL   NO ***
***                                                                                                 ***
***  AMX  PRINT ALL MIXED CROSS SECTIONS         NO        FAR  PRINT FIS. AND ABS. BY REGION       NO ***
***                                                                                                 ***
***  XS1  PRINT 1-D MIXTURE X-SECTIONS           NO        GAS  PRINT FAR BY GROUP                  NO ***
***                                                                                                 ***
***  XS2  PRINT 2-D MIXTURE X-SECTIONS           NO        PAX  PRINT XSEC-ALBEDO CORRELATION TABLES NO ***
***                                                                                                 ***
***  XAP  PRINT MIXTURE ANGLES & PROBABILITIES   NO        PWT  PRINT WEIGHT AVERAGE ARRAY          NO ***
***                                                                                                 ***
***  PKI  PRINT FISSION SPECTRUM                 NO        PGM  PRINT INPUT GEOMETRY                NO ***
***                                                                                                 ***
***  P1D  PRINT EXTRA 1-D CROSS SECTIONS         NO        BUG  PRINT DEBUG INFORMATION             NO ***
***                                                                                                 ***
***                                                        TRK  PRINT TRACKING INFORMATION          NO ***
***                                                                                                 ***
***                                                                                                 ***
*******************************************************************************************************
*******************************************************************************************************
*******************************************************************************************************
                              PARAMETER INPUT COMPLETED

              .......    0 IO'S WERE USED READING THE PARAMETER DATA       .......

            *************** DATA READING COMPLETED ***************
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

GENERATION	GENERATION K-EFFECTIVE	ELAPSED TIME MINUTES	AVERAGE K-EFFECTIVE	AVG K-EFF DEVIATION	MATRIX K-EFFECTIVE	MATRIX K-EFF DEVIATION
KENO MESSAGE NUMBER K5-132		WARNING....ONLY	966 INDEPENDENT	FISSION POINTS WERE	GENERATED	
1	8.86430E-01	1.63583E+00	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
2	9.30216E-01	1.64600E+00	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
KENO MESSAGE NUMBER K5-132		WARNING....ONLY	968 INDEPENDENT	FISSION POINTS WERE	GENERATED	
3	8.62103E-01	1.65600E+00	8.62103E-01	0.00000E+00	0.00000E+00	0.00000E+00
4	9.59846E-01	1.66517E+00	9.10975E-01	4.88714E-02	0.00000E+00	0.00000E+00
5	9.26128E-01	1.67533E+00	9.16026E-01	2.86645E-02	0.00000E+00	0.00000E+00
6	9.06831E-01	1.68533E+00	9.13727E-01	2.03988E-02	0.00000E+00	0.00000E+00
7	9.34797E-01	1.69450E+00	9.17941E-01	1.63531E-02	0.00000E+00	0.00000E+00
8	8.84345E-01	1.70450E+00	9.12342E-01	1.44788E-02	0.00000E+00	0.00000E+00
9	8.84580E-01	1.71467E+00	9.08376E-01	1.28635E-02	0.00000E+00	0.00000E+00
10	8.83476E-01	1.72383E+00	9.05263E-01	1.15667E-02	0.00000E+00	0.00000E+00
11	9.15707E-01	1.73383E+00	9.06424E-01	1.02667E-02	0.00000E+00	0.00000E+00
12	9.44775E-01	1.74383E+00	9.10259E-01	9.95150E-03	0.00000E+00	0.00000E+00
13	9.44424E-01	1.75300E+00	9.13365E-01	9.52225E-03	0.00000E+00	0.00000E+00
14	9.38542E-01	1.76400E+00	9.15463E-01	8.94221E-03	0.00000E+00	0.00000E+00
15	9.05427E-01	1.77317E+00	9.14691E-01	8.26178E-03	0.00000E+00	0.00000E+00
16	9.05457E-01	1.78333E+00	9.14031E-01	7.67731E-03	0.00000E+00	0.00000E+00
17	9.07366E-01	1.79250E+00	9.13587E-01	7.16098E-03	0.00000E+00	0.00000E+00
18	9.47593E-01	1.80150E+00	9.15712E-01	7.02758E-03	0.00000E+00	0.00000E+00
19	8.96175E-01	1.81167E+00	9.14563E-01	6.70055E-03	0.00000E+00	0.00000E+00
20	8.92676E-01	1.82167E+00	9.13347E-01	6.43330E-03	0.00000E+00	0.00000E+00
21	8.97286E-01	1.83083E+00	9.12502E-01	6.14372E-03	0.00000E+00	0.00000E+00
22	9.18874E-01	1.84100E+00	9.12820E-01	5.83715E-03	0.00000E+00	0.00000E+00
23	9.16554E-01	1.85100E+00	9.12998E-01	5.55508E-03	0.00000E+00	0.00000E+00
24	9.24305E-01	1.86117E+00	9.13512E-01	5.32144E-03	0.00000E+00	0.00000E+00
25	9.50884E-01	1.87117E+00	9.15137E-01	5.33812E-03	0.00000E+00	0.00000E+00
26	9.03892E-01	1.88033E+00	9.14668E-01	5.13230E-03	0.00000E+00	0.00000E+00
27	8.67111E-01	1.89033E+00	9.12766E-01	5.27749E-03	0.00000E+00	0.00000E+00
28	9.20762E-01	1.90050E+00	9.13074E-01	5.07977E-03	0.00000E+00	0.00000E+00
29	9.28867E-01	1.91050E+00	9.13659E-01	4.92288E-03	0.00000E+00	0.00000E+00
30	8.98241E-01	1.92067E+00	9.13108E-01	4.77566E-03	0.00000E+00	0.00000E+00
31	9.41922E-01	1.92967E+00	9.14102E-01	4.71394E-03	0.00000E+00	0.00000E+00
32	9.25394E-01	1.93983E+00	9.14478E-01	4.56963E-03	0.00000E+00	0.00000E+00
33	8.83837E-01	1.94983E+00	9.13490E-01	4.52894E-03	0.00000E+00	0.00000E+00
34	8.99376E-01	1.96000E+00	9.13049E-01	4.40725E-03	0.00000E+00	0.00000E+00
35	9.19662E-01	1.97000E+00	9.13249E-01	4.27631E-03	0.00000E+00	0.00000E+00
36	9.35925E-01	1.98017E+00	9.13916E-01	4.20189E-03	0.00000E+00	0.00000E+00
37	9.17451E-01	1.99017E+00	9.14017E-01	4.08132E-03	0.00000E+00	0.00000E+00
38	9.42446E-01	2.00017E+00	9.14807E-01	4.04418E-03	0.00000E+00	0.00000E+00
39	9.39725E-01	2.01033E+00	9.15480E-01	3.99060E-03	0.00000E+00	0.00000E+00
40	9.07176E-01	2.01950E+00	9.15262E-01	3.89031E-03	0.00000E+00	0.00000E+00
41	9.36038E-01	2.02950E+00	9.15794E-01	3.82651E-03	0.00000E+00	0.00000E+00
42	9.08300E-01	2.03967E+00	9.15607E-01	3.73432E-03	0.00000E+00	0.00000E+00
43	9.23285E-01	2.04967E+00	9.15794E-01	3.64691E-03	0.00000E+00	0.00000E+00
44	9.10821E-01	2.05967E+00	9.15676E-01	3.56099E-03	0.00000E+00	0.00000E+00
45	8.87317E-01	2.06983E+00	9.15016E-01	3.53918E-03	0.00000E+00	0.00000E+00
46	9.11245E-01	2.07983E+00	9.14931E-01	3.45887E-03	0.00000E+00	0.00000E+00
47	9.33556E-01	2.08900E+00	9.15344E-01	3.40637E-03	0.00000E+00	0.00000E+00
48	9.12917E-01	2.09917E+00	9.15292E-01	3.33192E-03	0.00000E+00	0.00000E+00
49	9.29311E-01	2.10817E+00	9.15590E-01	3.27387E-03	0.00000E+00	0.00000E+00
50	9.32855E-01	2.11833E+00	9.15950E-01	3.22506E-03	0.00000E+00	0.00000E+00
51	9.01676E-01	2.12833E+00	9.15658E-01	3.17196E-03	0.00000E+00	0.00000E+00
52	9.51940E-01	2.13850E+00	9.16384E-01	3.19147E-03	0.00000E+00	0.00000E+00
53	8.92347E-01	2.14850E+00	9.15913E-01	3.16357E-03	0.00000E+00	0.00000E+00
54	9.59600E-01	2.15867E+00	9.16753E-01	3.21389E-03	0.00000E+00	0.00000E+00
55	8.95899E-01	2.16867E+00	9.16359E-01	3.17712E-03	0.00000E+00	0.00000E+00
56	9.18557E-01	2.17783E+00	9.16400E-01	3.11800E-03	0.00000E+00	0.00000E+00
57	9.43905E-01	2.18783E+00	9.16900E-01	3.10137E-03	0.00000E+00	0.00000E+00
58	9.20120E-01	2.19800E+00	9.16958E-01	3.04603E-03	0.00000E+00	0.00000E+00
59	9.37297E-01	2.20800E+00	9.17314E-01	3.01331E-03	0.00000E+00	0.00000E+00
60	9.87268E-01	2.21817E+00	9.18521E-01	3.19713E-03	0.00000E+00	0.00000E+00
61	9.23956E-01	2.22817E+00	9.18613E-01	3.14382E-03	0.00000E+00	0.00000E+00
			.			
			.			
			.			
982	9.04672E-01	1.14153E+01	9.24700E-01	7.36990E-04	0.00000E+00	0.00000E+00
983	9.36419E-01	1.14255E+01	9.24712E-01	7.36335E-04	0.00000E+00	0.00000E+00
984	9.14772E-01	1.14355E+01	9.24702E-01	7.35654E-04	0.00000E+00	0.00000E+00

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

985	9.17418E-01	1.14447E+01	9.24694E-01	7.34943E-04	0.00000E+00	0.00000E+00
986	8.89156E-01	1.14547E+01	9.24658E-01	7.35083E-04	0.00000E+00	0.00000E+00
987	9.54606E-01	1.14648E+01	9.24689E-01	7.34966E-04	0.00000E+00	0.00000E+00
988	9.07762E-01	1.14740E+01	9.24671E-01	7.34421E-04	0.00000E+00	0.00000E+00
989	9.32998E-01	1.14840E+01	9.24680E-01	7.33725E-04	0.00000E+00	0.00000E+00
990	9.24344E-01	1.14942E+01	9.24680E-01	7.32982E-04	0.00000E+00	0.00000E+00
991	9.27070E-01	1.15042E+01	9.24682E-01	7.32244E-04	0.00000E+00	0.00000E+00
992	9.49672E-01	1.15133E+01	9.24707E-01	7.31940E-04	0.00000E+00	0.00000E+00
993	9.60024E-01	1.15233E+01	9.24743E-01	7.32069E-04	0.00000E+00	0.00000E+00
994	9.75624E-01	1.15335E+01	9.24794E-01	7.33127E-04	0.00000E+00	0.00000E+00
995	9.04812E-01	1.15435E+01	9.24774E-01	7.32664E-04	0.00000E+00	0.00000E+00
996	9.18264E-01	1.15537E+01	9.24767E-01	7.31956E-04	0.00000E+00	0.00000E+00
997	9.32982E-01	1.15628E+01	9.24776E-01	7.31267E-04	0.00000E+00	0.00000E+00
998	9.05779E-01	1.15728E+01	9.24757E-01	7.30781E-04	0.00000E+00	0.00000E+00
999	9.34645E-01	1.15828E+01	9.24767E-01	7.30115E-04	0.00000E+00	0.00000E+00
1000	9.34634E-01	1.15930E+01	9.24776E-01	7.29450E-04	0.00000E+00	0.00000E+00
1001	8.95950E-01	1.16022E+01	9.24748E-01	7.29291E-04	0.00000E+00	0.00000E+00
1002	9.32221E-01	1.16122E+01	9.24755E-01	7.28600E-04	0.00000E+00	0.00000E+00
1003	9.03383E-01	1.16223E+01	9.24734E-01	7.28184E-04	0.00000E+00	0.00000E+00

KENO MESSAGE NUMBER K5-123 EXECUTION TERMINATED DUE TO COMPLETION OF THE SPECIFIED NUMBER OF GENERATIONS.

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

```
LIFETIME = 4.29740E-05 + OR - 8.70199E-08          GENERATION TIME = 2.88492E-05 + OR - 4.67432E-08
NU BAR   = 2.44142E+00 + OR - 6.38806E-05     AVERAGE FISSION GROUP = 2.17829E+01 + OR - 3.80771E-03
          ENERGY(EV) OF THE AVERAGE LETHARGY CAUSING FISSION = 2.67732E-01 + OR - 8.25407E-04
```

NO. OF INITIAL GENERATIONS SKIPPED	AVERAGE K-EFFECTIVE	DEVIATION	67 PER CENT CONFIDENCE INTERVAL	95 PER CENT CONFIDENCE INTERVAL	99 PER CENT CONFIDENCE INTERVAL	NUMBER OF HISTORIES
3	0.92480	+ OR - 0.00073	0.92407 TO 0.92552	0.92334 TO 0.92625	0.92262 TO 0.92698	1000000
4	0.92476	+ OR - 0.00073	0.92404 TO 0.92549	0.92331 TO 0.92621	0.92258 TO 0.92694	999000
5	0.92476	+ OR - 0.00073	0.92403 TO 0.92549	0.92331 TO 0.92621	0.92258 TO 0.92694	998000
6	0.92478	+ OR - 0.00073	0.92405 TO 0.92551	0.92332 TO 0.92623	0.92260 TO 0.92696	997000
7	0.92477	+ OR - 0.00073	0.92404 TO 0.92550	0.92331 TO 0.92622	0.92258 TO 0.92695	996000
8	0.92481	+ OR - 0.00073	0.92408 TO 0.92554	0.92335 TO 0.92626	0.92263 TO 0.92699	995000
9	0.92485	+ OR - 0.00073	0.92412 TO 0.92558	0.92339 TO 0.92630	0.92267 TO 0.92703	994000
10	0.92489	+ OR - 0.00073	0.92416 TO 0.92562	0.92344 TO 0.92634	0.92271 TO 0.92707	993000
11	0.92490	+ OR - 0.00073	0.92417 TO 0.92563	0.92345 TO 0.92635	0.92272 TO 0.92708	992000
12	0.92488	+ OR - 0.00073	0.92415 TO 0.92561	0.92342 TO 0.92634	0.92270 TO 0.92706	991000
17	0.92490	+ OR - 0.00073	0.92417 TO 0.92563	0.92344 TO 0.92636	0.92271 TO 0.92709	986000
22	0.92498	+ OR - 0.00073	0.92424 TO 0.92571	0.92351 TO 0.92644	0.92278 TO 0.92717	981000
27	0.92504	+ OR - 0.00073	0.92431 TO 0.92577	0.92358 TO 0.92650	0.92284 TO 0.92724	976000
32	0.92505	+ OR - 0.00074	0.92432 TO 0.92579	0.92358 TO 0.92652	0.92284 TO 0.92726	971000
37	0.92512	+ OR - 0.00074	0.92438 TO 0.92586	0.92365 TO 0.92660	0.92291 TO 0.92733	966000
42	0.92511	+ OR - 0.00074	0.92437 TO 0.92585	0.92363 TO 0.92659	0.92289 TO 0.92733	961000
47	0.92518	+ OR - 0.00074	0.92443 TO 0.92592	0.92369 TO 0.92666	0.92295 TO 0.92740	956000
			. . .			
912	0.92641	+ OR - 0.00227	0.92414 TO 0.92868	0.92186 TO 0.93096	0.91959 TO 0.93323	91000
917	0.92684	+ OR - 0.00235	0.92449 TO 0.92919	0.92214 TO 0.93154	0.91979 TO 0.93388	86000
922	0.92810	+ OR - 0.00235	0.92574 TO 0.93045	0.92339 TO 0.93281	0.92104 TO 0.93516	81000
927	0.92697	+ OR - 0.00239	0.92458 TO 0.92937	0.92218 TO 0.93176	0.91979 TO 0.93416	76000
932	0.92664	+ OR - 0.00250	0.92414 TO 0.92915	0.92163 TO 0.93165	0.91913 TO 0.93416	71000
937	0.92719	+ OR - 0.00264	0.92455 TO 0.92983	0.92190 TO 0.93248	0.91926 TO 0.93512	66000
942	0.92638	+ OR - 0.00282	0.92356 TO 0.92920	0.92074 TO 0.93202	0.91792 TO 0.93484	61000
947	0.92701	+ OR - 0.00302	0.92399 TO 0.93003	0.92098 TO 0.93305	0.91796 TO 0.93607	56000
952	0.92705	+ OR - 0.00320	0.92385 TO 0.93025	0.92065 TO 0.93345	0.91745 TO 0.93665	51000
957	0.92734	+ OR - 0.00349	0.92386 TO 0.93083	0.92037 TO 0.93432	0.91688 TO 0.93781	46000
962	0.92770	+ OR - 0.00357	0.92413 TO 0.93127	0.92055 TO 0.93485	0.91698 TO 0.93842	41000
967	0.92517	+ OR - 0.00374	0.92143 TO 0.92891	0.91770 TO 0.93264	0.91396 TO 0.93638	36000
972	0.92346	+ OR - 0.00404	0.91942 TO 0.92749	0.91538 TO 0.93153	0.91135 TO 0.93557	31000
977	0.92528	+ OR - 0.00416	0.92112 TO 0.92945	0.91696 TO 0.93361	0.91279 TO 0.93778	26000

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

982	0.92631	+ OR - 0.00479	0.92153 TO 0.93110	0.91674 TO 0.93588	0.91196 TO 0.94067	21000
987	0.92751	+ OR - 0.00544	0.92207 TO 0.93295	0.91663 TO 0.93839	0.91120 TO 0.94383	16000
992	0.92712	+ OR - 0.00749	0.91963 TO 0.93461	0.91213 TO 0.94210	0.90464 TO 0.94960	11000
997	0.91777	+ OR - 0.00731	0.91045 TO 0.92508	0.90314 TO 0.93240	0.89583 TO 0.93971	6000

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
                    TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

                PLOT OF AVERAGE K-EFFECTIVE BY GENERATION RUN.
  THE LINE REPRESENTS K-EFF = 0.9248 + OR -  0.0007 WHICH OCCURS FOR  1003 GENERATIONS RUN.

                          0.9114                   0.9356                   0.9598
    |-------------------------|------------------------|------------------------|------------------------
    |
  5 +                                      | I                *                 I
    |                             I        |      *               I
    |                                  I   |       *          I
    |                       I            * |          I
    |                 I           *        |   I
 10 +             I           *          I |
    |               I         *         I  |
    |                   I         *        |I
    |                       I        *     |  I
    |                         I        *   |   I
 15 +                         I      *     | I
    |                        I      *      |I
    |                        I      *     I|
    |                          I      *    |I
    |                         I     *      I
 20 +                       I      *     I |
    |                       I    *     I   |
    |                       I     *    I   |
    |                       I     *    I   |
    |                        I    *    I   |
 25 +                          I    *    I |
    |                         I    *    I  |
    |                       I    *    I    |
    |                       I    *    I    |
    |                        I    *    I   |
 30 +                       I    *    I    |
    |                         I   *    I   |
    |                         I    *   I   |
    |                        I   *    I    |
    |                        I   *   I     |
 35 +                        I   *   I     |
    |                         I   *   I    |
    |                         I   *   I    |
    |                          I   *   I   |
    |                          I   *   I   |
 40 +                          I   *   I   |
    |                           I  *   I   |
    |                           I  *   I   |
    |                           I  *   I   |
    |                           I  *   I   |
 45 +                          I   *  I    |
    |                          I  *   I    |
    |                          I   *  I    |
    |                          I   *  I    |
    |                           I  *  I    |
 50 +                           I  *   I   |
    |                           I  *  I    |
    |                            I  *  I   |
    |                           I  *  I    |
    |                            I  *  I   |
 55 +                            I  *  I   |
    |                            I  *  I   |
    |                            I  *  I   |
    |                            I  *  I   |
    |                             I  *  I  |
 60 +                              I  *  I |
    |                              I  *  I |
    |                              I  *  I |
    |                              I  *  I |
    |                              I   *  I|
 65 +                              I  *  I |
    |                               I  *  I|
    |                               I  *  I|
    |                               I  *  I|
    |                              I  *  I |
 70 +                               I *  I |
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
     |                         I  *  I|
     |                         I *  I |
     |                         I *  I |
     |                         I  * I |
 75  +                         I  * I |
     |                         I  * I |
     |                         I  * I |
     |                         I  *  I|
     |                          I *  I|
 80  +                          I *  I|
     |                          I *  I|
     |                          I *  I|
     |                          I *  I|
     |                          I  * I|
 85  +                          I  * I|
     |                          I  * I|
     |                           I * I|
     |                           I *  I
     |                          I  * I|
 90  +                           I *  I
     |                           I *  I
     |                           I * I|
     |                           I * I|
     |                           I *  I
 95  +                          I  * I|
     |                           I *  I
     |                           I * I|
     |                           I * I|
     |                           I *  I
100  +                           I *  I
     |                           I  * I
     |                            I * I
     |                            I * I
     |                            I * |I
105  +                            I * I
     |                            I * I
     |                            I  *|I
     |                            I  *|I
     |                            I * |I
110  +                            I  *|I
     |                            I * |I
     |                            I  *|I
     |                             I *|I
     |                             I *|I
115  +                             I *|I
     |                             I *|I
     |                             I *|I
     |                             I *|I
     |                             I *|I
120  +                             I  * I
     |                              I * I
     |                             I *|I
     |                             I  * I
     |                             I *|I
125  +                              I * I
     |                              I * I
     |                              I * I
     |                              I * I
     |                              I * I
130  +                             I *|I
     |                             I *| I
     |                             I *|I
     |                             I *|I
     |                             I *|I
135  +                              I * I
     |                             I *|I
     |                             I *|I
     |                              I * I
     |                              I * I
140  +                              I * I
     |                              I * I
     |                              I * I
     |                              I * I
     |                              I * I
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
145 +                         I * I
    |                         I * I
    |                         I * I
    |                         I * I
    |                         I * I
150 +                         I * I
    |                         I * I
    |                         I * I
    |                         I * I
    |                         I * I
155 +                         I * I
    |                         I * I
    |                         I * I
    |                          I* I
    |                          I|*I
160 +                         I * I
    |                         I * I
    |                          I|*I
    |                          I* I
    |                          I* I
165 +                          I|*I
    |                          I|*I
    |                          I|*I
    |                          I|*I
    |                          I|*I
170 +                          I|*I
    |                          I|* I
    |                          I|* I
    |                          I|* I
    |                          I|* I
175 +                          I|* I
    |                          I|* I
    |                          I|* I
    |                          I|* I
    |                          I|* I
180 +                          I|* I
    |                          I|* I
    |                          I|* I
    |                          I|* I
    |                          I|* I
185 +                          I|*I
    |                          I|*I
    |                          I|* I
    |                          I|*I
    |                          I|*I
190 +                          I|* I
    |                          I|*I
    |                          I|* I
    |                          I|*I
    |                          I|* I
195 +                          I|*I
    |                          I|*I
    |                          I|*I
    |                          I|*I
    |                          I|*I
200 +                          I|*I
    |                          I|*I
    |                          I|*I
    |                          I|*I
    |                          I|* I
205 +                          I|* I
    |                          I|*I
    |                          I|* I
    |                          I|* I
    |                          I|*I
210 +                          I|*I
    |                          I|*I
    |                          I|*I
    |                          I|*I
    |                          I|*I
215 +                          I* I
    |                          I|*I
    |                          I* I
    |                          I|*I
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
    |                              I|*I
220 +                              I|*I
    |                              I|*I
    |                              I* I
    |                              I|*I
    |                              I|*I
225 +                              I|*I
    |                              I|*I
    |                              I* I
    |                              I* I
    |                              I* I
230 +                              I* I
    |                              I* I
    |                              I* I
    |                              I* I
    |                              I* I
235 +                              I* I
    |                              I* I
    |                              I|*I
    |                              I|*I
    |                              I|*I
240 +                              I|*I
    |                              I|*I
    |                              I|*I
    |                              I|*I
    |                              I|*I
245 +                              I|*I
    |                              I|*I
    |                              I|*I
    |                              I|*I
    |                               I* I
250 +                              I|*I
    |                              I|*I
    |                              I|*I
    |                               I* I
    |                               I* I
255 +                               I *I
    |                               I *I
    |                               I *I
    |                               I *I
    |                               I *I
260 +                               I *I
    |                               I *I
    |                               I *I
    |                               I *I
    |                               I *I
265 +                               I *I
    |                               I *I
    |                               I *I
    |                               I *I
    |                               |I* I
270 +                               |I* I
    |                               |I*I
    |                               |I*I
    |                               |I*I
    |                               |I* I
275 +                               |I*I
    |                               I *I
                                         .
                                         .
                                         .
905 +                              I*I
    |                              I*I
    |                              I*I
    |                              I*I
    |                              I*I
910 +                              I*I
    |                              I*I
    |                              I*I
    |                              I*I
    |                              I*I
915 +                              I*I
    |                              I*I
    |                              I*I
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
    |                         I*I
    |                         I*I
920 +                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
925 +                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
930 +                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
935 +                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
940 +                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
945 +                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
950 +                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
955 +                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
960 +                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
    |                         I*I
965 +                          *I
    |                          *I
    |                          *I
    |                          *I
    |                          *I
970 +                          *I
    |                          *I
    |                          *I
    |                          *I
    |                          *I
975 +                         I*I
    |                          *I
    |                          *I
    |                          *I
    |                          *I
980 +                          *I
    |                          *I
    |                          *I
    |                          *I
    |                          *I
985 +                          *I
    |                         I*I
    |                          *I
    |                         I*I
    |                         I*I
990 +                         I*I
    |                         I*I
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
        |                        *I
        |                        *I
        |                        *I
   995  +                        *I
        |                        *I
        |                        *I
        |                        *I
        |                        *I
  1000  +                        *I
        |                        *I
        |                        *I
        |                        *I
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
                     TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

                 PLOT OF AVERAGE K-EFFECTIVE BY GENERATION SKIPPED.
  THE LINE REPRESENTS K-EFF = 0.9248 + OR -  0.0007 WHICH OCCURS FOR     4 GENERATIONS SKIPPED.

