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NSD-NRC-96-4913
DCP/NRC0683
Docket No.: STN-52-003

December 13, 1996

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D. C., 20555

ATTENTION: T. R. QUAY

SUBJECT: AP600 RESPONSE TO REQUESTS FOR ADDITIONAL INFORMATION

Dear Mr. Quay:

Enclosure 1 provides Westinghouse responses to NRC requests for additional information pertaining to the in-vessel retention (IVR) of molten core debris. Specifically, the responses to RAIs 480.440 through 440.461 are included in this enclosure. The RAIs were transmitted to Westinghouse in a NRC letter dated November 7, 1996.

Enclosure 2 provides the response to a NRC request made at the June 24-26, 1996 Westinghouse/NRC AP600 PRA meeting. The request was to provide a limited scope sensitivity study on the baseline PRA. This meeting open item is record number 3969 in the OITS.

The responses close, from a Westinghouse perspective, the addressed questions. The NRC technical staff should review these responses. The status of these RAIs and meeting open item will be changed to "Action N" in the OITS on January 2, 1997.

A listing of the NRC requests for additional information responded to in this letter is contained in Attachment A.

Please contact Cynthia L. Haag on (412) 374-4277 if you have any questions concerning this transmittal.

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

Enclosures, Attachment

/jml

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cc: J. Sebrosky, NRC (enclosures, attachment))
J. Flack, NRC (w/o enclosures)
J. Kudrick, NRC (w/o enclosures)
N. J. Liparulo, Westinghouse (w/o enclosures)

Enclosure 1 to Westinghouse
Letter NSD-NRC-96-4913

December 13, 1996

Question: 480.440 Uncertainties

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

Material Properties

See responses to RAIs 480.448, 480.449, 480.450 and 480.451.

Natural Convection Heat Transfer

See responses to RAIs 480.442, 480.443, 480.444, and 480.445.

Decay Power Uncertainties

See responses to RAIs 480.452, 480.453, and 480.454.

Metal Layer Heat Transfer

See responses to RAIs 480.446, and 480.447.

Question: 480.441 Debris Bed Configuration

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

See responses to RAIs 480.455, 480.456, and 480.457.

Question: 480.442 Molten Pool Natural Convection Heat Transfer

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

It is fundamental that correlation applicability be restricted to the same geometry. A correlation can rarely be applied to another geometry, but never without clear justification that this is appropriate. Also, it is a fundamental requirement that the range of the Rayleigh numbers in the experiments from which the correlation was derived spans the range of Rayleigh numbers in the intended application.

As explained in the IVR report, the mini-ACOPO data satisfy the first requirement, however, a small extrapolation is required to meet the second requirement. The ACOPO data, as discussed in Appendix V-2, meets or exceeds the second requirement. These are half-scale data with temperature differences of order 100°K, so beyond the scaled similarity, there is physical similarity too. The mi -ACOPO and the ACOPO experiments provide a clear test of scalability as there is a linear scale factor of 4 (i.e., volume scale up by about two orders of magnitude).

The Kymalainen data are 30% higher than the Steinberner-Reinecke correlation used in the report. By contrast, the mini-ACOPO data are in excellent agreement with it. The ACOPO data approaches somewhat lower values as the Rayleigh numbers reach and exceed the prototypical range. Also, it should be noted that the 30% departure in the Kymalainen data occurs at Rayleigh number of $\sim 6 \times 10^{14}$, while below it the data agree with Steinberner-Reinecke. As noted in the report, the Kymalainen data are suspect in this departure and the ACOPO data confirm this suspicion in a definitive manner.

Regarding the sensitivity study requested, the impact has been calculated for both the base quantification and the extreme parametric case. As a result of the 30% increase in the Steinberner-Reinecke correlation, the upward fluxes increase by 11% in both cases. The consequent increase of the thermal loads in the metal layer region is 16% in both cases. For the base quantification, as seen from Figure 7.9, such an increase is negligible compared to the margins. For the extreme parametric cases, such an increase would cause the CHF to be exceeded by 10 to 20% depending in whether the 10% increase in critical heat flux in a highly localized zone is taken into account. It is emphasized that the 30% increase postulated is refuted in a robust way by the ACOPO data and that the extreme parametric case is shown only as an example of what it takes to produce failure.

Question: 480.443 Molten Pool Natural Convection Heat Transfer

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

As noted in Chapter 5 the IVR report, the flux shape data from BMFT RS 48/1 was utilizzed (reference 26 in the IVR report). The Rayleigh number for these data is $1.2x10^{10}$. The Jahn data shown in Mayinger's paper, which were used by INEL for Figure 3 has a Rayleigh number of $4x10^7$, and are further removed from the range of interest, Ra' ~10^{15} to 10^{16}. It should be noted that in the context in which this comparison was made in the IVR report, the deviations shown in Figure 3 have a trivial impact on the results.

As far as including the Kymalainen data in Figure 5.8 of the IVR report, the COPO geometry (torospherical) is very different from that of interest here (hemispherical) and including these data is inappropriate.

Question: 480.444 Molten Pool Natural Convection Heat Transfer

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

- The single point discrepancy in only three runs indicates an instrument error at the 40 degree location.

- The ACOPO data have been published in the Park City, UT PSA '96 meeting proceedings. The paper is provided as Attachment 480.444-1 to this RAI response.

- The sensitivity to a flatter flux shape can be conservatively answered for the base case (i.e., thick metal layer and oxidic pool) since for it the downward thermal loads are maximized. The result of Figure 7.10 apply and show the margins. The effect of any local changes in the flux shape can then be seen directly in relation to those margins.

  For example, take Figure 11 of Attachment 480.444-1. Data can be found that exceeds the correlation by approximately 40 percent. Using this in Figure 7.10, the $q(\theta)/q_{CHF}$ increases from 0.4 to 0.56. That is a local reduction in margin from 250% to 180%.

Proceedings, PSA'96
Park City, UT, September 29-October 3, 1996
Vol. III, 1343-1350

ATTACHMENT 480.444-1

THE FIRST RESULTS FROM THE ACOPO EXPERIMENT

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ABSTRACT

The ACOPO experiment simulates natural convection heat transfer from volumetrically heated pools, at a half-scale reactor lower head geometry (hemispherical). Data for Rayleigh numbers of up to $2 \cdot 10^{16}$, from the first round of experiments, are presented in this paper. The results are in substantial agreement with those of the mini-ACOPO proof-of-concept experiment. Moreover, it is shown that these ACOPO results confirm a key component of the in-vessel retention capability for an AP600-like design, as recently established in DOE/ID-10460.

I. INTRODUCTION

The purpose of this paper is to present the first experimental data of natural convection heat transfer for the range of Rayleigh numbers, 10^{15} - 10^{16}, directly relevant to a severe accident management concept known as "in-vessel retention" (IVR). The geometry is illustrated in Figure 1, and involves a volumetrically heated oxidic pool, and a lower head that is externally submerged in water. For an AP600-like design, the diameter is ~4 m, the decay power ~1.3 MW/m^3, and the distribution of Rayleigh numbers, accounting conservatively, for uncertainties, is as illustrated in Figure 2 (Theofanous et al., 1995). By comparison, previous data were limited to $\sim 10^{14}$ in the UCLA experiments (Asfia and Dhir, 1996), to $\sim 7 \cdot 10^{14}$ in the mini-ACOPO experiment (Theofanous and Liu, 1995), and to $\sim 10^{15}$ for the COPO experiments (Kymäläinen et al., 1996); that is, lacking by about one order of magnitude. For larger reactors there may be a need for almost another order of magnitude, to $\sim 10^{17}$. Besides this practical need, there are also some interesting fundamental questions on the behavior as $Ra' \rightarrow \infty$.

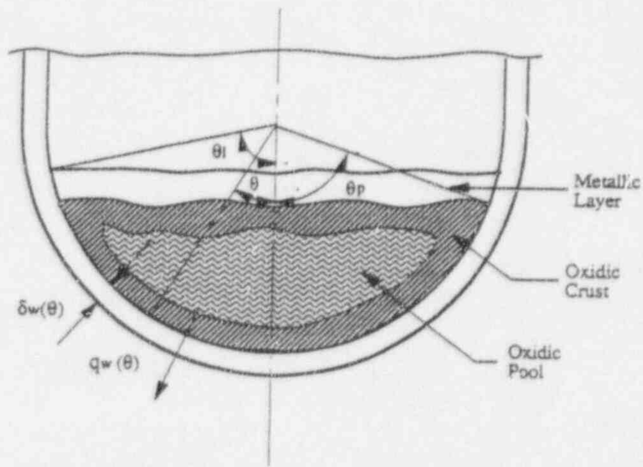


Fig. 1. Schematic of the in-vessel retention geometry (Theofanous et al., 1995). The lower head is externally cooled by boiling water.

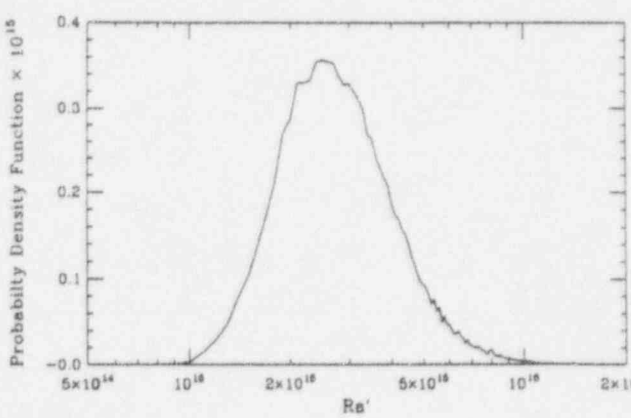


Fig. 2. The Ra′ number distribution found in calculations assessing the in-vessel retention concept for an AP600-like design (Theofanous et al., 1995).

As explained in detail before (Theofanous et al., 1995), the present practical need is to determine (a) the energy flow split between the upper (flat) and lower (hemispherical) boundaries, and (b) the shape factor along the hemispherical boundary, so that local heat flux conditions can be determined from the area-average value. Also, it was explained that the problem is completely determined from the shape, and the isothermal boundary conditions (due to the presence of crusts), and that it is properly and completely scaled by the Rayleigh number (Ra′), with the Pr number having only a minor independent effect

$$\mathrm{Nu} = f(\mathrm{Ra}') \qquad \mathrm{Ra}' = \frac{g\beta\dot{Q}H^5}{\nu\alpha k} \tag{1}$$

The long-standing difficulty in reaching the range of Ra′ numbers of interest, experimentally is due to the strong dependence on the length scale, and the difficulty of producing uniform volumetric heating at large enough scales and hemispherical geometries. For example, with a radiation method (such as used in the UCLA experiment) uniformity of power deposition requires a low-coupling system ("transparent fluid"), which really limits the magnitude of power depositions and the pool superheating possible. On the other hand, for direct electrical heating, power uniformity requires a parallel electrode configuration (as in the slice geometry of COPO), which rules out the hemispherical geometry of interest.

The ACOPO idea bypasses this difficulty, by using the internal energy of the fluid, preheated to some high initial temperature, to simulate volumetric heating, by suddenly cooling the boundaries and interpreting the transient system cooldown as a sequence of quasi-stationary natural convection states. That is, from the local instantaneous fluxes at the boundaries, a total heat loss rate can be obtained to define the instantaneous Rayleigh numbers, which then are correlated to the instantaneous Nusselt numbers. The idea is that the cooldown would be arrested, and nothing would really change, if at any instant in time during the cooldown, a volumetric heating rate could be supplied that was equal to the then heat loss rate. The mini-ACOPO experiments confirmed that this idea actually works. The present experiments provide additional, definitive evidence that this is so.

The mini-ACOPO test section has a diameter of 0.4 m (1/8 scale) and reached Ra′ numbers of $7 \cdot 10^{14}$ and $3 \cdot 10^{13}$, using Freon 113 and water as working fluids, respectively. The ACOPO test section has a diameter of 2 m (1/2 scale) and with water it reached a Ra′ number of up to $2 \cdot 10^{16}$.

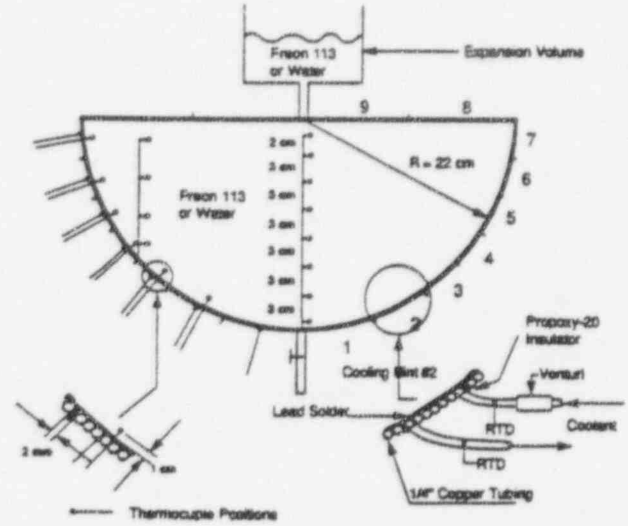
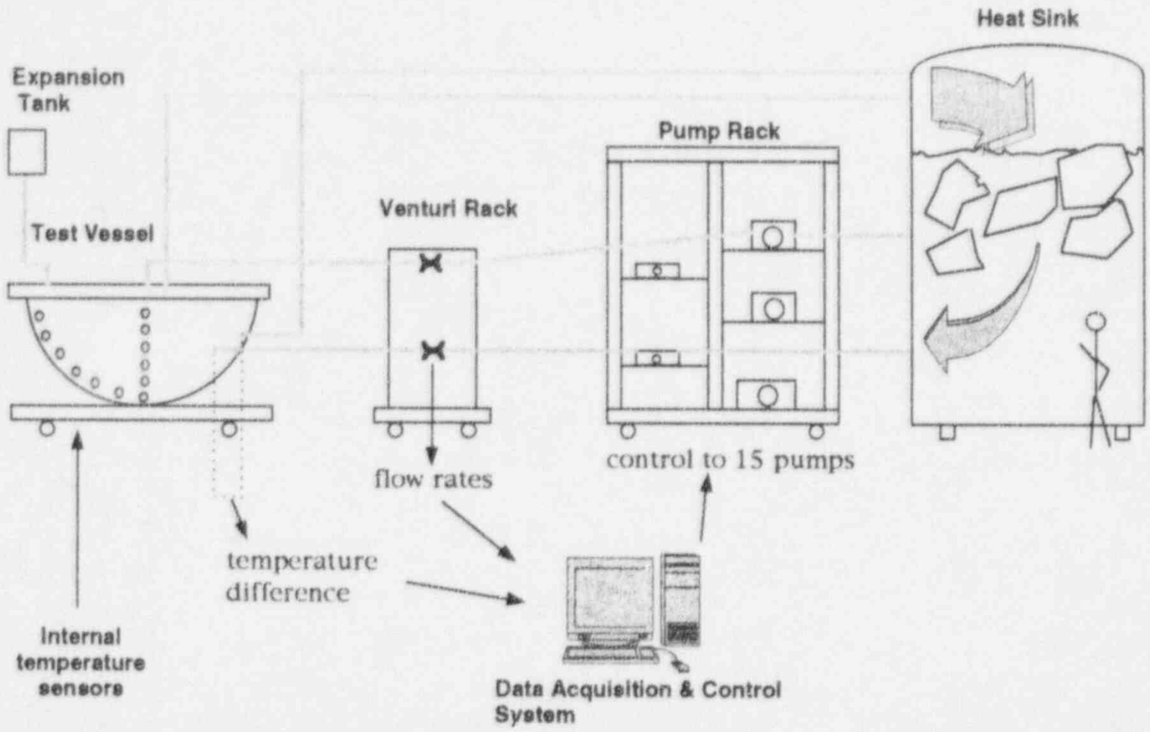


Fig. 3. Schematic of the mini-ACOPO experiment, including the key construction details and instrumentation.

