

ADDENDUM TO THE  
CRITICALITY ANALYSIS FOR THE  
GINNA NUCLEAR PLANT  
FUEL STORAGE RACKS  
TO ADDRESS THE  
STORAGE OF MIXED OXIDE FUEL ASSEMBLIES

By

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The following discussion summarizes the criticality safety of the Ginna fuel storage racks when loaded with mixed oxide fuel. The analytical techniques described here are identical to those previously used to license the Ginna spent fuel racks.

#### ANALYTICAL TECHNIQUE

The LEOPARD<sup>(1)</sup> computer program was used to generate macroscopic cross sections for input to four energy group diffusion theory calculations which are performed with the PDQ-7<sup>(2)</sup> program. LEOPARD calculates the neutron energy spectrum over the entire energy range from thermal up to 10 Mev and determines averaged cross sections over appropriate energy groups. The fundamental methods used in the LEOPARD program are those used in the MUFT<sup>(3)</sup> and SOFOCATE<sup>(4)</sup> programs which were developed under the Naval Reactor Program and thus, are well founded and extensively tested techniques. In addition, Westinghouse Electric Corporation, the developers of the original LEOPARD program, demonstrated the accuracy of these methods by extensive analysis of measured critical assemblies consisting of slightly enriched UO<sub>2</sub> fuel rods.<sup>(5)</sup>

In addition, Pickard, Lowe and Garrick, Inc. (PLG) has made a number of improvements to the LEOPARD program to increase its accuracy for the calculation of reactivities in systems which contain significant amounts of plutonium mixed with UO<sub>2</sub>. PLG has tested the accuracy of these modifications by analyzing a series of UO<sub>2</sub> and PuO<sub>2</sub>-UO<sub>2</sub> critical experiments. These benchmarking analyses not only demonstrate the improvements obtained



for the analysis of  $\text{PuO}_2\text{-UO}_2$  systems, but also demonstrate that these modifications have not adversely affected the accuracy of the PLG-modified LEOPARD program for calculations of slightly enriched  $\text{UO}_2$  systems.

The  $\text{UO}_2$  critical experiments chosen for benchmarking include variations in  $\text{H}_2\text{O}/\text{UO}_2$  volume ratios, U-235 enrichments, pellet diameters and cladding materials. Although the LEOPARD model also accurately calculates the reactivity effects of soluble boron, these experiments have not been included in the benchmarking criticals since the fuel storage rack calculations do not take credit for soluble boron.

Neutron leakage was represented by using measured buckling input to infinite lattice LEOPARD calculations to represent the critical assembly. A summary of the LEOPARD results is shown in Table 1 for the 27 measured criticals chosen as being directly applicable for benchmarking the model for spent fuel pool calculations. The average calculated  $k_{\text{eff}}$  is 0.9979, and the standard deviation from this average is  $0.0080 \Delta k$ . Reference 5 raised questions concerning the accuracy of the measured buckling reported for the experiments number 12 through 19. If these data are excluded, the average calculated  $k_{\text{eff}}$  for the remaining 19 experiments is 1.0006 with a standard deviation from this value of  $0.0063 \Delta k$ . In all of these experiments, there are significant uncertainties in the measured bucklings which are necessary inputs to the LEOPARD analysis. These uncertainties are the same order of magnitude as the indicated errors in the LEOPARD results and, therefore, a more definitive set of experimental data is used to establish the accuracy of the combined LEOPARD/PDQ-7 model used for the analysis of the fuel storage racks.



The PDQ series of programs have been extensively developed and tested over a period of 20 years, and there is no question that the current version, PDQ-7, is an accurate and reliable model for calculating the subcritical margin of the proposed fuel storage rack arrangements. This code or a mathematically equivalent method is used by all the U.S. suppliers of light water reactor cores and reload fuel. In addition, this code has received extensive utilization in the U.S. Naval Reactor Program.

As a specific demonstration of the accuracy of the calculational model used for the fuel storage rack calculations, the combined LEOPARD/PDQ-7 model has been used to calculate fourteen measured just critical assemblies. The criticals are high neutron leakage systems with a large variation in  $U/H_2O$  volume ratio and include parameters in the same range as those applicable to the proposed fuel pool design.<sup>(6,7)</sup> Experiments including soluble boron are included in this demonstration since the ability of PDQ-7 to calculate neutron leakage effects is of primary interest. The use of soluble boron allows changes in the neutron leakage of the assembly while maintaining a uniform lattice and, thus, allows a better test of the accuracy of the model. Furthermore, it eliminates the error associated with the measured bucklings which is inherent in the LEOPARD benchmarks, thus permitting determinations of the actual calculational uncertainty which must be accounted for in the spent fuel rack criticality analysis.

These combination LEOPARD/PDQ-7 calculations result in a calculated average  $k_{eff}$  of 0.9928, with a standard deviation about this value of 0.0012  $\Delta k$ . These results, as shown in Table 2, demonstrate that the proposed LEOPARD/PDQ-7 calculational model can calculate the reactivity of the proposed fuel storage rack arrangements with an accuracy of better than 0.010  $\Delta k$  at the 95 percent confidence level.





