71-5942

PDR
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GENERAL ELECTRIC

NUCLEAR ENERGY BUSINESS OPERATIONS
GENERAL ELECTRIC COMPANY • VALLECITOS NUCLEAR CENTER • PLEASANTON, CALIFORNIA 94566

'85 JUN -7 A10:57

June 5, 1985

Mr. C. E. MacDonald, Chief
Transportation Certification Branch
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

References:
1) Certificate of Compliance No. 5942, Docket 71-5942.
2) Application for Amendment to Certificate of Compliance No. 5942; May 30, 1985.
3) Application for Renewal of Certificate of Compliance No. 5942; May 30, 1985.

Dear Mr. MacDonald:

On May 30, 1985, General Electric requested an additional loading for the Model 700 shipping container (Ref. 2). General Electric wishes to supersede that application with the following proposed Section 5.(b)(2)(viii) to read:

(viii) 3,510 gm U-235 provided the fuel is in the form of MTR-type fuel elements with each element containing no more than 351 gm U-235 and inserted in a spaced stainless steel fuel shipping basket described in GE Drawing No. 106D4150, Rev. 0. A shoring device to limit vertical motion of the fuel elements will be included.

This request is supported by the attached criticality safety analysis.

An application fee check for $150.00 has been submitted with the May 30, 1985, request (Ref. 2).

Please add any action taken in regard to this request to our renewal application (Ref. 3) for Certificate of Compliance No. 5942.

RECEIVED
'85 JUN 20 A10:09
U.S. N.R.C. FEE MGMT BRANCH

Sincerely,

D. E. Cunningham

G. E. Cunningham
Senior Licensing Engineer

/ca

Att.

DOCKETED USNRC
JUN 11 1985
NMSS MAIL SECTION DOCKET CLERK

FEE EXEMPT
add up to 5/30/85 appl.
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CRITICALITY EVALUATION

A criticality evaluation of the General Electric 700 cask is given below. This cask has a cavity that is 15 inches in diameter by 54.75 inches long for holding material, including special nuclear material. The cask is of steel-encased, lead-shielded construction. If two casks are side by side, a minimum of at least 21.875 inches edge-to-edge separation is provided between the contents of one cask from the contents of the other.

6.1 Discussion and Results

Compliance with 10CFR71.40 for Fissile Class III shipments is demonstrated below for one loading. This loading involves 10 MTR-type fuel elements in which the elements are inserted in a stainless steel basket in a cask. The basket provides a fixed neutron poison for each fuel element. Each fuel element has 18 plates containing 19.5 grams U-235 of fully enriched uranium per plate. Each fuel element also contains two aluminum support plates. This gives 351 grams U-235 per fuel element and 3,510 grams U-235 per cask.

The contents of the cask during shipment are dry. After the accident mentioned in 10CFR71.33-.40, the contents of the cask are assumed to be wet. Also, for loading and unloading activities for which hot cells are not available, the loading and unloading may be accomplished under water. After an underwater loading is completed, for example, the lid is placed on the cask and the cask is removed from the water; then the water is drained from the cask.

In the discussion below, details of the package fuel loading are presented first. Then a description of the models used to calculate the k-effective values for the fuel loading is presented. This is followed by the criticality calculation discussion for each of the models. Finally, the criticality benchmark experiments section is presented.

6.2 Package Fuel Loading

The type, form, and maximum quantity of special nuclear material per package are:

1. 3,510 grams U-235 provided the fuel is in the form of MTR-type fuel elements with each element containing no more than 351 grams U-235 and inserted in a spaced stainless steel fuel shipping basket described in GE Drawing No. 106D4150, Rev. 0. A shoring device to limit vertical motion of the fuel elements will be included.

The loading above qualifies as Fissile Class III under provisions of 10CFR71.40, and the maximum number of packages per shipment is one (1).

6.3 Model Specification

The model for normal conditions is two casks side-by-side separated by 21.875 inches. The 15-inch cask inside diameter and the 36.875-inch cask outside diameter provide this minimum separation radially. When the overpacks are installed on each of the casks, the separation is greater; so the 21.875 inches is conservative. The gap between the casks is filled with a water mist having a density of 8.8 E-5 grams H_2O/cc, representing a humid condition of saturated air at about 120°F and at atmospheric pressure. The 8.8 E-5 density is then changed to 0.001, 0.01, 0.1, and 1.0 grams H_2O/cc; and the k-effective values are calculated for each of these densities. These models are formed with the ten fuel elements loaded inside a basket for each cask, but the two baskets and the 21.875 inches separating them are formed outside of the cask. This two-basket array is reflected on all sides by 12 inches of water.

The model for one cask under accident conditions involves ten fuel elements loaded in a basket that is fully flooded and reflected on all sides by 12 inches of water. The model is formed outside the cask, even though the flooding inside the cask would give a lower k-effective due to less water reflection immediately around the basket, and due to the neutron poisoning of the steel forming the cask cavity inside the cask and supporting the lead outside the cask. Therefore, the modeling of the fuel elements in the basket outside of the cask is conservative; and the same model may be used for determining k-effective values under conditions of underwater loading of the basket.

More details of this model are described below.

6.3.1 Description of Calculational Models

In this calculation, each fuel plate in a fuel element and each fuel element in a basket are described in three dimensions discretely. The model is prepared as input to the SCALE System using the 27GROUPNDF4 cross-section set and the KENO-IV criticality code to perform the k-effective calculations. The fuel element modeling is described first. Then the basket modeling is presented.

Each fuel element contains 20 plates: 18 fuel plates are in the middle of the fuel element, and two aluminum plates are at the top and bottom of each fuel element, respectively. Each fuel plate contains fuel meat that is 2.25 inches wide, 0.0228 inches thick, and 22.75 inches long. Each fuel plate contains 19.5 grams U-235 in this fuel meat space. The fuel meat is clad with 0.0136 inches of aluminum such that the fuel plate thickness becomes 0.05 inches.

Each fuel plate in the fuel element is separated by a gap of 0.096 inches in the center of the fuel element. These gap thicknesses change in the outer three layers to 0.108 inches, 0.118 inches, and 0.100 inches, respectively. See Figure 6.3.1-1. The aluminum beyond the 2.25-inch width and the 22.75-inch length of the fuel meat is represented as either water or water mist in this model. The numerical results of this modeling may be seen in Table 6.3.1-1 under Box Type 1 or Box Type 2.

The basket is modeled as a 304 stainless steel structure that has walls which are 0.25 inches thick and contain ten holes that measure 3.18 inches square by 22.75 inches long. There are three holes in the upper and lower rows and four holes in the middle row sufficient to hold 10 fuel elements. See Figure 6.3.1-2. The numerical results of this modeling may be seen in Table 6.3.1-1, and the arrangement of all the boxes showing two baskets separated by 21.875 inches may be seen in the same table in between the END GEOMETRY and END KENO cards.

6.3.2 Package Regional Densities

The number densities for the materials used in this model may be seen in Tables 6.3.1-1 and 6.4-1 through 6.4-5. The number density used for the fuel meat was 0.00261362 atoms/barn-cm for U-235. A molecular weight of 235.043933 gram/gram-mole and an Avogadro's number of 6.025 E23 gram-atom/gram-mole were used in calculating this number density. Other materials in the fuel meat such as U-238, oxygen, silicone, etc., were not modeled. The number densities for the materials specified in Table 6.3.1-1 that are provided by the SCALE system for the 27GROUPNDF4 cross-section set are shown in Tables 6.4-1 through 6.4-5.

6.4 Criticality Calculations

The SCALE* System that is running on the Control Data Corporation 7600 Computer at General Electric's Nuclear Energy Business Operations was used for the k-effective calculations.

The 27GROUPNDF4 cross-section set and the KENO-IV criticality code in the SCALE system were used to perform these calculations. The results of these calculations may be seen in Figure 6.4-1 and in Tables 6.4-1 through 6.4-5.

In Figure 6.4-1, k-effective values are plotted as a function of mist density. These results show the peak k-effective to be less than 0.87 for the fully water-flooded accident condition, and less than 0.33 for the mist densities up to 0.1 grams H_2O/cc. Thirty-thousand neutron histories were run to obtain the 0.87 k-effective result. However, all of the mist density calculations were stopped by a 15-minute time limit. The smallest number of histories run was 25,500. More detailed numerical results of all of these calculations may be seen in Tables 6.4-1 through 6.4-5.