II. THE EXPERIMENTAL FACILITY

The ACOPO experiment is a large version of the mini-ACOPO, the basic design of which is illustrated in Figure 3. The figure shows the individual cooling units, the insulation between them, internal fluid temperature measurement locations, and the expansion volume needed to accommodate the fluid during the transient, while maintaining the vessel completely full. In the ACOPO, construction details were much more involved, and actually building the facility proved to be a major challenge. Some perspectives of the sheer size of the project are provided in Figures 4 through 8, which will also be used to explain its key components.

Starting with Figure 4, we can see the test vessel (shown, in the photo, prior to insulation), the pump and venturi racks, the heat sink tank, the temperature instrumentation locations, and the data acquisition and experiment control system. The heat sink is a large stainless steel cylindrical tank (2 m x 3.5 m), loaded with ice (see Fig. 8), so as to maintain a constant water temperature at ~0 °C. There are 15 cooling units, 10 on the lower and 5 on the upper boundaries, that constitute the vessel wall, as shown in Figure 7. Unlike the mini-ACOPO, here each cooling unit is independently fed by a respective pump (see Fig. 4), whose speed is controlled such as to maintain the cooling unit operating at a near-optimum for the instrumentation. The object, as discussed in the next section,



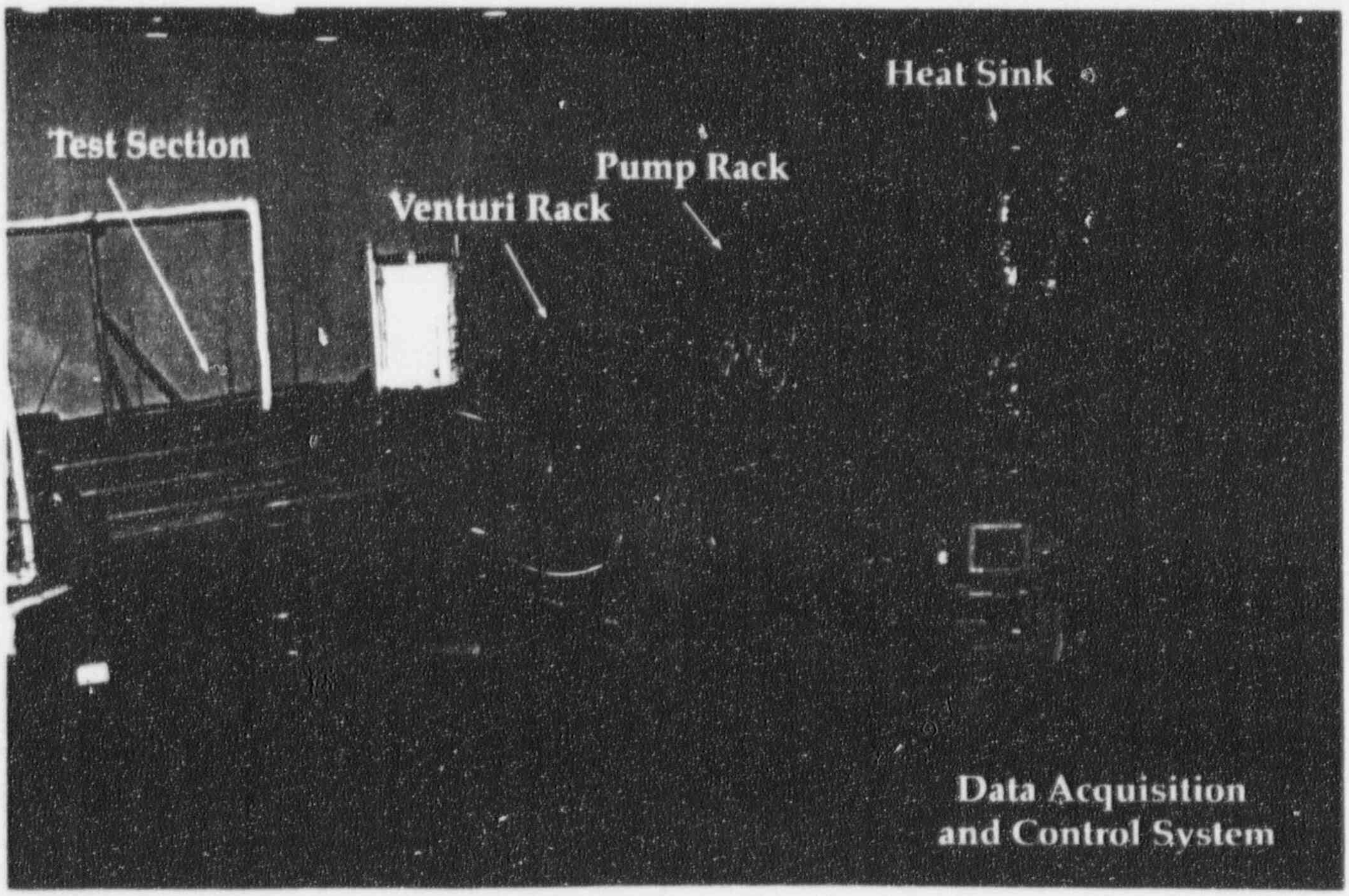


Figure V.4. The ACOPO half-scale facility.

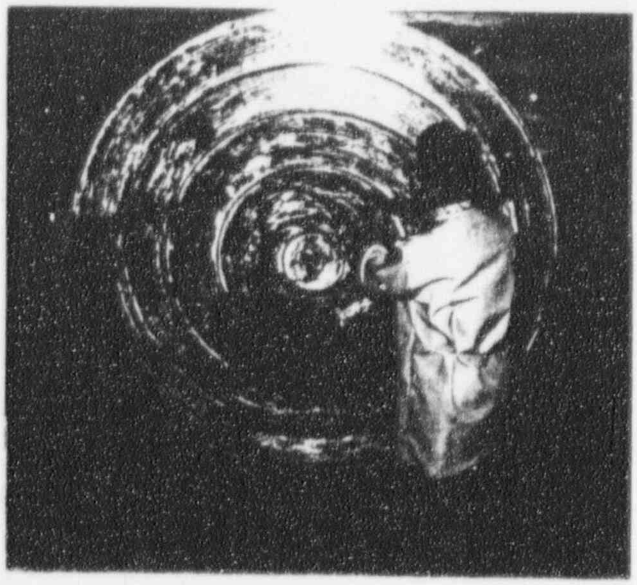


Figure V.5. The ACOPO test vessel lid in the final stages of polishing.

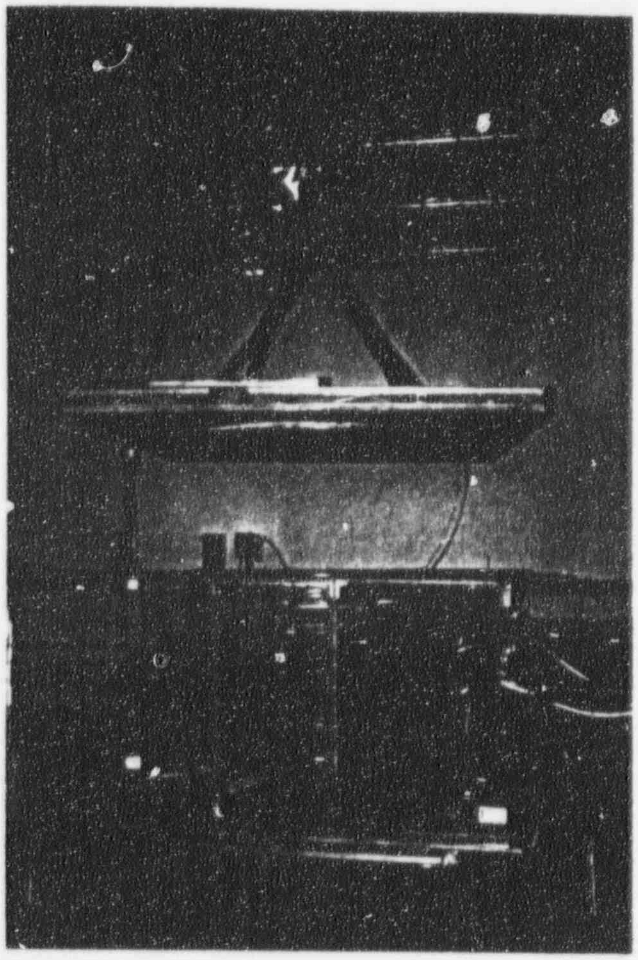


Figure V.6. The ACOPO test vessel lid being lowered upon the ACOPO test vessel.

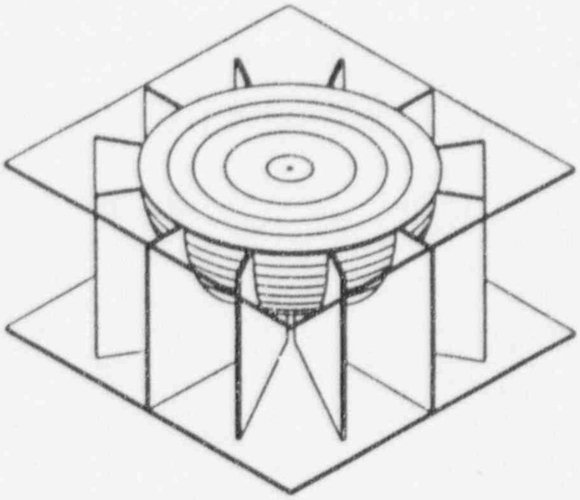


Figure V.7. Schematic of the ACOPO test vessel, showing the individual cooling units and the vessel support.

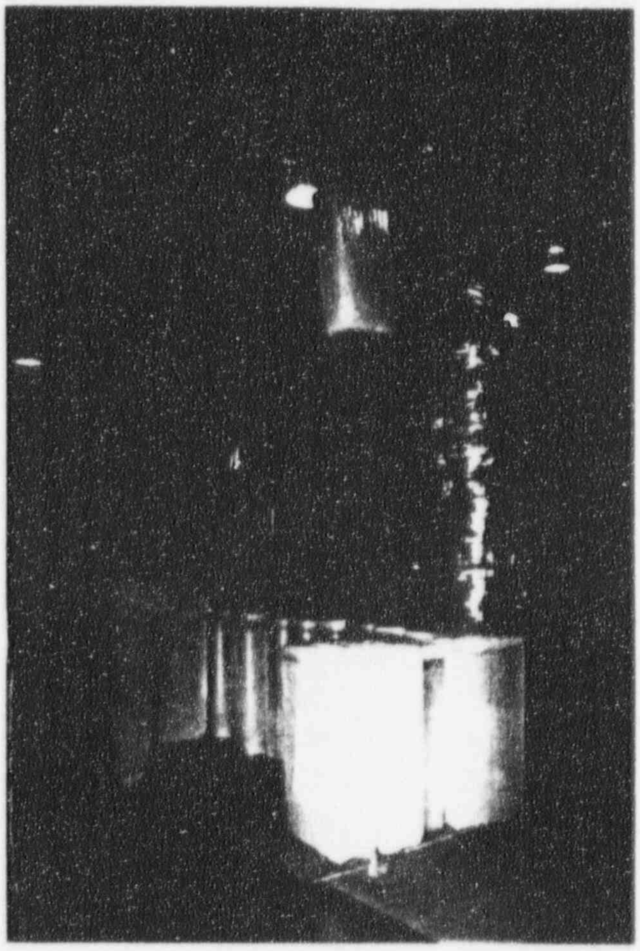


Figure V.8. Load of ice being transferred to the ACOPO heat sink vessel prior to a run.

is to keep the walls as nearly isothermal as possible, and yet obtain a ΔT in each cooling unit that is large enough to minimize measurement error.

The ACOPO test vessel is shown in Figures 5, 6, and 7. Each cooling unit was manufactured separately by welding together properly bent rings of square copper tubing (1/2-inch on the side), so as to make an effectively seamless internal surface. Within each cooling unit the rings could communicate, so that with a single inlet and outlet, the flow would traverse through all the rings. The whole vessel lower and upper parts were then built by putting together the cooling units, with special silicon rings between them for thermal insulation, on wooden supports, as shown in Figures 6 and 7. The test vessel was well insulated on the outside, and special care was taken that it is not connected to any thermal masses that could introduce external heat flow to the cooling units during operation.

III. MEASUREMENTS AND OPERATION

As noted above, the key aspect of the operation is in regards to balancing measurement accuracy against the required condition for isothermal boundaries of the test vessel. This was resolved as follows. With a maximum fluid-to-wall temperature difference of the order of $\sim$100 K, it was decided that the isothermal condition would be satisfied well enough if the cooling units operated, inlet-to-outlet, within a few degrees K. This then led to a requirement for measuring this temperature difference with an accuracy of better than 0.1 K. For this purpose, we chose thermistors, with a quoted accuracy of $\pm$0.1 K. The bulk fluid temperatures were measured with chromel-alumel thermocouples to an accuracy of $\pm$1 K. Thermocouples, thermistors, as well as the venturis used for flow rate measurement, were calibrated in situ, using the complete data acquisition system, and were found to perform very stably throughout this first experimental campaign. As shown from a typical energy balance in Figure 9, the overall accuracy is much better than 10%, which for an experiment of this size is deemed quite satisfactory.