The above methods may also be used to calculate the subcritical margin of the spent fuel storage rack designs when mixed oxide fuel is used. Table 3 shows a comparison of LEOPARD results with a set of five Saxton  $\text{PuO}_2\text{-UO}_2$  critical experiments. This set of critical experiments is described in detail in Reference 8. The average  $k_{\text{eff}}$  calculated for these just critical assemblies was 0.9995, with a standard deviation around this value of 0.0068  $\Delta k$ . A similar comparison is provided in Table 4 for a set of six ESADA  $\text{PuO}_2\text{-UO}_2$  critical experiments. This set of critical experiments is described in detail in Reference 9. The average  $k_{\text{eff}}$  calculated for these just critical assemblies was 0.9946, with a standard deviation around this value of 0.0061  $\Delta k$ . These predicted results are in excellent agreement with the measured critical data in view of the large variation in  $\text{H}_2\text{O}/\text{UO}_2$  volume ratios and the additional complexities introduced by the mixed  $\text{PuO}_2\text{-UO}_2$  fuel. Based on these two sets of critical experiments an uncertainty of 0.0163  $\Delta k$  has been established for the  $\text{PuO}_2\text{-UO}_2$  fuel at the 95 percent confidence level. This is analogous to the .0096  $\Delta k$  value that will be used for the  $\text{UO}_2$  fuel.

The PDQ-7 program is used in the final predictions of the reactivity of the fuel storage racks. The calculations are performed in four energy groups and take into account all the significant geometric details of the fuel assemblies, fuel boxes, and major structural components. The geometry used for most of the calculations is the basic cell, representing a repeating array of stainless-steel boxes. The specific geometry of this basic cell is shown in Figure 1 for the Ginna spent fuel storage rack with the mixed oxide fuel assemblies in place.



## CALCULATIONAL APPROACH AND RESULTS

The calculational approach is to use the basic cell as illustrated in Figure 1 to calculate the reactivity of an infinite array of uniform spent fuel racks loaded with the mixed oxide fuel assemblies. These fuel assemblies are identical in mechanical design to the Westinghouse 14 x 14 fuel assemblies which were the basis for the earlier spent fuel storage rack criticality analysis. Table 5 provides the relevant data on the four mixed oxide fuel assemblies, including the enrichment range. Figure 1 illustrates the loading pattern to be used for the mixed oxide fuel assemblies.

The base case for the mixed oxide fuel assumes the minimum spacing on the spent fuel rack as did the earlier analysis for the uranium oxide fuel. No credit was taken for the axial or radial leakage, soluble boron, lumped burnable poison, or inconel spacer grids. The resulting base case multiplication factor for an infinite array of mixed oxide fuel of the reference design was calculated conservatively to be 0.8672 at 68°F. This can be compared with the original base case for the 3.5 w/o U-235 uranium oxide fuel for which the calculated multiplication factor was 0.8779 at 80°F (or 0.8770 at 68°F). Even when the incremental difference in the calculational uncertainty of  $.0067 \Delta k$  ( $= .0163 \Delta k - .0096 \Delta k$ ) due to the differences between the  $UO_2$  and  $(UO_2-PuO_2)$  benchmark results is added to the base case for the mixed oxide fuel, the resulting multiplication factor 0.8739 ( $= .8672 + .0067$ ) is still less than the multiplication factor for the uranium oxide fuel of 0.8770. The other perturbations would be essentially the same as those previously determined for the uranium oxide fuel. The resulting worst case multiplication factor would therefore be less for the mixed oxide fuel than for the 3.5 w/o uranium oxide fuel for which these racks were originally licensed which was 0.8871.

Because of the well founded, conservative techniques used for determination of the infinite multiplication factor, there is



more than reasonable assurance that this spent fuel rack design will not cause undue risk to the public health and safety resulting from criticality considerations when loaded with mixed oxide fuel assemblies.