6.5 Critical Benchmark Experiments

In the discussion below, the benchmark experiments are presented first. This is followed by tables showing models of these experiments prepared as input to the SCALE system. Then the k-effective results using these models are presented, followed by the determination of biases required for each of the types of fissile material.

*Bucholz, J. A., "SCALE: A Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation", NUREG/CR-0200, ORNL/NUREG/CSD/2, Volume 1, Oak Ridge National Laboratory; July, 1980.

6.5.1 Benchmark Experiments and Applicability

Uranium with enrichments varying from 1.3 w/o to fully enriched and plutonium are the fissile materials that are considered in the validation of SCALE for this evaluation. The forms include fully enriched homogeneous uranium-water mixtures, low-enriched heterogeneous uranium dioxide-water mixtures, and homogeneous plutonium-water mixtures.

In Table 6.5.1-1 below, critical experiments suitable for validation are identified.

6.5.2 Details of the Benchmark Calculations

Models of TRX-1 and TRX-2 prepared as input to the SCALE system are shown in Tables 6.5.2-1 and 6.5.2-2, respectively. Models of ORNL-1 and ORNL-2 are shown in Table 6.5.2-3. Models of PNL-1 and PNL-2 are shown in Table 6.5.2-4. Models of the B&W UO_2 rod and MO_2 rod are shown in Table 6.5.2-5.

6.5.3 K-Effective Results of the Benchmark Calculations

K-effective results are presented for the ORNL, PNL, TRX, and B&W critical experiments in Table 6.5.3-1.

It is concluded that use of the SCALE System using the 27GROUPNDF4 cross-section set requires a negative 0.3 percent bias on the one sigma deviation for fully enriched uranium solutions and no bias for plutonium solutions; a negative bias of 2.3 percent on the mean value and 0.3 percent on the one sigma deviation for the multiplication factor must be applied for low-enriched, clumped uranium rods in water.

A bias of 2.3 percent on the mean value and 0.3 percent on the one sigma deviation is applied to the k-effective results in Figure 6.4-1 in this evaluation.