A run was begun by heating the vessel contents, to some high temperature near 95°C, very slowly, by recirculating the contents through an external heater. The water level was then adjusted to a few centimeters below the top lid, and steam was injected into the freeboard volume while also allowing for an exhaust, until the temperatures in this upper region reached 100 °C. This freeboard volume was then isolated, and immediately connected to the expansion tank, thus allowing this volume to fill, by the draining, of degassed, 100 °C water. This procedure ensured that there would be no air trapped, as bubbles, in the underside of the vessel lid. The cooling circuits were then switched on, to initiate the cooldown, which was continued until measurement accuracy was lost, typically about 1 hour later.

Data were recorded by a PC at a rate of 0.5 Hz, and were reduced with an interfacing computer program using a local smoothing routine before taking the time derivatives needed. All thermophysical properties were evaluated at the "film" temperature, i.e., the average value between the bulk and the wall. The energy balance was well within the 10% error bounds, as shown in Figure 9, and all data in fact were highly reproducible, as shown below.

IV. EXPERIMENTAL RESULTS

A total of five experiments have been run so far, in the manner described above. A typical transient of the Rayleigh number is shown in Figure 10, and a typical comparison of the heat flux shapes with the correlation obtained from mini-ACOPO is provided in Figure 11. The data variation around the correlation in this figure is also typical of what was found in mini-ACOPO; i.e., the correlation represents a fair representation through the middle of the data.

The upward heat transfer from Run 5/28/96 is compared to the Steinberner-Reineke (1978) correlation in Figure 12. The trend of the data veering off the correlation for $Ra' > 10^{13}$ was already slightly evident in the mini-ACOPO data, but it is quite clear now with the range extension by more than one order of magnitude. In this upper range of $10^{15} < Ra' < 10^{16}$, the data seem to indicate a Rayleigh number exponent near 0.2. This is the highly turbulent regime, and there has been some question of whether it should tend asymptotically to 0.2 or 0.25 (see Chapter 5, and the section on Natural Convection in Appendix U, of DOE/ID-10460). By a Ra' number of 10^{16} the deviation from the Steinberner-Reineke correlation is already significant. As shown in Figure 12, the data from Run 5/28/96 can be well correlated by

$$Nu = 1.95\, Ra'^{0.18} \qquad (2)$$

which is shown in relation to all ACOPO data in Figure 13. An essentially tight bound of $\pm$10% is observed.

The downward heat transfer data from ACOPO Run 5/28/96 is shown in comparison to the Mayinger (1975) and mini-ACOPO (Theofanous and Liu, 1995) correlations in Figure 14. In the latter case, the extension of the lower branch of the correlation, representing the water data obtained in the range $10^{12} < Ra' < 4 \cdot 10^{13}$, is used. It is seen that in the upper range both correlations and the data come together to a close agreement. The upper branch of the mini-ACOPO correlation, obtained with Freon 113, and extending from $\sim 3 \cdot 10^{13}$ to

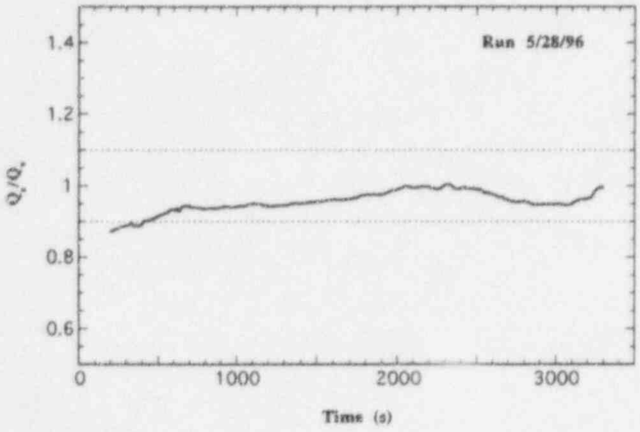


Fig. 9. The overall energy balance for Run 5/28/96. Q_s is the total heating rate of the cooling circuits, and Q_v is the total cooling rate of the vessel contents.

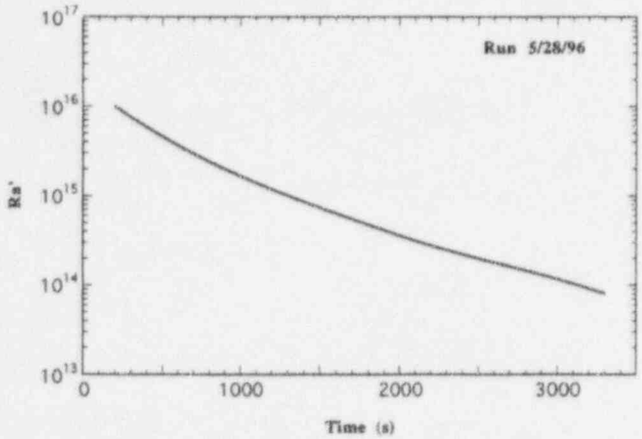


Fig. 10. The Rayleigh number transient in ACOPO Run 5/28/96.

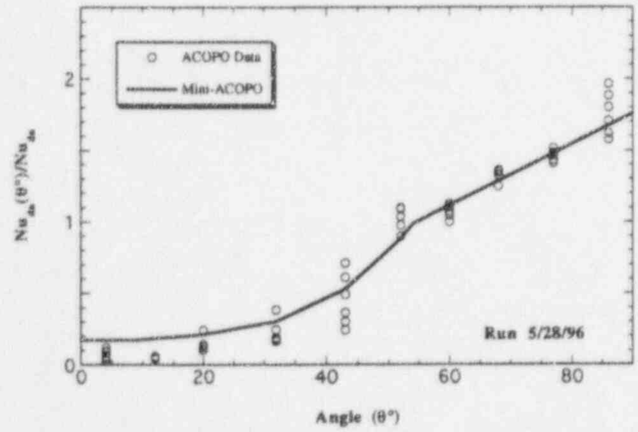


Fig. 11. The heat flux distribution along the lower boundary in ACOPO Run 5/28/96 compared with the correlation obtained from mini-ACOPO. Data shown only every 600 s (for clarity), for the duration of the run.

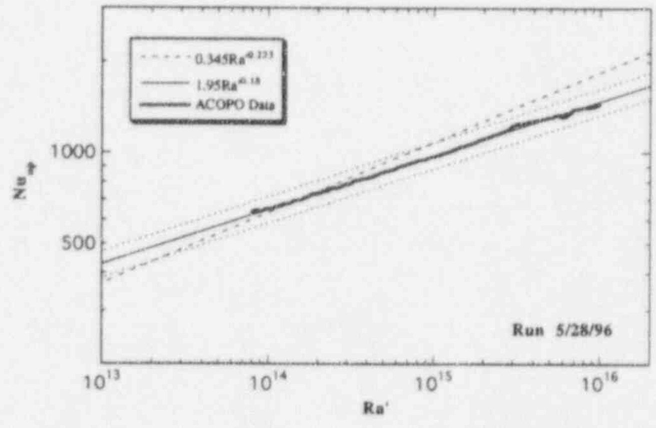


Fig. 12. Upward heat transfer from ACOPO Run 5/28/96 compared to the Steinberner-Reineke correlation. The dotted line shows the ±10% margins on the correlation. The solid line shows the present data fit.

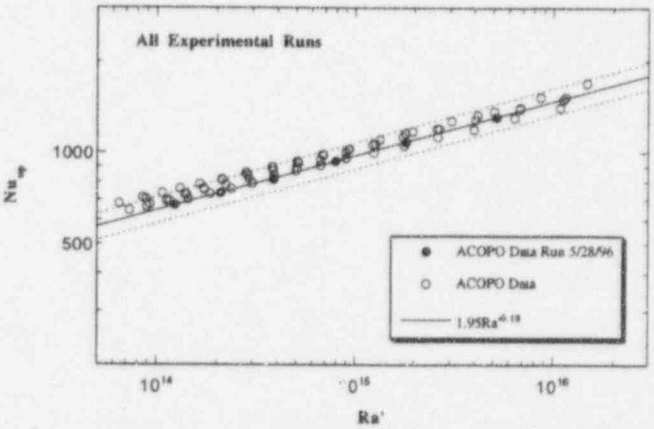


Fig. 13. Upward heat transfer from all five ACOPO runs. Data shown every 200 s, for clarity. The full points are from Run 5/28/96, and the solid line represents the fit to these data. The dotted lines show the ±10% margins on the correlation.

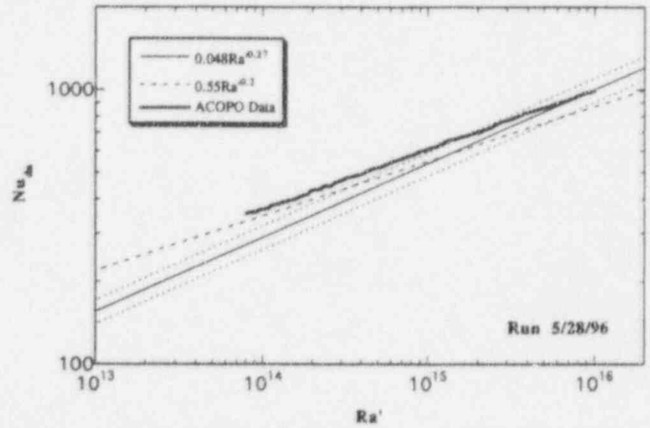


Fig. 14. Downward heat transfer from ACOPO Run 5/28/96 compared to the Mayinger correlation (- - -), and to the extension of the lower branch of the mini-ACOPO correlation (—). The dotted lines show the ±10% margins on the correlation.

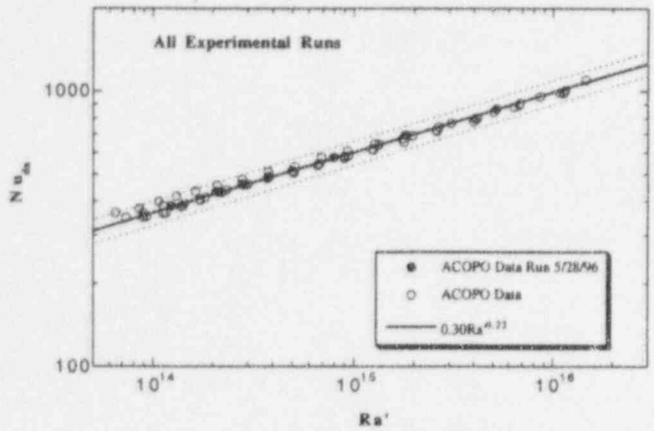


Fig. 15. Downward heat transfer from all five ACOPO runs compared to correlation (3). Data shown every 200 s, for clarity. The dotted lines show the ±10% margins on the correlation.

$7 \cdot 10^{14}$, exhibits a somewhat steeper slope. This matter is under investigation. A fit to the data from Run 1 yields

$$\mathrm{Nu}_{dn} = 0.3\ \mathrm{Ra}'^{0.22} \tag{3}$$

and it is shown in relation to all ACOPO data in Figure 15. An essentially 10% tight fit over the whole range of Ra′ is observed.

V. DISCUSSION

The in-vessel retention analysis for the AP600 noted above (Theofanous et al., 1995) was based on the Steinberner–Reineke and the mini-ACOPO (upper branch) correlations for the upward and downward heat transfer, respectively. They are given by

$$\mathrm{Nu}_{up} = 0.345\ \mathrm{Ra}'^{0.233} \tag{4}$$

and

$$\mathrm{Nu}_{dn} = 0.0038\ \mathrm{Ra}'^{0.35} \tag{5}$$

although the Mayinger correlation

$$\mathrm{Nu}_{dn} = 0.55\ \mathrm{Ra}'^{0.2} \tag{6}$$

was also utilized in sensitivity analysis. It is interesting, therefore, to consider how the new results, obtained directly on the prototypic range of Rayleigh numbers (see Fig. 2), might affect the conclusions.

Given the agreement on the flux shape, it is sufficient for this purpose to consider the average heat fluxes in the upward and downward directions. Let us denote their ratio by R′, and with subscripts "o" and "n" the "old" and "new" results respectively. That is, from Eqs. (4) and (5), we have

$$\mathrm{R}'_0 = \frac{\mathrm{Nu}_{up,o}}{\mathrm{Nu}_{dn,o}} = 90.7\ \mathrm{Ra}'^{-0.117} \tag{7}$$

while based on Eqs. (2) and (3), we have

$$\mathrm{R}'_n = \frac{\mathrm{Nu}_{up,n}}{\mathrm{Nu}_{dn,n}} = 6.5\ \mathrm{Ra}'^{-0.04} \tag{8}$$

Now the heat flux ratios of interest can be obtained (see Section 5.1 of DOE/ID-10460) from.

$$\frac{q_{up,n}}{q_{up,o}} = \frac{1 + 2/\mathrm{R}'_o}{1 + 2/\mathrm{R}'_n} \tag{9}$$

and

$$\frac{q_{dn,n}}{q_{dn,o}} = \frac{1 + 0.5\ \mathrm{R}'_0}{1 + 0.5\ \mathrm{R}'_n} \tag{10}$$

The results, for Rayleigh numbers bounding the region of interest, are summarized in Tables 1 and 2. It can be seen that in the previous results the upward flux was previously underestimated by ~10%, while the downward flux was overestimated by less than ~8%. These variations are negligible in the context of the analysis, and the margins to failure found in DOE/ID-10460.