                          0.9105                  0.9198                  0.9291
     |------------------------|-----------------------|-----------------------|-----------------------
     |
     |                                                           I * I
   5 +                                                           I * I
     |                                                           I * I
     |                                                           I * I
     |                                                           I * I
     |                                                           I * I
  10 +                                                           I * I
     |                                                           I * I
     |                                                           I * I
     |                                                           I * I
     |                                                           I * I
  15 +                                                           I * I
     |                                                           I * I
     |                                                           I * I
     |                                                           I * I
     |                                                           I * I
  20 +                                                           I * I
     |                                                           I * I
     |                                                           I * I
     |                                                           I * I
     |                                                           I * I
  25 +                                                           I * I
     |                                                           I * I
     |                                                            I|* I
     |                                                            I|* I
     |                                                            I|* I
  30 +                                                            I|* I
     |                                                            I|* I
     |                                                            I|* I
                                                     .
                                                     .
                                                     .
     |                                                        I    *    I
     |                                                        I    *    I
     |                                                       I    *|   I
 855 +                                                       I    *|   I
     |                                                      I    * | I
     |                                                      I    * | I
     |                                                      I    * | I
     |                                                      I    * | I
 860 +                                                     I     * | I
     |                                                     I    *  |I
     |                                                     I    *  |I
     |                                                      I    * | I
     |                                                      I    * | I
 865 +                                                      I    * | I
     |                                                     I     * | I
     |                                                     I    *  |I
     |                                                      I    * | I
     |                                                     I     * | I
 870 +                                                     I     * | I
     |                                                      I    * |  I
     |                                                      I    * |  I
     |                                                      I     *|  I
     |                                                      I     *|  I
 875 +                                                      I    * |  I
     |                                                      I    * |  I
     |                                                     I     * |  I
     |                                                      I    * |  I
     |                                                     I     * |  I
 880 +                                                     I     * | I
     |                                                     I    *  | I
     |                                                    I     *  | I
     |                                                     I     * |  I
     |                                                    I     *  | I
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
885 +          I    *  |  I
    |          I     * |   I
    |          I     * |  I
    |          I     * |   I
    |          I     * |   I
890 +          I    *  |  I
    |           I     *|   I
    |          I     * |   I
    |           I     *|    I
    |           I     *|    I
895 +            I    *|    I
    |           I     *|    I
    |           I     *|    I
    |           I     *|    I
    |            I     *     I
900 +           I     *|    I
    |            I     *     I
    |             I    |*     I
    |            I     |*     I
    |              I   | *     I
905 +              I   | *     I
    |              I   | *     I
    |               I  |  *     I
    |               I  |  *     I
    |                I |   *     I
910 +                 I|    *     I
    |                 I|    *     I
    |                I |   *     I
    |                 I|    *     I
    |                 I|    *     I
915 +                  I     *     I
    |                 I|    *      I
    |                 I|    *      I
    |                  I     *      I
    |                  I     *      I
920 +                  I      *     I
    |                  | I      *     I
    |                  | I      *     I
    |                  | I     *      I
    |                  I      *     I
925 +                  I      *     I
    |                  I      *     I
    |                 I|     *     I
    |                 I|     *     I
    |                  I      *     I
930 +                  I     *      I
    |                 I|    *      I
    |                I |    *      I
    |                I |    *      I
    |                I |    *      I
935 +                I |    *      I
    |                I |    *      I
    |                 I|     *      I
    |                 I|     *      I
    |                 I|     *      I
940 +                I |    *       I
    |                I |    *       I
    |               I  |   *       I
    |              I   |   *       I
    |              I   |   *      I
945 +               I  |    *      I
    |               I  |    *       I
    |                I |     *       I
    |               I  |    *       I
    |              I   |   *       I
950 +              I   |    *       I
    |                I |     *       I
    |               I  |     *        I
    |                 I|      *        I
    |                I |      *        I
955 +                I |      *        I
    |               I  |     *        I
    |               I  |      *        I
    |                 I|        *        I
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

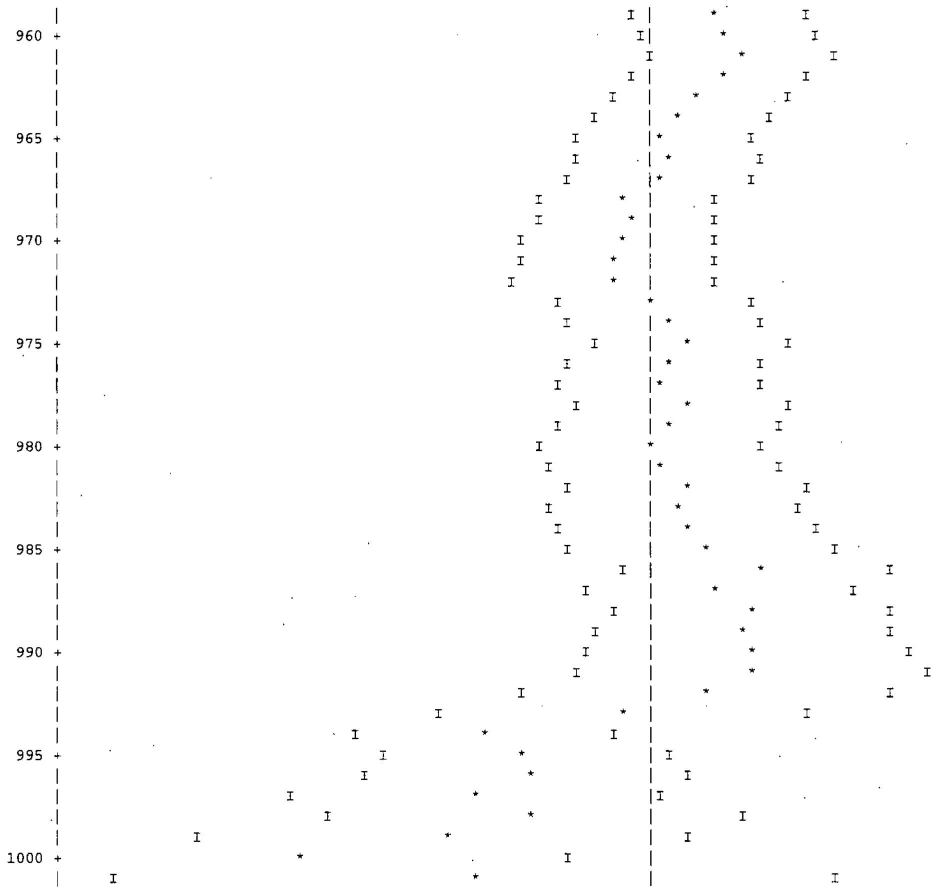

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

                             FREQUENCY FOR GENERATIONS    4 TO 1003
0.8469 TO 0.8499     *
0.8499 TO 0.8529
0.8529 TO 0.8560     *
0.8560 TO 0.8590
0.8590 TO 0.8620     *
0.8620 TO 0.8650
0.8650 TO 0.8680     **
0.8680 TO 0.8710     ****
0.8710 TO 0.8741     ****
0.8741 TO 0.8771     *
0.8771 TO 0.8801     ********
0.8801 TO 0.8831     *******
0.8831 TO 0.8861     ************
0.8861 TO 0.8891     ******************
0.8891 TO 0.8922     ********************
0.8922 TO 0.8952     ****************
0.8952 TO 0.8982     ***********************************
0.8982 TO 0.9012     ****************************
0.9012 TO 0.9042     *********************************
0.9042 TO 0.9072     **********************************************
0.9072 TO 0.9103     ********************************************
0.9103 TO 0.9133     ******************************************
0.9133 TO 0.9163     *************************************
0.9163 TO 0.9193     ******************************************
0.9193 TO 0.9223     **************************************************
0.9223 TO 0.9253     ******************************************
0.9253 TO 0.9284     ***********************************************************
0.9284 TO 0.9314     ****************************************************
0.9314 TO 0.9344     *************************************************************
0.9344 TO 0.9374     *********************************************
0.9374 TO 0.9404     ***************************************
0.9404 TO 0.9434     ************************************
0.9434 TO 0.9465     ********************************
0.9465 TO 0.9495     **************************************
0.9495 TO 0.9525     ********************************
0.9525 TO 0.9555     **********************
0.9555 TO 0.9585     **********************
0.9585 TO 0.9615     ******************
0.9615 TO 0.9646     **********
0.9646 TO 0.9676     ************
0.9676 TO 0.9706     ****
0.9706 TO 0.9736     ******
0.9736 TO 0.9766     ********
0.9766 TO 0.9796
0.9796 TO 0.9827     ****
0.9827 TO 0.9857     **
0.9857 TO 0.9887     *
0.9887 TO 0.9917     **
0.9917 TO 0.9947
0.9947 TO 0.9977
0.9977 TO 1.0008     *
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

                                   FREQUENCY FOR GENERATIONS  254 TO 1003
0.8469 TO 0.8499     *
0.8499 TO 0.8529
0.8529 TO 0.8560     *
0.8560 TO 0.8590
0.8590 TO 0.8620     *
0.8620 TO 0.8650
0.8650 TO 0.8680     *
0.8680 TO 0.8710     ****
0.8710 TO 0.8741     ****
0.8741 TO 0.8771     *
0.8771 TO 0.8801     *******
0.8801 TO 0.8831     *****
0.8831 TO 0.8861     ********
0.8861 TO 0.8891     ***********
0.8891 TO 0.8922     *************
0.8922 TO 0.8952     *************
0.8952 TO 0.8982     *****************************
0.8982 TO 0.9012     *********************
0.9012 TO 0.9042     ***********************
0.9042 TO 0.9072     **********************************
0.9072 TO 0.9103     ************************************
0.9103 TO 0.9133     ***********************************
0.9133 TO 0.9163     ****************************
0.9163 TO 0.9193     ****************************
0.9193 TO 0.9223     ************************************
0.9223 TO 0.9253     ********************************
0.9253 TO 0.9284     ********************************************
0.9284 TO 0.9314     ***********************************************
0.9314 TO 0.9344     ********************************************
0.9344 TO 0.9374     ******************************
0.9374 TO 0.9404     *************************
0.9404 TO 0.9434     *****************************
0.9434 TO 0.9465     *********************
0.9465 TO 0.9495     *****************************
0.9495 TO 0.9525     *************************
0.9525 TO 0.9555     ****************
0.9555 TO 0.9585     ******************
0.9585 TO 0.9615     *************
0.9615 TO 0.9646     ********
0.9646 TO 0.9676     ********
0.9676 TO 0.9706     ****
0.9706 TO 0.9736     *****
0.9736 TO 0.9766     ******
0.9766 TO 0.9796
0.9796 TO 0.9827     ***
0.9827 TO 0.9857     **
0.9857 TO 0.9887
0.9887 TO 0.9917
0.9917 TO 0.9947
0.9947 TO 0.9977
0.9977 TO 1.0008     *
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

                                 FREQUENCY FOR GENERATIONS  504 TO 1003
0.8469 TO 0.8499    *
0.8499 TO 0.8529
0.8529 TO 0.8560    *
0.8560 TO 0.8590
0.8590 TO 0.8620
0.8620 TO 0.8650
0.8650 TO 0.8680    *
0.8680 TO 0.8710    ****
0.8710 TO 0.8741    ***
0.8741 TO 0.8771    *
0.8771 TO 0.8801    ****
0.8801 TO 0.8831    **
0.8831 TO 0.8861    *******
0.8861 TO 0.8891    *****
0.8891 TO 0.8922    *********
0.8922 TO 0.8952    *********
0.8952 TO 0.8982    ******************
0.8982 TO 0.9012    *****************
0.9012 TO 0.9042    ****************
0.9042 TO 0.9072    **************************
0.9072 TO 0.9103    **********************
0.9103 TO 0.9133    ***********************
0.9133 TO 0.9163    *****************
0.9163 TO 0.9193    *******************
0.9193 TO 0.9223    ********************
0.9223 TO 0.9253    *********************
0.9253 TO 0.9284    *****************************
0.9284 TO 0.9314    ******************************
0.9314 TO 0.9344    ******************************
0.9344 TO 0.9374    *****************
0.9374 TO 0.9404    ****************
0.9404 TO 0.9434    ******************
0.9434 TO 0.9465    *****************
0.9465 TO 0.9495    *********************
0.9495 TO 0.9525    *************
0.9525 TO 0.9555    ************
0.9555 TO 0.9585    **************
0.9585 TO 0.9615    **********
0.9615 TO 0.9646    ******
0.9646 TO 0.9676    *******
0.9676 TO 0.9706    ****
0.9706 TO 0.9736    ***
0.9736 TO 0.9766    ****
0.9766 TO 0.9796
0.9796 TO 0.9827    *
0.9827 TO 0.9857    *
0.9857 TO 0.9887
0.9887 TO 0.9917
0.9917 TO 0.9947
0.9947 TO 0.9977
0.9977 TO 1.0008    *
```

Figure 6.7-11 CSAS Input/Output Summary for Damaged Fuel Can Configuration – Normal Conditions (continued)