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TABLE 1  
SUMMARY OF LEOPARD RESULTS MEASURED CRITICALS

| Case**<br>Number | Reference<br>Number | Enrichment<br>(atom %) | H <sub>2</sub> O/U<br>Volume | Fuel<br>Density<br>(g/cm <sup>3</sup> ) | Pellet<br>Diameter<br>(cm) | Clad<br>Diameter<br>(cm) | Clad<br>Thickness<br>(cm) | Lattice<br>Pitch<br>(cm) | Critical<br>Buckling<br>m <sup>-2</sup> | Calculated<br>k <sub>eff</sub> |
|------------------|---------------------|------------------------|------------------------------|---|----------------------------|--------------------------|---------------------------|--------------------------|---|--------------------------------|
| 1                | 11                  | 2.734                  | 2.18                         | 10.18                                   | 0.7620                     | 0.8594                   | 0.04085                   | 1.0287                   | 40.75                                   | 1.0015                         |
| 2                | 11                  | 2.734                  | 2.93                         | 10.18                                   | 0.7620                     | 0.8594                   | 0.04085                   | 1.1049                   | 53.23                                   | 1.0052                         |
| 3                | 11                  | 2.734                  | 3.80                         | 10.18                                   | 0.7620                     | 0.8594                   | 0.04085                   | 1.1938                   | 63.28                                   | 1.0043                         |
| 4                | 12                  | 2.734                  | 7.02                         | 10.18                                   | 0.7620                     | 0.8594                   | 0.04085                   | 1.4554                   | 65.64                                   | 1.0098                         |
| 5                | 12                  | 2.734                  | 8.49                         | 10.18                                   | 0.7620                     | 0.8594                   | 0.04085                   | 1.5621                   | 60.07                                   | 1.0118                         |
| 6                | 12                  | 2.734                  | 10.13                        | 10.18                                   | 0.7620                     | 0.8594                   | 0.04085                   | 1.6891                   | 52.92                                   | 1.0072                         |
| 7                | 13                  | 2.734                  | 2.50                         | 10.18                                   | 0.7620                     | 0.8594                   | 0.04085                   | 1.0617                   | 47.5                                    | 1.0003                         |
| 8                | 13                  | 2.734                  | 4.51                         | 10.18                                   | 0.7620                     | 0.8594                   | 0.04085                   | 1.2522                   | 68.8                                    | 0.9987                         |
| 9                | 13                  | 3.745                  | 2.50                         | 10.37                                   | 0.7544                     | 0.8600                   | 0.0406                    | 1.0617                   | 68.3                                    | 1.0010                         |
| 10               | 13                  | 3.745                  | 4.51                         | 10.37                                   | 0.7544                     | 0.8600                   | 0.0406                    | 1.2522                   | 95.1                                    | 1.0025                         |
| 11               | 14                  | 3.745                  | 4.51                         | 10.37                                   | 0.7544                     | 0.8600                   | 0.0406                    | 1.2522                   | 95.68                                   | 1.0009                         |
| 12               | 15                  | 4.099                  | 2.55                         | 9.46                                    | 1.1278                     | 1.2090                   | 0.0406                    | 1.5113                   | 88.0                                    | 0.9989                         |
| 13               | 15                  | 4.099                  | 2.14                         | 9.46                                    | 1.1278                     | 1.2090                   | 0.0406                    | 1.450                    | 79.0                                    | 0.9930                         |
| 14               | 16                  | 4.099                  | 2.59                         | 9.45                                    | 1.1268                     | 1.2701                   | 0.07163                   | 1.555                    | 69.25                                   | 0.9999                         |
| 15               | 16                  | 4.069                  | 3.53                         | 9.45                                    | 1.1268                     | 1.2701                   | 0.07163                   | 1.684                    | 85.52                                   | 0.9958                         |
| 16               | 16                  | 4.069                  | 8.02                         | 9.45                                    | 1.1268                     | 1.2701                   | 0.07163                   | 2.198                    | 92.84                                   | 1.0040                         |
| 17               | 16                  | 4.069                  | 9.90                         | 9.45                                    | 1.1268                     | 1.2701                   | 0.07163                   | 2.381                    | 91.79                                   | 0.9872                         |
| 18               | 16                  | 3.037                  | 2.64                         | 9.28                                    | 1.1268                     | 1.2701                   | 0.07163                   | 1.555                    | 50.75                                   | 0.9946                         |
| 19               | 16                  | 3.037                  | 8.10                         | 9.28                                    | 1.1268                     | 1.2701                   | 0.07163                   | 2.198                    | 68.81                                   | 0.9809                         |
| 20               | 8                   | 0.714*                 | 1.68                         | 9.52                                    | 0.8570                     | 0.9931                   | 0.0592                    | 1.3208                   | 108.8                                   | 0.9912                         |
| 21               | 8                   | 0.714*                 | 2.17                         | 9.52                                    | 0.8570                     | 0.9931                   | 0.0592                    | 1.4224                   | 121.5                                   | 1.0029                         |
| 22               | 8                   | 0.714*                 | 4.70                         | 9.52                                    | 0.8570                     | 0.9931                   | 0.0592                    | 1.8669                   | 159.6                                   | 0.9944                         |
| 23               | 8                   | 0.714*                 | 10.76                        | 9.52                                    | 0.8570                     | 0.9931                   | 0.0592                    | 2.6416                   | 128.4                                   | 1.0008                         |
| 24               | 9                   | 0.729*                 | 1.11                         | 9.35                                    | 1.2827                     | 1.4427                   | 0.0800                    | 1.7526                   | 39.1                                    | 0.9902                         |
| 25               | 9                   | 0.729*                 | 3.49                         | 9.35                                    | 1.2827                     | 1.4427                   | 0.0800                    | 2.4785                   | 104.72                                  | 1.0055                         |
| 26               | 9                   | 0.729*                 | 3.49                         | 9.35                                    | 1.2827                     | 1.4427                   | 0.0800                    | 2.4785                   | 79.5                                    | 0.9948                         |
| 27               | 9                   | 0.729*                 | 1.54                         | 9.35                                    | 1.2827                     | 1.4427                   | 0.0800                    | 1.9050                   | 90.0                                    | 0.9878                         |

\*These are PuO<sub>2</sub> in Natural UO<sub>2</sub>

\*\*Cases 1 through 19 are with stainless steel clad, Cases 20 through 27 are zircalloy