FIGURE 6.3.1-1

FUEL ELEMENT SCHEMATIC

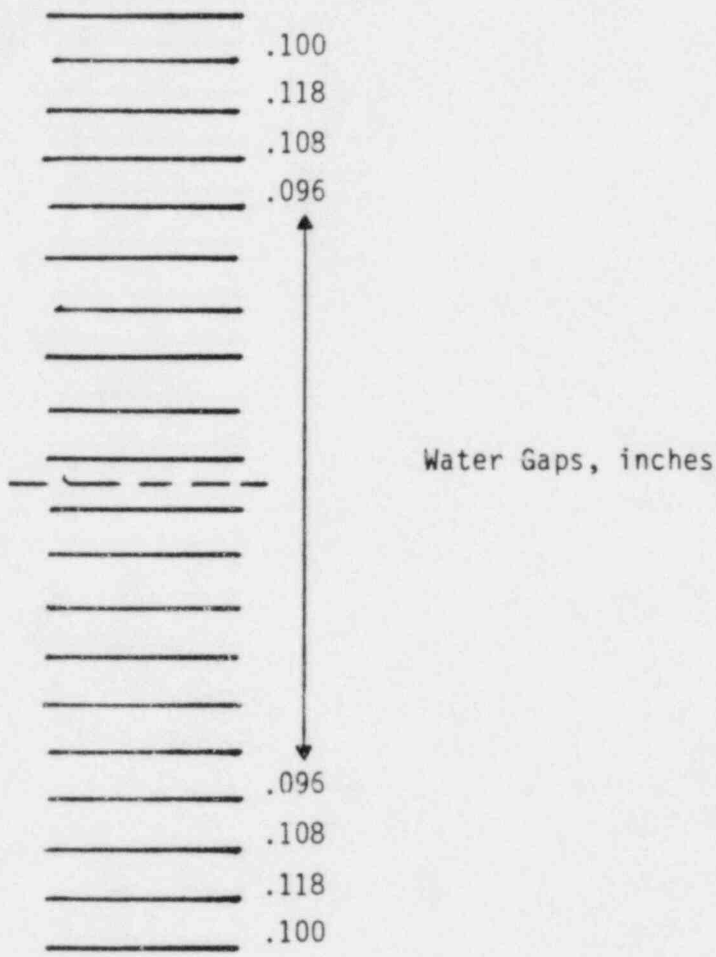

FIGURE 6.3.1-2

FUEL BASKET SCHEMATIC

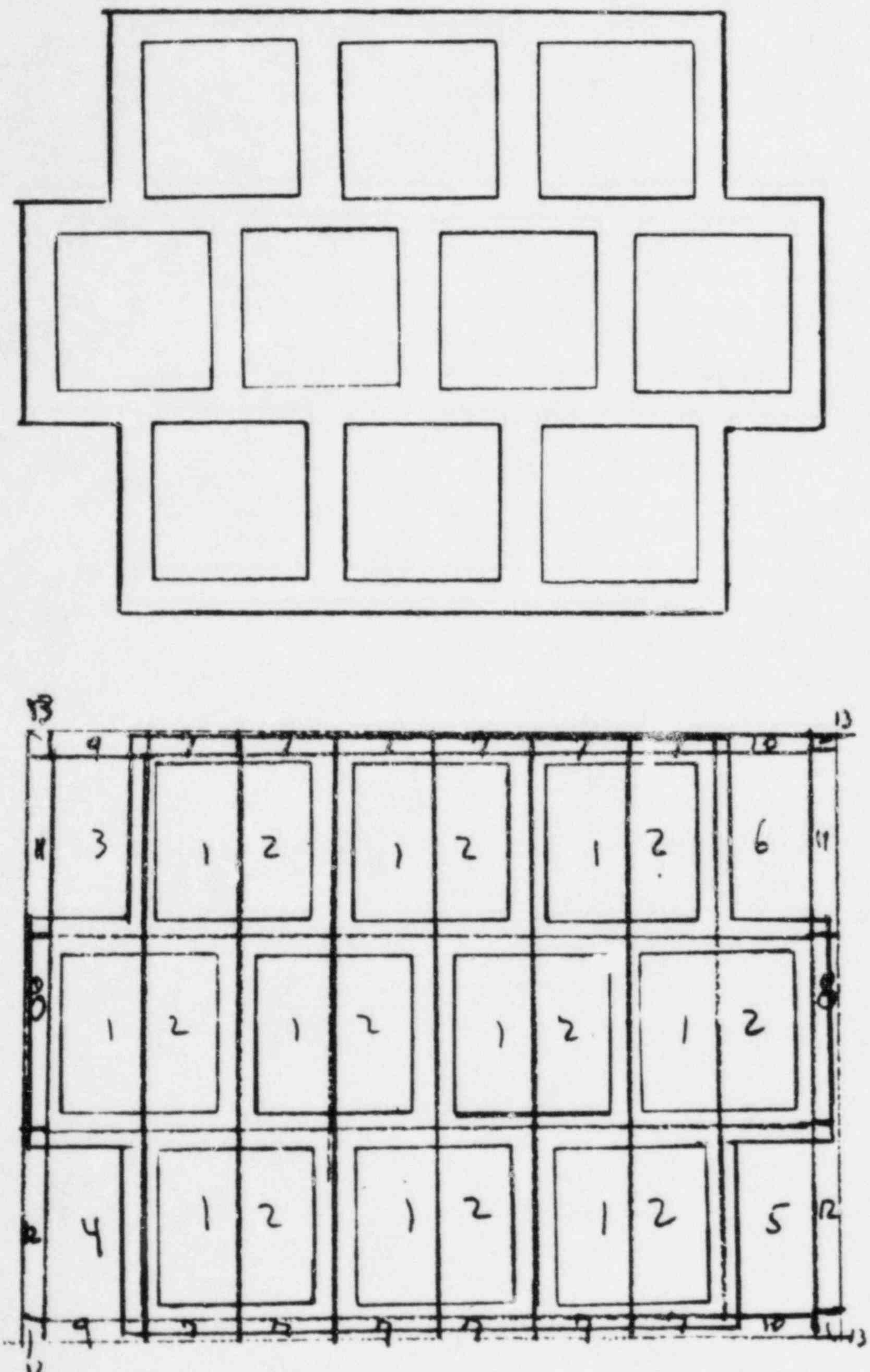

TABLE 6.3.1-1

```
KEFF BNL FUEL SHIPPING ARRAY  FWR 2 CONT SIDE-BY-SIDE
27GROUPNDF4  7  7  3  LATTICECELL  0  0
U-235  1 0. 2.61362-3 END
AL  2 1. END
H2O  3 8.8-5 END
AL  4 1. END
H2O  5 1. END
SS304  6 1. END
H2O  7 8.8-5 END
SYMMSLABCELL       0.37084 0.057912 1 3 0.127 2 END
KEFF BNL FUEL SHIPPING ARRAY  FWR 2 CONT SIDE-BY-SIDE
15.0 103 300 3 16 21 5 1 0
BOX TYPE      1
CUBOID  3   0. -2.857500   .121920  -.121920 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500   .156464  -.156464 28.892500 -28.892500 -0.5
CUBOID  1   0. -2.857500   .214376  -.214376 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500   .248920  -.248920 28.892500 -28.892500 -0.5
CUBOID  3   0. -2.857500   .492760  -.492760 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500   .527304  -.527304 28.892500 -28.892500 -0.5
CUBOID  1   0. -2.857500   .585216  -.585216 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500   .619760  -.619760 28.892500 -28.892500 -0.5
CUBOID  3   0. -2.857500   .863600  -.863600 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500   .898144  -.898144 28.892500 -28.892500 -0.5
CUBOID  1   0. -2.857500   .956056  -.956056 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500   .990600  -.990600 28.892500 -28.892500 -0.5
CUBOID  3   0. -2.857500  1.234440 -1.234440 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500  1.268984 -1.268984 28.892500 -28.892500 -0.5
CUBOID  1   0. -2.857500  1.326896 -1.326896 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500  1.361440 -1.361440 28.892500 -28.892500 -0.5
CUBOID  3   0. -2.857500  1.605280 -1.605280 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500  1.639824 -1.639824 28.892500 -28.892500 -0.5
CUBOID  1   0. -2.857500  1.697736 -1.697736 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500  1.732280 -1.732280 28.892500 -28.892500 -0.5
CUBOID  3   0. -2.857500  1.976120 -1.976120 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500  2.010664 -2.010664 28.892500 -28.892500 -0.5
CUBOID  1   0. -2.857500  2.068576 -2.068576 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500  2.103120 -2.103120 28.892500 -28.892500 -0.5
CUBOID  3   0. -2.857500  2.346960 -2.346960 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500  2.381504 -2.381504 28.892500 -28.892500 -0.5
CUBOID  1   0. -2.857500  2.439416 -2.439416 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500  2.473960 -2.473960 28.892500 -28.892500 -0.5
CUBOID  3   0. -2.857500  2.748280 -2.748280 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500  2.782824 -2.782824 28.892500 -28.892500 -0.5
CUBOID  1   0. -2.857500  2.840736 -2.840736 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500  2.875280 -2.875280 28.892500 -28.892500 -0.5
CUBOID  3   0. -2.857500  3.175000 -3.175000 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500  3.209544 -3.209544 28.892500 -28.892500 -0.5
CUBOID  1   0. -2.857500  3.267456 -3.267456 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500  3.302000 -3.302000 28.892500 -28.892500 -0.5
CUBOID  3   0. -2.857500  3.556000 -3.556000 28.892500 -28.892500 -0.5
CUBOID  2   0. -2.857500  3.683000 -3.683000 28.892500 -28.892500 -0.5
CUBOID     7    0.000     -4.039      4.039     -4.039     28.8925   -28.8925 -0.5
CUBOID     6    0.000     -4.356      4.356     -4.356     28.8925   -28.8925 -0.5
```

TABLE 6.3.1-1 (CONTINUED)

BOX TYPE	2							
CUBOID	3	2.857500	-0.	.121920	-.121920	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	.156464	-.156464	28.892500	-28.892500	-0.5
CUBOID	1	2.857500	-0.	.214376	-.214376	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	.248920	-.248920	28.892500	-28.892500	-0.5
CUBOID	3	2.857500	-0.	.492760	-.492760	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	.527304	-.527304	28.892500	-28.892500	-0.5
CUBOID	1	2.857500	-0.	.585216	-.585216	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	.619760	-.619760	28.892500	-28.892500	-0.5
CUBOID	3	2.857500	-0.	.863600	-.863600	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	.898144	-.898144	28.892500	-28.892500	-0.5
CUBOID	1	2.857500	-0.	.956056	-.956056	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	.990600	-.990600	28.892500	-28.892500	-0.5
CUBOID	3	2.857500	-0.	1.234440	-1.234440	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	1.268984	-1.268984	28.892500	-28.892500	-0.5
CUBOID	1	2.857500	-0.	1.326896	-1.326896	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	1.361440	-1.361440	28.892500	-28.892500	-0.5
CUBOID	3	2.857500	-0.	1.605280	-1.605280	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	1.639824	-1.639824	28.892500	-28.892500	-0.5
CUBOID	1	2.857500	-0.	1.697736	-1.697736	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	1.732280	-1.732280	28.892500	-28.892500	-0.5
CUBOID	3	2.857500	-0.	1.976120	-1.976120	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	2.010664	-2.010664	28.892500	-28.892500	-0.5
CUBOID	1	2.857500	-0.	2.068576	-2.068576	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	2.103120	-2.103120	28.892500	-28.892500	-0.5
CUBOID	3	2.857500	-0.	2.346960	-2.346960	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	2.381504	-2.381504	28.892500	-28.892500	-0.5
CUBOID	1	2.857500	-0.	2.439416	-2.439416	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	2.473960	-2.473960	28.892500	-28.892500	-0.5
CUBOID	3	2.857500	-0.	2.748280	-2.748280	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	2.782824	-2.782824	28.892500	-28.892500	-0.5
CUBOID	1	2.857500	-0.	2.840736	-2.840736	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	2.875280	-2.875280	28.892500	-28.892500	-0.5
CUBOID	3	2.857500	-0.	3.175000	-3.175000	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	3.209544	-3.209544	28.892500	-28.892500	-0.5
CUBOID	1	2.857500	-0.	3.267456	-3.267456	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	3.302000	-3.302000	28.892500	-28.892500	-0.5
CUBOID	3	2.857500	-0.	3.556000	-3.556000	28.892500	-28.892500	-0.5
CUBOID	2	2.857500	-0.	3.683000	-3.683000	28.892500	-28.892500	-0.5
CUBOID	7	[illegible].039	-0.000	4.039	-4.039	28.8925	-28.8925	-0.5
CUBOID	6	[illegible]56	-0.000	4.356	-4.356	28.8925	-28.8925	-0.5
BOX TYPE	3							
CUBOID	7	4.039	-0.000	4.356	-4.039	28.8925	-28.8925	-0.5
CUBOID	6	4.356	-0.000	4.356	-4.356	28.8925	-28.8925	-0.5
BOX TYPE	4							
CUBOID	7	4.039	-0.000	4.039	-4.356	28.8925	-28.8925	-0.5
CUBOID	6	4.356	-0.000	4.356	-4.356	28.8925	-28.8925	-0.5
BOX TYPE	5							
CUBOID	7	0.000	-4.039	4.039	-4.356	28.8925	-28.8925	-0.5
CUBOID	6	0.000	-4.356	4.356	-4.356	28.8925	-28.8925	-0.5
BOX TYPE	6							
CUBOID	7	0.000	-4.039	4.356	-4.039	28.8925	-28.8925	-0.5
CUBOID	6	0.000	-4.356	4.356	-4.356	28.8925	-28.8925	-0.5