```
TRANSPORT CRITICALITY: NORMAL CONDITIONS (PITCH = 300 CM) (IVF = 1.0) (EVF = 1.0

                                FREQUENCY FOR GENERATIONS  754 TO 1003
0.8469 TO 0.8499    *
0.8499 TO 0.8529
0.8529 TO 0.8560
0.8560 TO 0.8590
0.8590 TO 0.8620
0.8620 TO 0.8650
0.8650 TO 0.8680
0.8680 TO 0.8710    ***
0.8710 TO 0.8741    *
0.8741 TO 0.8771
0.8771 TO 0.8801    ****
0.8801 TO 0.8831    **
0.8831 TO 0.8861    ****
0.8861 TO 0.8891    **
0.8891 TO 0.8922    *****
0.8922 TO 0.8952    *****
0.8952 TO 0.8982    *********
0.8982 TO 0.9012    *************
0.9012 TO 0.9042    *******
0.9042 TO 0.9072    **************
0.9072 TO 0.9103    ********
0.9103 TO 0.9133    ***********
0.9133 TO 0.9163    ******
0.9163 TO 0.9193    *********
0.9193 TO 0.9223    ********
0.9223 TO 0.9253    ******
0.9253 TO 0.9284    *****************
0.9284 TO 0.9314    ************
0.9314 TO 0.9344    ***************
0.9344 TO 0.9374    ***********
0.9374 TO 0.9404    *************
0.9404 TO 0.9434    *********
0.9434 TO 0.9465    **********
0.9465 TO 0.9495    ********
0.9495 TO 0.9525    ******
0.9525 TO 0.9555    ******
0.9555 TO 0.9585    *********
0.9585 TO 0.9615    ***
0.9615 TO 0.9646    **
0.9646 TO 0.9676    ***
0.9676 TO 0.9706    *
0.9706 TO 0.9736    **
0.9736 TO 0.9766    ****
0.9766 TO 0.9796
0.9796 TO 0.9827    *
0.9827 TO 0.9857
0.9857 TO 0.9887
0.9887 TO 0.9917
0.9917 TO 0.9947
0.9947 TO 0.9977
0.9977 TO 1.0008
```

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7.0 OPERATING PROCEDURES

This chapter provides an outline of the operating procedures and tests that are performed to ensure proper function of the NAC-STC during transport operations. The operating procedures provided in this chapter are the minimum generic requirements for loading, unloading, preparation for transport, and for inspection and testing of the cask. Bolt torque values are provided in Table 7-1. Each licensee and cask user will develop, prepare and approve site specific procedures, based on the approved detailed operating procedures provided by NAC, to assure that cask handling and shipping activities are performed in accordance with the package Certificate of Compliance and the applicable Nuclear Regulatory Commission and Department of Transportation regulations governing the packaging and transport of radioactive materials.

These procedures assume that the unloaded NAC-STC arrives at a site already configured for use at the site. If this is not the case, then additional operations would be specified in the site specific procedures to configure the cask for the intended use.

The operating procedures in this chapter have been written assuming direct loading or unloading of fuel in the basket in the NAC-STC in a spent fuel pool, or dry loading and unloading of a sealed canister in the reactor cask receiving area, fuel building or other suitable location identified by the user. With minor modifications, site-specific procedures can be written to accommodate the dry direct loading or unloading of fuel from the cask in a hot cell.

Procedures are also provided for the preparation for shipment of an NAC-STC cask that has been loaded and stored at an Independent Spent Fuel Storage Installation (ISFSI) in accordance with the ISFSI license and the 10 CFR 72 requirements.

It is the responsibility of the cask user to prepare site-specific handling procedures in accordance with the Certificate of Compliance, these generic procedures, and the licensee's Quality Assurance program. User approved operating procedures ensure that critical steps are not overlooked, that the packaging is handled in accordance with its Certificate of Compliance and Safety Analysis Report.

The user will verify by fuel accounting, historical data, and inspection records, that the fuel assemblies to be loaded are in compliance with the content conditions of the Certificate of Compliance. In the directly loaded configuration, fuel assemblies or fuel rods with known or suspected cladding defects that exceed pin holes and hairline cracks are not to be loaded into the

NAC-STC. In the canistered configuration, damaged (failed) fuel will be separately containerized (canned) and sealed in the canister prior to transport.

The user shall verify that the NAC-STC transport cask has the correct O-ring configuration for the intended use. The transport cask may be configured with either metallic O-rings or with non-metallic Viton O-rings. The O-rings may not be used interchangeably, since each O-ring type requires a different lid O-ring groove configuration. Consequently, the inner lid, vent and drain port coverplates and outer lid are machined with a square O-ring groove to accept metallic O-rings or are machined with a truncated triangular (dove-tail) groove to accept Viton O-rings.

Viton O-rings may be used only when directly loading spent fuel for transport without interim storage. Metallic O-rings must be used when directly loading spent fuel for an extended period of storage and may be used when directly loading spent fuel for transport without interim storage. Metallic O-rings must also be used when loading canistered fuel or GTCC waste for transport. The metallic and nonmetallic O-rings have different limits of allowable leak rate as specified in the procedures.

Table 7-1 Torque Table

Component	No. Used	Fastener[1]	Torque Value[2]
Outer Lid Bolt	36	1-8 - UNC Socket Head Cap Screw	550 ± 50 ft.-lb (746 ± 68 N-m)
Inner Lid Bolt	42	1 ½ - 8 UN-2A Socket Head Cap Screw	2,540 ± 200 ft-lb (3,443 ± 271 N-m)
Port Cover Bolt	6	⅜ - 16 UNC Socket Head Cap Screw	140 ± 10 in-lb (16 ± 1 N-m)
Coverplate Bolt	8	½ - 13 UNC Socket Head Cap Screw	300 ± 20 in-lb (34 ± 2 N-m)
Test Plug	1	Part No. 423-803-13	30 ± 3 ft-lb (41 ± 4 N-m)
Test Plug	2	Part No. 423-806-3	70 ± 5 in-lb (8 ± 0.6 N-m)
Test Plug	2	Part No. 423-807-8	70 ± 5 in-lb (8 ± 0.6 N-m)
Redwood Impact Limiter Retaining Rods	32	Part No. 423-811-7	75 ± 5 ft-lb (102 ± 7 N-m)
Balsa Impact Limiter Retaining Rods	32	Part No. 423-859-1	75 ± 5 ft-lb (102 ± 7 N-m)
Impact Limiter Nut	32	1 - 8 UNC – 2B Heavy Hex Nut	35 ± 2 ft-lb (47 ± 3 N-m)
Impact Limiter Jam Nut	32	1 - 8 UN - 2B Heavy Hex Nut	75 ± 5 ft-lb (102 ± 7 N-m)
Adapter Ring	3	1 ½ -8UN-2A Socket Head Cap Screw	100 ± 20 ft-lb (136 ± 27 N-m)

1 Torque values for fasteners not shown are provided on the appropriate license drawing in Section 1.3.2.

2 All threaded fasteners shall be lightly lubricated using Nuclear Grade Pure Nickel NEVER-SEEZ® or equivalent.

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7.1 Outline of Procedures for Receipt and Loading the Cask

The following receipt and loading procedures are based on an acceptable cask receipt inspection for first time loading with spent fuel. For casks previously loaded and transported, the receiving inspections will require performance of radiation and removable contamination surveys of the empty cask and vehicle in accordance with 10 CFR 71 and 49 CFR 173 in the U.S. Similar requirements are contained in IAEA TS-R-1.

7.1.1 Receiving Inspection

1. Perform radiation and removable contamination surveys in accordance with 49 CFR 173.441 and 173.443 requirements.
2. Move the transport vehicle with the cask to the cask receiving area.
3. Secure the transport vehicle. Remove the personnel barrier hold down bolts from both sides of the personnel barrier. Using the lifting sling, lift the personnel barrier off of the cask and store it in a designated area.
4. Visually inspect the NAC-STC while secured to the transport vehicle in the horizontal orientation for any signs of damage.
5. Attach slings to the top impact limiter lifting points, remove impact limiter lock wires, impact limiter jam nuts, impact limiter nuts and retaining rods. Remove impact limiter and store upright. Repeat operation for the bottom impact limiter.
6. Release the tiedown assembly from the front support by removing the front tiedown bolts and lock washers.
7. Attach a sling to the tiedown assembly lifting eyes and remove the tiedown assembly from the transport vehicle.
8. Attach the cask lifting yoke to a crane hook with the appropriate load rating. Engage the two yoke arms with the lifting trunnions at the top (front) end of the cask. Rotate/lift the cask to the vertical orientation and raise the cask off of the blocks of the rear support structure of the transport vehicle. Place the cask in the vertical orientation in a decontamination area or other suitable location identified by the user. Disengage the cask lifting yoke from the lifting trunnions.

7.1.2 Preparation of Cask for Loading

The loading procedures are based on the assumption that the cask is being prepared for first time fuel loading following fabrication, or that the scheduled annual maintenance required by the

Certificate of Compliance has been successfully completed within the previous 12 months. If the cask has been used previously, at the start of this procedure, the cask is assumed to be externally decontaminated, empty of fuel contents, and sitting in the decontamination area, or in another location convenient for preparing the cask.

There are two (2) loading options for the NAC-STC. Each requires different preparation steps. The first is direct loading of fuel assemblies into a fuel basket installed in the cask, which is typically performed under water in the spent fuel pool cask loading area. The second is dry loading of a welded transportable storage canister that is already loaded with spent fuel assemblies, Reconfigured Fuel Assemblies, damaged fuel in damaged fuel cans, or with Greater Than Class C (GTCC) waste. Dry loading of the canister into the cask is performed in the cask receiving area, or another convenient location established by the user, using a transfer cask system. This section presents the generic procedures used to prepare the cask for loading for both wet direct fuel loading or dry canister loading.

7.1.2.1 <u>Preparation for Direct Fuel Loading (Uncanistered)</u>

This procedure presents the steps necessary to prepare the cask for under water direct loading of fuel into a basket contained in the NAC-STC cask. This procedure may be modified to accommodate the dry direct loading of fuel in a hot cell.

1. Install appropriate work platforms/scaffolding to allow access to the top of the cask.
2. Detorque in reverse torquing sequence and remove the outer lid bolts. Install the two outer lid alignment pins.
3. Install lifting eyes in the outer lid lifting holes and attach the outer lid lifting sling to the outer lid and overhead crane. Remove the outer lid and place it aside in a temporary storage area. When setting the outer lid down, protect the O-ring and the O-ring groove of the lid from damage. Remove the outer lid alignment pins. Decontaminate the surface of the inner lid and top forging as required. At a convenient time, if a metallic O-ring is used, remove and replace the metallic O-ring in the outer lid. If a Viton O-ring is used, inspect the O-ring and replace as necessary.
4. Detorque drain and vent coverplate bolts and remove the drain port and the vent port coverplates from the inner lid. Store in temporary storage area.

5. Connect demineralized water supply to drain port quick-disconnect. Connect vent hose to vent port quick-disconnect. Fill cask using demineralized water supply until water discharges from the vent hose. Ensure that the vent hose discharges into an appropriate rad waste handling system, as the cask interior may contain residual contamination.
6. Detorque and remove two inner lid bolts and install the two inner lid alignment pins at locations marked on the inner lid.
7. Detorque and remove the remaining inner lid bolts. Clean and visually inspect the outer lid bolts, inner lid bolts, and coverplate bolts for damage or excessive wear.
8. Detorque and remove the bolts and the interlid port and pressure port covers from the top forging. Store and protect all removed parts.
9. Attach the lifting yoke to a crane hook with the appropriate load rating and engage the yoke arms with the lifting trunnions.
10. Attach the lifting eyes to the inner lid. Install the inner lid lifting sling to the eyes in the inner lid and to the lifting eyes on the strongbacks of the lifting yoke.
11. Move the cask to the pool over the cask loading area. As the cask is lowered onto the cask loading area in the pool, spray the external surface of the cask with clean demineralized water to minimize external decontamination efforts.
12. After the cask is resting on the floor of the pool, disconnect the lifting yoke from the lifting trunnions and slowly raise the yoke to remove the inner lid.
13. Remove the lifting yoke and inner lid from the pool. Spray the yoke and lid, as they come out of the water to remove contamination.
14. Store the inner lid in a temporary storage area; remove and store the yoke and inner lid lifting sling in the storage area. When setting the inner lid down, ensure that the O-rings and O-ring grooves of the lid are protected from damage. Decontaminate inner lid, as necessary. At a convenient time, if metallic O-rings are used, remove and replace the metallic O-rings in the inner lid and in the vent and drain port coverplates. If Viton O-rings are used, inspect the O-rings and replace as necessary.
15. Visually examine the internal cavity, fuel basket and drain line to ensure that: (a) no damage has occurred during transit; (b) no foreign materials are present that would inhibit cavity draining; and (c) all required components are in place.

7.1.2.2 Preparation for Canister Loading

This procedure presents the steps required for loading canistered fuel or canistered GTCC waste into the NAC-STC. A canister of fuel or of GTCC waste is loaded dry into the cask, using a transfer cask and attendant support hardware. Configuration control of the NAC-STC is required to ensure the cask has the correct impact limiters and internal spacer(s) for the canister that is to be transported. The operation of the transfer cask is described in NAC approved site specific procedures. Loading of canistered fuel or canistered GTCC waste into the NAC-STC is done in the cask receiving area, or other suitable location specified by the user. The NAC-STC is assumed to be positioned in the area designated for dry canister loading and configured with metallic O-rings.

1. Install appropriate work platforms/scaffolding to allow access to the top of the cask.
2. Detorque in reverse torquing sequence and remove the outer lid bolts. Install the two outer lid alignment pins.
3. Install lifting eyes in the outer lid lifting holes and attach the outer lid lifting device to the outer lid and overhead crane. Remove the outer lid and place it aside in a temporary storage area. When storing the outer lid, protect the O-ring and the O-ring groove of the lid from damage. Remove the outer lid alignment pins. Decontaminate the surface of the inner lid and top forging as required.
4. Detorque the vent and drain coverplate bolts and remove the drain port coverplate and the vent port coverplate from the inner lid. Store the coverplates and bolts in a designated temporary storage area.
5. Detorque and remove two inner lid bolts and install the two inner lid alignment pins at locations marked on the inner lid.
6. Attach the inner lid lifting eyebolts and the inner lid lifting slings to the inner lid.
7. Detorque and remove the remaining inner lid bolts. Clean and visually inspect the outer lid bolts, inner lid bolts, and coverplate bolts for damage or excessive wear. Record inspection results on cask loading report. Replace damaged bolts with approved spare parts.
8. Detorque and remove the bolts and covers from the interlid port and the pressure port in the top forging. Store and protect all removed parts.
9. Lower auxiliary hook to above inner lid and engage lid lifting sling to auxiliary crane hook.
10. Slowly lift and remove the inner lid. The inner lid alignment pins will guide the inner lid until it clears the top forging.
11. Store the inner lid in a temporary storage area. When storing the inner lid, ensure that the O-rings and O-ring grooves of the lid are protected from damage. Decontaminate the inner lid, as necessary.

12. Visually examine the internal cavity to ensure that the cavity is free of damage and foreign materials.
13. Install the appropriate bottom spacer for the canister to be loaded. Attach the spacer lift fixture to the spacer. Using a suitable crane, lower the spacer into the cask cavity, and remove the lift fixture.
14. Install the adapter ring and torque the three bolts to 100 ± 20 ft.-lb.
15. Install the transfer cask adapter plate on top of the NAC-STC cask.

7.1.3 Loading the NAC-STC Cask

There are three loading options for the NAC-STC cask, with each requiring different steps. The first is direct loading of fuel assemblies for transport without interim storage and the second option is for transport after a period of interim storage. These loading configurations are assumed to be performed under water in the spent fuel pool cask loading area. The third option is dry loading into the cask of a sealed transportable storage canister that already contains spent fuel or GTCC waste. Dry loading of the canister into the cask is performed in the cask receiving area, or other convenient location established by the user, using a transfer cask. This section presents the generic loading procedures for these options. In both cases, the fuel assemblies to be directly loaded, or those contained within the sealed canister, must conform to the NAC-STC Certificate of Compliance.

7.1.3.1 Direct Loading of Fuel (Uncanistered)

The NAC-STC may be closed with either metallic or nonmetallic O-rings in the containment boundary and outer lid. Metallic O-rings are required: 1) when directly loading spent fuel for an extended period of storage; and 2) when loading canistered fuel or GTCC waste (for transport). Metallic O-rings or Viton O-rings may be used when directly loading spent fuel for transport without interim storage. However, the metallic and non-metallic O-rings may not be used interchangeably, as the O-ring grooves in the lids and port covers are different for each O-ring type. As specified in the appropriate steps of this procedure, the two types of O-rings have different allowable leak rates so the lid and O-ring configurations to be used must be confirmed and the associated leak test requirements identified.

1. Using approved fuel identification and handling procedures and fuel handling equipment, engage the fuel handling tool to the top of the fuel assembly, lift it from the storage rack location, transfer it to above the cask, and carefully lower it into the

designated location in the fuel basket. Be careful not to contact any of the sealing surfaces on the top forging, or to come in contact with the inner lid guide pins during fuel assembly movement.

Note: Each fuel assembly shall contain the standard number of fuel rods for an assembly of that type. Dummy rods of equivalent water displacement must be substituted for removed fuel rods.

2. Record in the cask loading report the fuel identification number and basket position where the fuel assembly was placed.
3. Repeat steps 1 and 2 until the basket is fully loaded or until all desired fuel assemblies have been loaded. If the cask is going to be partially loaded, the fuel assemblies should be loaded, if possible, in a fully symmetric pattern to ensure that the center of gravity of the cask remains aligned as close as possible to the longitudinal axis of the cask.
4. Attach the inner lid lifting sling to an auxiliary crane hook and lift the inner lid. For the Viton O-ring assembly, inspect the O-ring and replace if damaged. For the metallic O-ring assembly, remove the inner lid O-rings, clean the groove surfaces, and install new metallic O-rings. Inspect new O-rings for damage prior to installation. Secure the metallic O-rings in the groove by the use of the O-ring clips and screws. Similarly, replace the metallic O-rings in the vent and drain port coverplates, or inspect the Viton O-rings and replace if required.
5. After replacing the inner lid O-rings, lift the inner lid and place it on the cask using the inner lid alignment pins to assist in proper lid seating and orientation. Visually verify proper lid position.
6. Disconnect the lid lifting device from the auxiliary crane hook and remove crane hook from area.
7. Attach the lifting yoke to the crane hook, lower the lifting yoke into the lifting position over the cask lifting trunnions, and engage the lifting arms to the lifting trunnions. Slowly lift the cask out of the pool until the top of the cask is slightly above the pool water level.

   Note: As an alternative method, the cask and inner lid may be handled simultaneously. In the event that this method is chosen, instead of performing steps 5, 6 and 7, attach the lifting yoke to a crane hook and the inner lid lifting eyes to the lift yoke. Lower the lid and engage to the cask using the lid alignment pins. Engage lifting arms to lifting trunnions. Slowly lift the cask out of the pool until the top of the cask is slightly above the pool water level.
8. Attach a drain line to the quick-disconnect in the interlid port (located in the top forging) and allow the water to drain from the interlid region. Once drained, disconnect the drain line.

9. Install at least 10 inner lid bolts equally spaced on the bolt circle to hand tight.
10. Continue raising the cask from the pool while spraying the external cask surfaces with clean water to minimize surface contamination levels.
11. Move the cask to the cask decontamination area, lower the cask to the floor and disengage the lift yoke (or lift beam and inner lid lifting slings if the alternate method of handling the inner lid was used). Remove the lift yoke and crane from the area.
12. Connect a vent line to the vent port quick-disconnect. Direct the free end of the vent line to a radioactive waste handling system capable of handling liquids and gas.
13. Remove the inner lid alignment pins and install the remaining inner lid bolts and torque all of the bolts to the torque value specified in Table 7-1. The bolt torquing sequence is shown on the inner lid.
14. Connect a drain line to the drain port quick-disconnect (located in the inner lid). Remove the vent line from the vent port quick-disconnect.
15. Drain the cask cavity by connecting a nitrogen or helium supply to the vent port quick-disconnect (located in the inner lid). Purge the water from the cask by pressurizing to 35 to 40 psig and hold until all water is removed (observed when no water is coming from the drain line). Turn the nitrogen or helium supply off and disconnect the nitrogen or helium supply line from the vent port. Then, disconnect the drain line from the drain port quick-disconnect.
16. Connect a vacuum pump to the cask cavity via the vent and drain port quick-disconnects in the inner lid. Evacuate the cask cavity until a pressure of 4 mbar is reached. Continue pumping for a minimum of 1 hour after reaching 4 mbar. Valve off vacuum pump from system and using a calibrated vacuum gauge (minimum gauge readability of 2.5 mbar), observe for a pressure rise. If a pressure rise (ΔP) of more than 12 mbar in ten minutes is observed, continue pumping until the pressure does not rise more than 12 mbar in ten minutes. Repeat dryness test until cavity dryness has been verified ($\Delta P < 12$ mbar in 10 minutes). Record test results in the cask loading report.
17. Without allowing air to re-enter the cask cavity, turn off and isolate the vacuum pump. Connect a supply of helium (99.9% minimum purity) to the vent port quick-disconnect and backfill the cask cavity to 0 psig helium pressure.
18. Install the drain and vent port coverplates using new metallic O-rings or inspected Viton O-rings. Torque the bolts to the value indicated in Table 7-1.
19. Perform inner lid O-ring leakage testing as follows:

19a. For the metallic O-ring assembly, connect the leak detector vacuum pump to the inner lid interseal test port and evacuate the air between the O-rings to <1 mbar. Hold the vacuum on the interseal for the metallic O-ring assembly region. Using the helium leak detector, verify that any detectable leak rate for metallic O-rings is ≤ 2 × 10^{-7} cm^3/sec (helium). The test sensitivity shall be ≤ 1 ×10^{-7} cm^3/sec (helium).

19b. For Viton O-rings, perform the preshipment leakage rate test to confirm no detected leakage to a test sensitivity of 1 × 10^{-3} ref cm^3/sec by pressurizing the O-ring annulus to 15 (+2, -0) psig and isolating for a minimum of 15 minutes. There shall be no loss in pressure during the test period.

19c. For new replacement Viton O-rings, use a leak detector connected to the interseal test port to verify the total leakage rate is ≤ 9.3 × 10^{-5} cm^3/sec (helium) (1) with a minimum test sensitivity of 4.7 × 10^{-5} cm^3/sec (helium).

20. Install the test port plug for the inner lid interseal test port using a new metallic O-ring and torque the plug to the value specified in Table 7-1.

21a. For the metallic O-ring, connect a vacuum pump to the vent port coverplate interseal test port and evacuate the air between the O-rings to <1 mbar. Hold the vacuum on the interseal for the metallic O-ring assembly region. Using the helium leak detector, verify that any detectable leak rate for metallic O-rings is ≤ 2 × 10^{-7} cm^3/sec (helium). The test sensitivity shall be ≤ 1 ×10^{-7} cm^3/sec (helium).

21b. For Viton O-rings(1), perform the preshipment leakage rate test to confirm no detected leakage to a test sensitivity of 1 × 10^{-3} ref cm^3/sec by pressurizing the O-ring annulus to 15 (+2, -0) psig and isolating for a minimum of 15 minutes. There shall be no loss in pressure during the test period.

21c. For new replacement Viton O-rings, use a leak detector connected to the interseal test port to verify the leakage rate is ≤ 9.3 × 10^{-5} cm^3/sec (helium) (1) with a minimum test sensitivity of 4.7 × 10^{-5} cm^3/sec (helium).

22. Install the test port plug for the vent port coverplate using a new metallic O-ring and torque the plugs to the value specified in Table 7-1.

23. Repeat Steps 21 and 22 for the drain port coverplate.(1)

24. Drain residual water from the pressure port, ensuring that the pressure port is clear to also allow water to drain from the interlid region.

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(1) For new Viton O-rings, the combined leakage rates are for the inner O-ring of the lid, inner O-ring of the vent port cover plate and inner O-ring of the drain port cover plate, which are part of the containment boundary. The combined measured leakage rate from all three Viton O-rings must be less than or equal to ≤ 9.3 x 10^{-5} cm^3/sec (helium) in accordance with 10 CFR 71.51.

25. Install the transport pressure port cover on the pressure port. Torque the port cover bolts to the value specified in Table 7-1.
26. Perform a functional leak test on the pressure port cover by removing the O-ring test plug and using a test fixture, pressurize the annulus between the pressure port cover O-rings to 15 psig and isolate. During a 10-minute test period, there shall be no loss in pressure during the test period.
27. Install the pressure port cover interseal test port plug and O-ring and torque the plug to the value specified in Table 7-1.
28. For the metallic outer lid O-ring assembly, remove the O-ring, clean the O-ring seating surface and groove, and install a new metallic O-ring. For Viton O-ring assemblies, inspect the O-ring and replace if damaged.