TABLE 2

WESTINGHOUSE UO<sub>2</sub> Zr-4 CLAD CYLINDRICAL CORE CRITICAL EXPERIMENTS

| EXPERIMENT | PITCH<br>(IN) | BORON CON-<br>CENTRATION<br>(ppm) | MATERIAL<br>BUCKLING<br>(FOR<br>LEOPARD)<br>CM-2 | CRITICAL NO.<br>OF PINS | RADIUS OF<br>FUEL REGION<br>(cm) | k <sub>eff</sub><br>(LEOPARD/PDQ-7) |
|------------|---------------|-----------------------------------|--|-------------------------|----------------------------------|-------------------------------------|
| 1          | 0.600         | 0                                 | .008793  | 489.4                   | 19.021                           | 0.9912                              |
| 2          | 0.690         | 0                                 | .009725  | 317.0                   | 17.605                           | 0.9941                              |
| 3          | 0.848         | 0                                 | .008637  | 251.6                   | 19.276                           | 0.9927                              |
| 4          | 0.976         | 0                                 | .006458  | 293.0                   | 23.935                           | 0.9935                              |
| 5          | 0.600         | 306.                              | .007177  | 659.9                   | 22.088                           | 0.9927                              |
| 6          | 0.600         | 536.4                             | .006244  | 807.2                   | 24.429                           | 0.9937                              |
| 7          | 0.600         | 727.7                             | .005572  | 950.2                   | 26.504                           | 0.9940                              |
| 8          | 0.600         | 104.                              | .008165  | 546.3                   | 20.097                           | 0.9919                              |
| 9          | 0.600         | 218.                              | .007599  | 607.1                   | 21.186                           | 0.9917                              |
| 10         | 0.600         | 330.                              | .007106  | 669.5                   | 22.248                           | 0.9916                              |
| 11         | 0.600         | 446.                              | .006661  | 735.3                   | 23.315                           | 0.9909                              |
| 12         | 0.600         | 657.1                             | .005809  | 895.3                   | 25.727                           | 0.9944                              |
| 13         | 0.848         | 104.                              | .007320  | 321.0                   | 21.772                           | 0.9938                              |
| 14         | 0.848         | 218.                              | .006073  | 420.5                   | 24.919                           | 0.9925                              |
|            |               |                                   |  |                         |                                  | 0.9928 Mear                         |
|            |               |                                   |  |                         |                                  | 0.0012 Std                          |

Fuel Region Data

Enrichment = 2.719 w/o U-235  
 Fuel Density = 10.41 g/cm<sup>3</sup>  
 Pellet Radius = 0.20 in  
 Clad IR = 0.2027 in  
 Clad OR = 0.23415 in

(b) Thickness of water reflector is that required to attain total radius of 50 cm for model.

(c)  $B_z^2$  (PDQ-7) = .000527 cm<sup>-2</sup>



TABLE 3

SAXTON PuO<sub>2</sub>-UO<sub>2</sub> CRITICAL EXPERIMENTS<sup>(8)</sup>

| <u>Experiment</u> | <u>Boron</u><br><u>(ppm)</u> | <u>H<sub>2</sub>O/UO<sub>2</sub></u><br><u>(Volume)</u> | <u>Pitch</u><br><u>(In)</u> | <u>k<sub>eff</sub></u><br><u>LEOPARD</u> |           |
|-------------------|------------------------------|---|-----------------------------|--|-----------|
| 1                 | 0                            | 1.68  | .520                        | .9912                                    |           |
| 2                 | 0                            | 2.17  | .560                        | 1.0029                                   |           |
| 3                 | 337                          | 2.17  | .560                        | 1.0084                                   |           |
| 4                 | 0                            | 4.70  | .735                        | .9944                                    |           |
| 5                 | 0                            | 10.76   | 1.040                       | <u>1.0008</u>                            |           |
|                   |                              |   |                             | .9995                                    | Mean      |
|                   |                              |   |                             | .0068                                    | Std. Dev. |





TABLE 4

ESADA  $\text{PuO}_2$ - $\text{UO}_2$  CRITICAL EXPERIMENTS <sup>(9)</sup>

| <u>Experiment</u> | Boron<br><u>(ppm)</u> | $\text{H}_2\text{O}/\text{UO}_2$<br><u>(Volume)</u> | Pitch<br><u>(In)</u> | $k_{\text{eff}}$<br><u>LEOPARD</u> |
|-------------------|-----------------------|---|----------------------|------------------------------------|
| 1                 | 0                     | 1.11  | .690                 | .9902                              |
| 2                 | 0                     | 3.49  | .9758                | 1.0055                             |
| 3                 | 526                   | 3.49  | .9758                | .9949                              |
| 4                 | 0                     | 3.49  | .9758                | .9948                              |
| 5                 | 0                     | 1.54  | .750                 | .9878                              |
| 6                 | 526                   | 1.11  | .690                 | <u>.9945</u>                       |
|                   |                       |   |                      | .9946 Mean                         |
|                   |                       |   |                      | .0061 Std. Dev.                    |