TABLE 6.3.1-1 (CONTINUED)

```
BOX TYPE     7
CUBOID     6    0.000    -4.356     0.317    -0.000     28.8925   -28.8925 -0.5
BOX TYPE     8
CUBOID     6    0.000    -0.317     4.356    -4.356     28.8925   -28.8925 -0.5
BOX TYPE     9
CUBOID     7    4.039    -0.000     0.317    -0.000     28.8925   -28.8925 -0.5
CUBOID     6    4.356    -0.000     0.317    -0.000     28.8925   -28.8925 -0.5
BOX TYPE    10
CUBOID     7    0.000    -4.039     0.317    -0.000     28.8925   -28.8925 -0.5
CUBOID     6    0.000    -4.356     0.317    -0.000     28.8925   -28.8925 -0.5
BOX TYPE    11
CUBOID     7    0.000    -0.317     4.356    -4.039     28.8925   -28.8925 -0.5
CUBOID     6    0.000    -0.317     4.356    -4.356     28.8925   -28.8925 -0.5
BOX TYPE    12
CUBOID     7    0.000    -0.317     4.039    -4.356     28.8925   -28.8925 -0.5
CUBOID     6    0.000    -0.317     4.356    -4.356     28.8925   -28.8925 -0.5
BOX TYPE    13
CUBOID     7    0.317    -0.000     0.317    -0.000     28.8925   -28.8925 -0.5
BOX TYPE    14
CUBOID     7 27.78125    -27.78125     0.317    -0.000     28.8925   -28.8925 -0.5
BOX TYPE    15
CUBOID     7 27.78125    -27.78125     4.356    -4.356     28.8925   -28.8925 -0.5
BOX TYPE     16
CUBOID     7 27.78125    -27.78125     4.356    -4.356     28.8925   -28.8925 -0.5
ARRAY BDY     7 63.26325 -63.26325     13.385    -13.385 28.8925 -28.8925 -0.5
CUBOID     5  93.74325 -93.74325   43.865    -43.865 59.37250   -59.37250 -0.5
END GEOMETRY
      0 13  9  7  7  7  7  7  7 10 13 14 13  9  7  7  7  7  7  7 10 13
        11  3  1  2  1  2  1  2  6 11 15 11  3  1  2  1  2  1  2  6 11
         8  1  2  1  2  1  2  1  2  8 16  8  1  2  1  2  1  2  1  2  8
        12  4  1  2  1  2  1  2  5 12 15 12  4  1  2  1  2  1  2  5 12
        13  9  7  7  7  7  7  7 10 13 14 13  9  7  7  7  7  7  7 10 13  0
END KENO
```

TABLE 6.4-1

```
KEFF BNL FUEL SHIPPING ARRAY  FWR 2 CONT SIDE-BY-SIDE
27GROUPNDF4  7  7  3  LATTICECELL  0  0
U-235  1 0. 2.61362-3 END
AL  2 1. END
H2O  3 8.8-5 END
AL  4 1. END
H2O  5 1. END
SS304  6 1. END
H2O  7 8.8-5 END
SYMMSLABCELL       0.37084 0.057912 1 3 0.127 2 END
     MIXTURE  NUCLIDE   DENSITY       MIXTURE  NUCLIDE   DENSITY
         1    -92235   2.61362E-03       8    -92235   4.08154E-04
         2     13027   6.02383E-02       8     13027   1.12225E-02
         3      1001   5.87448E-06       8      1001   3.86267E-06
         3      8016   2.93724E-06       8      8016   1.93134E-06
         4         3   6.02383E-02
         5         5   6.67555E-02       5         8   3.33777E-02
         6     24304   1.74239E-02       6     25055   1.73634E-03
         6     26304   5.93526E-02       6     28304   7.72036E-03
         7         6   5.87448E-06       7         9   2.93724E-06
CROSS SECTIONS READ FROM TAPE
NUCLIDE =       1001   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =          5   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =          6   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =       8016   O-16 1276 218 GP 030476(7)
NUCLIDE =          8   O-16 1276 218 GP 030476(7)
NUCLIDE =          9   O-16 1276 218 GP 030476(7)
NUCLIDE =      13027   AL-27 1193 218 GP 040375(5)
NUCLIDE =          3   AL-27 1193 218 GP 040375(5)
NUCLIDE =      24304   CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'
NUCLIDE =      25055   MN-55 1197 SIGP=5+4 NEWXLACS 218NGP P-3 293K
NUCLIDE =      26304   FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'
NUCLIDE =      28304   NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'
NUCLIDE =      92235   U-235 1261 SIGP=5+4 NEWXLACS 218NGP P-3 293K(3)
 GENERATIONS      AVERAGE                        67 PER CENT            95 PER CENT            99 PER CENT        NUMBER OF
   SKIPPED      K-EFFECTIVE      DEVIATION   CONFIDENCE INTERVAL   CONFIDENCE INTERVAL   CONFIDENCE INTERVAL   HISTORIES
      3           .26772    + OR -  .00301     .26470 TO  .27073     .26169 TO  .27374     .25868 TO  .27676      25500
                                       FREQUENCY FOR GENERATIONS     4 TO    88
 .1869 TO  .2100     *
 .2100 TO  .2331     ***
 .2331 TO  .2562     *************************
 .2562 TO  .2793     ******************************
 .2793 TO  .3024     *******************
 .3024 TO  .3255     ***
 .3255 TO  .3485     ****
```

TABLE 6.4-2

```
KEFF BNL FUEL SHIPPING ARRAY  FWR 2 CONT SIDE-BY-SIDE
27GROUPNDF4  7  7  3  LATTICECELL  0  0
U-235  1 0. 2.61362-3 END
AL  2 1. END
H2O  3 1.-3 END
AL  4 1. END
H2O  5 1. END
SS304  6 1. END
H2O  7 1.-3 END
SYMMSLABCELL      0.37084 0.057912 1 3 0.127 2 END
     MIXTURE  NUCLIDE   DENSITY      MIXTURE  NUCLIDE   DENSITY
         1     -92235   2.61362E-03        8    -92235   4.08154E-04
         2      13027   6.02383E-02        8     13027   1.12225E-02
         3       1001   6.67555E-05        8      1001   4.38940E-05
         3       8016   3.33777E-05        8      8016   2.19470E-05
         4          3   6.02383E-02
         5          5   6.67555E-02        5         8   3.33777E-02
         6      24304   1.74239E-02        6     25055   1.73634E-03
         6      26304   5.93526E-02        6     28304   7.72036E-03
         7          6   6.67555E-05        7         9   3.33777E-05
CROSS SECTIONS READ FROM TAPE
NUCLIDE =       1001   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =          5   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =          6   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =       8016   O-16 1276 218 GP 030476(7)
NUCLIDE =          8   O-16 1276 218 GP 030476(7)
NUCLIDE =          9   O-16 1276 218 GP 030476(7)
NUCLIDE =      13027   AL-27 1193 218 GP 040375(5)
NUCLIDE =          3   AL-27 1193 218 GP 040375(5)
NUCLIDE =      24304   CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)
NUCLIDE =      25055   MN-55 1197 SIGP=5+4 NEWXLACS 218NGP P-3 293K
NUCLIDE =      26304   FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)
NUCLIDE =      28304   NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)
NUCLIDE =      92235   U-235 1261 SIGP=5+4 NEWXLACS 218NGP P-3 293K(3)
 GENERATIONS      AVERAGE                     67 PER CENT          95 PER CENT          99 PER CENT      NUMBER OF
   SKIPPED      K-EFFECTIVE     DEVIATION   CONFIDENCE INTERVAL  CONFIDENCE INTERVAL  CONFIDENCE INTERVAL  HISTORIES
      3            .27187   + OR -  .00299    .26888 TO  .27486    .26589 TO  .27786    .26290 TO  .28085     25500
                                 FREQUENCY FOR GENERATIONS    4 TO   88
 .1679 TO  .1910     *
 .1910 TO  .2141     *
 .2141 TO  .2372     ********
 .2372 TO  .2603     ****************
 .2603 TO  .2834     ******************************
 .2834 TO  .3065     **********************
 .3065 TO  .3296     ******
 .3296 TO  .3527     **
```