29. Install outer lid and align vent pins.
30. Attach the outer lid lifting device to the outer lid and overhead crane. Install the outer lid using the alignment pins to assist in proper seating. Remove the outer lid alignment pins. Install the outer lid bolts and torque to the value specified in Table 7-1. The bolt torquing sequence is shown on the outer lid.
31. Attach a supply of air or helium to the interlid port quick-disconnect. Backfill the interlid volume to 15 psig air or helium and hold for 10 minutes. There shall be no pressure loss during the test period. Disconnect air or helium supply.
32. Install the interlid port cover using new metallic O-rings. Torque the interlid port cover bolts to the value specified in Table 7-1.
33. Remove the test plug from the interlid port cover and, using the O-ring test fixture, pressurize the O-ring annulus to 15 psig with air or helium. Isolate the annulus and hold for 10 minutes. No loss of pressure is permitted during the test period.
34. Remove the air or helium supply and vent the annulus pressure. Replace the metallic O-ring on the interlid port cover test plug, install the test plug and torque it to the value specified in Table 7-1.
35. Perform final external decontamination and perform survey to verify acceptable level of removable contamination to ensure compliance with 49 CFR 173.443. Perform final radiation survey. Record the survey results.
36. Perform final visual inspection to verify assembly of the NAC-STC in accordance with the Certificate of Compliance. Verify that the loading documentation has been appropriately completed and signed off.

7.1.3.2 <u>Loading Canistered Fuel or GTCC Waste</u>

Canistered fuel or canistered GTCC waste is loaded into the NAC-STC using a transfer cask. This procedure assumes that the canister has been previously loaded, drained, vacuum dried, backfilled with helium and welded closed. The canister may have been retrieved from dry storage, or it may have been loaded and sealed immediately prior to loading in the NAC-STC. This procedure assumes the sealed canister conforms to the design basis of the NAC-STC and that the canister is already in the transfer cask.

1. Attach the transfer cask yoke to the cask handling crane hook.
2. Engage the transfer cask yoke to the trunnions of the transfer cask.
3. Raise the transfer cask over the NAC-STC cask and lower it until it rests on the transfer cask adapter plate. Remove and store the transfer cask lifting yoke. Remove the transfer cask shield door stops.
4. Attach the two (2) canister 3-legged lifting sling sets to the hoist rings in the canister lid. Attach the opposite end of the slings to the crane hook.
   Note: Alternative canister lifting systems may be utilized.
5. Attach the hydraulic system to the operating cylinders on the transfer cask adapter plate.
6. Raise the canister just enough to take the canister weight off of the transfer cask bottom doors.
7. Open the transfer cask shield doors.
8. Lower the canister into the NAC-STC cask. Exercise caution to avoid contact with the interior cavity wall.
9. Disconnect and remove the canister lifting sling from the crane hook and lower it onto the top of the canister.
10. Close the transfer cask bottom doors and install the door stops.
11. Retrieve the transfer cask lifting yoke and engage the transfer cask trunnions. Lift the transfer cask from the transfer cask adapter plate. Store the transfer cask and transfer cask lifting yoke in the designated locations.
12. Install the NAC-MPC canister top spacer (Yankee-MPC canister only).
13. Retrieve the cask adapter plate lifting sling and attach it to the transfer cask adapter plate.
14. Remove the transfer cask adapter plate and store it in the designated location. Using the appropriate lifting sling, remove the adapter ring and bolts. Install the inner lid alignment pins.

15. Remove the inner lid O-rings and clean inner lid O-ring groove surfaces. Replace the metallic O-rings on the inner lid, carefully inspecting the new O-rings for damage prior to installation. Secure the O-rings in the groove using the O-ring clips and screws.
16. Attach the inner lid lifting slings to an auxiliary crane hook, lift the inner lid and place it on the cask using the inner lid alignment pins to assist in proper lid seating and orientation. Visually verify proper lid position.
17. Disconnect the lid lifting device from the crane hook and remove it from the inner lid.
18. Install at least 10 inner lid bolts equally spaced on the bolt circle to hand tight. Remove the inner lid alignment pins.
19. Install the remaining inner lid bolts and torque all of the bolts to the torque value specified in Table 7-1. The bolt torquing sequence is shown on the inner lid.
20. Remove the metallic O-rings in the drain port coverplate, and clean and inspect the O-ring groove. Install new metallic O-rings and install the coverplate. Torque the coverplate bolts to the value specified in Table 7-1.
21. Connect the vacuum pump to the cask vent port and evacuate the cask cavity to a stable vacuum pressure of 4 mbar (approximately 3 mm of Hg). Without allowing air to re-enter the cask, backfill the cavity with helium (99.9% minimum purity) to 0 psig. Disconnect the helium supply.
22. Remove the metallic O-rings in the vent port coverplate and clean and inspect the O-ring groove. Install new metallic O-rings in the vent port coverplate and install the coverplate. Torque the coverplate bolts to the value specified in Table 7-1.
23. Connect the leak detector to the inner lid interseal test port and evacuate the air between the metallic O-rings until a pressure of <1 mbar is reached. Using the helium leak detector, verify that any detectable leak rate is $\leq 2 \times 10^{-7}$ cm^3/sec (helium). The test sensitivity shall be $\leq 1 \times 10^{-7}$ cm^3/sec (helium).
24. Install the test port plug for the inner lid interseal test port using a new metallic O-ring and torque the plug to the value specified in Table 7-1.
25. Connect the leak detector to the vent port coverplate interseal test port. Evacuate the interseal volume until a pressure of <1 mbar is reached. Using the helium leak detector, verify that any detectable leak rate is $\leq 2 \times 10^{-7}$ cm^3/sec (helium). The test sensitivity shall be $\leq 1 \times 10^{-7}$ cm^3/sec (helium).
26. Install the test port plug for the vent port coverplate using a new metallic O-ring and torque the plug to the value specified in Table 7-1.
27. Repeat Steps 25 and 26 for the drain port coverplate test port.
28. Remove the outer lid metallic O-ring. Clean the outer lid O-ring seating surface and groove. Install a new metallic outer lid O-ring. Install the outer lid alignment pins.

29. Attach the outer lid lifting device to the outer lid and overhead crane. Install the outer lid using the alignment pins to assist in proper seating. Remove the outer lid alignment pins. Install the outer lid bolts and torque to the value specified in Table 7-1. The bolt torquing sequence is shown on the outer lid.
30. Attach a supply of air or helium to the interlid port quick-disconnect. Backfill the interlid volume to 15 psig air or helium and hold for 10 minutes. No loss of pressure is permitted during the 10-minute test period. Disconnect air or helium supply.
31. Install the transport interlid port cover in the interlid port using new O-rings. Torque the interlid port cover bolts to the value specified in Table 7-1.
32. Remove the O-ring test plug from the interlid port cover and, using the O-ring test fixture, pressurize the O-ring annulus to 15 psig with air or helium. Isolate the annulus and hold for 10 minutes. No loss of pressure is permitted during the test period.
33. Vent the annulus pressure, remove the air or helium supply, replace the metallic O-ring on the interlid port cover test plug and install the test plug. Torque the plug to the value specified in Table 7-1.
34. Perform final external decontamination and perform survey to verify acceptable level of removable contamination to ensure compliance with 49 CFR 173.443. Perform final radiation survey. Record the survey results in the cask loading report.
35. Perform final visual inspection to verify assembly of the NAC-STC in accordance with the Certificate of Compliance. Verify that the loading procedure and checklist are appropriately completed and signed off.

7.2 Preparation for Transport

Perform the procedures of either Section 7.2.1 or 7.2.2, whichever is appropriate. Section 7.2.1 addresses preparation for transport without interim storage after loading the cask either with directly loaded fuel or with a previously loaded canister. Section 7.2.2 addresses transport following long-term storage of directly loaded fuel. Transport following long-term storage requires the verification of containment by leak testing the containment boundary formed by the outer O-rings of the inner lid and port covers and the O-ring test ports.

7.2.1 Preparation for Transport (Immediately After Loading)

1. Engage the lift beam to the cask lifting trunnions and move the cask to the cask loading area.
2. Load the cask onto the transport vehicle by gently lowering the rotation trunnion recesses into the rear support. Rotate the cask to horizontal by moving the overhead crane in the direction of the front support. Maintain the crane cables vertical over the lifting trunnions.
3. Using a lifting sling, place the tiedown assembly over the cask upper forging between the top neutron shield plate and front trunnions. Install the front tiedown bolts and lock washers to each side of the front support.
4. Complete a Health Physics removable contamination survey of the cask to ensure compliance with 49 CFR 173.443. Complete a Health Physics radiation survey of the entire package to ensure compliance with 49 CFR 173.441.
5. Using the designated lifting slings and a crane of appropriate capacity, install the top impact limiter. Install the impact limiter retaining rods into each hole and torque to the value specified in Table 7-1. Install the impact limiter attachment nuts and torque to the value specified in Table 7-1. Install the impact limiter jam nuts and torque to the value specified in Table 7-1. Install the impact limiter lock wires. Repeat the operation for the bottom impact limiter installation.

   Note: Balsa impact limiters shall be used for transport of the Connecticut Yankee fuel or GTCC waste canisters. The balsa impact limiters may also be used for transport of directly loaded fuel and for canisters containing Yankee fuel or GTCC waste. Redwood impact limiters may be used for transport of directly loaded fuel and for canisters containing MPC-Yankee fuel or GTCC waste.

6. Install security seals through holes provided in the upper impact limiter and one of the lifting trunnions; and through holes provided in all three bolts in the interlid port cover and the pressure port cover. Record the security seal identification numbers in the cask loading report.
7. Install the personnel barrier/enclosure and torque all attachment bolts to the prescribed torque value. Install padlocks on all personnel barrier/enclosure accesses.
8. Complete a Health Physics radiation survey of the entire package to ensure compliance with 49 CFR 173.441.
9. Complete a Health Physics removable contamination survey of the transport vehicle to ensure compliance with 49 CFR 173.443.
10. Determine the transport index (TI) corresponding to the maximum dose rate at 1 meter from the cask. Record on the shipping documents.
11. Determine the appropriate Criticality Safety Index (CSI) assigned to the package contents in accordance with the CoC, and indicate the correct CSI on the fissile material labels applied to the package.
12. Apply placards to the transport vehicle in accordance with 49 CFR 172.500 and provide special instructions to the carrier/shipper for an Exclusive Use Shipment.
13. Complete the shipping documentation in accordance with 49 CFR Subchapter C.

7.2.2 Preparation for Transport (After Long-Term Storage)

This procedure applies to the transport of directly loaded fuel that has been in storage in the NAC-STC. Canistered fuel or canistered GTCC waste may not be loaded in the NAC-STC for storage. Canistered fuel or GTCC waste is loaded into the NAC-STC only for transport without interim storage.

Prior to placing a directly loaded cask in long-term storage, the cask cavity is backfilled with 1.0 atmosphere (absolute) of helium (99.9% minimum purity) as the normal coolant for the spent fuel and to provide an inert atmosphere to prevent possible oxidation of the fuel. The inner lid interseal volume between the two inner lid metallic gaskets and the interseal volume between the O-rings in the vent and drain port covers are backfilled with 15 psig of helium (99.9% minimum purity). The interlid volume is pressurized to 100 psig and that pressure is monitored for pressure loss by a pressure transducer installed in the cask upper forging, and closed by a specially equipped port cover filled with a pressure feed-through tube (License Drawing No. 423-807). This overpressure system ensures that in the off-normal event of any leakage of the inner lid or port cover O-rings, the leakage path will be clean helium into the cavity. If, during the storage period, no significant pressure loss is observed in the pressure monitoring volume or system (normally recorded at a minimum of once every 24 hours during storage), it can be concluded that at the end of the storage period, the cask cavity remains backfilled with helium gas.

Prior to preparing the cask for transport, the pressure transducer wiring has been disconnected.

1. Move cask from extended storage location to a designated work area.
2. Evacuate a sample bottle using a vacuum pump and remove the interlid pressure port cover. Isolate the sample bottle and connect it to the interlid port quick-disconnect and fill it with interlid region atmosphere.

   Note: The interlid pressure may be as high as 100 psig. Use caution in collecting the gas sample.
3. Isolate the sample bottle and disconnect it from the interlid port quick-disconnect.
4. Bring the sample bottle to the appropriate facility and analyze the contents of the sample bottle.
5. If krypton-85 is present in the sample bottle, additional radiological precautions may be imposed by Health Physics personnel prior to proceeding with the removal of the outer lid. A determination shall also be made as to whether replacement of the inner lid seals is required. If the gas sample is acceptable, proceed with normal operations.
6. Attach valved venting hose to interlid port quick-disconnect and open valve to vent interlid region.
7. Remove the outer lid bolts and install the outer lid alignment pins and outer lid lifting eye bolts.
8. Attach the outer lid lifting device to the outer lid lifting eye bolts and overhead crane. Remove the outer lid and place it aside in a temporary storage area. Protect the O-ring and O-ring groove of the lid from damage. Remove the outer lid alignment pins.
9. Verify the torque of the inner lid bolts and vent and drain port coverplate bolts by torquing the bolts in accordance with the bolt torque sequence to the values specified in Table 7-1.
10. Remove the drain port coverplate port plug. Connect the leak detector vacuum pump to the drain port coverplate test port and evacuate the helium between the metallic O-rings to a pressure of <1 mbar. Without allowing air to re-enter the interseal region, backfill the drain port coverplate interseal region with helium (99.9% minimum purity) to a pressure of 0 psig.
11. Install the drain port coverplate test plug using a new O-ring and torque to the value specified in Table 7-1.
12. Repeat steps 10 and 11 for the vent port coverplate test plug.

13. Remove the inner lid interseal test port plug and connect a vacuum pump to the inner lid interseal test port quick-disconnect. Evacuate the inner lid interseal volume until a pressure of <1 mbar.
14. Without allowing air to re-enter the interseal volume, backfill the interseal volume with helium (99.9% minimum purity) to 0 psig. Disconnect helium supply.
15. Install the inner lid interseal test port plug with a new metallic O-ring and torque the plug to the value specified in Table 7-1.
16. Clean the outer lid O-ring seating surface and groove surface. Install a new metallic O-ring in the outer lid. Reinstall the outer lid alignment pins.
17. Attach the outer lid lifting device to the outer lid lifting eye bolts and the overhead crane. Install the outer lid and visually verify proper seating. Remove the alignment pins and lifting eye bolts, and install the outer lid bolts and torque to the value specified in Table 7-1. The bolt torquing sequence is shown on the outer lid.
18. Perform an evacuated envelope leakage test on the outer O-rings of the vent and drain port coverplates, the outer O-ring of the inner lid, and the interseal test ports by connecting a vacuum pump and a helium mass spectrometer leak detector connected to the interlid port quick-disconnect. Evacuate the interlid region to a vacuum of <1 mbar.
19. Using the helium leak detector, verify that the leakage rate into the evacuated envelope is $\leq 2 \times 10^{-7}$ cm^3/sec (helium) with a minimum leak test sensitivity of $\leq 1 \times 10^{-7}$ cm^3/sec.
20. Upon completion of the leak test, backfill the interlid region with helium (99.9% minimum purity) to 0 psig and disconnect the helium supply and leak test equipment.
21. Install the transport interlid port cover using new O-rings and torque the port cover bolts to the value specified in Table 7-1.
22. Remove the interseal port plug, attach the test fixture to the interlid port interseal test hole and perform a functional leak test on the interlid port cover O-rings by pressurizing the O-ring annulus to 15 psig and isolating for a minimum of 10 minutes. There shall be no loss in pressure during the test period. Record completion of an acceptable leakage test on the cask loading report. Upon completion of the test, equalize interseal region pressure with ambient and disconnect the test fixture. Install the interseal port plug and torque to the value specified in Table 7-1.
23. Using the lift yoke, load the cask on the transport vehicle.
24. Using a lifting sling, place the tiedown assembly over the cask upper forging between the top neutron shield plate and front trunnions. Install the front tiedown bolts and lock washers to each side of the front support.

25. Complete a Health Physics removable contamination survey of the entire package to ensure compliance with 49 CFR 173.443.
26. Using the designated lifting slings and a crane of appropriate capacity, install the top impact limiter. Install the impact limiter retaining rods into each hole and torque to the value specified in Table 7-1. Install the impact limiter attachment nuts and torque to the value specified in Table 7-1. Install the impact limiter jam nuts and torque to the value specified in Table 7-1. Install the impact limiter lock wires. Repeat the operation for the bottom impact limiter installation.
27. Install security seals through holes provided in the upper impact limiter and one of the lifting trunnions; and through holes provided in all three bolts in the interlid port cover and the pressure port cover.
28. Install personnel barrier/enclosure and torque all attachment bolts to the prescribed torque value. Install padlocks on all personnel barrier/enclosure accesses.
29. Complete radiation and contamination surveys to ensure compliance with 49 CFR 173.441 and 173.443 requirements.
30. Determine the transport index (TI) corresponding to the maximum dose rate at 1 meter from the cask. Record on the shipping documents.
31. Determine the appropriate Criticality Safety Index (CSI) assigned to the package contents in accordance with the CoC, and indicate the correct CSI on the fissile material labels applied to the package.
32. Apply placards to the transport vehicle in accordance with 49 CFR 172.500.
33. Complete the shipping documentation in accordance with 49 CFR Subchapter C and provide special instructions to the carrier/shipper for an Exclusive Use Shipment.

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7.3 Outline of Procedures for Unloading the Cask

This section presents the procedures to be followed for unloading the cask following transport of directly loaded fuel, canistered fuel or canistered GTCC waste.

7.3.1 Receiving Inspection

1. Perform radiation and removable contamination surveys in accordance with 10 CFR 20.1906, 49 CFR 173.441 and 173.443 requirements.
2. Remove the personnel barrier/enclosure and complete radiation and removable contamination surveys at the cask surfaces.
3. Visually inspect the NAC-STC while secured to the transport vehicle in the horizontal orientation for any signs of damage and record any damage. Verify that the tamper-indicating seals are in place and verify their numbers.
4. Secure the transport vehicle. Attach slings to the top impact limiter lifting points, remove impact limiter lock wires, jam nuts, attachment nuts and retaining rods, and remove the impact limiter. Store the impact limiter upright. Repeat the operation to remove the bottom impact limiter. Complete radiation and removable contamination surveys for exposed cask surfaces.
5. Release the tiedown assembly from the front support by removing the front tiedown bolts and lock washers.
6. Attach a sling to the tiedown assembly lifting eyes and remove the tiedown assembly from the transport vehicle.
7. Attach the cask lifting yoke to a crane hook with the appropriate load rating. Engage the two yoke arms with the lifting trunnions at the top end of the cask. Rotate/lift the cask to the vertical orientation and raise the cask off of the rear support structure of the transport vehicle. Place the cask in the vertical orientation in a decontamination area or other location identified by the user.
8. Wash any road dust and dirt off of the cask and decontaminate cask exterior, as required by contamination survey results.

7.3.2 Preparation of the NAC-STC Cask for Unloading

The NAC-STC may contain fuel directly loaded into a basket within the cask, or a sealed transportable storage canister containing spent fuel assemblies, Reconfigured Fuel Assemblies, Recaged Fuel Assemblies, four fuel assemblies loaded in Damaged Fuel Cans, or GTCC waste.

Unloading of fuel from the directly loaded cask basket typically takes place under water in the spent fuel pool cask loading area. Canister unloading is performed dry using a transfer cask. Canister unloading will take place in the cask receiving area, or other location identified by the user.

7.3.2.1 Preparation for Unloading the NAC-STC Cask (Directly Loaded Fuel Configuration)

1. Verify that excessive pressure does not exist in the interlid region by removing the interlid port cover and attaching a pressure test fixture to the interlid port quick-disconnect that will allow the monitoring of the cask interlid region for any pressure buildup that may have occurred during transport. If a positive pressure exists, connect a vent/drain line to the interlid quick-disconnect and vent the pressure to the off-gas system.
2. Remove the outer lid bolts and install the outer lid alignment pins and outer lid lifting eye bolts.
3. Attach the outer lid lifting device to the outer lid lifting eye bolts and the overhead crane. Remove the outer lid and place it aside in a temporary storage area. Protect the O-ring and the O-ring groove of the lid from damage.
4. Remove the port coverplates from the drain and vent ports in the inner lid with caution. Attach a pressure test fixture to the vent port that will allow the monitoring of the cask cavity for any pressure buildup that may have occurred during storage or transport. If a positive pressure exists, vent the pressure to the off-gas system.
5. Connect the cask cooldown system to the drain and vent quick-disconnects. The cask cooldown piping and controls schematic is shown in Figure 7.3-1.
6. To facilitate cooldown and to minimize thermal effects to the cask and its contents, slowly (8 – 10 gpm) fill the cask cavity with clean demineralized water (cavity is full when water flows out of the vent port drain line). Circulate water through the cask until the water leaving the vent port drain line is within 50°F of the average spent fuel pool water temperature.
7. Disconnect the fill line from the drain port quick-disconnect in the inner lid (Note: Leave a short drain line attached to the vent port quick-disconnect for continuous venting).
8. Loosen and remove all but 10, approximately equally spaced, inner lid bolts. Leave the 10 remaining inner lid bolts hand tight. Install the inner lid alignment pins at locations marked on the inner lid and the lid lifting eyebolts.

9. Remove the interlid port cover from the top forging. Disengage the vent line from the vent port quick-disconnect.
10. Attach the lifting yoke to a crane hook and engage the yoke arms with the lifting trunnions. Lift the cask and move it over to the cask loading area in the pool.
11. Spray the external surface of the cask with clean demineralized water to minimize external decontamination efforts. Slowly lower the cask into the pool. Just prior to submerging the top forging of the cask, complete the unthreading of the 10 remaining inner lid bolts and remove them.

    Note: Use caution when removing these bolts as pressure may rise slightly in the cask during the time since completion of Step 9.
12. Continue lowering the cask until it rests in the cask loading area on the pool floor.
13. Disconnect the lifting yoke from the lifting trunnions and move the yoke so that it will not interfere with fuel movements.
14. Using the inner lid lifting device attached to an auxiliary crane hook, remove the inner lid from the cask.

    Note: If the alternate method of handling the cask is being used, slowly raise the lift yoke and the inner lid using the lid alignment pins to guide movement. Move the lift yoke and the inner lid out of the area so that it will not interfere with fuel movements.
15. Place the inner lid aside ensuring that the O-rings and O-ring grooves are protected from damage. Decontaminate, as necessary, and clean all sealing surfaces.

7.3.2.2 Preparation for Unloading the NAC-STC Cask (Canistered Configuration)

1. Verify that excessive pressure does not exist in the interlid region by removing the interlid port cover and attaching a pressure test fixture to the interlid port quick-disconnect that will allow the monitoring of the cask interlid region for any pressure buildup that may have occurred during transport. If a positive pressure exists, connect a vent line to the interlid quick-disconnect and vent the pressure to the off-gas system.
2. Remove the outer lid bolts and install the outer lid alignment pins and outer lid lifting eye bolts.
3. Attach the outer lid lifting device to the outer lid lifting eye bolts and the overhead crane. Remove the outer lid and place it aside in a temporary storage area. Protect the O-ring and the O-ring groove of the lid from damage. Remove the outer lid alignment pins.

4. Remove the port coverplates from the drain and vent ports in the inner lid with caution. Attach a pressure test fixture to the vent port that will allow the monitoring of the cask cavity for any pressure buildup that may have occurred during transport. If a positive pressure exists, vent the pressure to the off-gas system.