TABLE 5

MIXED OXIDE FUEL ASSEMBLY DATA  
FOR  
THE GINNA NUCLEAR PLANT

| <u>Item</u>   | <u>Material</u>                                       | <u>Dimensions (in.)</u> |                    |
|---|---|-------------------------|--------------------|
| <u>Fuel Assembly</u>  |   |                         |                    |
| Overall Cross Section   |   | 7.784 x 7.784*          |                    |
| Overall Length  |   | 160.1                   |                    |
| <u>Control Rod Guide Tube</u>                                       |   |                         |                    |
| Number per Assembly   |   | 16                      |                    |
| Material  | 304 S.S.  |                         |                    |
| OD, Upper Section   |   | 0.5375                  |                    |
| ID, Upper Section   |   | 0.5075                  |                    |
| OD, Dashpot   |   | 0.4765                  |                    |
| ID, Dashpot   |   | 0.4455                  |                    |
| Dashpot Length  |   | 26.297                  |                    |
| <u>Instrumentation Tube</u>   |   |                         |                    |
| Number per Assembly   |   | 1                       |                    |
| Material  | 304 S.S.  |                         |                    |
| OD  |   | 0.422                   |                    |
| ID  |   | 0.3455                  |                    |
| <u>Fuel Rod</u>   |   |                         |                    |
| Number per Assembly   |   | 179                     |                    |
| Active Length, inches   |   | 141.4                   |                    |
| Overall Rod Length  |   | 148.6                   |                    |
| Rod Pitch   |   | 0.556                   |                    |
| Pre-pressurized   |   | Yes                     |                    |
| <u>Cladding</u>   |   |                         |                    |
| Material  | Zirc-4  |                         |                    |
| Outside Diameter  |   | 0.422                   |                    |
| Wall Thickness  |   | 0.0243                  |                    |
| Inside Diameter   |   | 0.3734                  |                    |
| <u>Fuel Pellets</u>   |   |                         |                    |
| Material  | (UO <sub>2</sub> +PuO <sub>2</sub> ) Sintered Pellets |                         |                    |
| Pellet Diameter   |   | 0.3659                  |                    |
| Pellet Density  |   | 95%                     |                    |
| Dilutent  | Natural UO <sub>2</sub>                               |                         |                    |
| Enrichments (See Figure 1 for assembly<br>fuel rod loading pattern) |   | <u>w/o (U+Pu) Fis.</u>  | <u>w/o Pu. tot</u> |
| High enrichment (115 per assembly)                                  |   | 3.279                   | 3.110              |
| Medium enrichment (44 per assembly)                                 |   | 3.090                   | 2.883              |
| Low enrichment (20 per assembly)                                    |   | 2.736                   | 2.452              |

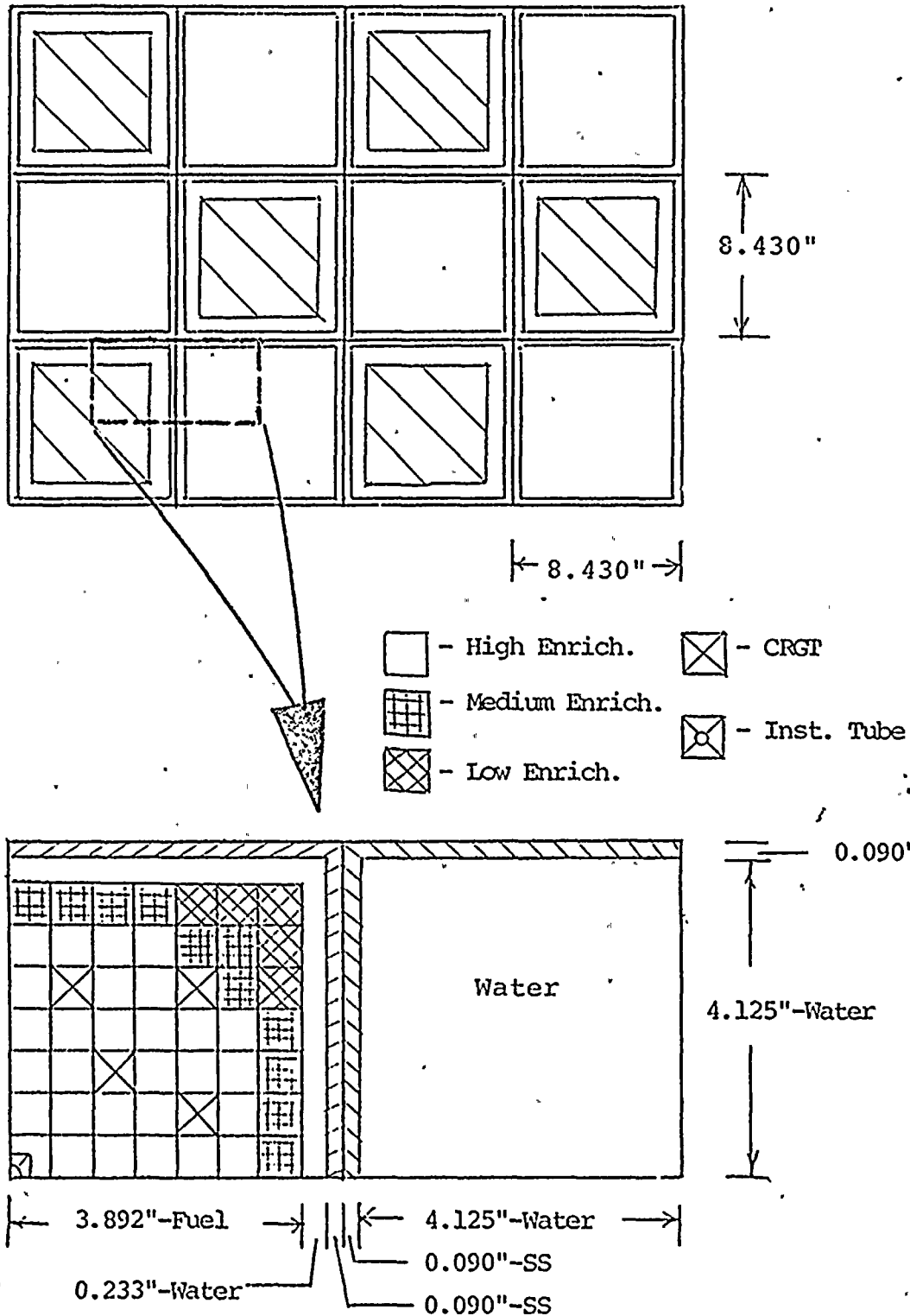
Note: Pu fissile/Pu total = .8329

\*(14 x .556") x (14 x .556") = 7.784" x 7.784"

e 8-0-20

FIGURE 1

PDQ CALCULATIONAL MODEL  
FOR THE  
GINNA SPENT FUEL STORAGE RACK  
WITH MIXED OXIDE FUEL



Note: Boundary condition at top of detailed figure is 180° Rotational Symmetry

9.9.23

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## Radiological Impact of Mixed Oxide Fuel Assemblies