TABLE 6.4-3

```
KEFF BNL FUEL SHIPPING ARRAY  FWR 2 CONT SIDE-BY-SIDE
27GROUPNDF4  7  7  3  LATTICECELL  0  0
U-235  1 0. 2.613E-3 END
AL  2 1. END
H2O  3 1.-2 END
AL  4 1. END
H2O  5 1. END
SS304  6 1. END
H2O  7 1.-2 END
SYMMSLABCELL      0.37084 0.057912 1 3 0.127 2 END
     MIXTURE  NUCLIDE   DENSITY      MIXTURE  NUCLIDE   DENSITY
        1     -92235   2.61362E-03       8    -92235   4.08154E-04
        2      13027   6.02383E-02       8     13027   1.12225E-02
        3       1001   6.67555E-04       8      1001   4.38940E-04
        3       8016   3.33777E-04       8      8016   2.19470E-04
        4          3   6.02383E-02
        5          5   6.67555E-02       5         8   3.33777E-02
        6      24304   1.74239E-02       6     25055   1.73634E-03
        6      26304   5.93526E-02       6     28304   7.72036E-03
        7          6   6.67555E-04       7         9   3.33777E-04
CROSS SECTIONS READ FROM TAPE
NUCLIDE =      1001   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =         5   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =         6   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =      8016   O-16 1276 218 GP 030476(7)
NUCLIDE =         8   O-16 1276 218 GP 030476(7)
NUCLIDE =         9   O-16 1276 218 GP 030476(7)
NUCLIDE =     13027   AL-27 1193 218 GP 040375(5)
NUCLIDE =         3   AL-27 1193 218 GP 040375(5)
NUCLIDE =     24304   CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)
NUCLIDE =     25055   MN-55 1197 SIGP=5+4 NEWXLACS 218NGP P-3 293K
NUCLIDE =     26304   FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)
NUCLIDE =     28304   NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)
NUCLIDE =     92235   U-235 1261 SIGP=5+4 NEWXLACS 218NGP P-3 293K(3)
 GENERATIONS     AVERAGE                        67 PER CENT           95 PER CENT           99 PER CENT       NUMBER OF
   SKIPPED     K-EFFECTIVE     DEVIATION    CONFIDENCE INTERVAL   CONFIDENCE INTERVAL   CONFIDENCE INTERVAL   HISTORIES

     3           .26963   + OR -  .00313     .26650 TO  .27275     .26338 TO  .27588     .26025 TO  .27900      25500
                                   FREQUENCY FOR GENERATIONS    4 TO   88
 .1888 TO  .2119     **
 .2119 TO  .2350     ********
 .2350 TO  .2581     *****************
 .2581 TO  .2812     ********************************
 .2812 TO  .3043     ****************
 .3043 TO  .3274     *********
 .3274 TO  .3505     **
```

TABLE 6.4-4

```
KEFF BNL FUEL SHIPPING ARRAY  FWR 2 CONT SIDE-BY-SIDE
27GROUPNDF4  7  7  3  LATTICECELL  0  0
U-235  1 0. 2.61362-3 END
AL  2 1. END
H2O  3 1.-1 END
AL  4 1. END
H2O  5 1. END
SS304  6 1. END
H2O  7 1.-1 END
SYMMSLABCELL      0.37084 0.057912 1 3 0.127 2 END
     MIXTURE  NUCLIDE   DENSITY      MIXTURE  NUCLIDE   DENSITY
        1     -92235   2.61362E-03      8     -92235   4.08154E-04
        2      13027   6.02383E-02      8      13027   1.12225E-02
        3       1001   6.67555E-03      8       1001   4.38940E-03
        3       8016   3.33777E-03      8       8016   2.19470E-03
        4          3   6.02383E-02
        5          5   6.67555E-02      5          8   3.33777E-02
        6      24304   1.74239E-02      6      25055   1.73634E-03
        6      26304   5.93526E-02      6      28304   7.72036E-03
        7          6   6.67555E-03      7          9   3.33777E-03
CROSS SECTIONS READ FROM TAPE
NUCLIDE =       1001   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =          5   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =          6   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =       8016   O-16 1276 218 GP 030476(7)
NUCLIDE =          8   O-16 1276 218 GP 030476(7)
NUCLIDE =          9   O-16 1276 218 GP 030476(7)
NUCLIDE =      13027   AL-27 1193 218 GP 040375(5)
NUCLIDE =          3   AL-27 1193 218 GP 040375(5)
NUCLIDE =      24304   CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'
NUCLIDE =      25055   MN-55 1197 SIGP=5+4 NEWXLACS 218NGP P-3 293K
NUCLIDE =      26304   FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'
NUCLIDE =      28304   NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)'
NUCLIDE =      92235   U-235 1261 SIGP=5+4 NEWXLACS 218NGP P-3 293K(3)
 GENERATIONS     AVERAGE                       67 PER CENT          95 PER CENT          99 PER CENT       NUMBER OF
   SKIPPED     K-EFFECTIVE     DEVIATION    CONFIDENCE INTERVAL   CONFIDENCE INTERVAL  CONFIDENCE INTERVAL  HISTORIES
      3           .29635  + OR -  .00309     .29326 TO  .29944     .29017 TO  .30252     .28708 TO  .30561      26400
                            FREQUENCY FOR GENERATIONS    4 TO   91
 .2386 TO  .2617     ***********
 .2617 TO  .2848     **********************
 .2848 TO  .3079     ************************
 .3079 TO  .3310     **********************
 .3310 TO  .3541     *******
 .3541 TO  .3772     **
```

TABLE 6.4-5

```
KEFF BNL FUEL SHIPPING ARRAY  FWR
27GROUPNDF4  7  7  3  LATTICECELL  0  0
U-235  1 0. 2.61362-3 END
AL  2 1. END
H2O  3 1. END
AL  4 1. END
H2O  5 1. END
SS304  6 1. END
H2O  7 1. END
SYMMSLABCELL      0.37084 0.057912 1 3 0.127 2 END
     MIXTURE  NUCLIDE   DENSITY       MIXTURE  NUCLIDE   DENSITY
         1     -92235   2.61362E-03      8     -92235   4.08154E-04
         2      13027   6.02383E-02      8      13027   1.12225E-02
         3       1001   6.67555E-02      8       1001   4.38940E-02
         3       8016   3.33777E-02      8       8016   2.19470E-02
         4          3   6.02383E-02
         5          5   6.67555E-02      5          8   3.33777E-02
         6      24304   1.74239E-02      6      25055   1.73634E-03
         6      26304   5.93526E-02      6      28304   7.72036E-03
         7          6   6.67555E-02      7          9   3.33777E-02
CROSS SECTIONS READ FROM TAPE
NUCLIDE =        1001   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =           5   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =           6   H 1269 F, 1002 T 218 GP 032475(2)
NUCLIDE =        8016   O-16 1276 218 GP 030476(7)
NUCLIDE =           8   O-16 1276 218 GP 030476(7)
NUCLIDE =           9   O-16 1276 218 GP 030476(7)
NUCLIDE =       13027   AL-27 1193 218 GP 040375(5)
NUCLIDE =           3   AL-27 1193 218 GP 040375(5)
NUCLIDE =       24304   CR 1191 WT SS-304(1/EST) P-3 293K SP=5+4(42375)
NUCLIDE =       25055   MN-55 1197 SIGP=5+4 NEWXLACS 218NGP P-3 293K
NUCLIDE =       26304   FE 1192 WT SS-304(1/EST) P-3 293K SP=5+4(42375)
NUCLIDE =       28304   NI 1190 WT SS-304(1/EST) P-3 293K SP=5+4(42375)
NUCLIDE =       92235   U-235 1261 SIGP=5+4 NEWXLACS 218NGP P-3 293K(3)
 GENERATIONS      AVERAGE                          67 PER CENT            95 PER CENT            99 PER CENT         NUMBER OF
   SKIPPED      K-EFFECTIVE      DEVIATION    CONFIDENCE INTERVAL    CONFIDENCE INTERVAL    CONFIDENCE INTERVAL    HISTORIES
      3            .81978   + OR -  .00475     .81502 TO  .82453      .81027 TO  .82929      .80551 TO  .83404       30000
                                    FREQUENCY FOR GENERATIONS    4 TO  103
 .6928 TO  .7159     **
 .7159 TO  .7389     *******
 .7389 TO  .7620     ***
 .7620 TO  .7851     **********
 .7851 TO  .8082     *************
 .8082 TO  .8313     ********************
 .8313 TO  .8544     ********************
 .8544 TO  .8775     ****************
 .8775 TO  .9006     ******
 .9006 TO  .9237     **
 .9237 TO  .9468     *
```

FIGURE 6.4-1: K-Effective (±2 Sigma) Vs. Water Mist Density For Model 2. Two Casks, Each Containing 3510 Grams U-235 Of Fully Enriched Uranium In Plate Fuel In Ten Fuel Elements In A 304 Stainless Steel Basket, Are In An Array Separated By 21.875" Edge-To-Edge Containing A Mist. There Is 12" Of Water Reflection Around The Array. The K-Effective Results Contain A Bias Of 0.3% In The 1 Sigma Value And 2.3% In The Mean Value.