5. Loosen and remove all inner lid bolts. Install the inner lid alignment pins at locations marked on the inner lid and the lid lifting hoist rings.
6. Using the inner lid lifting slings, attached to a suitable crane, remove the inner lid from the cask. Remove the inner lid alignment pins.
7. Place the inner lid aside ensuring that the O-rings and O-ring grooves are protected from damage. Decontaminate, as necessary, and clean all sealing surfaces.
8. If present, remove the top spacer from the NAC-STC cask cavity.
9. Install the adapter ring on the NAC-STC and torque the three captive bolts to the torque specified in Table 7-1.
10. Install the transfer cask adapter plate on the top surface of the cask and remove the handling slings.

7.3.3 Unloading the NAC-STC Cask

The NAC-STC may contain either fuel directly loaded in the cask basket, or a welded transportable storage canister. The procedures for unloading the directly loaded fuel or canisters are presented in the following.

7.3.3.1 Unloading Directly Loaded (Uncanistered) Fuel

1. Using approved fuel identification and handling procedures, withdraw one fuel assembly from the basket and deposit it in the proper storage rack location. Be careful not to contact any of the sealing surfaces on the top forging or the inner lid alignment pins.
2. Record and document the fuel movement from the cask to the fuel rack.
3. Repeat steps 1 and 2 until all fuel assemblies have been removed from the cask.
4. Attach the inner lid lifting slings to a crane hook, lift the inner lid and place it on the cask using the alignment pins to assist in proper seating. Visually verify proper lid position.

   Note: O-ring seals on the lids, port coverplates and test plugs do not require replacement for an empty packaging shipment.
5. Disconnect the lid-lifting sling from the crane hook.

6. Attach the lifting yoke to the crane hook, lower to lifting position and engage lifting arms to lifting trunnions. Slowly lift the cask out of the pool until the top of the cask is slightly above the pool water level.

   Note: As an alternative method, the cask and inner lid may be handled simultaneously. In the event that this method is chosen, instead of performing steps 4, 5 and 6, attach the lifting yoke to a crane hook and the inner lid to the lift yoke. Lower the lid and engage to the cask using the lid alignment pins. Engage lifting arms to lifting trunnions. Slowly lift the cask out of the pool until the top of the cask is slightly above the pool water level.

7. Attach a drain line to the quick-disconnect in the interlid port (located in the top forging) and allow the water to drain from the interlid region.
8. Install at least four inner lid bolts approximately equally spaced on the bolt circle to hand tight. Remove the inner lid alignment pins.
9. Move the NAC-STC cask to the cask decontamination area and disengage the lift yoke or lift beam and inner lid lifting slings if the alternate method of handling the inner lid was used. Remove the inner lid lifting eye bolts.
10. Move the cask lifting equipment away from the cask work area.
11. Install the remaining inner lid bolts and torque all of the inner lid bolts to the value specified in Table 7-1 in accordance with the bolt torquing sequence shown on the inner lid.
12. Disconnect the drain line from the quick-disconnect in the interlid port.
13. Connect a drain line to the drain port quick-disconnect and a regulated air fill line to the vent port quick-disconnect.
14. Purge the water from the cask by pressurizing to 35 to 40 psig and hold until all water is removed (observed when no water is coming from the drain line). Adjust final internal cavity pressure to 0 psig.
15. Remove the lines from the drain and the vent port quick-disconnects.
16. Install the port coverplates over the vent and drain ports in the inner lid. Torque the coverplate bolts to the value specified in Table 7-1.
17. Decontaminate the surfaces of the inner lid and the inner surfaces of the top forging.
18. Install the outer lid alignment pins. Using the outer lid lifting device, install the outer lid using the alignment pins to assist in proper seating. Remove the lid lifting device, lid lifting eyebolts, and the outer lid alignment pins.
19. Install the outer lid bolts and torque them to the value specified in Table 7-1, using the bolt torquing sequence shown on the outer lid.
20. Install the interlid port cover and torque the bolts to the value specified in Table 7-1.

7.3.3.2 Unloading Canistered Fuel or Canistered GTCC Waste

Canistered fuel or GTCC waste is unloaded from the NAC-STC using a transfer cask. The transfer cask could be used to transfer the loaded canister to a work station where the canister could be opened, or to transfer it to another storage or disposal overpack.

1. Install the lift hoist rings in the canister lid.
   Note: The canister lid may be thermally hot.
2. Attach the canister lifting sling to the hoist rings in the canister lid. Position the sling so that the free end of the sling can be engaged by the cask handling crane hook.
3. Attach the transfer cask lifting yoke to the cask handling crane hook. Engage the yoke to the lifting trunnions of the transfer cask.
4. Lift the transfer cask and move it over the NAC-STC cask. Lower the transfer cask to engage the transfer cask adapter plate. Once the transfer cask is fully seated, remove the transfer cask lifting yoke and store it in the designated location.
   Note: O-ring seals on the lids, port coverplates and test plugs do not require replacement for an empty packaging shipment.
5. Remove the shield door stops, connect the hydraulic operating system and open the transfer cask bottom doors.
6. Using tag lines, lift the canister lifting slings through the transfer cask and attach them to the crane hook.
   Note: Alternative canister handling systems may be used.
7. Raise the canister into the transfer cask just far enough to allow the transfer cask bottom doors to close. Use caution to minimize the contact between the canister and the cavity walls of the NAC-STC and of the transfer cask.
8. Close the bottom doors and install the door stops.
9. Carefully lower the canister until it rests on the transfer cask bottom doors. Disengage the canister lifting sling from the crane hook.
10. Retrieve the transfer cask lifting yoke and attach it to the transfer cask trunnions. Lift the transfer cask from the NAC-STC cask and move it to its intended destination.
11. Attach the transfer cask adapter plate-lifting slings and disconnect the hydraulic operating system.
12. Using the crane, lift the transfer cask adapter plate from the top of the cask. Move the transfer cask adapter plate to the designated storage location.
13. Detorque the three bolts and remove the adapter ring.

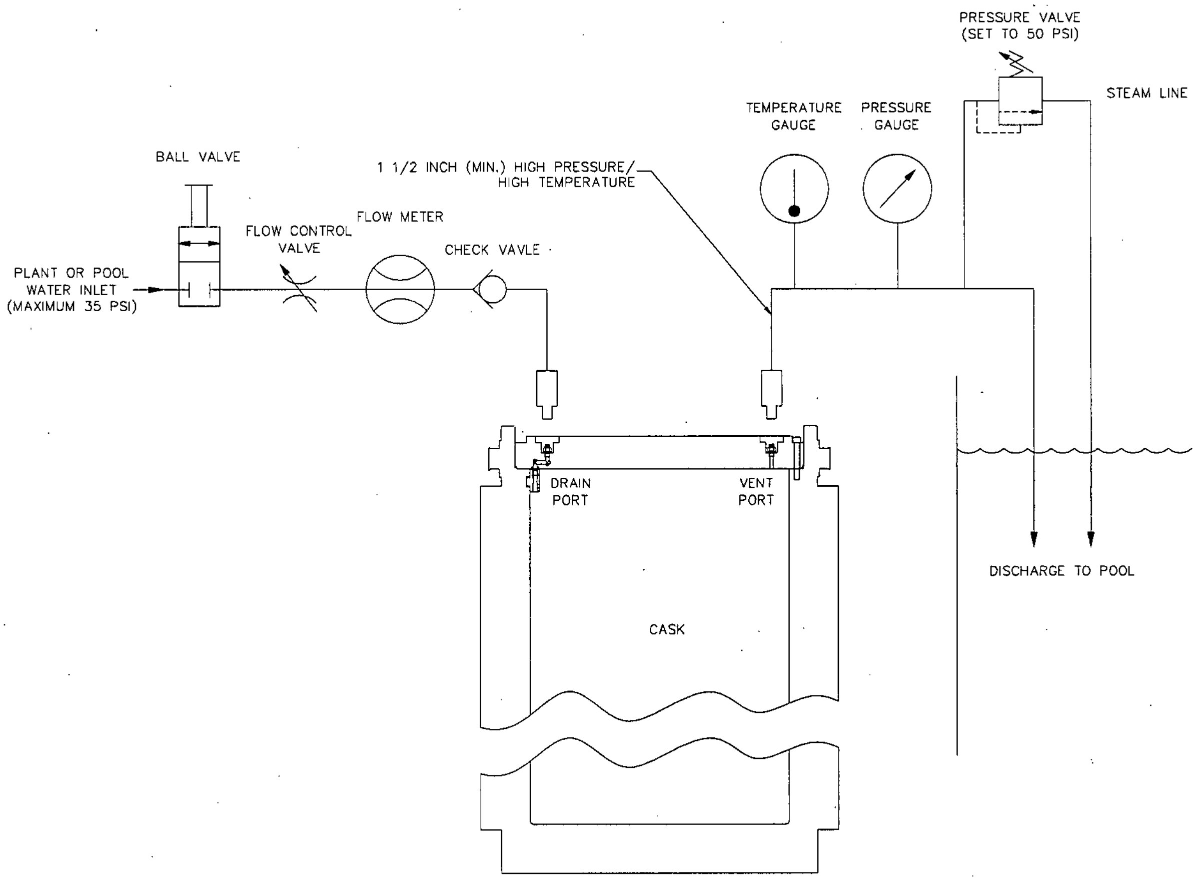
14. Install the inner lid alignment pins.
15. Attach the inner lid lifting fixture to the inner lid and engage the lifting fixture to the auxiliary crane. Install the inner lid in the NAC-STC using the alignment pins to assist in proper seating.
16. Disconnect the lifting fixture and remove the guide pins.
17. Install and torque the inner lid bolts to the values specified in Table 7-1 using the bolt torquing sequence shown on the inner lid.
18. Install the port coverplates over the vent and drain ports in the inner lid. Torque the coverplate bolts to the values specified in Table 7-1.
19. Decontaminate the surfaces of the inner lid and the inner surfaces of the top forging.
20. Install the outer lid alignment pins. Using the outer lid lifting device, install the outer lid using the alignment pins to assist in proper seating. Remove the lid lifting device, lid lifting eyebolts, and the outer lid alignment pins.
21. Install the outer lid bolts and torque them to the value specified in Table 7-1 using the bolt torquing sequence shown on the outer lid.
22. Install the interlid port cover and torque the bolts to the value specified in Table 7-1.

7.3.4 Preparation of Empty Cask for Transport

1. Decontaminate all surfaces of the cask to acceptable release limits as defined in 49 CFR 173.
2. Attach the lifting yoke to a crane hook and engage the yoke arms with the lifting trunnions. Lift the cask onto the transport vehicle and lower to the horizontal position.
3. Using a lifting sling, place the tiedown assembly over the cask upper forging between the top neutron shield plate and front trunnions. Install the front tiedown bolts and lock washers to each side of the front support. Torque each of the tiedown bolts.
4. Initiate Health Physics radiation and removable contamination surveys to ensure compliance with 49 CFR 173.441 and 49 CFR 173.443.
5. Using the designated lifting slings and a crane of appropriate capacity, install the top impact limiter. Install the impact limiter retaining rods into each hole and torque to the value specified in Table 7-1. Install the impact limiter attachment nuts and torque to the value specified in Table 7-1. Install the impact limiter jam nuts and torque to the value specified in Table 7-1. Install the impact limiter lock wires. Repeat the operation for the bottom impact limiter installation.
6. Apply labels to the package in accordance with 49 CFR 172.200.

7. Install the personnel barrier/enclosure and torque all attachment bolts to the prescribed torque value. Install padlocks on all personnel barrier/enclosure accesses.
8. Complete the Health Physics radiation and removable contamination surveys to ensure compliance with 49 CFR 173 requirements.
9. Complete the shipping documents.
10. Apply placards, if required, to the transport vehicle in accordance with 49 CFR 172.500.

Figure 7.3-1 Cask Cooldown Piping and Controls Schematic



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7.4 Leak Test Requirements

This section provides the leak testing procedures used to perform the Containment System Verification Leak Tests for the NAC-STC containment boundary O-ring seals. These tests are required following cask loading operations for transport without interim storage for casks provided with metallic seals and after long-term storage in preparation for transport. For transport of uncanistered spent fuel without interim storage, casks provided with Viton O-rings are leak tested to confirm that the containment system is properly assembled for shipment. The preshipment leakage rate test confirms that there is no detected leakage from any seal to a minimum sensitivity of 1×10^{-3} ref·cm^3/sec. Detailed procedures, describing the equipment and the leak test system used to perform the leak tests, are developed for use at the licensee's facilities. The containment boundary conditions, required leak tests and leak test acceptance criteria are provided in Table 4.1-1.

The transport cask may be configured with either metallic O-rings or with Viton O-rings. The two types of O-rings may not be used interchangeably, since each O-ring type requires a different O-ring groove configuration. Consequently, the inner lid, vent and drain port coverplates and outer lid are machined with a square O-ring groove to accept metallic O-rings or are machined with a truncated triangular (dove-tail) groove to accept Viton O-rings.

Viton O-rings may be used only when directly loading spent fuel for transport without interim storage. Metallic O-rings must be used when directly loading spent fuel for an extended period of storage and for canistered contents. Metallic O-rings may be used when directly loading spent fuel for transport without interim storage. The metallic and nonmetallic O-rings have different allowable leak rates, as specified in the procedures.

7.4.1 Containment System Verification Leak Test Procedures

As described in Chapter 4, the NAC-STC primary containment boundary is designed and tested to assure that there is no leakage under any of the normal conditions of transport or accident conditions that exceeds the allowable value determined in accordance with 10 CFR 71.51. This leakage rate is verified prior to transport by the performance of leak tests on the containment boundary filled with metallic O-rings to ensure that the leakage rate is less than 2×10^{-7} cm^3/sec (helium). For casks provided with Viton O-rings, the Containment System Verification Leak Test is performed annually or after replacement of a Viton O-ring, and the cumulative leak rate is less than 9.3×10^{-5} cm^3/sec (helium). As described in Section 4.1, the containment boundary is defined differently for transport after long-term storage than for loading for transport without interim storage. As described in this section, leak tests are performed in accordance with the requirements of ANSI N14.5-1997.

The leak test requirements and acceptance criteria performed after long-term storage in preparation for transport and performed following cask loading operations for transport without interim storage are described in Sections 7.4.2 and 7.4.3, respectively. The generic procedures used to perform leak testing are incorporated in the NAC-STC loading procedures in Section 7.2. Detailed procedures, describing the equipment and the leak test system used to perform the leak tests, are developed for use at the licensee's facilities. As noted in Section 7.1, the transportable storage canister will have been loaded, closed and sealed prior to loading into the NAC-STC. The canister is a separate inner container for the transport of damaged fuel.

Section 7.4.4 provides the procedural guidance on corrective actions to be taken in the event a leak test does not meet the acceptance criteria.

7.4.2 Leak Testing for Transport After Long-Term Storage

This section summarizes the leak test method used to demonstrate continued containment of PWR spent fuel prior to transport following an extended period of storage. The containment boundary for this transport condition is defined as Containment Condition A in Section 4.1 and requires the use of metallic O-rings in the containment boundary. In addition to the steel inner lid and port coverplates, the containment boundary is specified as the outer O-rings of the inner lid and of the vent and drain port coverplates and the O-rings of the test port plugs. As specified in the generic loading procedure, the outer lid must be removed to test the inner lid and the vent and drain port coverplates prior to transport.

To conduct the leak test, the inner seal regions (annulus between the O-rings) of the inner lid and the vent and drain port coverplates are evacuated to less than one millibar, and backfilled to 0 psig with 99.9% pure helium, and the test port plugs are reinstalled. The outer lid is reinstalled using a new metallic O-ring. The interlid region (between the inner and outer lids) is evacuated to a vacuum of 1 millibar, or less. After the vacuum condition is reached, a helium leak detector is used to sample the interlid region for helium leakage past the inner lid outer O-ring, the vent and drain port coverplate outer O-rings, and O-ring test port plugs. The allowable leak rate is $\leq 2 \times 10^{-7}$ cm^3/sec (helium) with a minimum test sensitivity of $\leq 1 \times 10^{-7}$ cm^3/sec (helium). This test method conforms to A5.4 (evacuated envelope) of Appendix A of ANSI N14.5-1997. If helium leakage is detected exceeding the criteria, corrective action is taken as described in Section 7.4.4.

The outer lid and pressure port are tested using a pressure drop method to confirm the installation of the outer lid and pressure port O-rings. The interlid region is pressurized using the interlid port to 15 psig with air and the pressure is held for 10 minutes. No loss of pressure is permitted during the test period. Following the test, the interlid region pressure is reduced to 0 psig. The interlid port cover is installed and the annulus between the O-rings of the port cover is tested using the same method. This test confirms the installation of the interlid port cover O-rings and conforms to test method A.5.1 (gas pressure drop) of Appendix A of ANSI N14.5-1997.

7.4.3 Leak Testing for Transport After Loading without Interim Storage

This section summarizes the leak tests required to demonstrate containment of directly loaded PWR spent fuel without interim storage, or for sealed transportable storage canisters containing spent fuel or GTCC waste. The containment boundary for these transport conditions is defined as Containment Condition B in Section 4.1. In addition to the steel inner lid and port coverplates, the containment boundary is specified as the inner O-rings of the inner lid and of the vent and drain port coverplates. The inner lid O-ring and vent and drain port coverplate O-rings are leak tested using the evacuated envelope method (test description A5.4 of Appendix A of ANSI N14.5-1997) with a vacuum in the annulus between the O-rings. The containment boundary O-rings for fuel directly loaded for transport without interim storage may be either metallic or Viton. The containment boundary O-rings for canistered fuel or GTCC waste are required to be metallic O-rings. The leak detector is used to detect helium in the annulus between the O-rings. The allowable leakage rate for each metallic O-ring defined as the containment boundary is $\leq 2 \times 10^{-7}$ cm^3/sec (helium) with a minimum test sensitivity of $\leq 1 \times 10^{-7}$ cm^3/sec (helium). The allowable cumulative leakage rate for all Viton O-rings defined as the containment boundary is $\leq 9.3 \times 10^{-5}$ cm^3/sec (helium) with a minimum test sensitivity of $\leq 4.7 \times 10^{-5}$ cm^3/sec (helium). For leak testing prior to transport of a NAC-STC cask with reusable Viton O-rings, a preshipment leakage test is performed to a minimum test sensitivity of 1×10^{-3} ref·cm^3/sec. The higher sensitivity test for the Viton O-rings is performed during annual maintenance testing or when the Viton O-rings or other containment components are replaced.

As the metallic O-rings are replaced for each loaded transport canister, the higher sensitivity test is always required. The series of helium leak tests described confirms that the allowable leak rates are satisfied for the O-rings used in the containment boundary for Containment Condition B. Section 7.4.4 provides the procedural guidance on corrective actions to be taken in the event a leak test does not meet the acceptance criteria.

Following completion of the inner lid and vent and drain port coverplate leak tests, the outer lid and pressure port are tested using a pressure drop method to confirm the installation of the outer lid and pressure port O-rings. The interlid region is pressurized using the interlid port to 15 psig with air and the pressure is held for a minimum of 10 minutes. No loss of pressure is permitted during the test period. Following the test, the interlid region pressure is reduced to 0 psig. The interlid port cover is installed and the annulus between the O-rings of the port cover is tested using the same method. This test confirms the installation of the interlid port cover O-rings. These components form an additional barrier against the release of radioactive material, but are not a containment boundary.

7.4.4 Corrective Action

If a specific component containing an O-ring fails to meet the leak test acceptance criteria for that component, the component is removed and the O-ring removed. The O-ring groove is cleaned and visually inspected to ensure proper cleanliness and surface condition. A new O-ring of the appropriate type (i.e., metallic or Viton) is installed. The removed component is reinstalled and the bolts torqued to the appropriate torque value. The component is then retested in accordance with the applicable test procedure and acceptance criteria.

For the replacement of the inner lid O-ring either immediately after loading, or after extended storage for the directly loaded configuration, it will be necessary to return the cask to the spent fuel pool to remove the inner lid and allow access for inner lid O-ring replacement. For placement of the cask in the fuel pool following extended storage, the procedures for cask unloading (Section 7.3.3) are utilized to prepare and cool down the cask prior to placement in the pool. At cask storage facilities having appropriate dry transfer or hot cell facilities, the inner lid O-ring can be replaced without placement of the cask in a fuel pool for shielding purposes. Prior to removal of the inner lid, a gas sample should be taken at the vent port to verify the condition in the cavity environment. If there are indications that fuel has failed during the storage period, care should be exercised in both flooding the cask and in removing the inner lid.

In the canistered configuration, the NAC-STC inner lid metallic O-rings may be replaced without returning to the pool since the canister confines and shields the spent fuel or GTCC waste.

7.5 Railcar Design and Certification Requirements

The NAC-STC dual-purpose packaging is designed for transport by rail, heavy-haul vehicle, and barge/ship. The NAC-STC intermodal transport skid and tie-down systems will be designed in accordance with the U.S. Department of Transportation (DOT) regulations applicable to the mode of transport to be utilized. The design requirements for the railcar and tie-down components are defined in the following sections.

7.5.1 Railcar and Tie-Down Design Requirements

The railcar and package tie-down system to be used for transporting the NAC-STC will be designed in accordance with the requirements of the Association of American Railroads (AAR) Manual of Standards and Recommended Practices, Section C, Part II, M-1001, and the Field Manual of the AAR Interchange Rules, Rule Number 88.

7.5.2 Railcar Tie-Down Design Loadings

The railcar tie-down system for the NAC-STC package will be designed to withstand the following transport loads acting simultaneously without generating stresses exceeding the tie-down material yield strength:

- Longitudinal: 7.5 g
- Vertical: 4 g
- Lateral: 1.8 g

7.5.3 Railcar and Tie-Down Certification

The NAC-STC railcar and tie-down system design will be submitted to the AAR Mechanical Division for certification and approval in accordance with the AAR rules and requirements.

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7.6 Procedures for Loading and Unloading the Transportable Storage Canister

This section generally describes the procedures for loading and closing, and for opening and unloading, the Transportable Storage Canister. This description is provided for information only since it is intended that the canister be closed, and opened if necessary, using the transfer cask. As described in this SAR, the canister is designed to be transported in the NAC-STC, or stored in the NAC-MPC Storage System for an extended period. The NAC-MPC storage system is described in the NAC-MPC SAR, Docket No. 72-1025. The NAC-MPC FSAR contains more detailed procedures for loading and unloading fuel in the Transportable Storage Canister. Loading of GTCC waste must meet the modified generic criteria as described below.

The transfer cask is primarily a lifting device used to move the canister assembly, and to provide biological shielding when it contains a loaded canister. The transfer cask is used for the vertical transfer of the canister between work stations and the storage or transport casks.

The principal closing and sealing operations are the draining, drying, and helium backfilling of the canister, and sealing it by welding the shield lid, penetration port covers, and structural lid in place. The principal opening operations are cutting the lid welds or canister side wall to remove the structural lid, opening the vent port to sample the canister atmosphere, cutting the shield lid welds to remove the shield lid, and removing the spent fuel or GTCC waste.

7.6.1 Loading and Closing the Transportable Storage Canister

This procedure assumes that the canister and the transfer cask are positioned in the decontamination area or other suitable work station. The staging area should be within the handling "footprint" of the cask handling crane.

1. Visually inspect the Transportable Storage Canister (canister) to ensure that it is clean and free of debris.
2. Place the canister in the transfer cask.
3. Place the transfer cask and canister into the fuel loading pool.
4. Load the previously designated spent fuel assemblies or the GTCC waste into the canister.

   Note: Spent fuel and GTCC waste must be loaded in separate canisters.
5. Place the shield lid on top of the loaded canister.

6. Remove the transfer cask with the loaded canister from the fuel loading pool.
7. Insert the drain tube assembly and remove approximately 50 gallons of water from the Yankee-MPC canister or 65 gallons from the CY-MPC canister.
8. Weld the shield lid in place and verify the adequacy of welds with liquid penetrant examinations. Record results of examinations as required.
9. Pressurize the Yankee-MPC canister to 15 psig with air, nitrogen, or helium and hold the pressure for 10 minutes. For the CY-MPC canister, a pressure of 20 psig is to be used and held for 10 minutes.
10. Release the pressure.
11. Drain the remaining water from the canister.
12. Vacuum dry the canister.
13. For fuel canisters, evacuate to $\leq$ 3mm Hg. For GTCC waste canisters, evacuate to $\leq$ 10mm Hg.
14. Backfill canister with helium to a pressure of one atmosphere.
15. For fuel canister only, evacuate canister to a vacuum of $\leq$ 3mm Hg.
16. For fuel canister only, backfill canister with helium to a pressure of one atmosphere.
17. Remove vacuum drying and helium equipment from the canister vent and drain.
18. Install vent and drain port covers and weld into place. Verify the adequacy of welds with liquid penetrant examinations. Record results of examinations as required.
19. Install the leak test lid and connect the leak detector system to the test lid. Evacuate the test lid volume and verify the leaktightness of the shield lid welds.
20. Install the structural lid in place.
21. Weld the structural lid in place and verify the adequacy of welds with liquid penetrant examinations. Record results of examinations as required.
22. Perform a smear survey of the accessible areas of the canister to ensure that the surface contamination is within limits.
23. Install the transfer cask retaining ring.
24. Decontaminate the external surface of the transfer cask to the limits established for the site.

At this point, the loaded canister may be transferred into the NAC-STC in accordance with the procedures presented in Section 7.1, contingent upon the loaded contents meeting the requirements for the authorized contents for the transport cask system, as described in the cask Certificate of Compliance.

7.6.2 Opening and Unloading the Transportable Storage Canister

Circumstances could arise that dictate the opening of a previously loaded canister and the removal of the stored spent fuel or GTCC waste. This section describes the basic operations needed to open the sealed canister. It is assumed that the canister is positioned in the transfer cask and that the transfer cask is in a suitable work station. The work station must provide for control of airborne radioactive material and gases that could potentially be released from the open canister. It is not intended that the canister be opened while it is in the NAC-STC cask. The principal mechanical operations are the cutting of the closure welds, filling with water, and removing the spent fuel or GTCC waste. Supplemental shielding is used as required.

1. Place the canister in the transfer cask.