### I. Summary

An assessment is performed which addresses the radiological impact of the use of four mixed oxide fuel assemblies in the Ginna Station reactor core. Normal operation and accidental effluent releases are evaluated by comparing the relative quantities of radioisotopes generated for uranium-only and mixed oxide fuel.

### II. Method of Evaluation

A substantial amount of information pertaining to the use and impact of mixed oxide fuel was developed in NUREG-0002, the Final Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors or GESMO Report. In that report, a model LWR using MOX fuel was devised for comparative impact assessment with LWR's fueled only with uranium. The model MOX-fueled LWR reactor is assumed to be charged with fuel having an average plutonium content of 1.8 weight percent of the heavy metal (Pu and U) in the charged fuel. Furthermore, as many as 40 percent of the rods in the model LWR may be MOX rods. The planned Ginna core reload with 4 MOX fuel assemblies will comprise less than a 0.5 weight percent average Pu content of the total heavy metal being added and less than 4 percent of the rods in the reactor will be MOX rods. Therefore, radiological impacts calculated for the GESMO model reactor will envelop those for the Ginna case.

A radiological assessment was then performed using the radioactive source terms calculated in the GESMO Report for the model MOX-fueled plant and an equivalent-sized reactor unit utilizing  $\text{UO}_2$  fuel. Relative inventories and release quantities of key<sup>2</sup> dose-contributing radionuclides could then be directly used in determining the net effect upon resultant whole body and thyroid doses.

### III. Accidental Releases

#### 1. Spent Fuel Assembly Drop:

The radiological impact of a postulated fuel handling accident involving a dropped MOX fuel assembly was derived by comparing the calculated GESMO source terms with the results of an evaluation which considered the potential consequences of a refueling accident inside the Ginna Station containment building (submitted to A. Schwencer, Nuclear Regulatory Commission, March 18, 1977). The limiting accident dose pathway identified in the March 18, 1977 evaluation was the 0-2 hour thyroid dose from inhalation, which was calculated to be 103 rem and within the guidelines of 10 CFR Part 100. The associated maximum





whole body dose was approximately 2 rads from cloud immersion. Although containment isolation would occur in the event of such an accident, no credit was taken for isolation.

Table IV C-35 illustrates the results of the GESMO analysis of MOX and uranium fuel source terms for calculating thyroid and whole body dose. In general, whole body dose due to released quantities of noble gas and iodine from a MOX assembly having a burnup history similar to that assumed in the 1977 Ginna evaluation would not be expected to exceed the dose from a uranium assembly. For thyroid dose, GESMO showed that the iodine thyroid dose source term may increase 3-14 percent depending upon the Pu characteristics and degree of burnup. More typically, at high burnups, which is the limiting case for a fuel handling accident, the increase in the thyroid dose source term is at the lower end of the range.

The resulting impact upon the fuel handling accident with a MOX fuel assembly will therefore be a modest increase in the maximum offsite thyroid dose and the thyroid dose remains well within the site boundary dose guidelines of 10 CFR Part 100.

## 2. Loss-of-Coolant Accident:

The design basis loss-of-coolant accident was analyzed by the Commission Staff in the January 20, 1972 Safety Evaluation for the R. E. Ginna Nuclear Power Plant Increase; in Section 14 of the R. E. Ginna FSAR, in Section 7 of the R. E. Ginna Final Environmental Statement, and in Section 6 of the R. E. Ginna Environmental Report. In each evaluation the offsite consequences of a postulated accident were shown to be well within the 10 CFR Part 100 guidelines.

The 0-2 hour site boundary thyroid inhalation dose was calculated to be 155 rem in the Commission's 1972 Safety Evaluation, and was more limiting than the associated dose to the whole body. The total increase in iodine core inventory available for release contributed by the addition of 4 MOX fuel assemblies will necessarily be well below the 3-14 percent mentioned above due to the presence of 117 other uranium fuel assemblies. Thus, the potential offsite thyroid dose will increase by only a small amount and will remain below 10 CFR Part 100 by a considerable margin.

## IV. Routine Releases

The June 4, 1976 evaluation entitled Dose Calculations to Conform with Appendix I Requirements - Ginna Station demonstrated that calculated effluent releases were well within the Appendix I

100-100000



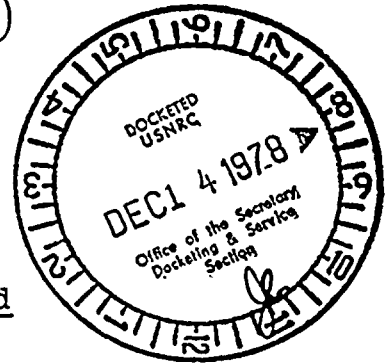
design objectives. In Tables IV C-18 and IV C-19 of the GESMO report, a comparison is made between calculated liquid and gaseous radioactive release quantities for PWR's utilizing MOX and  $UO_2$  fuel, respectively. The GESMO tables indicate that differences in the relative quantities of radionuclides releases are insignificant, except where modest increases result in I-131 and tritium source terms in the MOX case. The percentage increases are 8 percent and 9 percent, respectively. The total increase in normal effluents will be less because only 4 MOX assemblies will be loaded. Therefore the Appendix I objectives will still be met.