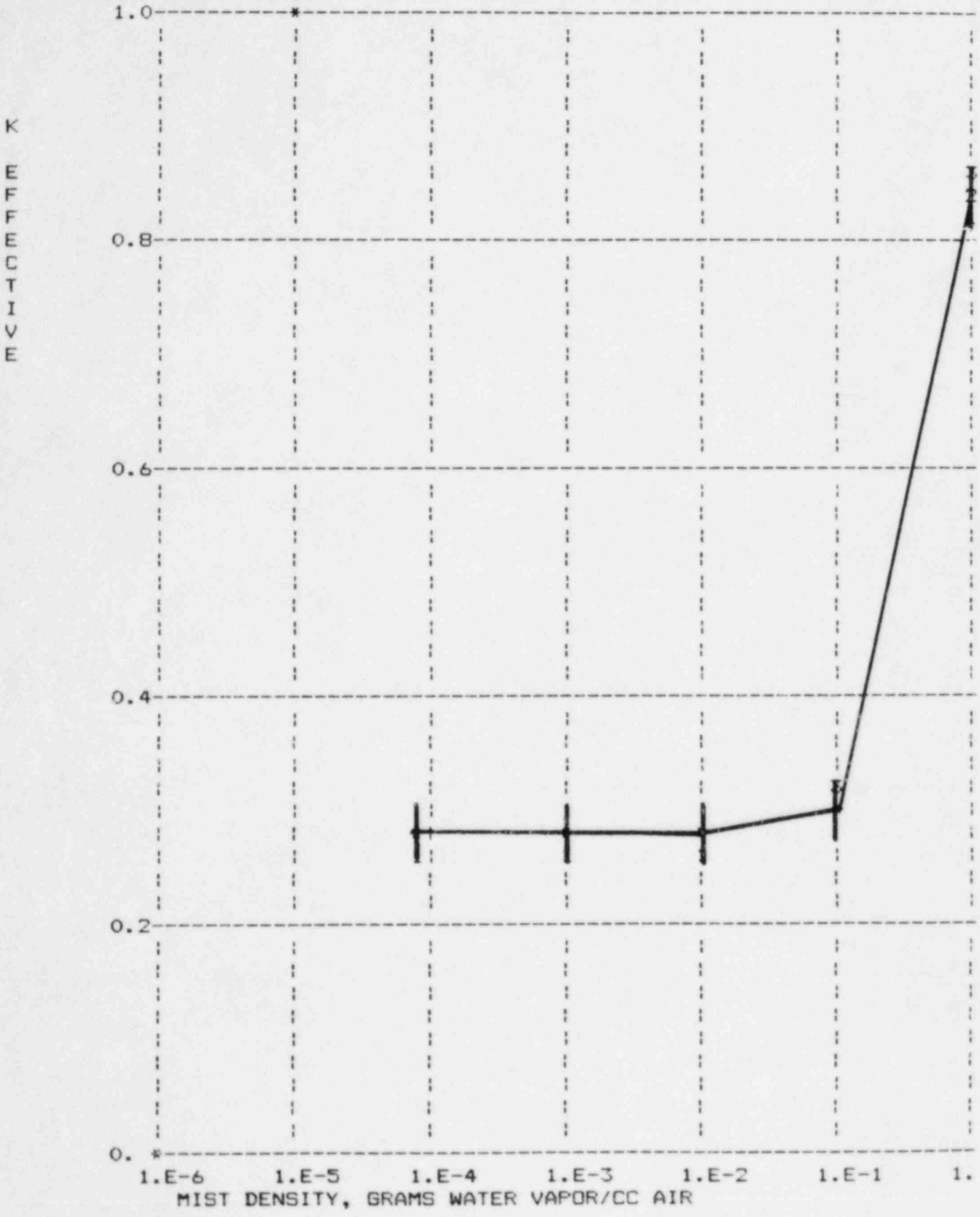

TABLE 6.5.1-1

Critical Experiments for Computational Tool Evaluation

Experiment Name	References
A. TRX-1 & TRX-2 Low-Enriched Uranium Rods in Water	A.1. J. Hardy, Jr., D. Klein and J. J. Volpe; "A Study of Physics Parameters In Several Water-Moderated Lattices of Slightly Enriched and Natural Uranium", WAPD-TM-931; March, 1970.
	A.2. J. Hardy, Jr., D. Klein and J. J. Volpe; Nucl. Sci. Eng. 40, 101 (1970). J. J. Volpe, J. Hardy, Jr., and D. Klein, Nucl. Sci. Eng. 40, 116 (1970).
	A.3. J. Hardy, Jr., D. Klein and R. Dannels; Nucl. Sci. Eng. 26, 462 (1966).
	A.4. J. R. Brown et al., "Kinetics and Buckling Measurements In Lattices of Slightly Enriched U or UO_2 Rods In H_2O", WAPD-176 (January, 1958).
	A.5. R. Sher and S. Fiarman, "Studies of Thermal Reactor Benchmark Data Interpretation: Experimental Corrections", EPRI NP-209; October, 1976.
B. ORNL 1-4 & ORNL 10 Fully Enriched Uranium Spherical Solutions	B.1. R. Gwin and D. W. Magnuson, "Eta of U-233 and U-235 for Critical Experiments", Nuc. Sci. Eng. 12, 364 (1962).
	B.2. A. Staub et al., "Analysis of A Set of Critical Homogeneous U-H_2O Spheres", Nuc. Sci. Eng. 34, 263 (1968).

TABLE 6.5.1-1
(Continued)

Experiment Name		References
C. PNL 1-5 Plutonium Spherical Solutions	C.1.	R. C. Lloyd et al., "Criticality Studies With Plutonium Solutions", Nuc. Sci. Eng. 25, 165 (1966).
	C.2.	L. E. Hansen and E. D. Clayton, "Theory-Experiment Tests Using ENDF/B Version II Cross-Section Data", Trans. Amer. Nuc. Soc. 15, 309 (June, 1972).
	C.3.	F. E. Kruesi et al., "Critical Mass Studies of Plutonium-Nitrate Solution", HW-24514 (1952).
D. Babcock & Wilcox Small Lattice Facility Low-Enriched UO_2 Rods in Water	D.1.	M. N. Baldwin et al., "Physics Verification Program - Part III", BAW-3647-6, Babcock & Wilcox, 1970.
MO_2 Rods in Water	D.2.	G. T. Fairburn et al., "Pu Lattice Experiments In Uniform Test Lattice of UO_2-1.5% PuO_2 Fuel", BAW-1357, Babcock & Wilcox; August, 1970.

TABLE 6.5.2-1 TRX-1

```
KEFF TRX-1 763 U METAL RODS 1.291W/O WAPD 176 JAN. 1958
27GROUPNDF4  7 10 4 LATTICECELL  0 0
U-235  1 0. 6.253-4 END
U-238  1 0. 0.047205 END
AL  2 0. 0.06025 END
H  3 0. 0.06676 END
O  3 0. 0.03338 END
H2O  4 8.8-5 END
H  5 0. 0.06676 END
O  5 0. 0.03338 END
FE  6 1. END
AL  7 0. 0.06025 END
TRIANGPITCH  1.806 0.983 1 3 1.1506 2 1.0084 4 END
KEFF TRX-1 763 U METAL RODS 1.291W/O WAPD 176 JAN. 1958
15.0 103 300 3 6 60 33 2 0
BOX TYPE  1
ZHEMICYL+X  7 0.5753 0. -15.24 -0.5
CUBOID  5 0.903 -0. 0.782 -0.782 0. -15.24 -0.5
CUBOID  500 0.903 -0. 0.782 -0.782 0. -76.20 -0.5
CUBOID  6 0.903 -0. 0.782 -0.782 5.08 -76.20 -0.5
BOX TYPE  2
ZHEMICYL-X  7 0.5753 0. -15.24 -0.5
CUBOID  5 0. -0.903 0.782 -0.782 0. -15.24 -0.5
CUBOID  500 0. -0.903 0.782 -0.782 0. -76.20 -0.5
CUBOID  6 0. -0.903 0.782 -0.782 5.08 -76.20 -0.5
BOX TYPE  3
ZHEMICYL+X  7 0.5753 20.32 -0. -0.5
CUBOID  5 0.903 -0. 0.782 -0.782 20.32 -0. -0.5
CUBOID  500 0.903 -0. 0.782 -0.782 81.28 -0. -0.5
CUBOID  6 0.903 -0. 0.782 -0.782 81.28 -1.27 -0.5
BOX TYPE  4
ZHEMICYL-X  7 0.5753 20.32 -0. -0.5
CUBOID  5 0. -0.903 0.782 -0.782 20.32 -0. -0.5
CUBOID  500 0. -0.903 0.782 -0.782 81.28 -0. -0.5
CUBOID  6 0. -0.903 0.782 -0.782 81.28 -1.27 -0.5
BOX TYPE  5
CUBOID  5 0.903 -0. 0.782 -0.782 0. -76.20 -0.5
CUBOID  6 0.903 -0. 0.782 -0.782 5.08 -76.20 -0.5
BOX TYPE  6
CUBOID  5 0.903 -0. 0.782 -0.782 81.28 -0. -0.5
CUBOID  6 0.903 -0. 0.782 -0.782 81.28 -1.27 -0.5
ARRAY BDY  5 27.090 -27.090 25.806 -25.806 81.915 -81.915 -0.5
CUBOID  5 57.090 -57.090 55.806 -55.806 81.915 -81.915 -0.5
```