2. Survey the top of the canister to establish the radiation level and contamination level at the structural lid.
3. Set up the weld cutting equipment to cut the structural lid weld.
4. Operate the cutting equipment to cut the structural lid weld.
5. Remove the cutting equipment and using a three-legged sling, remove the structural lid.
6. Cut the weld joining the vent port cover to the shield lid.
7. Remove the vent port cover.
8. Sample the canister cover gas and vent any pressure in the canister to a radioactive waste handling system.
9. Cut the weld joining the drain port cover to the shield lid and remove the drain.
10. Attach a nitrogen gas line to the drain port quick-disconnect and a discharge line from the vent port quick-disconnect to an off-gas handling system.
11. Continue to flow nitrogen through the line until there is no evidence of fission gas activity in the discharge line (or 10 minutes minimum).
12. Attach a source of clean water with a minimum temperature of 70°F and a maximum supply pressure of 15 psig to the drain port quick-disconnect. Replace the vent port quick-disconnect with a straight-through fitting fitted with a Viton O-ring, and attach the discharge water line. Slowly start the flow of clean water to establish a flow rate of 5 (+ 3, - 0) gpm.
13. Continue to flow water through the canister until the exit water temperature stabilizes to a temperature below 200°F.
14. Stop the flow of water and remove the connection to the drain line.
15. Set up the weld cutting equipment to cut the shield lid weld.

16. Remove approximately 50 gallons of water from the Yankee-MPC canister or 65 gallons of water from the CY-MPC canister.
17. Using a hydrogen gas detector, check the vent port for hydrogen gas. Purge the hydrogen gas if the concentration of hydrogen gas exceeds 2.4%.
18. Cut the shield lid weld. Attach the shield lid lifting sling.
19. Attach the clean water line to the transfer cask.
20. Retrieve the transfer cask lifting yoke and engage the transfer cask lifting trunnions.
21. Move the transfer cask over the pool and lower the bottom of the transfer cask to the surface. Start the flow of clean water to the transfer cask annulus. Continue to lower the transfer cask, as the annulus fills with clean water, until the top of the transfer cask is about 4 inches above the pool surface. Hold the cask in this position until clean water fills the top of the transfer cask.
22. Lower the transfer cask to the bottom of the cask loading area and remove the lifting yoke.
23. Attach the shield lid lifting sling to the crane hook.
24. Slowly lift the shield lid. Move the shield lid to one side after it is raised clear of the transfer cask.
25. Visually inspect the spent fuel or GTCC waste.

At this point, the spent fuel or GTCC waste can be removed from the canister.

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8.0 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

This chapter describes the acceptance tests and maintenance program to be used for the NAC-STC to assure compliance with 10 CFR 71 and IAEA Safety Series No. TS-R-1 acceptance and maintenance criteria. Also included is a general description of the fabrication of the NAC-STC cask and the transportable storage canister with additional information on the lead pouring requirements and procedures.

Where required, specific procedures for inspection, special processes, and testing will be developed to support the entire manufacturing process with a Quality Assurance (QA) program that has been approved in accordance with 10 CFR 71 Subpart H and IAEA Safety Series No. TS-R-1.

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8.1 Fabrication Requirements and Acceptance Tests

This section identifies the fabrication, inspection and acceptance requirements, tests, and acceptance criteria established for the NAC-STC to verify, prior to acceptance and packaging marking per 10 CFR 71.85(c), that the packaging has been fabricated, assembled, tested, inspected and accepted in accordance with the applicable NAC-STC License Drawings (Section 1.3.2) and the other requirements of this application.

8.1.1 Weld Procedures, Examination, and Acceptance

The primary containment components of the package and the canister shell will be fabricated in accordance with the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Division I, Subsection NB requirements. The noncontainment components of the packaging, except the fuel basket assembly and the neutron shield vessel and fins, will be fabricated in accordance with ASME Code, Section VIII, Division 1 requirements. The fuel basket assembly components for either the directly loaded fuel basket or the canister fuel basket will be fabricated in accordance with ASME Code, Section III, Subsection NG. The fabrication of the neutron shield shell and fins, the heat transfer disks and the GTCC basket will be in accordance with ASME Code, Section III, Subsection NF. The fabrication and welding requirements for the NAC-STC cask, and the transportable storage canister, are shown on the NAC-STC License Drawings. Fabrication of the transportable storage canister is described in Section 8.1.8.

In the fabrication of the NAC-STC, the plates and forgings that comprise the cask body are joined by welding. The welding procedure qualifications and the welding performance qualifications for the fabrication of the NAC-STC will be in accordance with Part QW-Welding, Section IX of the ASME Code. All exposed welds on the NAC-STC will be ground flush to the base metal or to a smooth fillet.

Fabricators of the NAC-STC will be experienced and qualified with nuclear component fabrication. Fabrication will be in full accordance with the applicable requirements of ASME Code Section III for the containment vessel, recognizing that design specification, design report, authorized inspection agency, and code stamping do not apply. The fabricator will establish a detailed written weld inspection plan, in accordance with an approved Quality Assurance program, of visual, dye penetrant, ultrasonic and radiographic weld examinations to be performed during fabrication and prior to acceptance of the cask. The weld inspection plan will identify the welds to be examined, the sequence of the examinations, the weld examination method used, and the criteria for acceptance of the weld in accordance with the applicable sections of the ASME Code.

The finished surfaces of all welds on the NAC-STC will be visually examined in accordance with ASME Code, Section V, Article 9, to verify that the components are assembled in accordance with the License Drawings and that the components are free of nicks, gouges, or other damage. The acceptance criteria for the visually examined welds will be in accordance with ASME Code, Section VIII, Division 1, UW-35 and UW-36.

The NAC-STC primary containment boundary welds shall be radiographic examined in accordance with ASME Code, Section V, Article 2. Acceptance criteria for radiographic examinations shall be in accordance with ASME Code Section III, Division I, Subsection NB, Article NB-5320. Unacceptable imperfections such as a crack, a zone of incomplete fusion or penetration, elongated indications with lengths greater than specified limits, and rounded indications in excess of the limits specified shall be cause for rejection of the weld. Repair of unacceptable weld metal defects in welds shall be in accordance with paragraph NB-4450, of the ASME Code, Section III. Repaired welds shall be reexamined in accordance with the original examination criteria.

The circumferential and longitudinal welds of the outer shell assembly, and the connection welds of the outer shell assembly to the upper forging shall be radiographic examined in accordance with the ASME Code, Section V, Article 2. Acceptance criteria for radiographic examinations of the outer shell welds shall be in accordance with ASME Code, Section VIII, Division 1, UW-51. Repair of unacceptable defects shall be in accordance with UW-38. Repaired welds shall be re-examined in accordance with the original examination criteria.

The final NAC-STC cask closure welds of the bottom ring forging to the bottom forging and to the outer shell, and the closure weld of the bottom plate to the bottom ring forging shall be ultrasonic examined in accordance with ASME Code, Section V, Article 5. Acceptance criteria for the ultrasonic examination shall be in accordance with ASME Code, Section VIII, Division 1, UW-53 and Appendix 12. Repair of unacceptable defects shall be in accordance with UW-38. Repaired welds shall be re-examined in accordance with the original examination criteria.

Welds that are marked "PT Root and Final Pass" on the NAC-STC License Drawings (Section 1.3.2) will be liquid penetrant (PT) examined in accordance with ASME Code, Section V, Article 6. The liquid penetrant examination method is used to detect discontinuities, such as cracks, seams, laps, laminations and porosity, that are open to the surface of nonporous metals. Acceptance criteria for liquid penetrant examined welds shall be in accordance with ASME Code, Section III, Division I, Subsection NB, Article NB-5350. All other noncontainment welds that are marked "PT" on the NAC-STC License Drawings will be liquid penetrant examined in accordance with ASME Code, Section V, Article 6. Acceptance criteria for these noncontainment welds shall be in accordance with ASME Code, Section VIII, Division 1, Appendix 8, except for the fin to outer shell, and fin to neutron shield closure plate welds which will be examined and evaluated in accordance with ASME Code, Section III, Subsection NF, Article NF-5350. Unacceptable indications shall be cause for rejection of the welds. Rejected welds shall be repaired in accordance with approved weld repair procedures prepared in accordance with the applicable provisions of the ASME Code, Section III, NB-4450, for containment welds, NF-4450 for fin to neutron shield shell and cask outer shell welds, and Section VIII, UW-38 for other non-containment welds. Repaired welds shall be re-examined in accordance with the original examination criteria.

All weld inspections shall be performed by qualified personnel in accordance with written procedures. Inspection personnel shall be qualified in accordance with SNT-TC-1A, "Personnel Qualifications and Certification in Nondestructive Testing," the American Society for Nondestructive Testing, Inc., edition as invoked by the applicable ASME Code.

8.1.2 Structural and Pressure Tests

8.1.2.1 Lifting Trunnion Load Testing

Each of the two pairs of the cask lifting trunnions shall be load tested in accordance with the requirements of ANSI N14.6 "Special Lifting Devices for Shipping Containers Weighing 10,000 pounds (4500 kg) or More for Nuclear Materials." The load test will be performed for one pair and repeated for the other pair. The load test shall be performed in accordance with approved written procedures.

The lifting trunnion load test shall consist of applying a vertical load of 750,000 pounds, which is 300 percent of the maximum service load, to diametrically opposite trunnion pairs.

The load will be applied in a vertical direction, equally distributed between the two trunnions and over the length of 2.25 inches of the trunnion/lifting yoke interface areas. The inner and outer lids will be bolted in place for the test. The test may be carried out by the use of calibrated hydraulic rams combined with a load spreading beam, or the cask lifting yoke, attached to the trunnion pair. The load will be held for a minimum of 10 minutes.

Following completion of the lifting trunnion load test, all accessible trunnion welds and load bearing surfaces shall be visually inspected for permanent deformation, galling or cracking. Inspections utilizing liquid penetrant examination shall be performed in accordance with the ASME Code, Section V, Article 6. Liquid penetrant acceptance standards shall be in accordance with Paragraph NF-5350 of the ASME Code, Section III, Division 1.

Any evidence of permanent deformation, cracking, galling of the load bearing surfaces or unacceptable dye penetrant results shall be cause for rejection of the trunnion or related welds.

8.1.2.2 Load Testing of the Rotation Trunnion Recesses

The rotation trunnion recesses at the lower end of the cask shall be load tested. The load test shall be performed in accordance with approved written procedures.

The load test for recesses shall consist of applying a vertical load of 375,000 pounds (170.1 MT) to the rotation trunnion recess pair, which is 150 percent of the maximum service load. The load will be applied in a vertical direction and equally distributed between the two rotation trunnion recesses by the use of hydraulic rams combined with a load-spreading beam.

Following completion of the rotation trunnion recesses load test, all accessible trunnion recess welds and load bearing surfaces shall be visually inspected for permanent deformation, galling or cracking. Inspections utilizing liquid penetrant examination shall be performed in accordance with the ASME Code, Section V, Article 6. Liquid penetrant acceptance standards shall be as indicated in paragraph NF-5350 of the ASME Code, Section III, Division 1.

Any evidence of permanent deformation, cracking, galling of the load bearing surfaces or unacceptable dye penetrant results shall be cause for rejection of the rotation trunnion recesses or related welds.

8.1.2.3 Hydrostatic Testing

A hydrostatic test shall be performed on the NAC-STC cask containment boundary, prior to final acceptance of the cask, in accordance with the ASME Code, Section III, Division I, Article NB-6200. The hydrostatic test pressure shall be at least 76 psig, which is 150 percent of the Maximum Normal Operating Pressure. This test shall be performed in accordance with approved written procedures. All pressure retaining components, appurtenances, and completed systems shall be pressure tested.

The vent port will be used for the test connection. Only the vent port quick-disconnect will be installed during the testing. The hydrostatic test will be performed with the inner lid and the drain port coverplate installed and torqued.

The hydrostatic test system components, although not part of the cask containment boundary, will be visually inspected prior to the start of the hydrostatic test. Leakage from the valves or connections will be corrected prior to the start of the hydrostatic test.

The test pressure gauge installed on the cask will have an upper limit of approximately twice that of the test pressure. The hydrostatic test pressure shall be maintained for a minimum of 30 minutes, during which time a visual inspection is made to detect any evidence of a leak. Any evidence of a leak during the minimum hold period will be cause for rejection.

After completion of the hydrostatic test, the cask containment boundary will be dried and prepared for visual and/or dye penetrant inspections as appropriate. The components of the cask containment boundary shall be visually inspected. All accessible welds within the cavity shall be liquid penetrant inspected. Any evidence of cracking or permanent deformation is cause for rejection of the affected component.

8.1.2.4 Pneumatic Bubble Testing of the Neutron Shield Tank

A pneumatic bubble test of the neutron shield tank will be performed in accordance with Section V, Article 10, Appendix I, of the ASME Code following final closure welding of the bottom closure plates. The pneumatic test pressure shall be 12.5 + 1.5/-0 psig, which is 125 percent of the relief valve set pressure. The test shall be performed in accordance with approved written procedures.

During the test, the two relief valves on the neutron shield tank will be removed. One of the relief valves threaded connections will be used for connection of the air pressure line and test pressure gauge. The other relief valve connection will be plugged with a threaded plug.

Following introduction of pressurized air into the neutron shield, a 15-minute minimum soak time will be required. Following completion of the soak time, approved soap bubble solution will be applied to all fin to shell, shell to end plate, and end plate to outer shell welds. The acceptance criteria for the bubble test will be no air leak from any tested weld as indicated by continuous bubbling of the solution. If an air leak is indicated, the weld shall be repaired in accordance with approved weld repair procedures and the pneumatic bubble test shall be repeated until no unacceptable air leak is observed.

8.1.3 Leak Tests

Leak tests shall be performed in accordance with Section 7.3 of ANSI N14.5-1997, containment System Fabrication Verification, on the NAC-STC cask containment boundary seals to verify proper fabrication of the cask. The leak tests shall be performed in accordance with approved written procedures. Leak tests shall be performed on the cask containment weldment, the inner lid O-rings, the inner lid interseal test port plug, the vent port coverplate O-rings and its interseal test plug, and the drain port coverplate O-rings and its interseal test plug.

Following completion and NDE of the containment weldment, a helium leak test of the containment weldment shall be performed in accordance with the requirements of ASME Code, Section V, Article 10. The containment weldment shall have an indicated leak rate of less than 2×10^{-7} cm^3/sec (helium), using a minimum test sensitivity of 1×10^{-7} cm^3/sec (helium). If a leak is detected, the affected weld shall be rejected. Rejected welds shall be repaired in accordance with the requirements of ASME Code, Section III, Division I, Subsection NB, Article NB-4450. The repaired weld area shall be retested and reinspected in accordance with the above test requirements and acceptance standards.

The containment boundary closures may use either metallic O-rings or nonmetallic Viton O-rings. The two O-ring types require different O-ring groove designs and, therefore, may not be used interchangeably and must be used with the inner lid, vent and drain port coverplates and outer lid having the appropriate O-ring groove machined in the component. The two O-ring types also have different allowable leak rate criteria as described in Section 4.1. Consequently, different acceptance criteria are applied to the metallic and nonmetallic O-ring configurations.

The detailed procedures for the NAC-STC cask leak testing are presented in Section 7.4.

Metallic O-ring Testing

The final fabrication verification leak testing of the containment boundary closures using metallic O-rings consists of a series of leak tests using (minimum 99.9 percent pure) helium as a tracer gas and a helium leak detection system calibrated to a minimum sensitivity of 1×10^{-7} cm^3/sec (helium).

The test plug O-rings on the coverplates and the interseal test plug will be tested using the vacuum air pressure rise method. The metallic O-rings in the inner lid and the vent and drain port coverplates will be tested to ensure that the leakage rate is $\leq 2 \times 10^{-7}$ cm^3/sec (helium). The tracer gas shall be introduced on the containment side of the O-ring in all cases. The test procedures and methods will be selected to ensure that the sensitivity of each leak test is $\leq 1 \times 10^{-7}$ cm^3/sec (helium).

A leak rate past any seal or closure that exceeds 2.0×10^{-7} cm^3/sec (helium) shall be cause for rejection of the item being tested. Seal replacement or other corrective actions will be taken to correct the leak. The item shall then be retested and inspected in accordance with the above test requirements and acceptance standards.

Viton O-ring Testing

The final fabrication verification leak testing of the containment boundary closures using Viton O-rings consists of leak tests of the closure O-rings using (minimum 99.9 percent pure) helium as a tracer gas and a helium leak detection system calibrated to a minimum sensitivity of 9.3×10^{-5} cm^3/sec (helium).

The test plug O-rings on the coverplate and the interseal test plug will be tested using the vacuum air pressure rise method. The Viton O-rings in the inner lid and the vent and drain port coverplates will be tested to ensure that the leak past all three O-rings will not exceed a cumulative total of 9.3×10^{-5} cm^3/sec (helium). The tracer gas shall be introduced on the containment side of the O-ring in all cases. The test procedures and methods will be selected to ensure that the sensitivity of each leak test is 4.7×10^{-5} cm^3/sec (helium) or better.

A leak rate past any seal or closure, or the cumulative leakage rate of all containment seals, exceeding 9.3×10^{-5} cm^3/sec (helium) shall be cause for rejection of the item(s) being tested. Seal replacement or other corrective actions will be taken to correct the leak. The item shall then be retested and inspected in accordance with the above test requirements and acceptance standards.

8.1.4 Component Tests

Tests performed on individual components are designed to ensure that the component meets the design requirements for correct and proper operation of the cask system.

Acceptance criteria are established based on the functions and design requirements of the component being tested.

8.1.4.1 Valves

There are no valves that are part of the NAC-STC containment boundary for transport. Quick-disconnects are installed in the vent, drain and interseal test port openings in the inner lid to provide access to the cavity, and in the interlid port to provide access to the interlid region. These fittings serve as valves when the mating parts are connected, and are used to connect ancillary equipment to the cask cavity for filling, draining, drying, backfilling, gas sampling, and leak testing operations. Upon removal of the external fitting, the valve in the quick-disconnect closes automatically. The design and selection of the quick-disconnects is based on similar equipment and procedures used with other NRC-approved storage and transport casks. For transport, the quick-disconnects are sealed inside the transport containment boundary using a bolted coverplate fitted with two O-ring seals.

There are no rupture disks on the NAC-STC.

Two self-actuating pressure relief valves are installed on the external shell of the neutron shield to provide for venting of vapor from the shielding material during transport thermal accident conditions. These valves have stainless steel bodies and an operating pressure range of zero to 200 psig with an adjustable cracking pressure within this range. The cracking pressure is set at 10 psig. These relief valves do not provide a safety function, but have been designed to minimize recovery efforts in the unlikely event of a neutron shield overpressure condition.

8.1.4.2 Gaskets

As described in Section 8.1.3, the containment boundary of the NAC-STC may use either metallic O-rings or non-metallic Viton O-rings. The two O-ring types require different O-ring groove designs and, therefore, may not be used interchangeably and must be used with the inner lid, vent and drain port coverplates and outer lid having the appropriate O-ring groove machined in the component. Metallic O-rings must be used for direct loading of the NAC-STC with fuel for extended storage and for loading of a transportable storage canister (for transport). For direct loading of fuel for immediate transport, either metallic or non-metallic O-rings may be used.

The outer lid, inner lid, drain port coverplate, vent port coverplate, interlid port cover, pressure port cover, and interseal test plug gaskets are O-rings. For transport after an extended period of storage, the containment boundary is formed by the outer metallic O-ring of the inner lid, the outer metallic O-rings on the vent and drain port coverplates, and the interseal test plug metallic O-rings for the inner lid, the vent port coverplate and the drain port coverplate. The inner metallic O-rings of the inner lid, vent port coverplate and drain port coverplate, the metallic O-ring of the outer lid, and the PTFE O-rings of the interlid and pressure port covers provide a secondary closure to the cask contents. For immediate transport, the containment boundary is formed by the inner O-rings of the inner lid and vent and drain port coverplates. A second boundary is formed by the O-rings of the outer lid and interseal and pressure port covers.

The O-ring replacement schedule depends upon the O-ring material. The metallic O-ring(s) of any component shall be replaced prior to reinstallation of the component. Viton O-rings are inspected prior to each use and replaced as necessary. The PTFE O-rings of the interlid and pressure ports will be visually inspected prior to each use, and replaced if necessary. The PTFE O-rings shall be replaced at least once every two years during cask transport operations, or prior to transport if they have been installed longer than two years (i.e., after extended storage).

The containment boundary O-ring shall be tested and maintained in accordance with the Maintenance Program Schedule of Table 8.2-1 and the leak test criteria of Section 8.2.2.

8.1.4.3 Miscellaneous

The removable transport impact limiters consist of redwood and balsa wood. License drawings and the supporting analyses specify the crush strengths of the redwood and balsa wood to be 6240 psi ± 620 psi and 1550 psi ± 150 psi respectively. For manufacturing purposes, verification of the impact limiter material is accomplished by verifying the densities of the wood. Three samples from each redwood board are to be tested for density, and the average density of the samples shall be 23.5 ± 3.5 pounds/cubic foot. Each 15-degree and 30-degree pie shaped section of the impact limiter shall have a density of 22.3 ± 1.2 pounds/cubic foot in accordance with the License Drawings. The moisture content for any single redwood board must be greater than 5 percent, but less than 15 percent. The average moisture content for a lot of redwood used in impact limiter construction must not be greater than 12 percent.

Following final closure welding of the transport impact limiter stainless steel shell, a leak test of the shell welds shall be performed to verify weld integrity. The test shall be performed by evacuating the impact limiter to 75 mbar and performing a 30-minute test to determine if there is any increase in the impact limiter pressure. Any detected leak shall not exceed 1×10^{-2} cm^3/sec. If a leak exceeding this value is detected, the cause of the leak shall be determined, and the weld repaired and retested.

8.1.5 Tests for Shielding Integrity

8.1.5.1 Gamma Shield Test

The gamma scan test shall be conducted by continuous scanning or probing over 100 percent of all accessible cask surfaces using a 3-inch detector and a ^{60}Co source. The source strength shall be of an intensity sufficient to produce a count rate that equals or exceeds three times the background count rate on the external surfaces of the cask. The count rate shall be maintained for greater than one minute prior to the start of scanning. The detector scan path spacing (cask exterior surface) will be a maximum of 2.5 inches and the scanning speed will be 4.5 feet per minute or less. The source scan path spacing (cask interior surface) will be on a 2-inch grid pattern (when using a 3-inch detector). Flat surfaces, such as the cask bottom and closure lids, will use a 2.5 inch spacing for both the detector and source scan paths (when using a 3-inch detector).