Table 1. Illustration of the Variation in the Heat Flux Ratio, R′, as a Result of the New Correlation Basis

Ra′	R'_o	R'_n
10^{15}	1.59	1.63
$5 \cdot 10^{15}$	1.32	1.53
10^{16}	1.22	1.49

Table 2. Bounding Values of the Effect of the New Correlation Basis on In-Vessel Retention in an AP600-Like Design

Ra′	$q_{up,n}/q_{up,o}$	$q_{dn,n}/q_{dn,o}$
10^{15}	1.01	0.99
$5 \cdot 10^{15}$	1.09	0.94
10^{16}	1.12	0.92

VI. CONCLUSIONS

- The first round of experiments from the ACOPO facility confirm the experimental concept, and extend the mini-ACOPO results, to fully cover the prototypic range of Rayleigh numbers of current interest to in-vessel retention
- Some variations from the extensions of previous correlations are found, but they are mainly of a detailed fundamental interest. The net impact on the assessment of in-vessel retention is less than 10%.

NOMENCLATURE

g	acceleration of gravity
H	depth of pool
Nu	Nusselt number$\equiv (qH)/k(T_{max} - T_w)$
q	average heat flux at pool boundaries
$\dot{Q}$	volumetric heat generate rate
Ra'	Rayleigh number, internal $\equiv (g\beta\dot{Q}H^5/(k\nu\alpha)$
T	temperature

Greek

α	thermal diffusivity
β	thermal expansion coefficient
ν	kinematic viscosity

Subscripts

dn	downward (over the hemispherical boundary)
n	new
o	old
up	upward (over the flat boundary)
w	wall value

ACKNOWLEDGEMENTS

Support from DOE's ARSAP program, and of the program's Project Manager, Mr. S. Sorrell (DOE, Idaho Operations Office), are gratefully acknowledged.

The authors also wish to express their appreciation to Dr. C. Liu for his participation in the design of ACOPO, and to Messrs. Al Khamseh, Richard Becker and Godfrey Nairn, for their essential contribution in the construction of the ACOPO test vessel.

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3. F. Mayinger, M. Jahn, H. Reineke and U. Steinberner, "Examination of Thermo-hydraulic Processes and Heat Transfer in a Core Melt," Final Report BMFT RS 48/1. Technical University, Hannover, W. Germany, 1975. As reviewed by F.A. Kulacki, Ohio State University, for the US NRC, March 31, 1976.

4. U. Steinberner and H.-H. Reineke, "Turbulent buoyancy convection heat transfer with internal heat sources," Proceedings Sixth International Heat Transfer Conference, Toronto, Canada, August 1978.

5. T.G. Theofanous and C. Liu, "Natural Convection Experiments in a Hemisphere with Rayleigh Numbers up to 10^{15}," Proceedings, 1995 ANS National Heat Transfer Conference, Portland, Oregon, August 5-9, 1995, 349–365.

6. T.G. Theofanous, C. Liu, S. Additon, S. Angelini, O. Kymäläinen and T. Salmassi, "In-Vessel Coolability and Retention of a Core Melt," DOE/ID-10460, Vols. 1 and 2, July 1995.

Question: 480.445 Molten Pool Natural Convection Heat Transfer

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

Low volatized material cannot exist in a superheated oxidic pool. Any trapped quantities will be released as vapor and/or liquid masses as the pool crosses its solid to liquid transition region. During this period, the thermal loads are negligible as the decay heat is melting oxide and vaporizing trapped metal and hence the impact of the increased convection is negligible.

Question: 480.446 Molten Metal Layer Heat Transfer

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

- The ABAQUS 5.4 code was used for the two-dimensional heat transfer modeling.

- The vessel dimensions and the heat fluxes used in Figure 5.15 are discussed on Page 5-25 of the IVR Report. The heat fluxes are from the extreme parametric case (Figure 7.16 of the IVR report) and the wall shape is adjusted to obtain an isothermal boundary at the specified melting point of 1600°K.

- At 70° inclination, due to the inclination of the gravity vector, the effective gravitational force would be approximately 6% lower, and the effect on the heat transfer would be approximately 1%.

- The analyses were performed for the purpose of demonstrating that 2-dimensional conduction can dissipate highly localized hot spots. So a hot spot on the inside surface of the wall dissipates as heat is transferred through the wall to the outside surface which is cooled by water.

Question: 480.447 Molten Metal Layer Heat Transfer

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

The Globe-Dropkin correlation involves heat transfer through a bottom-heated layer and provides the Nusselt number in terms of the external Rayleigh number. As explained in Chapter 5 of the IVR report, this correlation is widely supported by many different works.

The Kulacki-Emura correlation (the lower line in Figure 5 of the INEL question) was obtained in a 2-layer system with the bottom layer volumetrically heated. The Nusselt number is provided in terms of the internal Rayleigh number, which was defined to involve the heights of both layers.

Based on the above, it is not appropriate to compare the results of the Globe-Dropkin correlation with the Kulacki-Emura correlation, or to use the Kulacki-Emura correlation for our system.

Question: 480.448 Material Properties

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

To reach a liquidus below the value used in the IVR report (1300°C), the zirconium mass fraction would have to be in the range of 55 to 85%. For any other concentration the value used is conservative. In Appendix P and Chapter 7 of the IVR report, it is argued that the expected compositions would be in the iron-rich region (Zr mass fraction less than 50%). This is due to the unavoidable addition of the radial reflector (~40 tons of steel) to the melt. The reflector slumps into the melt as the support plate is subsumed by the oxide pool.

The SCDAP/RELAP5 results do not provide a better basis for assessing the liquidus. For example, these calculations do not take into account the reflector which would be subsumed into the melt. Even without accounting for the reflector, the 50% Zr mass fraction quoted from SCDAP/RELAP5 analysis does not produce a lower liquidus value than used in the IVR report. For 50% Zr mass fraction, the appropriate value is 1500°C. Also, there can be no unmixed regions to produce a lower liquidus, as the convection that drives the heat transfer to the vessel walls to produce the thermal loads also drives the mixing in the metal layer.

The response to Olander's comment is quoted out of context in the RAI. It could not be argued with confidence that the metal layer composition is away from the iron-rich eutectic (see Figure 6.1) to justify using a higher liquidus value than the conservative bound that was chosen.

By comparison to the above, uncertainties of ±10% in conductivity and CHF pale. The effective conductivity value used in the report is 32 W/K/m, which is properly obtained from Figure L.3 over the range 130°C to 1300°C. The CHF values used are the lower bound of a very tight correlation. The uncertainty in the CHF is below the normal ±20% because of advantages in the experimental facility that allowed us to zero-in on the CHF value by successive runs.

Therefore, the vessel thickness used in the IVR report is appropriate. No further finite element analysis are required.

Question: 480.449 Material Properties

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

The melting point for the wall was chosen conservatively as discussed in RAI 480.448. The oxidic melting point uncertainty is not important, because the superheat is what drives the thermal loads. Similarly, the emissivity is considered an intangible in the ROAAM analysis and was quantified conservatively at the lowest possible value. Impact of variations in emissivity were covered by the parametric results in the report and also in responding to the expert's comments. Uncertainties in density and specific heat reflect negligibly on the top-to-bottom split of heat fluxes because they are reflected through the Ra' number dependency to the 0.117 power (see equation 5.31).

Question: 480.450 Material Properties

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

Uncertainties in the parameters associated with composition and temperature are addressed in the response to RAI 480.449. The thermal conductivity of the crust does not affect the peak heat loads. Rather, the heat load affects the thickness of the crusts. Thus, the uncertainties in the conductivity of the ceramic crust has no impact on the analysis. The same applies to gap conductance between the crust and the vessel wall. No discrepancies exist between Appendix L and Table 7.1, and therefore, no revisions are appropriate.

Question: 480.451 Material Properties

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

The difference in the thermal conductivity between steel and stainless steel is a solid state effect. For example, see variations with minute quantities of carbon in Figure L.4 of the IVR report. In the liquid state, for which this question applies, the thermal conductivities are the same.

Question: 480.452 Decay Heat Assumptions

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

A 10% change in the decay power would produce a 10% change in the thermal loading, both downward and in the metal layer. However, the decay power curve (Figure 7.1) used in the IVR report contains both a reasonable estimate of the decay heat including the uncertainty (see table below) and a conservative treatment of the loss of volatile fission products. No sensitivity analysis is required.

Time after Shutdown (seconds)	ANS 1979 Best Estimate (WM)	ANS 1979 +2σ (MW)	IVR Report (Figure 7.1) (MW)
200	55.9	58.0	62
500	46.8	48.5	48
1000	40.1	41.5	40
2000	33.2	34.3	33
3000	29.3	30.3	29
5000	25.0	25.9	25
10000	20.4	21.1	21
20000	16.9	17.5	17
40000	14.0	14.5	14

Question: 480.453 Decay Heat Assumptions

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

A significantly sized circulating pool in the lower plenum cannot occur before 3 hours. Although the code results quoted in the RAI do not appear to consider the impact of the core radial reflector and the time it takes the melt to penetrate it, the SCDAP/RELAP5 calculation shows the relocation beginning at 3 hours. There will be at least another hour to reach the final bounding state (as described in Appendix O). Similarly, it will take additional time after the depletion of the water in the lower plenum (the 2.7 hours quoted) to reach the melt superheating needed to produce significant thermal loads.

The MAAP4 calculations quoted in the RAI were not oriented to the purpose of melt relocation timing as they also do not include the effect of the reflector on the melt progression. The estimates of the minimal times to the final bounding state in the IVR report (Appendix O) are more reliable than the code results because the melt progression is carefully decomposed and includes the important effect of the reflector. See also the response to RAI 480.105.

Question: 480.454 Decay Heat Assumptions

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

Estimation of the decay power is one of the most robust aspects of the IVR ROAAM. There is no room for arbitrary variations. With proper consideration of the event timing (see RAIs 480.105 and 480.453), conservative hand calculations of the volumetric heating in the oxide pool can produce values up to 1.4 MW/m^3. To produce a value as high as 1.7 MW/m^3, it must be assumed that no oxidation of the zirconium cladding occurs. This is not a physically reasonable assumption. If SCDAP calculations can provide a basis for higher values, it must be assessed how these results are obtained and in which time frame they are applied. It is critical in this regard that the SCDAP calculation did not consider the core radial reflector and phenomenology and timing associated with its melt-through followed by core barrel melt-through.

Question: 480.455 Assumed "Bounding" End-State Condition

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

Configuration A

It appears that the reflector was not modeled in the SCDAP calculation referred to in the RAI. It is physically impossible to relocate 85% of the core without melting a significant portion of the reflector. This is explained in the IVR report and in more detail in Appendix O. If the SCDAP calculation is used to propose a configuration, then the calculation basis needs to be supplied, and more details on the results provided so the scenario can be constructed with the necessary details.

Configuration B

The geometry and scenario are not sufficiently well-defined to perform calculations. For example, if the second metal layer is described as thin, where is the material of the reflector and core barrel? As in the response to Configuration A, a consistent scenario must be established prior to meaningful quantification of consequences.

Question: 480.456 Assumed "Bounding" End-State Condition

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

The inclusion of the upper internals metal to the molten metal pool is considered to be highly unlikely (page 7-5 of the IVR report) and is quantified as such. The sources of metal mass are specifically outlined on page 7-5.

Question: 480.457 Assumed "Bounding" End-State Condition

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

As seen in Tur6 in the IVR Report, Turland is satisfied on this point. Natural convection flows would naturally promote rapid segregation of metallic components on the top, and there are no sufficient forces or mechanisms to re-entrain in the wall boundary layers.

Question: 480.458 Heat Addition Due to Chemical Interactions

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

a. The water pool is not considered a source for oxidation. The water is completely vaporized before a significantly sized molten pool exists.

b. The primary coolant volume of AP600 is approximately 200 m^3 and at fully depressurized conditions corresponds to a water volume of approximately 0.1 m^3 (100 kg). This mass of water could oxidize only 200 kg of Fe. Also note that the frothy oxide layer mentioned in the INEL comments would provide a self-limiting mechanism to oxidation. See also closing comments to Olander in Appendix V-1 of the IVR report.

c. The conditions stated in the RAI, oxidation on the surface of the metal pool and reduced heat transfer from the upper layer due to an oxidic crust are mutually exclusive. The presence of an adiabatic oxidic crust at the top of the pool would prevent oxidation of the metal layer below by the steam above. Each of the conditions is assessed separately in the IVR report. The case with the adiabatic oxide layer at the top of the metal pool is presented in Figure 7.13. An assessment of Olander's metal layer oxidation scenario on page T-69 of the IVR report. Neither of the cases produces failure of the reactor vessel.

Question: 480.459 Radiative Boundary Condition on the Upper Surface of the Melt

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

a. The effect of radiation heat transfer from steam or air at low pressure (density) is negligible. Aerosols were not considered, because under strong natural circulation in the gas atmosphere and the well-cooled side walls of the reactor vessel, any aerosols generated would be quickly depleted from the atmosphere by deposition. The sensitivity studies in Chapter 7 of the IVR report include a case with a perfectly insulated upper metal layer boundary. The sensitivity case conservatively addresses this question.

b. Specific aerosol behavior calculations were not performed. The sensitivity studies in Chapter 7 of the IVR report include a case with a perfectly insulated upper metal layer boundary. The sensitivity case conservatively addresses this question.

c. The δ_o and δ_s are the core barrel (2 inches) and vessel wall thicknesses (8 inches) respectively. The S_s is the side wall (cylindrical) vessel area (57.4 m^2) above the melt. These are used in both the base and extreme parametric cases.

Question: 480.460 Structural Analyses

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

Approximate Solution

a. The approximate solution was provided for understanding of the key features of the problem. For the exact solution and end-effects in the ablated area, see the finite element solutions provided in Chapter 4 of the IVR report.

b. As noted for case 1APC, the decay power is so low that it presents no significant challenge to the vessel wall. For case 3DC, the pressure difference is so low as to produce a negligible effect. To get a general perspective on the pressures that can be accommodated see Appendix G of the IVR report. Conservatively, the AP600 PRA, revision 8 does not credit IVR success for any accident sequences pressurized above 1.0 MPa. The accident classes are evaluated for pressure and the vessel is assumed to fail, regardless of the success of external reactor vessel cooling, if the internal vessel pressure is greater than 1.0 MPa.

c. The point intended by the specific paragraph quoted in the RAI is that under thermal stresses, an elastic-perfectly plastic assumption is grossly conservative.

d. A temperature-dependent yield stress for SA106B is used as explained on page 4-4. The use of SA106B is conservative as it results in less core material holding the loads than would SA533B1.

e. The value used in the report was the minimum possible for iron-rich melts, and thus gives the minimum wall thickness. See also RAI 480.448.

f. Under thermal stress loading, the position in the IVR report is correct. See Shewmon's comments on page T-144. The margins are large.