TABLE 6.5.2-1 TRX-1 (CONTINUED)

```
KEFF TRX-1 763 U METAL RODS 1.291W/O WAPD 176 JAN. 1958
END GEOMETRY
 5  1 60 1  1 33 1 2 2 1 0 6  1 60 1  1 33 1 1 1 1 0 2 24 38 2  1 33 2 2 2 1 0
 1 25 39 2  1 33 2 2 2 1 0 2 17 43 2  2 32 2 2 2 1 0 1 18 44 2  2 32 2 2 2 1 0
 2 14 46 2  3 31 2 2 2 1 0 1 15 47 2  3 31 2 2 2 1 0 2 13 47 2  4 30 2 2 2 1 0
 1 14 48 2  4 30 2 2 2 1 0 2 12 48 2  5 29 2 2 2 1 0 1 13 49 2  5 29 2 2 2 1 0
 2  9 51 2  6 28 2 2 2 1 0 1 10 52 2  6 28 2 2 2 1 0 2  8 52 2  7 27 2 2 2 1 0
 1  9 53 2  7 27 2 2 2 1 0 2  7 53 2  8 26 2 2 2 1 0 1  8 54 2  8 26 2 2 2 1 0
 2  6 54 2  9 25 2 2 2 1 0 1  7 55 2  9 25 2 2 2 1 0 2  5 55 2 10 24 2 2 2 1 0
 1  6 56 2 10 24 2 2 2 1 0 2  4 56 2 11 23 2 2 2 1 0 1  5 57 2 11 23 2 2 2 1 0
 2  3 57 2 12 22 2 2 2 1 0 1  4 58 2 12 22 2 2 2 1 0 2  2 58 2 13 21 2 2 2 1 0
 1  3 59 2 13 21 2 2 2 1 0 2  1 59 2 16 18 2 2 2 1 0 1  2 60 2 16 18 2 2 2 1 0
 4 24 38 2  1 33 2 1 1 1 0 3 25 39 2  1 33 2 1 1 1 0 4 17 43 2  2 32 2 1 1 1 0
 3 18 44 2  2 32 2 1 1 1 0 4 14 46 2  3 31 2 1 1 1 0 3 15 47 2  3 31 2 1 1 1 0
 4 13 47 2  4 30 2 1 1 1 0 3 14 48 2  4 30 2 1 1 1 0 4 12 48 2  5 29 2 1 1 1 0
 3 13 49 2  5 29 2 1 1 1 0 4  9 51 2  6 28 2 1 1 1 0 3 10 52 2  6 28 2 1 1 1 0
 4  8 52 2  7 27 2 1 1 1 0 3  9 53 2  7 27 2 1 1 1 0 4  7 53 2  8 26 2 1 1 1 0
 3  8 54 2  8 26 2 1 1 1 0 4  6 54 2  9 25 2 1 1 1 0 3  7 55 2  9 25 2 1 1 1 0
 4  5 55 2 10 24 2 1 1 1 0 3  6 56 2 10 24 2 1 1 1 0 4  4 56 2 11 23 2 1 1 1 0
 3  5 57 2 11 23 2 1 1 1 0 4  3 57 2 12 22 2 1 1 1 0 3  4 58 2 12 22 2 1 1 1 0
 4  2 58 2 13 21 2 1 1 1 0 3  3 59 2 13 21 2 1 1 1 0 4  1 59 2 16 18 2 1 1 1 0
 3  2 60 2 16 18 2 1 1 1 9
END KENO
```

TABLE 6.5.2-2 TRX-2

```
KEFF TRX-2 577 U METAL RODS 1.291W/O WAPD 176 JAN. 1958
27GROUPNDF4  7 10 4 LATTICECELL  0 0
U-235  1 0. 6.253-4 END
U-238  1 0. 0.047205 END
AL  2 0. 0.06025 END
H  3 0. 0.06676 END
O  3 0. 0.03338 END
H2O  4 8.8-5 END
H  5 0. 0.06676 END
O  5 0. 0.03338 END
FE  6 1. END
AL  7 0. 0.06025 END
TRIANGPITCH  2.174 0.983 1 3 1.1506 2 1.0084 4 END
KEFF TRX-2 577 U METAL RODS 1.291W/O WAPD 176 JAN. 1958
15.0 103 300 3 6 52 29 2 0
BOX TYPE  1
ZHEMICYL+X  7 0.5753 0. -15.24 -0.5
CUBOID  5  1.087 -0. 0.941 -0.941 0. -15.24 -0.5
CUBOID  500 1.087 -0. 0.941 -0.941 0. -76.20 -0.5
CUBOID  6 1.087 -0. 0.941 -0.941 5.08 -76.20 -0.5
BOX TYPE  2
ZHEMICYL-X  7 0.5753 0. -15.24 -0.5
CUBOID  5  0. -1.087 0.941 -0.941 0. -15.24 -0.5
CUBOID  500 0. -1.087 0.941 -0.941 0. -76.20 -0.5
CUBOID  6 0. -1.087 0.941 -0.941 5.08 -76.20 -0.5
BOX TYPE  3
ZHEMICYL+X  7 0.5753 20.32 -0. -0.5
CUBOID  5  1.087 -0. 0.941 -0.941 20.32 -0. -0.5
CUBOID  500 1.087 -0. 0.941 -0.941 81.28 -0. -0.5
CUBOID  6 1.087 -0. 0.941 -0.941 81.28 -1.27 -0.5
BOX TYPE  4
ZHEMICYL-X  7 0.5753 20.32 -0. -0.5
CUBOID  5  0. -1.087 0.941 -0.941 20.32 -0. -0.5
CUBOID  500 0. -1.087 0.941 -0.941 81.28 -0. -0.5
CUBOID  6 0. -1.087 0.941 -0.941 81.28 -1.27 -0.5
BOX TYPE  5
CUBOID  5 1.087 -0. 0.941 -0.941 0. -76.20 -0.5
CUBOID  6 1.087 -0. 0.941 -0.941 5.08 -76.20 -0.5
BOX TYPE  6
CUBOID  5 1.087 -0. 0.941 -0.941 81.28 -0. -0.5
CUBOID  6 1.087 -0. 0.941 -0.941 81.28 -1.27 -0.5
ARRAY BDY  5 28.262 -28.262 27.289 -27.289 81.915 -81.915 -0.5
CUBOID  5 58.262 -58.262 57.289 -57.289 81.915 -81.915 -0.5
END GEOMETRY
 5  1 52 1  1 29 1 2 2 1 0 6  1 52 1  1 29 1 1 1 1 0 2 22 32 2  1 29 2 2 2 1 0
 1 23 33 2  1 29 2 2 2 1 0 2 15 37 2  2 28 2 2 2 1 0 1 16 38 2  2 28 2 2 2 1 0
 2 12 40 2  3 27 2 2 2 1 0 1 13 41 2  3 27 2 2 2 1 0 2 11 41 2  4 26 2 2 2 1 0
 1 12 42 2  4 26 2 2 2 1 0 2 10 42 2  5 25 2 2 2 1 0 1 11 43 2  5 25 2 2 2 1 0
 2  7 45 2  6 24 2 2 2 1 0 1  8 46 2  6 24 2 2 2 1 0 2  6 46 2  7 23 2 2 2 1 0
 1  7 47 2  7 23 2 2 2 1 0 2  5 47 2  8 22 2 2 2 1 0 1  6 48 2  8 22 2 2 2 1 0
 2  4 48 2  9 21 2 2 2 1 0 1  5 49 2  9 21 2 2 2 1 0 2  3 49 2 10 20 2 2 2 1 0
 1  4 50 2 10 20 2 2 2 1 0 2  2 50 2 11 19 2 2 2 1 0 1  3 51 2 11 19 2 2 2 1 0
 2  1 51 2 14 16 2 2 2 1 0 1  2 52 2 14 16 2 2 2 1 0 4 22 32 2  1 29 2 1 1 1 0
 3 23 33 2  1 29 2 1 1 1 0 4 15 37 2  2 28 2 1 1 1 0 3 16 38 2  2 28 2 1 1 1 0
 4 12 40 2  3 27 2 1 1 1 0 3 13 41 2  3 27 2 1 1 1 0 4 11 41 2  4 26 2 1 1 1 0
 3 12 42 2  4 26 2 1 1 1 0 4 10 42 2  5 25 2 1 1 1 0 3 11 43 2  5 25 2 1 1 1 0
 4  7 45 2  6 24 2 1 1 1 0 3  8 46 2  6 24 2 1 1 1 0 4  6 46 2  7 23 2 1 1 1 0
 3  7 47 2  7 23 2 1 1 1 0 4  5 47 2  8 22 2 1 1 1 0 3  6 48 2  8 22 2 1 1 1 0
 4  4 48 2  9 21 2 1 1 1 0 3  5 49 2  9 21 2 1 1 1 0 4  3 49 2 10 20 2 1 1 1 0
 3  4 50 2 10 20 2 1 1 1 0 4  2 50 2 11 19 2 1 1 1 0 3  3 51 2 11 19 2 1 1 1 0
 4  1 51 2 14 16 2 1 1 1 0 3  2 52 2 14 16 2 1 1 1 9
END KENO
```