The acceptance criteria for the shield test will be that the shield effectiveness of the cask body and lids shall be equal to or greater than the shield effectiveness of a lead and steel mock-up. The steel thickness of the mockup shall be equivalent to the minimum steel thickness specified on the License Drawings and the lead thickness shall be equivalent to the minimum lead thickness specified in the License Drawings less 3 percent. The shielding mock-up will be produced using the same fabrication techniques as those approved for the cask.

Measured count rates that exceed those established by the test mock-up shall cause the component to be rejected. The rejected areas/components shall be evaluated to determine the corrective action to be taken. Any repaired areas shall be retested prior to acceptance.

An additional gamma shield effectiveness test shall be performed on each cask following first fuel loading. The neutron and gamma shield effectiveness test procedures and acceptance criteria are described in Section 8.1.5.4.

8.1.5.2 Neutron Shielding Test

The neutron shielding of the NAC-STC is provided by a solid layer of NS-4-FR, which is a hard polymer material. A 5.5-inch layer of NS-4-FR is located in the annulus formed by the outer shell and the 0.236-inch (6 mm) thick neutron shield shell. The neutron shield is divided in sections by the copper/stainless steel fins. A 2-inch thick layer of NS-4-FR is also installed in the cask inner lid and in the cask bottom.

The installation of NS-4-FR material in the fabrication of the cask is a special process and, as such, procedures will be prepared and qualified to ensure that the mix ratios, mixing method, degassing, pouring, and curing of the material is properly performed. The NS-4-FR raw material is provided in the form of a 3-part mixing kit. The material content of the raw material is tested and certified at the time of kit preparation. The neutron shielding material is installed into the annulus between the outer shell and the neutron shield shell by pouring it with the cask in an inverted vertical position. Prior to installation, samples from each mix of the actual material being poured into the annulus are wet density tested to ensure that the material is properly mixed. Mixes that do not meet the wet density acceptance criteria are rejected. Procedures used for installation of the material are validated prior to use by destructive examination of a full scale mock-up of the neutron shield cavity. Qualification of the installation procedure verifies material homogeneous properties and minimizes the potential deleterious voids.

8.1.5.3 Neutron Shielding Material Testing

The neutron shield properties of NS-4-FR are provided in Chapters 1 and 3. Each lot (mixed batch) of neutron shield material shall be tested to verify that the material composition (aluminum and hydrogen), boron concentration, and neutron shield density meet the requirements specified in Chapters 1 and 3 and the License Drawings. Testing shall be performed by qualified laboratories in accordance with written and approved procedures. Material composition, boron concentration, and density data for each lot of neutron shield material shall become part of the quality record documentation package.

Dimensional inspection of the cavities containing the neutron shielding material shall ensure that the required thickness specified in the License Drawings is incorporated into the cask.

The installation of the neutron shielding material shall be performed in accordance with written, approved, and qualified procedures. The procedures shall ensure that mix ratios and mixing methods are controlled in order to achieve proper material composition, boron concentration and distribution, and that pours are controlled in order to prevent gaps or unacceptable voids from occurring in the material. Procedures shall be qualified by the use of mock-ups to ensure that the NS-4-FR installation does not result in the creation of unacceptable voids. Samples of each lot of neutron shield material shall be maintained as part of the quality record documentation package.

8.1.5.4 Neutron and Gamma Shield Effectiveness Tests

Following first fuel loading, a neutron and gamma shield effectiveness test shall be performed for each cask prior to transport. The test shall be performed with the cask loaded with fuel, drained, vacuum dried and backfilled with helium. The purpose of the test is to document the effectiveness of the neutron and gamma shielding materials. The test shall be performed in accordance with detailed, approved written test procedures.

Calibrated neutron and gamma dose rate meters shall be used to measure the neutron and gamma dose rate at contact with the outer shell of the neutron shield and at 2.3 meters from the surface (equivalent to 2 meters from the sides of the railcar). Dose measurement points shall be established on the external surface of the shell at 30° intervals and at five points along the height of the shield (a total of 60 measuring points). In addition, neutron and gamma dose rate measurements shall be made of the trunnion areas above the neutron shield, at four points below the neutron shield, and at the edges and center of the cask top (outer lid) and cask bottom surfaces. Dose rates at the top and bottom of the cask shall be measured with the transport impact limiters installed. The dose rates measured at contact and at 2.3 meters shall be recorded on the test data sheet, along with the total power of the loaded fuel assemblies; date, time and location of test; identification and calibration of instrumentation; and identification of test engineer and operators.

To allow an evaluation of the measured dose rates to be completed, the burnup and cool time for the actual fuel assemblies loaded into the cask will be determined and recorded. From this fuel history data, the total actual neutron and gamma source terms will be estimated using ORIGEN or similar calculations.

If the measured dose rates exceed the applicable regulatory limits, the licensee shall notify the NRC. Appropriate corrective measures will be taken, including fuel unloading and correction of the shielding deficiency. Following corrective actions, the test will be reperformed to the original acceptance criteria prior to final acceptance.

8.1.6 Thermal Test

Prior to acceptance at the factory, a thermal test shall be performed on each fabricated packaging to confirm and verify that the fabricated and assembled cask possesses the heat rejection capabilities predicted by the thermal analyses. The thermal test shall be performed in accordance with approved written procedures.

8.1.6.1 Thermal Test Set-up

The thermal test set-up is shown in Figure 8.1-1(a). As depicted, the thermal test shall be performed with the cask positioned horizontally on a test frame. The transport impact limiter or equivalent insulating material shall be installed on each end of the cask to simulate the transport configuration. The cask will be located in a covered building in a still environment. The cask shall be assembled with the basket installed. A thermal test lid with connections for thermocouple leads and electric heater power cables shall be installed in place of the inner lid. The outer lid will not be installed for the test. The thermal test lid will be provided with an O-ring seal capable of containing the containment cavity helium atmosphere.

Electric heaters shall be installed in each fuel tube. The electric heaters will have an active length of between 120 and 150 inches and be capable of generating a minimum of 22 kilowatts (kw). The heaters will be supported in the basket so as to not be in contact with the wall of the fuel tube. The power supplied to the heater will be recorded throughout the test duration.

Calibrated test thermocouples, with an accuracy of ±2°F, will be installed on the cask basket, inner shell, and outer neutron shield shell surfaces. The location of the test thermocouples are shown in Figure 8.1-1. The specific location of the thermocouples are as follows:

TC1 - basket top steel weldment
TC2 - steel disk at cask basket midpoint
TC3 - aluminum disk at cask basket midpoint
TC4 - basket bottom steel weldment
TC5; TC6; TC7; and TC8 - located at 90° intervals on the inner shell surface at cavity midpoint
TC9 - top of inner shell surface at 30-40 inches from top of cavity
TC10 -bottom of inner shell surface at 30 to 40 inches from base of the cavity
TC11; TC12; TC13; and TC14 - located at 90° intervals on the neutron shield shell surface (at fin tip) at cask midpoint.
TC15 - top of neutron shield shell surface (at fin tip) at 30-40 inches from top of neutron shell.
TC16 - bottom of neutron shield shell surface (at fin tip) at 30-40 inches from bottom of neutron shield shell.
TC17 - top of upper forging

TC18 - outer shell surface at centerline of cask bottom face
TC19 - inner fuel tube wall surface near the center of the cask basket
TC20 - ambient temperature of testing area

The output of the test thermocouples will be recorded throughout the test by a strip chart recorder.

8.1.6.2 Test Procedure

With the cask assembled and instrumented as described above, the cask cavity is evacuated and backfilled to 1.0 atmosphere absolute (14.6 psia) with helium. Power will be applied to the heaters to simulate the cask contents. After initiation of power to the heaters, the temperatures of all thermocouples and heater power levels will be monitored and recorded on data sheets at 60 minute intervals. Power will be maintained to the electrical heaters until the cask has reached thermal equilibrium.

For the purpose of the test, thermal equilibrium is defined as being achieved when over two consecutive hours:

$\Delta t_{TC13} \leq 2°F/hr$, and
$\Delta t_{TC3} \leq 2°F/hr$

Based upon the thermal heat-up evaluation, thermal equilibrium should be achieved in approximately five days.

After verification of thermal equilibrium, final temperature measurements will be recorded for all test thermocouples. The final power readings for the electric heaters will also be recorded. The strip chart will be marked to indicate the time of the final cask measurements. The printout of the strip chart recorder and the completed test data sheets will be incorporated into an approved final thermal test report. The test will be determined to be acceptable if the acceptance criteria of Section 8.1.6.3 are met.

If the acceptance criteria are not met, the cask will not be accepted until appropriate corrective actions are completed. Upon completion of corrective actions, the cask shall be retested to the original test requirements and acceptance criteria.

8.1.6.3 Acceptance Criteria

The purpose of the thermal test is to confirm the heat rejection capabilities of the as-built cask are acceptable and correspond to the temperatures calculated by thermal analyses for the directly loaded (uncanistered) configuration presented in Chapter 3.0 of this application.

Package heat dissipation acceptance testing assures: 1) maximum material temperatures do not exceed material allowables; and that 2) measured temperature gradients are less than the thermal gradients calculated in the package thermal analyses.

The thermal acceptance test is accepted when the following criteria are met:

1) When corrected for physical test boundary conditions and heat load, the following measured temperatures are not exceeded:

TC No.	Location	Temperature °F
TC1	Top Basket Steel Weldment	435
TC3	Aluminum Disk Center	485
TC2	Steel Support Disk Center	495
TC4	Basket Bottom Steel Weldment	475
TC5-TC8	Cask Inner Shell	330
TC11-TC14	Neutron Shield Shell	240
TC17	Cask Top Forging	200
TC18	Cask Bottom	330
TC19	Tube Wall	540

2) The measured temperature gradient across the central steel disk from TC2 to the average of TC5, TC6; TC7 and TC8 is less than 200°F;

3) The measured temperature gradient across the central aluminum disk from TC3 to the average of TC5; TC6; TC7 and TC8 is less than 190°F; and

4) The measured temperature gradient across the cask body as measured by thermocouple pairs TC5-TC13; TC6-TC14; TC7-TC11; and TC8-TC12 are less than 90°F.

8.1.7 Neutron Absorber Tests

Two alternate neutron poison materials, BORAL and TalBor, have been qualified by NAC for use in the fuel tubes. BORAL is manufactured by AAR Advanced Structures (AAR), under a

Quality Assurance/Quality Control program in conformance with the requirements of 10 CFR 50, Appendix B. The manufacturing process consists of several steps: the first step is the mixing of the aluminum and boron-carbide powders that form the core of the finished material, with the amount of each powder a function of the desired ^{10}B areal density. The methods used to control the weight and blend of the powders are patented and proprietary processes of AAR. The mixture of powders is placed in an aluminum box with walls approximately one inch thick. The top lid is welded in place. This "ingot" is heated for several hours and then is hot-rolled to produce the sheet of design thickness. The rolling process densifies and bonds the powder mixture. The aluminum box walls become the cladding for the Al-B_4C core.

TalBor is manufactured by Talon Composites, Inc. (TalBor was formerly called Boralyn, and was produced by Alyn Corporation. Alyn Corporation went out of business and Talon Composites acquired the major production equipment and the patent rights for Boralyn. TalBor is essentially identical to Boralyn.) TalBor is manufactured and controlled using a Quality Assurance program that is compliant with the applicable requirements of 10 CFR 50, Appendix, B. TalBor is a metal matrix composite (MMC). The aluminum and B_4C powders are mixed to the specified ^{10}B areal density and the powder mixture is vacuum sintered and hot pressed to achieve a fully dense billet. The billet is extruded, then cut and rolled to the design thickness.

After manufacturing, test samples from each batch of neutron absorber (poison) sheets shall be tested to verify the presence, proper distribution, and minimum weight percent of ^{10}B. Neutron transmission testing or augmented wet chemistry testing may be used. The tests shall be performed in accordance with approved written procedures.

8.1.7.1 Neutron Absorber Material Sampling Plan

The neutron absorber sampling plan is selected to demonstrate a 95/95 (95% probability and 95% confidence level) statistical confidence level in the neutron absorber sheet material compliance with the specification. In addition to the specified sampling plan, each sheet of material is visually and dimensionally inspected using at least 6 measurements (along the edges near each corner and the longitudinal centerline) on each sheet. No rejected neutron absorber sheet is used. The sampling plan is supported by written and approved procedures.

The sampling plan requires that a coupon sample be taken from each sheet of the first set of 100 sheets of absorber material. Thereafter, coupon samples are taken from 20 randomly selected sheets from each set of 100 sheets. This 1 in 5 sampling plan continues until there is a change in lot or batch of constituent materials of the sheet (i.e., boron carbide powder, aluminum powder, or aluminum extrusion), or a process change, at which time the sampling process is reinitiated as previously described. The sheet samples are indelibly marked and recorded for identification. This identification is used to document neutron absorber test results, which become part of the quality record documentation package.

8.1.7.2 Wet Chemistry Test Performance

An approved facility with chemical analysis capability shall be selected to perform the wet chemistry tests. The tests will ensure the presence of boron and enable the calculation of the ^{10}B areal density. Acceptability of the uniformity of boron distribution is based on the manufacturer's material qualification tests.

The most common method of verifying the acceptability of neutron absorber material is the wet chemistry method—a chemical analysis where the aluminum is separated from a sample with known thickness and volume. The remaining boron-carbide material is weighed and the areal density of ^{10}B is computed. A statistical conclusion about the BORAL or TalBor sheet from which the sample was taken and that batch of sheets may then be drawn based on the test results and the established manufacturing processes previously noted.

8.1.7.3 Neutron Transmission Test Performance

An approved facility with a neutron source and neutron detection capability shall be selected to perform the described tests, if the neutron transmission test method is used. The tests will assure that the neutron absorption capacity of the material tested is equal to, or higher than, the given reference value and will verify the uniformity of boron distribution. The principle of measurement of neutron absorption is that the presence of boron results in a reduction of neutron flux between the thermalized neutron source and the neutron detector—depending on the material thickness and boron content.

Typical test equipment will consist of thermal neutron source equipment, a neutron detector and a counting instrument. The test equipment is calibrated using a known standard, whose ^{10}B content has been checked and verified by an independent method such as chemical analysis. This calibration process shall be repeated daily (every 24 hours) while tests are being performed.

8.1.7.4 Acceptance Criteria

The neutron transmission test results shall be considered acceptable if the minimum ^{10}B areal density is determined to be equal to, or greater than, that specified on the fuel tube drawings.

Any specimen not meeting the acceptance criteria shall be rejected and all of the sheets from that batch shall be similarly rejected unless coupons from each individual absorber plate are tested and confirmed to meet or exceed the specified areal density.

8.1.8 Transportable Storage Canister

The transportable storage canister is constructed of Type 304L stainless steel and is fabricated by welding. If circumferential welds are required to join two shell sections, the seam welds shall not be aligned within 45° circumferentially. The welded cylinder is closed at the bottom by a circular plate welded to the shell wall. The top of the cylinder is closed by two field-installed circular plates, welded to the canister shell wall following fuel loading.

The transportable storage canister is a welded closed component. The canister serves as the confinement boundary component of the NAC-MPC System during storage of spent fuel in the vertical concrete cask.

The finished surfaces of all canister welds are visually examined in accordance with ASME Code Section V, Article 9, to verify that the components are assembled in accordance with the License Drawings and that the components are free of nicks, gouges, and other damage. The acceptance criteria for the visually examined welds is in accordance with ASME Code Section VIII, Division 1, UW-35 and UW-36 and Section III, Subsection NB, NB-4424 and NB-4427.

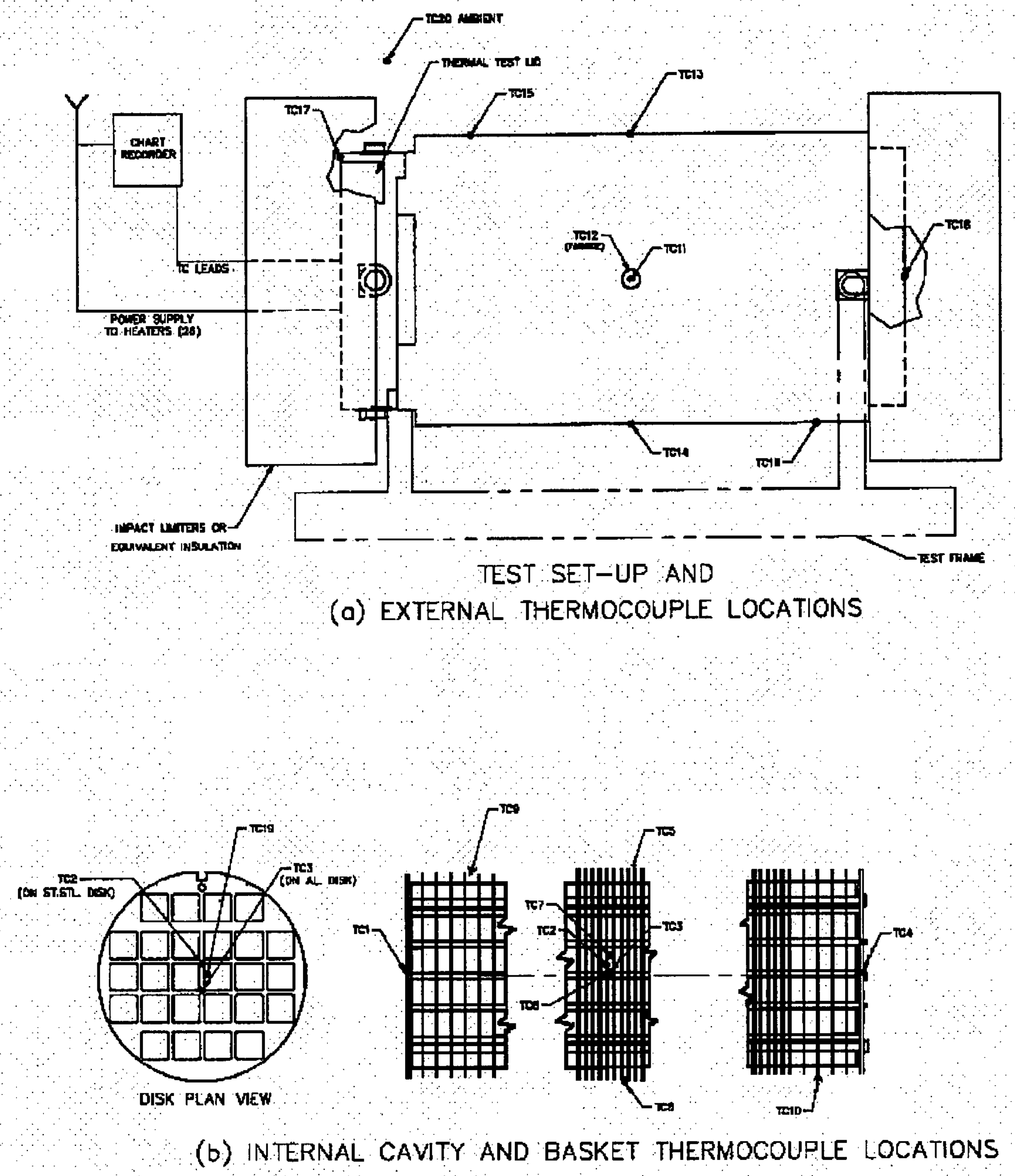
The seam and girth welds in the transportable storage canister shell are full-penetration welds that are radiographic (RT) examined in accordance with ASME Code Section V, Article 2. The acceptance criteria for the RT-examined welds is that specified in ASME Code Section III, Subsection NB, Article NB-5320. The canister shell to bottom plate weld is a full-penetration double-bevel weld with an inside fillet weld that is ultrasonic examined in accordance with ASME Code Section V, Article 5, with acceptance criteria as specified in ASME Code Section III, Subsection NB, Article NB-5330. The final surfaces of the seam and girth welds in the canister and the canister shell to bottom plate weld are also liquid penetrant examined in accordance with ASME Code Section V, Article 6, with the acceptance criteria being that specified in ASME Code Section III, Subsection NB, Article NB-5350.

Field installed partial-penetration groove welds attach the shield (inner) lid to the canister shell and the vent port and the drain port coverplates to the shield lid, after the canister is loaded. The structural lid is attached to the canister shell by a partial penetration weld. The root and final surfaces of the shield lid weld are liquid penetrant examined in accordance with the ASME Code

Section V, Article 6. Acceptance criteria are as specified in ASME Code Section III, Division 1, Subsection NB, Article NB-5330. The vent port and the drain port coverplate to shield lid welds are liquid penetrant examined, i.e., root and final surfaces, in accordance with ASME Code Section V, Article 6. Acceptance criteria is specified in ASME Code Section III, Division 1, Subsection NB, Article NB-5350. The structural lid weld is either ultrasonic (UT) examined in accordance with the ASME Code, Section V, Article 5 with the final weld surface liquid penetrant examined in accordance with ASME Code, Section V, Article 6, or progressively liquid penetrant examined in accordance with the ASME Code, Section V, Article 6. Acceptance criteria is specified in ASME Code Section III, Division 1, Subsection NB, Article NB-5330 (ultrasonic) and Article NB-5350 (liquid penetrant). Following completion of the shield lid to canister shell weld and the drain port coverplate to shield lid welds, the canister is leak tested in accordance with ASME Code Section V, Article 10, Appendix V, using a minimum leak rate test sensitivity of 1×10^{-7} cm^3/sec (helium).

The fabricator of the transportable storage canister will establish a written weld inspection plan in accordance with an approved quality assurance program. The weld inspection plan will include visual, liquid penetrant, ultrasonic, and radiographic examination. In addition, the weld inspection plan will identify the welds to be examined, the sequence of the examinations, the type of examination method to be used, and the criteria for acceptance of the weld in accordance with the applicable sections of the ASME Code.

Figure 8.1-1 Thermal Test Arrangement



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8.2 Maintenance Program

To ensure that the NAC-STC packaging is in compliance with the requirements of the regulations, the Certificate of Compliance, and this application, a cask Maintenance Program for the NAC-STC shall be established. The cask Maintenance Program shall specify the inspections, tests, and replacement of components to be performed, and the frequency and schedule for these activities. This chapter describes the overall requirements of the Maintenance Program and establishes the frequency and schedule for the maintenance activities. The detailed, written inspection, test, component replacement, and repair procedures shall be included in the NAC-STC Operations Manual. The NAC-STC Operations Manual will be issued to Users of the packaging and will be prepared and issued prior to first use of the cask in each configuration.

There are no maintenance requirements for the welded canister containing either fuel or GTCC waste.

8.2.1 Structural and Pressure Tests of the Cask

The four lifting trunnions and the two rotation trunnion recesses shall be visually inspected prior to each shipment. The visual inspections shall be performed in accordance with approved written procedures, and inspection results shall be evaluated against established acceptance criteria.

Evidence of cracking on the load bearing surfaces shall be cause for rejection of the affected trunnion until an approved repair has been completed, and the surfaces re-inspected and accepted. Such repairs shall be implemented and documented in accordance with an approved QA program.

The lifting trunnions are also inspected annually in accordance with Paragraph 6.3.1(b) of ANSI N14.6. All accessible trunnion welds and accessible welds that are part of the load path are visually inspected for permanent deformation, galling, or cracking. Liquid penetrant examinations of welds and load bearing surfaces are performed in accordance with the ASME Code, Section V, Article 6 [3]. Liquid penetrant acceptance standards are those of Paragraph NF-5350 of the ASME Code, Section III, Division 1.

During periods of nonuse of the transport cask, the inspection of the trunnions may be omitted provided that the trunnions are inspected in accordance with this section prior to the next use.

8.2.2 Leak Tests

Leak tests are performed in accordance with the methodologies and requirements of ANSI N14.5-1997, using approved written procedures.

8.2.2.1 Containment Fabrication Verification Leak Test

The containment fabrication verification leak test is performed on each NAC-STC cask at the fabricator's facility in accordance with Section 8.1.3.

8.2.2.2 Containment Periodic Verification Leak Test

The periodic verification leak test shall be performed on each cask after the third use (prior to fourth cask loading sequence) and every twelve months thereafter to verify the containment capability and whenever a replaceable containment component is installed. Metallic O-rings used for the containment boundary seals shall be replaced during each cask loading operation and the seals leak tested in accordance with the containment system periodic verification leak test requirements. Viton O-rings shall be inspected prior to each use and replaced as necessary. Viton O-ring performance shall be demonstrated by leak testing prior to each shipment.

The periodic verification leak test shall be performed using approved written test procedures and in accordance with the test requirements and acceptance criteria established in Section 8.1.3 for the containment fabrication verification leak test.

During periods when the cask is not in use for transport, the periodic verification leak test need not be performed on an annual basis, but shall be reperformed prior to returning the cask to service and use as a transport package.

8.2.2.3 Acceptance Criteria

For the containment verification leak tests, the leak rate for containment boundary metallic O-rings shall be less than or equal to 2×10^{-7} cm^3/sec (helium). The minimum test sensitivity for both the fabrication verification and verification leak tests shall be 1.0×10^{-7} cm^3/sec (helium).

For Viton O-rings, the maximum (total) permissible leak rate for all containment boundary O-rings shall be less than or equal to 9.3×10^{-5} cm^3/sec (helium). The minimum test sensitivity for both the fabrication verification and verification leak tests shall be 4.7×10^{-5} cm^3/sec (helium). Unacceptable leak test results shall be cause for rejection of the component tested. Corrective actions, including repair or replacement of the O-rings and/or closure component, shall be taken and documented as appropriate. The leak test shall be repeated and accepted prior to returning the cask to service.

8.2.3 Subsystems Maintenance

There are no subsystems maintenance requirements on the NAC-STC.

8.2.4 Valves, Rupture Disks and Gaskets on the Containment Vessel

There are no valves on the NAC-STC packaging providing a containment function. Four quick-disconnects, one each on the vent, drain, inner lid interseal test and interlid ports, are provided for ease of cask operation.

The quick-disconnect shall be inspected during each cask loading and unloading operation for proper performance and function. As necessary, the subject quick-disconnect shall be replaced. The quick-disconnects shall be replaced every two years during transport operations, and following fuel unloading after extended storage.