V. Conclusion

The radiological impacts caused by the addition of 4 mixed oxide fuel assemblies have been conservatively analyzed for accidents and routine operations. The incremental radiological doses attributed to the presence of the MOX assemblies have been shown to be small for the most potentially significant dose pathways and all applicable guidelines for routine and accidental radiation exposure continue to be met.

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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

|                                    |   |                                |
|------------------------------------|---|--------------------------------|
| In the Matter of                   | ) | Docket Nos.:                   |
|                                    | ) | 50-237, 50-249, 50-254, 50-265 |
| COMMONWEALTH EDISON COMPANY        | ) |                                |
|                                    | ) | Amendments to Facility         |
| (Dresden Station, Units 2 & 3, and | ) | Operating License Nos.:        |
| Quad Cities Station, Units 1 & 2)  | ) | DPR-19, DPR-25, DPR-29, DPR-30 |

ORDER

This Board, by an Order docketed on December 4, 1978, gave notice that a Special Prehearing Conference in the above proceeding would be held on January 11, 1979, in Chicago, Illinois. In response to this notice the parties to this proceeding and the persons seeking to intervene in this proceeding (petitioners) jointly arranged and participated in a telephone conference on December 11, 1978, with the Chairman of the Board in order to discuss the Special Prehearing Conference.

During the telephone conference the parties and petitioners stated their belief that the business of the Special Prehearing Conference could be conducted more effectively if the Conference were postponed. The parties and petitioners requested additional time to discuss possible contentions, and they proposed a schedule for filing and responding to contentions which would enable the Board to have received substantially all argument on the contentions by the date of the Conference. According to the schedule proposed, petitioners' contentions

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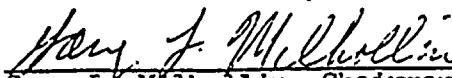
shall be filed on December 29, 1978, responses to those contentions  
~~shall be filed on January 12, 1979; and responses to the responses~~  
shall be filed on January 26, 1979. Oral argument at the Conference  
could be focused on the precise issues which then remain.

For good cause shown, the Special Prehearing Conference scheduled  
for January 11, 1979, is hereby cancelled and notice is hereby given  
that the Conference will be held at 10:00 a.m. on Thursday, February 1,  
1979, in Room 2502, United States Courthouse and Federal Building,  
219 South Dearborn Street, Chicago, Illinois.

In light of the change in the date of the Conference, the parties  
and petitioners are excused from the requirement that they report to  
the Board by December 15, 1978, the progress of their negotiations.

IT IS SO ORDERED.

FOR THE ATOMIC SAFETY AND LICENSING  
BOARD DESIGNATED TO RULE ON  
PETITIONS FOR LEAVE TO INTERVENE

  
\_\_\_\_\_  
Gary L. Milhollin, Chairman

Dated at Madison, Wisconsin,  
December 13, 1978.

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

In the Matter of )

COMMONWEALTH EDISON COMPANY )

(Dresden Nuclear Power Station, )

Units 2 and 3; Quad Cities )

Nuclear Power Station, Units 1, )

and 2) )

Docket No.(s) -50-237

50-249

50-254

50-265

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document(s) upon each person designated on the official service list compiled by the Office of the Secretary of the Commission in this proceeding in accordance with the requirements of Section 2.712 of 10 CFR Part 2 - Rules of Practice, of the Nuclear Regulatory Commission's Rules and Regulations.

Dated at Washington, D.C. this

14th day of DEC 1978.

Peggy T. Downing

Office of the Secretary of the Commission



3.



UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

In the Matter of )

COMMONWEALTH EDISON COMPANY )

Docket No.(s) 50-237

50-249

(Dresden Nuclear Power Station, )

50-254

Units 2 and 3; Quad Cities )

50-265

Nuclear Power Station, Units 1 )

and 2) )

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Key Cn

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

3/8/78

In the Matter of

ROCHESTER GAS & ELECTRIC  
CORPORATION

(R. E. Ginna Nuclear Power Plant,  
Unit No. 1)

Docket No. 50-244

NOTICE OF WITHDRAWAL OF APPEARANCE

Notice is hereby given that effective March 10, 1978, I will withdraw my appearance in the above captioned proceeding. All mail and service lists should be amended to delete my name after that date.

Respectfully submitted,

*Auburn L. Mitchell*

Auburn L. Mitchell  
Counsel for NRC Staff

Dated at Bethesda, Maryland  
this 8th day of March, 1978



**BEFORE THE ATOMIC SAFETY AND LICENSING BOARD**

**Docket No. 50-244**

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U.S. Nuclear Regulatory Commission  
Washington, D. C. 20555

Atomic Safety and Licensing Appeal  
Board  
U.S. Nuclear Regulatory Commission  
Washington, D. C. 20555

Docketing and Service Section  
Office of the Secretary  
U.S. Nuclear Regulatory Commission  
Washington, D. C. 20555

*Auburn L. Mitchell*  
Auburn L. Mitchell  
Counsel for NRC Staff

1950







Contentions C, G, and H are rejected as issues in controversy because each of them is vague and lacking in particularity.