Finite Element Analysis

g. Conditions of the analysis are for a freely hung vessel (from the top). As stated in page 4-7 of the IVR report, the model is loaded with the hydrostatic pressure distribution - both inside and outside, but their effect is negligible compared to the thermal stresses. Inner surface temperature is obtained from bounding calculations (see Appendix Q). Mechanical properties are for SA106B steel. Change in elastic properties of the material with temperature is included, but perfect plasticity is conservatively assumed (see page 4-7).

h. The purpose of Appendix G is to provide perspective. Pressures of 400 psi are of no interest to IVR. The AP600 PRA, revision 8 does not credit IVR for pressures beyond 1.0 MPa (150 psi).

i. The basis of the INEL analysis was refuted above. The 2.5 cm is the thickness according to the extreme parametric sensitivity, and it was used in the detailed structural analysis presented in the Addendum to Chapter 4. The pool dead load was included and found to be of negligible effect. The vessel dead weight is also negligible.

j. In the Addendum to Chapter 4, the maximum principle strain reaches values of 7% and 18% at the outer and inner layers respectively. This strain level presents no threat to the structural integrity of the vessel. The material properties are temperature dependent.

k. As noted in the report, part of the reactor vessel wall material specification is that it can withstand an accidental flooding and still remain within operation. This means that material damage during such a cooldown event is negligible.

l. The RTNDT is specified as 23°F maximum at end of life.

Question: 480.461 Typo/Errors

The question can be found as Enclosure 1 in NRC letter to Westinghouse dated November 7, 1996.

Response:

a. - f. These typographical errors are noted.

g. For our purposes we are interested in the estimates, rather than the actual TMI wall temperatures, which were affected by an additional cooling mechanism. The caption should be clarified if the report is revised.

Enclosure 2 to Westinghouse
Letter NSD-NRC-96-4913

December 13, 1996

RESPONSE TO MEETING OPEN ITEM

AP600

Question: (#3969)

It was agreed during a Westinghouse/NRC PRA meeting on June 24-26, 1996 that Westinghouse would do a limited scope sensitivity analysis on the baseline PRA to address the staff's concerns on focused PRA. The limited scope sensitivity analysis would keep the following systems, unless the initiating event caused them to fail: main feedwater, condensate, AC power, plant control, non-1E DC power, circulating water, main steam, chilled water, turbine building closed cooling water, component cooling water, service water, and instrument air. Westinghouse would not take credit for the following systems: chemical and volume control, startup feedwater, normal residual heat removal, diverse actuation, and the diesel generators. It was also agreed that this sensitivity analysis would be done with the Revision 7 baseline at power analysis cutsets and that the results would represent a good approximation of the actual number. Westinghouse will submit the results of this analysis to the staff for review.

Response:

As requested by the NRC at the June 24-26, 1996 meeting, Westinghouse has performed the sensitivity study as defined above. The sensitivity of the AP600 core damage frequency for internal events at power to the unavailability of five standby nonsafety-related systems/subsystems was studied. These five systems are: CVS, SFW, RNS, DAS, and the diesel generators. For the sensitivity study, these nonsafety-related systems are assumed to be unavailable in response to a reactor trip or a demand for one.

The core damage frequency for this sensitivity analysis is 4.4E-06 events per year. This increase from the baseline PRA (whose core damage frequency is 1.7E-07 events per year) is primarily due to the unavailability of DAS. The contribution of initiating event categories to the core damage frequency is summarized in Table 1. According to this table, transients (with MFW available), SGTR, ATWS, and loss of main feedwater are the main contributors to plant core damage frequency. The top 200 core damage cutsets are provided in Table 2.

As reported in Chapter 52 of the AP600 PRA, the focused PRA at-power core damage frequency is 7.7E-06 events per year.

Common cause failure of I&C software, totally failing both PMS and PLS, is a dominant contributor to the core damage frequency of this sensitivity case. This event's contribution to core damage frequency is conservative. The PLS and PMS functions are different, and it is expected that the software used for those systems will be sufficiently different that common cause failure of the software will be smaller than is currently represented in the PRA.

Another insight evident from this sensitivity study, and the focused PRA sensitivity study, is that the AP600 design can meet the NRC safety goal without the defense in depth that is provided by the nonsafety-related systems.

PRA Revision: None.

TABLE 1
SENSITIVITY STUDY -- CONTRIBUTION OF INITIATING EVENT CATEGORIES TO CORE DAMAGE FREQUENCY

	Initiating Event (IEV)	IMPORTANCE (%DECREASE)	NUMBER OF CUTSETS	CONTRIBUTION TO CDF	IEV FREQUENCY
1	IEV-TRANS	39.47	328	1.72E-06	1.40E+00
2	IEV-SGTR	15.44	139	6.73E-07	5.20E-03
3	IEV-ATWS	10.65	55	4.64E-07	4.81E-01
4	IEV-LMFW	9.79	114	4.27E-07	3.35E-01
5	IEV-LMFW1	5.39	105	2.35E-07	1.92E-01
6	IEV-LCOND	4.42	61	1.92E-07	1.12E-01
7	IEV-LCCW	4.23	140	1.84E-07	1.44E-01
8	IEV-NLOCA	2.95	747	1.28E-07	7.70E-04
9	IEV-LLOCA	1.15	616	5.02E-08	1.05E-04
10	IEV-LOSP	.95	77	4.13E-08	1.20E-01
11	IEV-SI-LB	.94	188	4.11E-08	1.04E-04
12	IEV-SLB-V	.62	60	2.69E-08	1.21E-03
13	IEV-MLOCA	.61	211	2.64E-08	1.62E-04
14	IEV-LRCS	.50	23	2.19E-08	1.80E-02
15	IEV-ATW-S	.47	32	2.06E-08	2.05E-02
16	IEV-SLOCA	.38	379	1.67E-08	1.01E-04
17	IEV-CMTLB	.34	210	1.49E-08	8.94E-05
18	IEV-PRSTR	.31	132	1.35E-08	2.50E-04
19	IEV-POWEX	.29	108	1.28E-08	4.50E-03
20	IEV-SLB-D	.28	7	1.24E-08	5.96E-04
21	IEV-RV-RP	.23	1	1.00E-08	1.00E-08
22	IEV-RCSLKC	.19	27	8.25E-09	5.02E-05
23	IEV-SLB-U	.18	46	8.06E-09	3.72E-04
24	IEV-LCAS	.17	69	7.45E-09	3.48E-02
25	IEV-ATW-T	.03	5	1.41E-09	1.17E+00
26	IEV-ISLOC	.00	1	5.00E-11	5.00E-11

TABLE 2
SENSITIVITY STUDY -- TOP 200 CORE DAMAGE CUTSETS

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
1	1.68E-06	38.49	INITIATING EVENT - TRANSIENT WITH MFW EVENT OCCURS	1.40E+00	IEV-TRANS
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
2	5.46E-07	12.51	INITIATING EVENT - STEAM GENERATOR TUBE RUPTURE EVENT OCCURS	5.20E-03	IEV-SGTR
			OPERATOR FAILS TO MANUALLY ACTUATE ADS (SGTR IF PRZ SPR FAILS)	5.00E-01	ADF-MAN01
			COMMON CAUSE FAILURE OF RCP BREAKERS FAIL TO OPEN	4.20E-04	RPX-CB-GO
			COND. PROB. OF ADN-MAN01(OPER. FAILS TO ACT. ADS)	5.00E-01	ADN-MAN01C
3	4.02E-07	9.21	INITIATING EVENT - LOSS OF MAIN FEEDWATER EVENT OCCURS	3.35E-01	IEV-LMFW
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
4	3.34E-07	7.65	FAILURE OF PRS RELIEF FOR LOSS OF MFW ATWS, WITH UET	3.27E-01	OTH-PRESU
			INITIATING EVENT - ATWS PRECURSOR WITH NO MFW OCCURS	4.81E-01	IEV-ATWS
			COMMON CAUSE FAILURE OF PMS REACTOR TRIP SYSTEM HARDWARE	7.89E-05	CCX-PMS-HARDWARE
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-02	ATW-MAN03
			COND. PROB. OF ATW-MAN01 (OPER. FAILS TO STEP-IN CONTROL ROD	5.17E-01	ATW-MAN01C
5	2.30E-07	5.27	INITIATING EVENT - LOSS OF MFW TO ONE SG EVENT OCCURS	1.92E-01	IEV-LMFW1
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
6	1.73E-07	3.96	INITIATING EVENT - LOSS OF CCW/SW EVENT OCCURS	1.44E-01	IEV-LCCW
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
7	1.34E-07	3.07	INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
8	5.72E-08	1.31	INITIATING EVENT - STEAM GENERATOR TUBE RUPTURE EVENT OCCURS	5.20E-03	IEV-SGTR
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
9	4.48E-08	1.03	INITIATING EVENT - STEAM GENERATOR TUBE RUPTURE EVENT OCCURS	5.20E-03	IEV-SGTR
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
10	4.20E-08	.96	FAILURE OF PRS RELIEF FOR LOSS OF MFW ATWS, WITH UET	3.27E-01	OTH-PRESU
			INITIATING EVENT - ATWS PRECURSOR WITH NO MFW OCCURS	4.81E-01	IEV-ATWS
			COMMON CAUSE FAILURE OF REACTOR TRIP BREAKERS	8.10E-06	RCX-RB-FA
			OPERATOR FAILS TO STEP IN THE CONTROL RODS	3.30E-02	ATW-MAN01
11	3.43E-08	.79	FAILURE OF PRS RELIEF FOR LOSS OF MFW ATWS, WITH UET	3.27E-01	OTH-PRESU
			INITIATING EVENT - ATWS PRECURSOR WITH NO MFW OCCURS	4.81E-01	IEV-ATWS
			COMMON CAUSE FAILURE OF REACTOR TRIP BREAKERS	8.10E-06	RCX-RB-FA
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA DAS	5.20E-02	ATW-MAN04
			COND. PROB. OF ATW-MAN01 (OPER. FAILS TO STEP-IN CONTROL ROD	5.17E-01	ATW-MAN01C
12	3.00E-08	.69	INITIATING EVENT - ATWS PRECURSOR WITH NO MFW OCCURS	4.81E-01	IEV-ATWS
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-02	ATW-MAN03
13	2.59E-08	.59	INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	2.10E-02	OTH-SLSOV1
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
14	2.50E-08	.57	INITIATING EVENT - SAFETY INJECTION LINE BREAK EVENT OCCURS	1.04E-04	IEV-SI-LB
			IWRST DISCHARGE LINE "A" STRAINER PLUGGED	2.40E-04	IWA-PLUG
15	2.31E-08	.53	INITIATING EVENT - INTERMEDIATE LOCA EVENT OCCURS	7.70E-04	IEV-NLOCA
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION CHECK VALVES	3.00E-05	IWX-CV-AO

TABLE 2
SENSITIVITY STUDY -- TOP 200 CORE DAMAGE CUTSETS

16	2.31E-08	.53	INITIATING EVENT - INTERMEDIATE LOCA EVENT OCCURS	7.70E-04	IEV-NLOCA
			COMMON CAUSE FAILURE OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
17	2.16E-08	.49	INITIATING EVENT - LOSS OF RSC FLOW EVENT OCCURS	1.80E-02	IEV-LRCS
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
18	2.03E-08	.47	INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	2.10E-02	OTH-SLSOV1
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
19	2.00E-08	.46	INITIATING EVENT - INTERMEDIATE LOCA EVENT OCCURS	7.70E-04	IEV-NLOCA
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION SQUIB VALVES	2.60E-05	IWX-EV-SA
20	2.00E-08	.46	INITIATING EVENT - INTERMEDIATE LOCA EVENT OCCURS	7.70E-04	IEV-NLOCA
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
21	1.94E-08	.44	INITIATING EVENT - LOSS OF OFFSITE POWER EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	2.10E-02	OTH-SLSOV1
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
22	1.74E-08	.40	INITIATING EVENT - TRANSIENT WITH MFW EVENT OCCURS	1.40E+00	IEV-TRANS
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
23	1.52E-08	.35	INITIATING EVENT - LOSS OF OFFSITE POWER EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	2.10E-02	OTH-SLSOV1
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
24	1.42E-08	.33	INITIATING EVENT - ATWS PRECURSOR WITH SI SIGNAL OCCURS	2.05E-02	IEV-ATW-S
			FAILURE OF PRS RELIEF FOR LOSS OF MFW ATWS, WITH UET	3.27E-01	OTH-PRESU
			COMMON CAUSE FAILURE OF PMS REACTOR TRIP SYSTEM HARDWARE	7.89E-05	CCX-PMS-HARDWARE
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-02	ATW-MAN03
			COND. PROB. OF ATW-MAN01 (OPER. FAILS TO STEP-IN CONTROL ROD	5.17E-01	ATW-MAN01C
25	1.33E-08	.30	INITIATING EVENT - MAIN STEAM LINE STUCK-OPEN SV OCCURS	1.21E-03	IEV-SLB-V
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
26	1.04E-08	.24	INITIATING EVENT - MAIN STEAM LINE STUCK-OPEN SV OCCURS	1.21E-03	IEV-SLB-V
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
27	1.00E-08	.23	INITIATING EVENT - REACTOR VESSEL RUPTURE EVENT OCCURS	1.00E-08	IEV-RV-RP
28	9.24E-09	.21	INITIATING EVENT - INTERMEDIATE LOCA EVENT OCCURS	7.70E-04	IEV-NLOCA
			COMMON CAUSE FAILURE OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
29	9.24E-09	.21	INITIATING EVENT - INTERMEDIATE LOCA EVENT OCCURS	7.70E-04	IEV-NLOCA
			COMMON CAUSE FAILURE OF RECIRC LINES DUE TO SUMP SCREEN PLUGGING	1.20E-05	REX-FL-GP
30	8.47E-09	.19	INITIATING EVENT - INTERMEDIATE LOCA EVENT OCCURS	7.70E-04	IEV-NLOCA
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
31	7.79E-09	.18	FAILURE OF PRZ SV FOR LOSS OF MFW ATWS, NO UET	2.00E-03	OTH-PRES
			INITIATING EVENT - ATWS PRECURSOR WITH NO MFW OCCURS	4.81E-01	IEV-ATWS
			COMMON CAUSE FAILURE OF REACTOR TRIP BREAKERS	8.10E-06	RCX-RB-FA