There are no rupture disks on the NAC-STC containment vessel.

All O-rings on the NAC-STC shall be visually inspected for damage during each cask operation. All metallic O-rings shall be replaced during each cask loading sequence. PTFE O-rings shall be replaced if damage is noted during the visual inspection and every two years during transport operations. Viton O-rings shall be replaced annually and as required, based on leak testing results and inspections during operations.

8.2.5 Shielding

The gamma and neutron shields of the NAC-STC packaging do not degrade with time or usage. The radiation surveys performed by licensees prior to transport and upon receipt of the loaded cask provide a continuing validation of the shield effectiveness of the NAC-STC.

8.2.6 Periodic Thermal Test

A periodic thermal test program will be established for each operational NAC-STC packaging. During use of the packaging for transport operations, the periodic thermal test will be performed every five years, or prior to the next use if the period exceeds five years. For NAC-STC packagings utilized for extended storage operations exceeding five years, the periodic thermal test will be performed prior to transport. The periodic thermal test shall be performed in accordance with written, approved procedures.

8.2.6.1 Periodic Thermal Test Set-Up

For periodic thermal test performance, the cask will be in a vertical orientation, loaded with spent fuel, and at thermal equilibrium. For the periodic thermal test, thermal equilibrium is defined as a temperature change of ≤ 3°F/hr at a single centerline fin tip location.

The decay heat load and fuel cycle history of the fuel assemblies loaded in the cask will be known and recorded on the test data sheets. Thermocouples and/or a surface pyrometer calibrated to an accuracy of ± 2°F will be used for temperature measurements during the test.

8.2.6.2 Periodic Thermal Test Procedure

With the cask in a vertical orientation located in a cask preparation area or on a storage pad, a temperature measurement will be taken at a marked cask neutron shield shell centerline fin tip and recorded. Repeat temperature measurement at the marked fin tip location until thermal equilibrium criteria of a temperature change of ≤ 3°F/hr is met. Upon verification of thermal equilibrium, the test temperature measurements will be performed as follows:

- eight (8) fin tip locations will be marked and identified at 45° intervals in the top one-third of the neutron shield shell;
- eight (8) fin tip locations will be marked and identified at 45° intervals in the central one-third of the neutron shield shell;
- eight (8) fin tip locations will be marked and identified at 45° intervals in the bottom one-third of the neutron shield shell;

- four (4) upper forging surface locations will be marked and identified at 90° intervals above the neutron shield; and

- four (4) bottom forging surface locations will be marked and identified at 90° intervals below the neutron shield.

Temperature measurements will be taken and recorded at the twenty-four (24) marked fin tip locations and recorded on the test data sheets. Temperature measurements of the top forging and bottom forging will also be taken and recorded.

The test results will be reviewed and evaluated to verify the acceptance criteria of 8.2.6.3 are met. The results of the test will be documented in an approved test report and maintained in the packagings maintenance program records. If the acceptance criteria are not met, the cask will be tagged as non-conforming until corrective actions are taken. Upon completion of the corrective actions, the cask shall be retested to the original periodic thermal test requirements and acceptance criteria.

8.2.6.3 Periodic Thermal Test Acceptance Criteria

The relationship between the temperature of both ends of the cask relative to the average mid-plane temperature approaches unity as the cask heat load decreases from the design bases. The results of the periodic thermal test will be accepted if the test criteria of a), b), c), and d) below are met:

a) The temperature ratio for the outside surface of the top forging with respect to the average mid-plane neutron shield shell surface temperature meets the test criteria:

Design

$$\frac{T_{Top}}{T_{mid-plane}} = \frac{170}{243} = 0.7$$

Test

$$1.0 \geq \frac{T_{Top}}{T_{mid-plane}} \geq 0.7$$

b) The ratio of temperatures of the outside surface of the bottom forging with respect to average mid-plane neutron shield shell surface temperature meets the test criteria:

Design

Test

$$\frac{T_{Bottom}}{T_{mid-plane}} = \frac{280}{243} = 1.2 \qquad\qquad 1.0 \le \frac{T_{Bottom}}{T_{mid-plane}} \le 1.2$$

c) Measured temperatures at the top, bottom, and package mid-plane will be equal to or less than design values when corrected for heat load and ambient temperature in accordance with the following relationship:

$$T_{Actual} \le \frac{Q_{Decay}(T_{Design} - 100)}{Q_{Design}} + T_{Test\ Ambient}$$

d) The individual variations of fin tip temperatures around each zone (upper, middle, and lower) do not exceed 20°F from the zone average.

8.2.7 Miscellaneous

The transport impact limiters shall be visually inspected prior to each shipment. The limiters shall be visually inspected for gross damage or cracking to the stainless steel shells in accordance with approved written procedures and established acceptance criteria. Impact limiters not meeting the established acceptance criteria shall be rejected until repairs are performed and the component reinspected and accepted.

The cask cavity shall be visually inspected prior to each fuel loading. Evidence of gross scoring of the cavity surface, or build-up of other foreign matter in the cask cavity that could block the cavity drainage paths shall be cause for rejection of the cask for use until approved maintenance and/or repair activities have been acceptably completed. The basket assembly for the directly loaded (uncanistered) or canistered configuration shall be visually inspected for deformation of the basket disks or tubes. Evidence of damage shall be cause for rejection of the basket until approved repair activities have been completed, and the basket has been re-inspected and approved for use.

The overall condition of the cask, including the fit and function of all removable components, shall be visually inspected and documented during each cask use. Components or cask conditions which are not in compliance with the Certificate of Compliance shall cause the cask to be rejected for transport use until repairs and/or replacement of the cask or component are performed, and the component reinspected and accepted.

The results of the visual inspections, leak tests, shielding and radiological contamination surveys; fuel identification information for the package contents; date, time, and location of the cask loading operations; and remarks regarding replaced components shall be included in the cask loading report for each loaded cask transport. The requirements of the cask loading report shall be detailed in the NAC-STC Operations Manual.

8.2.8 Maintenance Program Schedule

Table 8.2-1 presents the overall maintenance program schedule for the NAC-STC.

Table 8.2-1 Maintenance Program Schedule

Task	Frequency
Cavity Visual Inspection	Prior to Fuel Loading
Basket Visual Inspection	Prior to Fuel Loading
O-ring Visual Inspection	Prior to Fuel Loading
Outer Lid, Inner Lid and Port Coverplate Bolt Visual Inspection	Prior to installation during each use
Cask Visual and Proper Function Inspections	Prior to each Shipment
Lifting and Rotation Trunnion Visual Inspection Liquid Penetrant Inspection of surfaces and accessible welds	 Prior to each Shipment Annually during use
Maintenance Periodic Leak Rate Test of Inner Lid and Port Coverplate O-rings	For Viton O-rings, annually or when replaced. For metallic O-rings, prior to each shipment
Preshipment Leak Rate Test	Prior to shipment for casks with Viton O-rings
Transport Impact Limiter Visual Inspection	Prior to each shipment
Quick-disconnect Inspection for Proper Function	During each Cask Loading/Unloading Operation
Quick-disconnect Replacement	Every two years during transport operations
Metallic O-ring Replacement	Prior to installation for a loaded transport
Viton O-ring Replacement	Annually, or more often, based on inspection or leak test results
Inner and Outer Lid Bolt Replacement	Every 240 bolting cycles (Every 20 years at 12 cycles per year)
PTFE O-ring Replacement	Every two years during transport operations or as required by inspection
Periodic Leakage Rate Test	Performed within 12 months prior to each shipment for Viton O-rings. No testing needed for out-of-service packaging.
Periodic Thermal Test	Every five years during transport operations, or prior to transport following extended storage periods exceeding five years.

8.3 Quick-Disconnect Valves

"Snap-Tite" quick-disconnect nipples (quick-disconnects) are used in the vent, drain, and inner lid interseal test ports to isolate the cavity, and in the interlid port to isolate the region between the inner and outer lids. No credit is taken for any containment function provided by these components. The drain line quick-disconnect of the Transportable Storage Canister need not be valved.

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8.4 Cask Body Fabrication

8.4.1 General Fabrication Procedures

The NAC-STC cask body is a welded structure of stainless steel plates and forgings. Chemical Copper lead is poured in place between the inner and outer shells to serve as the main gamma shielding material. NS-4-FR is poured in place between the neutron shield shell and the outer shell. NS-4-FR is also form fit between the bottom inner forging and the bottom plate and in the inner lid. Welding on the NAC-STC shall be performed in accordance with the requirements of the ASME Code and the American Welding Society (AWS) Structural Welding Code - Steel (ANSI/AWS D.1-1) as specified on the NAC-STC License Drawings and Section 8.1.1.

The general fabrication procedures for the NAC-STC are summarized, herein, to facilitate an understanding of the component configurations and the weld locations shown on the license drawings.

Each of the two inner shell rings (upper and lower) is rolled from Type XM-19 stainless steel plate and seam welded longitudinally. The outside diameter of each inner shell ring is machined to the defined transition section dimensions. The minimum length of each Type XM-19 shell ring shall be in accordance with the License Drawings. The central inner shell sections are each rolled from Type 304 stainless steel plate and seam welded longitudinally. The number and length of the individual inner shell sections to be used to obtain the required total inner shell length is optional. The inner shell sections are girth welded to each other and the inner shell rings are girth welded on each end of the inner shell. Longitudinal seam welds in adjacent inner shell sections shall be offset 180 degrees for girth-welded sections.

After initial rough machining and final weld preparation, the top forging and the bottom inner forging are individually welded to the opposite ends of the inner shell/inner shell ring weldment to form the cask cavity. The preparation, examination, and acceptance procedures for the welds are described in Section 8.1.1 and defined on the License Drawings. Following inspection and acceptance of the welds, the top forging and the outside diameter of the cask cavity weldment are final machined. Following final machining of both sides of the inner shell, an ultrasonic thickness test of the inner shell wall of the cask cavity shall be performed to confirm that the wall thickness of any location on the shell is not less than 1.46 inches (37.1 mm). A wall thickness at any location of less that 1.46 inches (37.1 mm) will be cause for rejection. Rejected areas of the shell wall can be repaired by weld overlay using approved written weld overlay procedures. Following repair, the repaired areas shall be examined in accordance with the original inspection requirements and acceptance criteria.

Following thickness testing, the cask cavity weldment, which is the NAC-STC primary containment boundary, shall be hydrostatically tested according to ASME Code, Section III, Subsection NB-6000, as described in Section 8.1.2.3. The cask cavity weldment is dried, the primary containment boundary welds are liquid penetrant examined in accordance with ASME Code, Section V, Article 6, and the welds are accepted in accordance with ASME Code, Section III, Subsection NB-5350. The cask cavity weldment is then helium leak tested to verify that the Containment System Fabrication Verification leak rate is satisfied, as described in Section 8.1.3.

Each of the outer shell sections is rolled from Type 304 stainless steel plate and seam welded longitudinally. The number and length of outer shell sections to be used to achieve the required total outer shell length is optional. The outer shell sections are girth welded to each other and the inside diameter of the "outer shell weldment" is final machined. Longitudinal seam welds in adjacent outer shell sections are offset 180 degrees for girth-welded sections. The outer shell weldment is welded to the cask cavity weldment at the top forging/outer shell interface to form the "body weldment." The preparation, examination, and acceptance procedures for the welds are described in Section 8.1.1 and defined on the License Drawings.

The body weldment is inverted (closure end down) in a pit or other sheltered location in preparation for lead pouring. A temporary dam extension and supports are welded to the open end of the outer shell to permit the full length of the lead shell to be poured and to maintain the outer shell position. "Backing bars" are tack-welded on the inside diameter of the outer shell overlapping the end of the weld prep and on the top surface of the bottom inner forging overlapping the outside diameter of the forging (adjacent to the outside diameter of the inner shell). The backing bars prevent the lead contamination of the welds when the outer shell/bottom outer forging weld and the bottom outer forging/bottom inner forging weld are performed after cask body cooldown following the lead pour. Lead pouring preparations, the pour itself, and the cooldown are performed in accordance with the lead pour requirements and procedures as described in Section 8.4.2.

Following cooldown, the cask may be moved to a location that is more suitable for the fabrication activities that are to follow. The temporary dam extension and supports at the open end of the outer shell are removed and the lead is machined to its final configuration, including facing off the backing bars to ensure that no lead remains on the weld side of the backing bars.

The bottom outer forging is welded to the outer shell and to the bottom inner forging with the backing bars preventing lead contamination of the welds. The weld examination and acceptance criteria are described in Section 8.1.1 and defined on the License Drawings. The NS-4-FR neutron shield material is installed in the bottom forging of the NAC-STC. The NS-4-FR is machined to obtain the specified 2-inch thickness and to provide a groove around the outside diameter. A backing bar is tack-welded on the inside diameter of the bottom outer forging in the groove in the NS-4-FR and flush with its surface. The bottom plate is positioned and welded to the bottom outer forging. The weld examination and acceptance criteria are described in Section 8.1.1 and are defined on the License Drawings.

The outside diameter of the outer shell is then machined to the specified final dimensions. If required to achieve dimensional compliance with the License Drawings, additional localized machining of the inner shell will be performed. Remachined areas of the inner shell shall be re-examined by ultrasonic testing to confirm that the minimum thickness of 1.46 inches (37.1 mm) is maintained. Upon completion of final machining and prior to removal from the machine, the dimensional inspection of the inside diameter and cylindricity of the cavity shall be performed. Using inside micrometers, the inside diameter at 0, 45, 90 and 135 degree radial locations shall be measured. This measurement shall be repeated at a minimum of 6 axial locations through the bore of the inner shell. Using a dial indicator or the electronic measuring system on the machine, a "sweep" of the entire length of the bore at the same radial locations measured with the inside micrometers and also a "sweep" of the diameter at the same axial locations will be performed. The combination of these two inspections will demonstrate the actual diameter and cylindricity of the inner shell bore. Calibrated inspection equipment and approved written procedures will be used to perform the final dimensional inspections.

The Type 17-4 PH stainless steel lifting trunnions are welded to the top forging. The Type 17-4 PH stainless steel rotation trunnion recesses are welded to the outer shell at its juncture with the bottom outer forging. Both the lifting trunnion and rotation trunnion recess weld surfaces are prepared with a minimum 0.25-inch thick overlay of Inconel. The shear ring and the neutron shield upper end plate are welded to the top forging. The weld examination and acceptance criteria are described in Section 8.1.1, and are defined on the License Drawings.

The explosively-bonded stainless steel/copper (SS/Cu) heat transfer fins extending through the neutron shield are welded (only the stainless steel is welded) to the upper end plate and to the outer shell. Following liquid penetrant examination of the fin to outer shell welds, the 24 neutron shield shell plates are prepared for installation and 1/8-inch thick expansion foam is applied to the interior surface using approved adhesive in accordance with the License Drawings. The neutron shield shell plates are individually positioned and welded to the stainless steel extended tip of the SS/Cu fins. These closure welds are then examined and accepted in accordance with the requirements of the License Drawings. The cask is then placed in the inverted position (closure end down). Following an installation procedure that has been approved by NAC and by the material supplier, the NS-4-FR neutron shield material is installed by pouring into each of the 24 regions between the fins in the NAC-STC neutron shield cavity. After the NS-4-FR has hardened, expansion foam (Section 4.5.3) is installed in the open end of the neutron shield. The inside and outside diametrical (curved) surfaces of the expansion foam are covered by a protective thermal insulation material (Fiberfrax, see Section 4.5.4). The 24 sections of the neutron shield bottom end plate are each positioned and welded to the outer shell, the fins, the neutron shield shell, and to each other. All of the neutron shield and fin welds are liquid penetrant examined and accepted in accordance with the License Drawings. The neutron shield tank is leak tested using the pneumatic bubble method to verify shell integrity.

The Type 17-4 PH stainless steel outer lid forging and the Type 304 stainless steel inner lid forging are machined to the specified final dimensions. The NS-4-FR neutron shield material is installed in the top of the inner lid following an installation procedure that has been approved by NAC and by the material supplier. The exposed surface of the NS-4-FR is machined to obtain the specified 2-inch thickness and the coverplate is welded to the inner lid body. The weld examination and acceptance are in accordance with the requirements of the License Drawings. The top surface of the inner lid is then final machined.

The remaining fabrication details (including the installation of the drain line) are then completed.

Following machining of the structural steel support disks and the aluminum heat transfer disks, the components will be individually inspected for dimensional compliance to the License Drawings to ensure that each disk meets the stated tolerances. The diameter of each disk is measured using a calibrated external micrometer. The openings in each disk are inspected using a calibrated three coordinate measurement machine. The machining center may also be used for these inspections if previously qualified and calibrated. In the case of the diametral tolerances of the disks, the inspections are performed at 65 ± 5°F (18 ± 3°C) or else thermal expansion corrections will be addressed during the inspection process.

The separately fabricated and assembled fuel basket is then inserted into the cask body by carefully guiding the pre-assembled basket into the cask cavity. The acceptance tests described in Section 8.1, not previously completed during fabrication, are performed and the completed NAC-STC is prepared for delivery.

8.4.2 Description of Lead Pour Procedures

This section describes the general requirements and the procedure that applies to the pouring of the lead in the annulus formed by the inner and outer shells of the NAC-STC cask body. The lead annulus provides the primary radial gamma shielding in the cask body and is subjected to a gamma scan test to verify its shielding integrity. The description that follows includes the pre-pour preparations, the pouring of the molten lead in the annulus between the inner and outer shells of the NAC-STC, and the post-pour controlled cooldown of the cask.

8.4.2.1 Preparation for Lead Pour

The following activities must be completed in preparation for pouring of the lead in the NAC-STC cask body:

1. Temporary stiffener bars/rings are installed both inside and outside of the body weldment at intermittent locations along the cask length. The stiffeners support the inner and outer shells during the lead pour and cooldown in order to maintain the specified dimensions of the lead annulus. The stiffeners are removed after the cooldown operation is completed.

2. A minimum of 12 pairs of thermocouples are used to monitor the heating and cooling cycle of the inner and outer shells. Each pair of thermocouples is positioned at approximately the same radial and axial location, one on the inside diameter of the inner shell and one on the outside diameter of the outer shell.

3. Electric heaters are installed in the cask cavity for use in heating the inner shell.

4. The body weldment (Section 8.4.1) of the NAC-STC is inverted and supported in a stable, vertical position in a "pit" or within a windbreak structure to provide a basically draft-free operations area.

5. An auxiliary dam extension and supports are welded to the open end of the outer shell. The extension and supports permit the full length of the lead shell to be poured in one operation while maintaining the annulus spacing at the open end of the outer shell.

6. A minimum of 20 gas heating/water cooling rings are installed around the outside of the body weldment for use in heating, and later in cooling, the outer shell. Gas torches are provided for heating the outside surface of the bottom inner forging.

7. The body weldment surfaces, especially the lead annulus, are checked for dimensional accuracy to ensure that the required spacing has been maintained and for cleanliness to ensure that no foreign materials are present.

8. The general arrangement of the equipment for the lead pour operation is shown in Figure 8.4-1.

8.4.2.2 Lead Pour Operations

The requirements and activities that must be completed during the pouring of the lead in the NAC-STC cask body are:

1. The lead material certification is checked to ensure that it conforms to the requirements of the American Society of Testing Materials (ASTM) B29, Chemical Copper Grade - 99.90 percent pure.

2. Approximately 60,000 pounds of lead is placed in appropriate size kettles and melted. During the lead pouring operations the temperature of the molten lead is maintained between 650°F (343°C) and 750°F (399°C).

3. At the same time that the lead is being melted, the NAC-STC body weldment is simultaneously heated using both the electric heaters on the interior and the gas heating rings on the exterior. The body weldment will be heated in a steady and uniform manner at a rate not exceeding 125°F/hour (52°C/hour). Gas torches are used to heat the exterior of the bottom inner forging. The surface temperature of the body weldment is never permitted to exceed 800°F (427°C). The temperature of the entire

body weldment is maintained between 640°F (338°C) and 740°F (393°C) throughout the lead pour operations.

4. The lead pour is initiated immediately after the temperatures of the lead and the body weldment are stabilized in the ranges previously specified. The actual pouring of the lead is completed without interruption and in as short a period of time as possible. During the lead pour the bottom end of the filler-tube is kept below the surface of the molten lead to preclude the formation of voids in the lead.

5. The lead is poured to a level that is sufficient to ensure that dross removal and contraction during solidification do not reduce the finished surface below the required level. A long steel rod inserted into the molten lead annulus is used to ensure that no solidification has begun anywhere in the volume of molten lead.

8.4.2.3 Cooldown Following Lead Pour

The procedures and requirements that must be completed during cooldown of the NAC-STC body weldment following completion of the lead pour are as follows:

1. Cooldown is initiated by turning off the electrical heater (interior) and the gas heating/water cooling ring (exterior) at the lowest end of the cask (in the as-poured position). The gas heating/water cooling ring is then used to facilitate and control cooling by spraying water on the exterior surface of the cask. As cooldown proceeds, the heaters and rings upward along the cask are successively turned off and the cooling water spray is turned on from each ring.

2. The cooldown process is temperature controlled to maintain approximately uniform solidification conditions across the thickness and around the circumference of the annulus.

3. The cooldown rate is held steady and uniform at a rate not to exceed 125°F/hour (52°C/hour) and the temperature differential between the inside shell and the outside shell is not allowed to exceed 100°F (38°C). Once the inner and outer shell temperatures have cooled to 150°F (66°C), it is no longer necessary to control the cooldown rate.

4. The solidification level in the lead annulus is checked with the aid of a long steel rod. The maximum difference in the elevation of the solidified lead between the inside surface of the outer shell and the outside surface of the inner shell is not permitted to exceed 2 inches (51 mm).

5. Dross is skimmed off the top of the lead while maintaining the molten head throughout the cooldown process.

8.4.2.4 Lead Pour Documentation

The following data is included in the Data Package for the Lead Pour Operation:

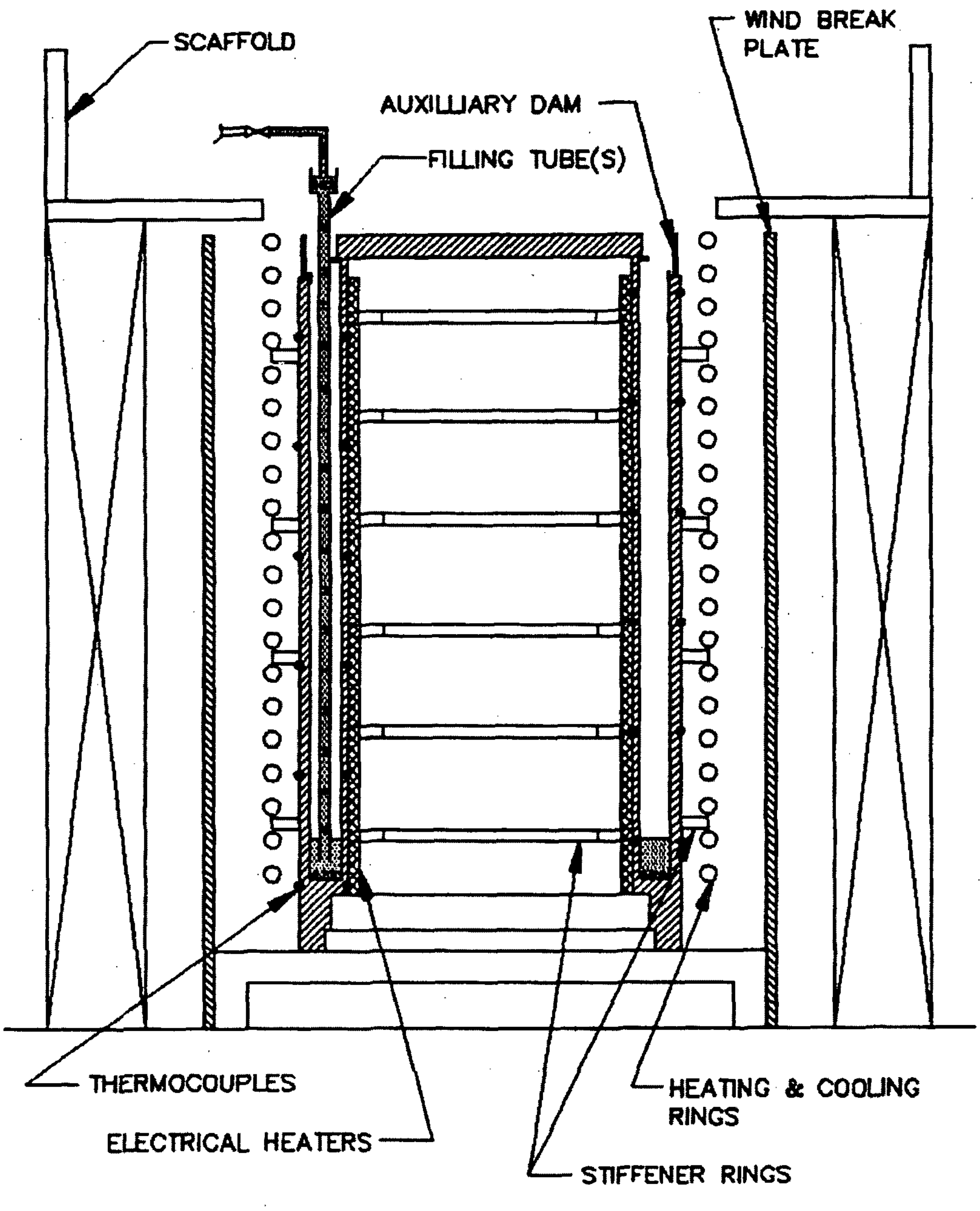
1. Certificate of Chemical Analysis of the lead.

2. Heating and cooling charts showing elapsed time and temperatures.

3. Location, time and temperature for readings taken with a handheld pyrometer or other temperature reading device.

4. Difference in solidification elevations when checking at the inside surface of the outer shell and the outside surface of the inner shell.

Figure 8.4-1 Arrangement of Lead Pour Equipment



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