The remaining contentions are admitted, as follows:

Contention A

The Applicant's quality assurance program is inadequate and/or fails to conform to 10 CFR Part 50, Appendix B criteria because:

- a) it has not corrected malfunctions of electric type valve operators;
- b) the main steamline isolation valves do not meet minimum code requirements for wall thicknesses; and
- c) criterion X is not met in that there is an inadequate operations program for inspection of activities affecting quality.

Contention B

Applicant has not demonstrated conformance with the amended ECCS criteria as determined by the AEC in Docket RM-50-1.

Contention D

The Applicant is in violation of applicable Federal and New York State water quality standards in that it does not possess an exemption for the discharge of water at



temperatures of 23.4°F above ambient as described in the FES, pp. 3-7, sec. 3.4.1.

Contention E

The NEPA analysis for the facility is inadequate because it fails to adequately consider the effect of cold shock on lake biota resulting from emergency shutdown of the facility, and because it fails to adequately consider the effect of cold shock on lake biota as a result of recirculation of discharge water into the intake water during the winter when lake ambient temperature falls below 37°F.

Contention F

The FES is inadequate because it fails to treat the following energy conservation alternatives:

- a) ending special discounts for large volume electrical use;
- b) increasing electrical pricing in order to decrease demand;
- c) implementation by the Applicant of maximum lighting levels per square foot by its customers;
- d) setting insulation standards for new and old customers;
- e) promoting energy efficiency labeling;
- f) discouraging electric space heating and air conditioning (in climatic conditions that do not require it); and



g) peak or demand load flattening techniques including time of day metering charges, load staggering and/or selective load shedding.

Contention I

Applicant has failed to submit an adequate site contingency plan because the Applicant has failed to apprise the population of the existence of the site contingency plan and what would be required of the surrounding population if the plan had to be implemented.

Contention J

Applicant has failed to provide flood protection against maximum high water levels shown to have occurred or to have been projected for Lake Ontario.

Contention K

Applicant's radwaste systems management program is inadequate because it does not keep releases to a level as low as reasonably achievable.






The State of New York shall participate in this proceeding as an interested State pursuant to 10 CFR §2.715(c).

SO ORDERED.

THE ATOMIC SAFETY AND  
LICENSING BOARD



Edward Luton, Chairman

Dated at Bethesda, Maryland  
this 25th day of March 1977.



UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

In the Matter of )

ROCHESTER GAS AND ELECTRIC )  
COMPANY )

(R. E. Ginna Nuclear Power )  
Plant, Unit No. 1) )  
)

Docket No.(s) 50-244

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document(s) upon each person designated on the official service list compiled by the Office of the Secretary of the Commission in this proceeding in accordance with the requirements of Section 2.712 of 10 CFR Part 2 - Rules of Practice, of the Nuclear Regulatory Commission's Rules and Regulations.

Dated at Washington, D.C. this

28th day of MAR 1977.

PA Sawney  
Office of the Secretary of the Commission



UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

In the Matter of )

ROCHESTER GAS AND ELECTRIC )  
CORPORATION )

(R. E. Ginna Nuclear Power )  
Plant, Unit No. 1) )  
)

Docket No.(s) 50-244

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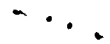
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Docket No. 50-244

ORDER

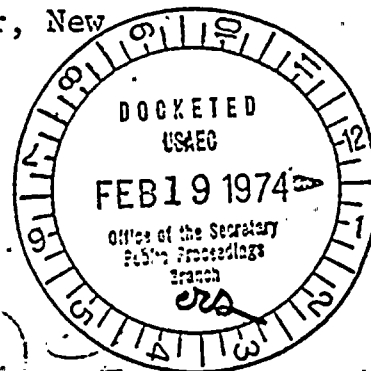
The prehearing conference in this matter is hereby rescheduled and will take place on March 12, 1974, at 9:30 a.m., local time, in the East Courtroom, 2nd Floor, U.S. District Court, 100 State Street, Rochester, New York.

IT IS SO ORDERED.

THE ATOMIC SAFETY AND  
LICENSING BOARD

Edward Luton, Chairman

Issued at Washington, D. C.,  
this 19th day of February, 1974.



HEARING





UNITED STATES OF AMERICA  
ATOMIC ENERGY COMMISSION

In the Matter of )  
)

ROCHESTER GAS & ELECTRIC COMPANY )  
(R.E. Ginna Nuclear Power Plant, )  
Unit No. 1) )

Docket No. 50- 244

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the official service list compiled by the Office of the Secretary of the Commission in this proceeding in accordance with the requirements of Section 2.712 of 10 CFR Part 2 - Rules of Practice, of the Atomic Energy Commission's Rules and Regulations.

Dated at Washington, D. C.  
this 19th day of April, 1974.

P. A. Downing  
Office of the Secretary of the Commission



UNITED STATES OF AMERICA  
ATOMIC ENERGY COMMISSION

In the Matter of )

ROCHESTER GAS AND ELECTRIC )  
CORPORATION )

(R. E. Ginna Nuclear Power )  
Plant Unit No. 1) )

Docket No. 50-244

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