TABLE 6.5.2-3 ORNL-1 & ORNL-2

```
KEFF ORNL-1 NSE 34 263-274 (1968P) SCALE MODEL
27GROUPNDF4  1 7 1 INFHOMMEDIUM  1 0
U-235  1 0. 4.8066-5 END
U-238  1 0. 2.807-6 END
U-234  1 0. 5.38-7 END
U-236  1 0. 1.38-7 END
N  1 0. 1.869-4 END
O  1 0. 0.033736 END
H  1 0. 0.066228 END
 ISN=12 IIM=40 ICM=70 IUS=1 END
KEFF ORNL-1 NSE 34 263-274 (1968P) SCALE MODEL
15.0 103 300 3 0 0 0 0 0
SPHERE  1 34.5948 -0.5
END GEOMETRY
END KENO
KEFF ORNL-2 NSE 34 263-274 (1968P) SCALE MODEL
27GROUPNDF4  1 8 1 INFHOMMEDIUM  1 0
U-235  1 0. 5.6205-5 END
U-238  1 0. 3.28-6 END
U-234  1 0. 6.31-7 END
U-236  1 0. 1.63-7 END
N  1 0. 2.129-4 END
O  1 0. 0.0338 END
H  1 0. 0.066148 END
B-10  1 0. 1.0286-6 END
 ISN=12 IIM=40 ICM=70 IUS=1 END
KEFF ORNL-2 NSE 34 263-274 (1968P) SCALE MODEL
15.0 103 300 3 0 0 0 0 0
SPHERE  1 34.5948 -0.5
END GEOMETRY
END KENO
```

TABLE 6.5.2-4 PNL-1 & PNL-2

```
KEFF PNL-1 NSE 25 165 (1966)
27GROUPNDF4  1 5 1 INFHOMMEDIUM  1 0
PU-239  1 0. 9.373-5 END
PU-240  1 0. 4.501-6 END
N  1 0. 6.216-4 END
O  1 0. 0.03456 END
H  1 0. 0.06563 END
 ISN=12 IIM=40 ICM=70 IUS=1 END
KEFF PNL-1 NSE 25 165 (1966)
15. 103 300 3 0 0 0 0 0
SPHERE  1 19.509 -0.5
END GEOMETRY
END KENO
KEFF PNL-2 NSE 25 165 (1966)
27GROUPNDF4  1 5 1 INFHOMMEDIUM  1 0
PU-239  1 0. 4.141-4 END
PU-240  1 0. 1.988-5 END
N  1 0. 4.720-3 END
O  1 0. 0.03977 END
H  1 0. 0.05416 END
 ISN=12 IIM=40 ICM=70 IUS=1 END
KEFF PNL-2 NSE 25 165 (1966)
15. 103 300 3 0 0 0 0 0
SPHERE  1 19.509 -0.5
END GEOMETRY
END KENO
```

TABLE 6.5.2-5 B&W UO2 & MO2 EXPERIMENTS

```
B&W UO2 EXP CELL  SCALE MODEL  ENDFB-IV LATTICE SELFSHLD
27GROUPNDF4  3 7 3  LATTICECELL    0 0
O      1  0.  4.472785-2  END
U-235  1  0.  5.570288-4  END
U-238  1  0.  2.180690-2  END
AL     2  0.  6.051481-2  END
H      3  0.  6.668320-2  END
B-10   3  0.  2.243000-5  END
O      3  0.  3.334160-2  END
SQUAREPITCH   1.6256 1.0434   1  3 1.2060 2 END
B&W UO2 EXP CELL  SCALE MODEL  ENDFB-IV LATTICE SELFSHLD
15.  103  300  3  4R1  1
6R1
CYLINDER  1  .521716  .8128  -.8128  -.5
CYLINDER  2  .603     .8128  -.8128  -.5
CUBOID    3  .8128  -.8128  .8128  -.8128  .8128  -.8128  -.5
END GEOMETRY
END KENO
```

```
B&W MUO2 EXPERIMENT  SCALE MODEL  LATTICECELL SELFSHIELDIN
27GROUPNDF4  3 12  3 LATTICECELL    0 0
O          1  0.  4.358350-2  END
U-235      1  0.  1.543510-4  END
U-238      1  0.  2.131198-2  END
PU-239     1  0.  2.646750-4  END
PU-240     1  0.  5.295900-5  END
PU-241     1  0.  5.271000-6  END
PU-242     1  0.  8.320000-7  END
AM-241     1  0.  1.616000-6  END
ZIRCALLOY  2  1.019225        END
H          3  0.  6.668320-2  END
B-10       3  0.  2.465000-5  END
O          3  0.  3.334160-2  END
SQUAREPITCH  1.89738  1.2751  1  3  1.4275  2  END
B&W MUO2 EXPERIMENT  SCALE MODEL LATTICE SLFSHLDING
10.  103  300  3  4R1  1
6R1
CYLINDER  1  .63754   .94869  -.94869                            -.5
CYLINDER  2  .71374   .94869  -.94869                            -.5
CUBOID    3  .94869  -.94869   .94869  -.94869  .94869  -.94869 -.5
END GEOMETRY
END KENO
```

TABLE 6.5.3-1

K-Effective Results

Computational Tool Evaluation

Name of Critical Experiment	Feature	SCALE Results K-eff ± 2 Sigma	SCALE Results No. of Neutron Histories
ORNL-1	Fully Enriched	1.0021 ± 0.0060	30,000
ORNL-2	U-235 Nitrate	0.9977 ± 0.0068	30,000
TRX-1	Low Enriched	0.9773 ± 0.0060	30,000
TRX-2	U-235 Rods	0.9820 ± 0.0060	30,000
PNL-1	Plutonium	1.0157 ± 0.0108	30,000
PNL-2	Nitrate (5Pu240)	1.0105 ± 0.0114	30,000
B&W	UO_2 Rod	0.9920*± 0.0046	30,000
B&W	MO_2 Rod	0.9972*± 0.0054	30,000

*k-infinity values

DOCKET NO. 71-5942

CONTROL NO. 25349

DATE OF DOC. 06/05/85

DATE RCVD. 06/07/85

FCUF ____ PDR ✓

FCAF ____ LPDR ____

WM ____ I&E REF. ✓

WMUR ____ SAFEGUARDS ____

FCTC ✓ OTHER ____

DESCRIPTION:

wishes to supersede application of 05/30/85 with the enclosed application

06/12/85 INITIAL CEC