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32	7.36E-09	.17	INITIATING EVENT - TRANSIENT WITH MFW EVENT OCCURS	1.40E+00	IEV-TRANS
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
33	6.64E-09	.15	INITIATING EVENT - INTERMEDIATE LOCA EVENT OCCURS	7.70E-04	IEV-NLOCA
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
34	6.60E-09	.15	INITIATING EVENT - STEAM GENERATOR TUBE RUPTURE EVENT OCCURS	5.20E-03	IEV-SGTR
			COMMON CAUSE FAILURE OF RCP BREAKERS FAIL TO OPEN	4.20E-04	RPX-CB-GO
			OPERATOR FAILS TO MANUALLY ACTUATE ADS	3.02E-03	ADN-MAN01
35	6.56E-09	.15	INITIATING EVENT - STEAM LINE BREAK DOWNSTREAM OF MSIV OCCURS	5.96E-04	IEV-SLB-D
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
36	6.50E-09	.15	INITIATING EVENT - PASSIVE RHR TUBE RUPTURE EVENT OCCURS	2.50E-04	IEV-PRSTR
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
37	6.24E-09	.14	INITIATING EVENT - STEAM GENERATOR TUBE RUPTURE EVENT OCCURS	5.20E-03	IEV-SGTR
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
38	6.15E-09	.14	INITIATING EVENT - LOSS OF MAIN FEEDWATER EVENT OCCURS	3.35E-01	IEV-LMFW
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF CMT/SUMP LEVEL HEATED RTD SENSORS	3.84E-05	CMX-VS-FA
39	5.77E-09	.13	INITIATING EVENT - TRANSIENT WITH MFW EVENT OCCURS	1.40E+00	IEV-TRANS
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
40	5.71E-09	.13	INITIATING EVENT - ATWS PRECURSOR WITH NO MFW OCCURS	4.81E-01	IEV-ATWS
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-02	ATW-MAN03
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF PZR LEVEL SENSORS	4.78E-04	CCX-XMTR195
41	5.41E-09	.12	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE -LOWER END OF BREAK SIZE	5.00E-01	BSIZE
			COMMON CAUSE FAILURE OF PMS ESF INPUT LOGIC GROUPS (HARDWARE)	1.03E-04	CCX-INPUT-LOGIC
42	5.41E-09	.12	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE - UPPER END OF BREAK SIZE	5.00E-01	BSIZE-LARGE
			COMMON CAUSE FAILURE OF PMS ESF INPUT LOGIC GROUPS (HARDWARE)	1.03E-04	CCX-INPUT-LOGIC
43	5.40E-09	.12	INITIATING EVENT - CORE POWER EXCURSION EVENT OCCURS	4.50E-03	IEV-POWEX
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
44	5.36E-09	.12	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			COMMON CAUSE FAILURE OF 2 ACCUMULATOR CHECK VALVES	5.10E-05	ACX-CV-GO
45	5.14E-09	.12	INITIATING EVENT - STEAM LINE BREAK DOWNSTREAM OF MSIV OCCURS	5.96E-04	IEV-SLB-D
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
46	4.86E-09	.11	INITIATING EVENT - MEDIUM LOCA EVENT OCCURS	1.62E-04	IEV-MLOCA
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION CHECK VALVES	3.00E-05	IWX-CV-AO
47	4.86E-09	.11	INITIATING EVENT - MEDIUM LOCA EVENT OCCURS	1.62E-04	IEV-MLOCA
			COMMON CAUSE FAILURE OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
48	4.21E-09	.10	INITIATING EVENT - MEDIUM LOCA EVENT OCCURS	1.62E-04	IEV-MLOCA
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA

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49	4.21E-09	.10	INITIATING EVENT - MEDIUM LOCA EVENT OCCURS	1.62E-04	IEV-MLOCA
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION SQUIB VALVES	2.60E-05	IWX-EV-SA
50	4.16E-09	.10	INITIATING EVENT - LOSS OF MAIN FEEDWATER EVENT OCCURS	3.35E-01	IEV-LMFW
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
51	4.16E-09	.10	INITIATING EVENT - LOSS OF MAIN FEEDWATER EVENT OCCURS	3.35E-01	IEV-LMFW
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
52	4.09E-09	.09	INITIATING EVENT - STEAM LINE UPSTREAM OF MSIV OCCURS	3.72E-04	IEV-SLB-U
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
53	3.95E-09	.09	FAILURE OF PRZ SV FOR LOSS OF MFW ATWS, NO UET	2.00E-03	OTH-PRES
			INITIATING EVENT - ATWS PRECURSOR WITH NO MFW OCCURS	4.81E-01	IEV-ATWS
			COMMON CAUSE FAILURE OF PMS REACTOR TRIP SYSTEM HARDWARE	7.89E-05	CCX-PMS-HARDWARE
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-02	ATW-MAN03
54	3.83E-09	.09	INITIATING EVENT - LOSS OF COMPRESSED AIR EVENT OCCURS	3.48E-02	IEV-LCAS
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV)	1.00E-02	OTH-SLSOV2
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
55	3.68E-09	.08	INITIATING EVENT - INTERMEDIATE LOCA EVENT OCCURS	7.70E-04	IEV-NLOCA
			COMMON CAUSE FAILURE OF TANK LEVEL TRANSMITTERS (IRWST, BAT)	4.78E-04	IWX-XMTR
			OPERATOR FAILS TO ACTUATE CONT. SUMP RECIR. (LEVEL SIGNAL FAILS)	1.00E-02	REN-MAN04
56	3.21E-09	.07	INITIATING EVENT - STEAM LINE UPSTREAM OF MSIV OCCURS	3.72E-04	IEV-SLB-U
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
57	3.20E-09	.07	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE -LOWER END OF BREAK SIZE	5.00E-01	BSIZE
			COMMON CAUSE FAILURE OF 4 AOVS TO OPEN	6.10E-05	CCX-AV-LA
58	3.20E-09	.07	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE - UPPER END OF BREAK SIZE	5.00E-01	BSIZE-LARGE
			COMMON CAUSE FAILURE OF 4 AOVS TO OPEN	6.10E-05	CCX-AV-LA
59	3.20E-09	.07	INITIATING EVENT - TRANSIENT WITH MFW EVENT OCCURS	1.40E+00	IEV-TRANS
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF TANK LEVEL TRANSMITTERS (IRWST, BAT)	4.78E-04	IWX-XMTR
			OPERATOR FAILS TO ACTUATE CONT. SUMP RECIR. (LEVEL SIGNAL FAILS)	1.00E-02	REN-MAN04
60	3.12E-09	.07	INITIATING EVENT - SAFETY INJECTION LINE BREAK EVENT OCCURS	1.04E-04	IEV-SI-LB
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION CHECK VALVES	3.00E-05	IWX-CV-AO
61	3.12E-09	.07	INITIATING EVENT - SAFETY INJECTION LINE BREAK EVENT OCCURS	1.04E-04	IEV-SI-LB
			COMMON CAUSE FAILURE OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
62	3.03E-09	.07	INITIATING EVENT - SMALL LOCA EVENT OCCURS	1.01E-04	IEV-SLOCA
			COMMON CAUSE FAILURE OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
63	3.03E-09	.07	INITIATING EVENT - SMALL LOCA EVENT OCCURS	1.01E-04	IEV-SLOCA
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION CHECK VALVES	3.00E-05	IWX-CV-AO

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64	3.00E-09	.07	INITIATING EVENT - LOSS OF COMPRESSED AIR EVENT OCCURS	3.48E-02	IEV-LCAS
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV)	1.00E-02	OTH-SLSOV2
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
65	2.93E-09	.07	INITIATING EVENT - STEAM GENERATOR TUBE RUPTURE EVENT OCCURS	5.20E-03	IEV-SGTR
			COMMON CAUSE FAILURE OF RCP BREAKERS FAIL TO OPEN	4.20E-04	RPX-CB-GO
			OPERATOR FAILS TO RECOGNIZE NEED FOR RCS DEPR. (SLOCA/TRANSIENT)	1.34E-03	LPM-MAN01
66	2.75E-09	.06	INITIATING EVENT - PASSIVE RHR TUBE RUPTURE EVENT OCCURS	2.50E-04	IEV-PRSTR
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
67	2.70E-09	.06	INITIATING EVENT - SAFETY INJECTION LINE BREAK EVENT OCCURS	1.04E-04	IEV-SI-LB
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION SQUIB VALVES	2.60E-05	IWX-EV-SA
68	2.68E-09	.06	INITIATING EVENT - CMT LINE BREAK EVENT OCCURS	8.94E-05	IEV-CMTLB
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION CHECK VALVES	3.00E-05	IWX-CV-AO
69	2.68E-09	.06	INITIATING EVENT - CMT LINE BREAK EVENT OCCURS	8.94E-05	IEV-CMTLB
			COMMON CAUSE FAILURE OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
70	2.68E-09	.06	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE -LOWER END OF BREAK SIZE	5.00E-01	BSIZE
			COMMON CAUSE FAILURE OF 4 CMT CHECK VALVES TO OPEN	5.10E-05	CMX-CV-GO
71	2.68E-09	.06	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE - UPPER END OF BREAK SIZE	5.00E-01	BSIZE-LARGE
			COMMON CAUSE FAILURE OF 4 CMT CHECK VALVES TO OPEN	5.10E-05	CMX-CV-GO
72	2.63E-09	.06	INITIATING EVENT - SMALL LOCA EVENT OCCURS	1.01E-04	IEV-SLOCA
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
73	2.63E-09	.06	INITIATING EVENT - SMALL LOCA EVENT OCCURS	1.01E-04	IEV-SLOCA
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION SQUIB VALVES	2.60E-05	IWX-EV-SA
74	2.39E-09	.05	INITIATING EVENT - LOSS OF MFW TO ONE SG EVENT OCCURS	1.92E-01	IEV-LMFW1
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
75	2.32E-09	.05	INITIATING EVENT - CMT LINE BREAK EVENT OCCURS	8.94E-05	IEV-CMTLB
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
76	2.32E-09	.05	INITIATING EVENT - CMT LINE BREAK EVENT OCCURS	8.94E-05	IEV-CMTLB
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION SQUIB VALVES	2.60E-05	IWX-EV-SA
77	2.22E-09	.05	INITIATING EVENT - TRANSIENT WITH MFW EVENT OCCURS	1.40E+00	IEV-TRANS
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF 4/4 STAGE 2 & 3 LINE MOVs TO OPEN	1.10E-03	ADX-MV-GO
			OPERATOR FAILS TO MANUALLY ACTUATE ADS	3.02E-03	ADN-MAN01
78	2.16E-09	.05	INITIATING EVENT - PASSIVE RHR TUBE RUPTURE EVENT OCCURS	2.50E-04	IEV-PRSTR
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
79	2.12E-09	.05	INITIATING EVENT - LOSS OF OFFSITE POWER EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	2.10E-02	OTH-SLSOV1
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW

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80	2.06E-09	.05	INITIATING EVENT - LOSS OF CCW/SW EVENT OCCURS	1.44E-01	IEV-LCCW
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION CHECK VALVES	3.00E-05	IWX-CV-AO
81	2.06E-09	.05	INITIATING EVENT - LOSS OF CCW/SW EVENT OCCURS	1.44E-01	IEV-LCCW
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
82	2.06E-09	.05	INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF CMT/SUMP LEVEL HEATED RTD SENSORS	3.84E-05	CMX-VS-FA
83	2.02E-09	.05	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE -LOWER END OF BREAK SIZE	5.00E-01	BSIZE
			COMMON CAUSE FAILURE OF CMT/SUMP LEVEL HEATED RTD SENSORS	3.84E-05	CMX-VS-FA
84	2.02E-09	.05	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE - UPPER END OF BREAK SIZE	5.00E-01	BSIZE-LARGE
			COMMON CAUSE FAILURE OF CMT/SUMP LEVEL HEATED RTD SENSORS	3.84E-05	CMX-VS-FA
85	2.01E-09	.05	INITIATING EVENT - STEAM GENERATOR TUBE RUPTURE EVENT OCCURS	5.20E-03	IEV-SGTR
			OPERATOR FAILS TO DIAGNOSE SGTR EVENT	1.84E-03	CIB-MAN00
			COMMON CAUSE FAILURE OF RCP BREAKERS FAIL TO OPEN	4.20E-04	RPX-CB-GO
			COND. PROB. OF ADN-MAN01(OPER. FAILS TO ACT. ADS)	5.00E-01	ADN-MAN01C
86	1.94E-09	.04	INITIATING EVENT - MEDIUM LOCA EVENT OCCURS	1.62E-04	IEV-MLOCA
			COMMON CAUSE FAILURE OF RECIRC LINES DUE TO SUMP SCREEN PLUGGING	1.20E-05	REX-FL-GP
87	1.94E-09	.04	INITIATING EVENT - MEDIUM LOCA EVENT OCCURS	1.62E-04	IEV-MLOCA
			COMMON CAUSE FAILURE OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
88	1.86E-09	.04	INITIATING EVENT - ATWS PRECURSOR WITH NO MFW OCCURS	4.81E-01	IEV-ATWS
			COMMON CAUSE FAILURE OF REACTOR TRIP BREAKERS	8.10E-06	RCX-RB-FA
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
89	1.86E-09	.04	INITIATING EVENT - ATWS PRECURSOR WITH NO MFW OCCURS	4.81E-01	IEV-ATWS
			COMMON CAUSE FAILURE OF REACTOR TRIP BREAKERS	8.10E-06	RCX-RB-FA
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
90	1.79E-09	.04	INITIATING EVENT - ATWS PRECURSOR WITH SI SIGNAL OCCURS	2.05E-02	IEV-ATW-S
			FAILURE OF PRS RELIEF FOR LOSS OF MFW ATWS, WITH UET	3.27E-01	OTH-PRESU
			COMMON CAUSE FAILURE OF REACTOR TRIP BREAKERS	8.10E-06	RCX-RB-FA
			OPERATOR FAILS TO STEP IN THE CONTROL RODS	3.30E-02	ATW-MAN01
91	1.79E-09	.04	INITIATING EVENT - LOSS OF CCW/SW EVENT OCCURS	1.44E-01	IEV-LCCW
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
92	1.79E-09	.04	INITIATING EVENT - LOSS OF CCW/SW EVENT OCCURS	1.44E-01	IEV-LCCW
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION SQUIB VALVES	2.60E-05	IWX-EV-SA
93	1.78E-09	.04	INITIATING EVENT - MEDIUM LOCA EVENT OCCURS	1.62E-04	IEV-MLOCA
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
94	1.76E-09	.04	INITIATING EVENT - LOSS OF MAIN FEEDWATER EVENT OCCURS	3.35E-01	IEV-LMFW
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM

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			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
95	1.76E-09	.04	INITIATING EVENT - LOSS OF MAIN FEEDWATER EVENT OCCURS	3.35E-01	IEV-LMFW
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
96	1.58E-09	.04	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE - UPPER END OF BREAK SIZE	5.00E-01	BSIZE-LARGE
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION CHECK VALVES	3.00E-05	IWX-CV-AO
97	1.58E-09	.04	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE -LOWER END OF BREAK SIZE	5.00E-01	BSIZE
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION CHECK VALVES	3.00E-05	IWX-CV-AO
98	1.51E-09	.03	IEV-RCSLKC	5.02E-05	IEV-RCSLKC
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION CHECK VALVES	3.00E-05	IWX-CV-AO
99	1.51E-09	.03	IEV-RCSLKC	5.02E-05	IEV-RCSLKC
			COMMON CAUSE FAILURE OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
100	1.46E-09	.03	INITIATING EVENT - ATWS PRECURSOR WITH SI SIGNAL OCCURS	2.05E-02	IEV-ATW-S
			FAILURE OF PRS RELIEF FOR LOSS OF MFW ATWS, WITH UET	3.27E-01	OTH-PRESU
			COMMON CAUSE FAILURE OF REACTOR TRIP BREAKERS	8.10E-06	RCX-RB-FA
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA DAS	5.20E-02	ATW-MAN04
			COND. PROB. OF ATW-MAN01 (OPER. FAILS TO STEP-IN CONTROL ROD	5.17E-01	ATW-MAN01C
101	1.45E-09	.03	INITIATING EVENT - MAIN STEAM LINE STUCK-OPEN SV OCCURS	1.21E-03	IEV-SLB-V
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
102	1.40E-09	.03	INITIATING EVENT - MEDIUM LOCA EVENT OCCURS	1.62E-04	IEV-MLOCA
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
103	1.39E-09	.03	INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
104	1.39E-09	.03	INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
105	1.39E-09	.03	INITIATING EVENT - ATWS PRECURSOR WITH MFW AVAILA. OCCURS	1.17E+00	IEV-ATW-T
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-03	ATW-MAN05
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF PZR LEVEL SENSORS	4.78E-04	CCX-XMTR195
106	1.38E-09	.03	INITIATING EVENT - LOSS OF MAIN FEEDWATER EVENT OCCURS	3.35E-01	IEV-LMFW
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
107	1.38E-09	.03	INITIATING EVENT - LOSS OF MAIN FEEDWATER EVENT OCCURS	3.35E-01	IEV-LMFW
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
108	1.37E-09	.03	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE -LOWER END OF BREAK SIZE	5.00E-01	BSIZE
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA

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109	1.37E-09	.03	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE -LOWER END OF BREAK SIZE	5.00E-01	BSIZE
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION SQUIB VALVES	2.60E-05	IWX-EV-SA
110	1.37E-09	.03	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE - UPPER END OF BREAK SIZE	5.00E-01	BSIZE-LARGE
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION SQUIB VALVES	2.60E-05	IWX-EV-SA
111	1.37E-09	.03	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE - UPPER END OF BREAK SIZE	5.00E-01	BSIZE-LARGE
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
112	1.35E-09	.03	INITIATING EVENT - CORE POWER EXCURSION EVENT OCCURS	4.50E-03	IEV-POWEX
			FAILURE OF EITHER PZR SV FAILS TO RECLOSE	1.00E-02	OTH-PRSOV
			COMMON CAUSE FAILURE OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
113	1.35E-09	.03	INITIATING EVENT - CORE POWER EXCURSION EVENT OCCURS	4.50E-03	IEV-POWEX
			FAILURE OF EITHER PZR SV FAILS TO RECLOSE	1.00E-02	OTH-PRSOV
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION CHECK VALVES	3.00E-05	IWX-CV-AO
114	1.31E-09	.03	IEV-RCSLKC	5.02E-05	IEV-RCSLKC
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
115	1.31E-09	.03	IEV-RCSLKC	5.02E-05	IEV-RCSLKC
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION SQUIB VALVES	2.60E-05	IWX-EV-SA
116	1.28E-09	.03	INITIATING EVENT - ATWS PRECURSOR WITH SI SIGNAL OCCURS	2.05E-02	IEV-ATW-S
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-02	ATW-MAN03
117	1.24E-09	.03	INITIATING EVENT - STEAM GENERATOR TUBE RUPTURE EVENT OCCURS	5.20E-03	IEV-SGTR
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	ECOMOD01
			COMMON CAUSE FAILURE OF CLASS 1E BATTERIES	4.70E-05	CCX-BY-PN
118	1.21E-09	.03	INITIATING EVENT - SMALL LOCA EVENT OCCURS	1.01E-04	IEV-SLOCA
			COMMON CAUSE FAILURE OF RECIRC LINES DUE TO SUMP SCREEN PLUGGING	1.20E-05	REX-FL-GP
119	1.21E-09	.03	INITIATING EVENT - SMALL LOCA EVENT OCCURS	1.01E-04	IEV-SLOCA
			COMMON CAUSE FAILURE OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
120	1.20E-09	.03	INITIATING EVENT - PASSIVE RHR TUBE RUPTURE EVENT OCCURS	2.50E-04	IEV-PRSTR
			COMMON CAUSE FAILURE OF TANK LEVEL TRANSMITTERS (IRWST, BAT)	4.78E-04	IWX-XMTR
			OPERATOR FAILS TO ACTUATE CONT. SUMP RECIR. (LEVEL SIGNAL FAILS)	1.00E-02	REN-MAN04
121	1.17E-09	.03	INITIATING EVENT - CORE POWER EXCURSION EVENT OCCURS	4.50E-03	IEV-POWEX
			FAILURE OF EITHER PZR SV FAILS TO RECLOSE	1.00E-02	OTH-PRSOV
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
122	1.17E-09	.03	INITIATING EVENT - CORE POWER EXCURSION EVENT OCCURS	4.50E-03	IEV-POWEX
			FAILURE OF EITHER PZR SV FAILS TO RECLOSE	1.00E-02	OTH-PRSOV
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION SQUIB VALVES	2.60E-05	IWX-EV-SA
123	1.14E-09	.03	INITIATING EVENT - SAFETY INJECTION LINE BREAK EVENT OCCURS	1.04E-04	IEV-SI-LB
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
124	1.11E-09	.03	INITIATING EVENT - SMALL LOCA EVENT OCCURS	1.01E-04	IEV-SLOCA
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW

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125	1.07E-09	.02	INITIATING EVENT - CMT LINE BREAK EVENT OCCURS	8.94E-05	IEV-CMTLB
			COMMON CAUSE FAILURE OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
126	1.07E-09	.02	INITIATING EVENT - CMT LINE BREAK EVENT OCCURS	8.94E-05	IEV-CMTLB
			COMMON CAUSE FAILURE OF RECIRC LINES DUE TO SUMP SCREEN PLUGGING	1.20E-05	REX-FL-GP
127	1.07E-09	.02	INITIATING EVENT - INTERMEDIATE LOCA EVENT OCCURS	7.70E-04	IEV-NLOCA
			COMMON CAUSE FAILURE OF RCP BREAKERS FAIL TO OPEN	4.20E-04	RPX-CB-GO
			OPERATOR FAILS TO RECOGNIZE NEED FOR RCS DEPR. (MLOCA)	3.30E-03	LPM-MAN02
128	1.04E-09	.02	INITIATING EVENT - SAFETY INJECTION LINE BREAK EVENT OCCURS	1.04E-04	IEV-SI-LB
			COMMON CAUSE FAILURE OF 2 IRWST INJEC. SQUIBS IN 1 LINE TO OPEN	1.00E-05	IWX-EV1-SA
129	1.01E-09	.02	INITIATING EVENT - LOSS OF MFW TO ONE SG EVENT OCCURS	1.92E-01	IEV-LMFW1
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
130	9.86E-10	.02	INITIATING EVENT - TRANSIENT WITH MFW EVENT OCCURS	1.40E+00	IEV-TRANS
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF 4/4 STAGE 2 & 3 LINE MOVs TO OPEN	1.10E-03	ADX-MV-GO
			OPERATOR FAILS TO RECOGNIZE NEED FOR RCS DEPR. (SLOCA/TRANSIENT)	1.34E-03	LPM-MAN01
131	9.83E-10	.02	INITIATING EVENT - CMT LINE BREAK EVENT OCCURS	8.94E-05	IEV-CMTLB
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
132	9.77E-10	.02	INITIATING EVENT - INTERMEDIATE LOCA EVENT OCCURS	7.70E-04	IEV-NLOCA
			COMMON CAUSE FAILURE OF RCP BREAKERS FAIL TO OPEN	4.20E-04	RPX-CB-GO
			OPERATOR FAILS TO MANUALLY ACTUATE ADS	3.02E-03	ADN-MAN01
133	9.58E-10	.02	INITIATING EVENT - STEAM GENERATOR TUBE RUPTURE EVENT OCCURS	5.20E-03	IEV-SGTR
			COMMON CAUSE FAILURE OF 4 AOVS TO OPEN	6.10E-05	CCX-AV-LA
			OPERATOR FAILS TO MANUALLY ACTUATE ADS	3.02E-03	ADN-MAN01
134	9.43E-10	.02	INITIATING EVENT - ATWS PRECURSOR WITH NO MFW OCCURS	4.81E-01	IEV-ATWS
			COMMON CAUSE FAILURE OF PMS REACTOR TRIP SYSTEM HARDWARE	7.89E-05	CCX-PMS-HARDWARE
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-02	ATW-MAN03
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
135	9.43E-10	.02	INITIATING EVENT - ATWS PRECURSOR WITH NO MFW OCCURS	4.81E-01	IEV-ATWS
			COMMON CAUSE FAILURE OF PMS REACTOR TRIP SYSTEM HARDWARE	7.89E-05	CCX-PMS-HARDWARE
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-02	ATW-MAN03
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
136	9.24E-10	.02	INITIATING EVENT - INTERMEDIATE LOCA EVENT OCCURS	7.70E-04	IEV-NLOCA
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
137	8.96E-10	.02	INITIATING EVENT - SAFETY INJECTION LINE BREAK EVENT OCCURS	1.04E-04	IEV-SI-LB
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
138	8.86E-10	.02	INITIATING EVENT - TRANSIENT WITH MFW EVENT OCCURS	1.40E+00	IEV-TRANS
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	1.10E-02	OTH-SLSOV
			TRANSMITTER FAILURE	5.23E-03	CDNTF01BRI
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
139	8.86E-10	.02	INITIATING EVENT - TRANSIENT WITH MFW EVENT OCCURS	1.40E+00	IEV-TRANS
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	1.10E-02	OTH-SLSOV
			FAILURE OF AIR COMPRESSOR TRANSMITTER	5.23E-03	CANTP011RI
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW

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140	8.71E-10	.02	INITIATING EVENT - SMALL LOCA EVENT OCCURS	1.01E-04	IEV-SLOCA
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
141	8.49E-10	.02	INITIATING EVENT - TRANSIENT WITH MFW EVENT OCCURS	1.40E+00	IEV-TRANS
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF RCP BREAKERS FAIL TO OPEN	4.20E-04	RPX-CB-GO
			OPERATOR FAILS TO MANUALLY ACTUATE ADS	3.02E-03	ADN-MAN01
142	8.41E-10	.02	FAILURE OF PRS RELIEF FOR LOSS OF MFW ATWS, WITH UET	3.27E-01	OTH-PRESU
			INITIATING EVENT - ATWS PRECURSOR WITH NO MFW OCCURS	4.81E-01	IEV-ATWS
			COMMON CAUSE FAILURE OF REACTOR TRIP BREAKERS	8.10E-06	RCX-RB-FA
			FAILURE OF ROD CONTROL SYSTEM TO STEP IN RODS	6.60E-04	ROD-CTRL-SYS
143	8.36E-10	.02	INITIATING EVENT - LOSS OF MAIN FEEDWATER EVENT OCCURS	3.35E-01	IEV-LMFW
			COMMON CAUSE FAILURE OF PRHR AOVs	9.60E-05	PXX-AV-LA
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
144	8.26E-10	.02	INITIATING EVENT - LOSS OF CCW/SW EVENT OCCURS	1.44E-01	IEV-LCCW
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
145	8.26E-10	.02	INITIATING EVENT - LOSS OF CCW/SW EVENT OCCURS	1.44E-01	IEV-LCCW
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF RECIRC LINES DUE TO SUMP SCREEN PLUGGING	1.20E-05	REX-FL-GP
146	8.01E-10	.02	INITIATING EVENT - STEAM GENERATOR TUBE RUPTURE EVENT OCCURS	5.20E-03	IEV-SGTR
			COMMON CAUSE FAILURE OF 4 CMT CHECK VALVES TO OPEN	5.10E-05	CMX-CV-GO
			OPERATOR FAILS TO MANUALLY ACTUATE ADS	3.02E-03	ADN-MAN01
147	7.91E-10	.02	INITIATING EVENT - LOSS OF MFW TO ONE SG EVENT OCCURS	1.92E-01	IEV-LMFW1
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
148	7.74E-10	.02	INITIATING EVENT - MEDIUM LOCA EVENT OCCURS	1.62E-04	IEV-MLOCA
			COMMON CAUSE FAILURE OF TANK LEVEL TRANSMITTERS (IRWST, BAT)	4.78E-04	IWX-XMTR
			OPERATOR FAILS TO ACTUATE CONT. SUMP RECIR. (LEVEL SIGNAL FAILS)	1.00E-02	REN-MAN04
149	7.71E-10	.02	INITIATING EVENT - CMT LINE BREAK EVENT OCCURS	8.94E-05	IEV-CMTLB
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
150	7.65E-10	.02	INITIATING EVENT - LOSS OF MAIN FEEDWATER EVENT OCCURS	3.35E-01	IEV-LMFW
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF TANK LEVEL TRANSMITTERS (IRWST, BAT)	4.78E-04	IWX-XMTR
			OPERATOR FAILS TO ACTUATE CONT. SUMP RECIR. (LEVEL SIGNAL FAILS)	1.00E-02	REN-MAN04
151	7.65E-10	.02	INITIATING EVENT - LOSS OF MAIN FEEDWATER EVENT OCCURS	3.35E-01	IEV-LMFW
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF TANK LEVEL TRANSMITTERS (IRWST, BAT)	4.78E-04	IWX-XMTR
			OPERATOR FAILS TO ACTUATE CONT. SUMP RECIR. (LEVEL SIGNAL FAILS)	1.00E-02	REN-MAN04
152	7.57E-10	.02	INITIATING EVENT - LOSS OF CCW/SW EVENT OCCURS	1.44E-01	IEV-LCCW
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
153	7.30E-10	.02	INITIATING EVENT - STEAM GENERATOR TUBE RUPTURE EVENT OCCURS	5.20E-03	IEV-SGTR
			FAILURE OF SG PORV & 1 SG SV ON RUPTURED SG TO CLOSE	5.40E-03	OTH-SLSOV3
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA

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154	7.15E-10	.02	INITIATING EVENT - STEAM LINE BREAK DOWNSTREAM OF MSIV OCCURS	5.96E-04	IEV-SLB-D
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
155	7.06E-10	.02	CONSEQUENTIAL SGTR OCCURS	1.00E-02	OTH-SGTR
			INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	2.10E-02	OTH-SLSOV1
			COMMON CAUSE FAILURE OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
156	7.06E-10	.02	CONSEQUENTIAL SGTR OCCURS	1.00E-02	OTH-SGTR
			INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	2.10E-02	OTH-SLSOV1
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION CHECK VALVES	3.00E-05	IWX-CV-AO
157	6.30E-10	.01	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE - UPPER END OF BREAK SIZE	5.00E-01	BSIZE-LARGE
			COMMON CAUSE FAILURE OF RECIRC LINES DUE TO SUMP SCREEN PLUGGING	1.20E-05	REX-FL-GP
158	6.30E-10	.01	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE - UPPER END OF BREAK SIZE	5.00E-01	BSIZE-LARGE
			COMMON CAUSE FAILURE OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
159	6.30E-10	.01	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE -LOWER END OF BREAK SIZE	5.00E-01	BSIZE
			COMMON CAUSE FAILURE OF RECIRC LINES DUE TO SUMP SCREEN PLUGGING	1.20E-05	REX-FL-GP
160	6.30E-10	.01	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE -LOWER END OF BREAK SIZE	5.00E-01	BSIZE
			COMMON CAUSE FAILURE OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
161	6.12E-10	.01	CONSEQUENTIAL SGTR OCCURS	1.00E-02	OTH-SGTR
			INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	2.10E-02	OTH-SLSOV1
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
162	6.12E-10	.01	CONSEQUENTIAL SGTR OCCURS	1.00E-02	OTH-SGTR
			INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	2.10E-02	OTH-SLSOV1
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION SQUIB VALVES	2.60E-05	IWX-EV-SA
163	6.03E-10	.01	IEV-RCSLKC	5.02E-05	IEV-RCSLKC
			COMMON CAUSE FAILURE OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
164	6.03E-10	.01	IEV-RCSLKC	5.02E-05	IEV-RCSLKC
			COMMON CAUSE FAILURE OF RECIRC LINES DUE TO SUMP SCREEN PLUGGING	1.20E-05	REX-FL-GP
165	5.93E-10	.01	INITIATING EVENT - LOSS OF CCW/SW EVENT OCCURS	1.44E-01	IEV-LCCW
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
166	5.89E-10	.01	INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
167	5.89E-10	.01	INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW

TABLE 2
SENSITIVITY STUDY -- TOP 200 CORE DAMAGE CUTSETS

168	5.78E-10	.01	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE - UPPER END OF BREAK SIZE	5.00E-01	BSIZE-LARGE
			COMMON CAUSE FAILURE OF PMS ESF ACTUATION LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD2-SW
169	5.78E-10	.01	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE - UPPER END OF BREAK SIZE	5.00E-01	BSIZE-LARGE
			COMMON CAUSE FAILURE OF PMS ESF INPUT LOGIC SOFTWARE	1.10E-05	CCX-IN-LOGIC-SW
170	5.78E-10	.01	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE -LOWER END OF BREAK SIZE	5.00E-01	BSIZE
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
171	5.78E-10	.01	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE - UPPER END OF BREAK SIZE	5.00E-01	BSIZE-LARGE
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
172	5.78E-10	.01	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE -LOWER END OF BREAK SIZE	5.00E-01	BSIZE
			COMMON CAUSE FAILURE OF PMS ESF INPUT LOGIC SOFTWARE	1.10E-05	CCX-IN-LOGIC-SW
173	5.78E-10	.01	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE -LOWER END OF BREAK SIZE	5.00E-01	BSIZE
			COMMON CAUSE FAILURE OF PMS ESF ACTUATION LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD2-SW
174	5.53E-10	.01	IEV-RCSLKC	5.02E-05	IEV-RCSLKC
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
175	5.40E-10	.01	INITIATING EVENT - CORE POWER EXCURSION EVENT OCCURS	4.50E-03	IEV-POWEX
			FAILURE OF EITHER PZR SV FAILS TO RECLOSE	1.00E-02	OTH-PRSOV
			COMMON CAUSE FAILURE OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
176	5.40E-10	.01	INITIATING EVENT - CORE POWER EXCURSION EVENT OCCURS	4.50E-03	IEV-POWEX
			FAILURE OF EITHER PZR SV FAILS TO RECLOSE	1.00E-02	OTH-PRSOV
			COMMON CAUSE FAILURE OF RECIRC LINES DUE TO SUMP SCREEN PLUGGING	1.20E-05	REX-FL-GP
177	5.32E-10	.01	INITIATING EVENT - LOSS OF MAIN FEEDWATER EVENT OCCURS	3.35E-01	IEV-LMFW
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF 4/4 STAGE 2 & 3 LINE MOVs TO OPEN	1.10E-03	ADX-MV-GO
			OPERATOR FAILS TO MANUALLY ACTUATE ADS	3.02E-03	ADN-MAN01
178	5.32E-10	.01	INITIATING EVENT - LOSS OF MAIN FEEDWATER EVENT OCCURS	3.35E-01	IEV-LMFW
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF 4/4 STAGE 2 & 3 LINE MOVs TO OPEN	1.10E-03	ADX-MV-GO
			OPERATOR FAILS TO MANUALLY ACTUATE ADS	3.02E-03	ADN-MAN01
179	5.29E-10	.01	CONSEQUENTIAL SGTR OCCURS	1.00E-02	OTH-SGTR
			INITIATING EVENT - LOSS OF OFFSITE POWER EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	2.10E-02	OTH-SLSOV1
			COMMON CAUSE FAILURE OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
180	5.29E-10	.01	CONSEQUENTIAL SGTR OCCURS	1.00E-02	OTH-SGTR
			INITIATING EVENT - LOSS OF OFFSITE POWER EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	2.10E-02	OTH-SLSOV1
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION CHECK VALVES	3.00E-05	IWX-CV-AO

TABLE 2
SENSITIVITY STUDY -- TOP 200 CORE DAMAGE CUTSETS

181	5.01E-10	.01	INITIATING EVENT - ATWS PRECURSOR WITH SI SIGNAL OCCURS	2.05E-02	IEV-ATW-S
			COMMON CAUSE FAILURE OF REACTOR TRIP BREAKERS	8.10E-06	RCX-RB-FA
			OPERATOR FAILS TO MANUALLY ACTUATE ADS	3.02E-03	ADN-MAN01
182	4.95E-10	.01	INITIATING EVENT - CORE POWER EXCURSION EVENT OCCURS	4.50E-03	IEV-POWEX
			FAILURE OF EITHER PZR SV FAILS TO RECLOSE	1.00E-02	OTH-PRSOV
			COMMON CAUSE FAILURE OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
183	4.83E-10	.01	INITIATING EVENT - SMALL LOCA EVENT OCCURS	1.01E-04	IEV-SLOCA
			COMMON CAUSE FAILURE OF TANK LEVEL TRANSMITTERS (IRWST, BAT)	4.78E-04	IWX-XMTR
			OPERATOR FAILS TO ACTUATE CONT. SUMP RECIR. (LEVEL SIGNAL FAILS)	1.00E-02	REN-MAN04
184	4.61E-10	.01	INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			COMMON CAUSE FAILURE OF SENSORS IN HIGH PRESSURE ENVIRONMENT	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
185	4.61E-10	.01	INITIATING EVENT - LOSS OF CONDENSER EVENT OCCURS	1.12E-01	IEV-LCOND
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
186	4.59E-10	.01	CONSEQUENTIAL SGTR OCCURS	1.00E-02	OTH-SGTR
			INITIATING EVENT - LOSS OF OFFSITE POWER EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	2.10E-02	OTH-SLSOV1
			COMMON CAUSE FAILURE OF 4 SQUIB VALVES IN RECIRC LINES	2.60E-05	IWX-EV4-SA
187	4.59E-10	.01	CONSEQUENTIAL SGTR OCCURS	1.00E-02	OTH-SGTR
			INITIATING EVENT - LOSS OF OFFSITE POWER EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			FAILURE OF A SECONDARY SIDE RELIEF VALVE TO CLOSE (SV/PORV)	2.10E-02	OTH-SLSOV1
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION SQUIB VALVES	2.60E-05	IWX-EV-SA
188	4.53E-10	.01	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE -LOWER END OF BREAK SIZE	5.00E-01	BSIZE
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
189	4.53E-10	.01	INITIATING EVENT - LARGE LOCA EVENT OCCURS	1.05E-04	IEV-LLOCA
			LLOCA BREAK SIZE - UPPER END OF BREAK SIZE	5.00E-01	BSIZE-LARGE
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
190	4.46E-10	.01	INITIATING EVENT - STEAM LINE UPSTREAM OF MSIV OCCURS	3.72E-04	IEV-SLB-U
			COMMON CAUSE FAILURE OF PMS AND PLS SOFTWARE	1.20E-06	CCX-SFTW
191	4.39E-10	.01	INITIATING EVENT - LOSS OF MFW TO ONE SG EVENT OCCURS	1.92E-01	IEV-LMFW1
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF TANK LEVEL TRANSMITTERS (IRWST, BAT)	4.78E-04	IWX-XMTR
			OPERATOR FAILS TO ACTUATE CONT. SUMP RECIR. (LEVEL SIGNAL FAILS)	1.00E-02	REN-MAN04
192	4.33E-10	.01	IEV-RCSLKC	5.02E-05	IEV-RCSLKC
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
193	4.27E-10	.01	INITIATING EVENT - CMT LINE BREAK EVENT OCCURS	8.94E-05	IEV-CMTLB
			COMMON CAUSE FAILURE OF TANK LEVEL TRANSMITTERS (IRWST, BAT)	4.78E-04	IWX-XMTR
			OPERATOR FAILS TO ACTUATE CONT. SUMP RECIR. (LEVEL SIGNAL FAILS)	1.00E-02	REN-MAN04

TABLE 2
SENSITIVITY STUDY -- TOP 200 CORE DAMAGE CUTSETS

194	4.26E-10	.01	FAILURE OF PRS RELIEF FOR LOSS OF MFW ATWS, WITH UET	3.27E-01	OTH-PRESU
			INITIATING EVENT - ATWS PRECURSOR WITH NO MFW OCCURS	4.81E-01	IEV-ATWS
			COMMON CAUSE FAILURE OF PMS REACTOR TRIP SYSTEM HARDWARE	7.89E-05	CCX-PMS-HARDWARE
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-02	ATW-MAN03
			FAILURE OF ROD CONTROL SYSTEM TO STEP IN RODS	6.60E-04	ROD-CTRL-SYS
195	3.88E-10	.01	INITIATING EVENT - CORE POWER EXCURSION EVENT OCCURS	4.50E-03	IEV-POWEX
			FAILURE OF EITHER PZR SV FAILS TO RECLOSE	1.00E-02	OTH-PRESV
			COMMON CAUSE FAILURE OF OUTPUT DRIVERS	8.62E-06	CCX-EP-SAM
196	3.79E-10	.01	INITIATING EVENT - LOSS OF OFFSITE POWER EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			COMMON CAUSE FAILURE OF PRHR AOVs	9.60E-05	PXX-AV-LA
			COMMON CAUSE FAILURE OF CLASS 1E BATTERIES	4.70E-05	CCX-BY-PN
197	3.77E-10	.01	INITIATING EVENT - TRANSIENT WITH MFW EVENT OCCURS	1.40E+00	IEV-TRANS
			COMMON CAUSE FAILURE OF SENSORS IN LOW PRESSURE ENVIRONMENT	4.78E-04	CCX-TRNSM
			COMMON CAUSE FAILURE OF RCP BREAKERS FAIL TO OPEN	4.20E-04	RPX-CB-GO
			OPERATOR FAILS TO RECOGNIZE NEED FOR RCS DEPR. (SLOCA/TRANSIENT)	1.34E-03	LPM-MAN01
198	3.63E-10	.01	INITIATING EVENT - MAIN STEAM LINE STUCK-OPEN SV OCCURS	1.21E-03	IEV-SLB-V
			CONSEQUENTIAL SGTR OCCURS	1.00E-02	OTH-SGTR
			COMMON CAUSE FAILURE OF 4 IRWST INJECTION CHECK VALVES	3.00E-05	IWX-CV-AO
199	3.63E-10	.01	INITIATING EVENT - MAIN STEAM LINE STUCK-OPEN SV OCCURS	1.21E-03	IEV-SLB-V
			CONSEQUENTIAL SGTR OCCURS	1.00E-02	OTH-SGTR
			COMMON CAUSE FAILURE OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
200	3.32E-10	.01	INITIATING EVENT - ATWS PRECURSOR WITH SI SIGNAL OCCURS	2.05E-02	IEV-ATW-S
			FAILURE OF PRZ SV FOR LOSS OF MFW ATWS, NO UET	2.00E-03	OTH-PRES
			COMMON CAUSE FAILURE OF REACTOR TRIP BREAKERS	8.10E-06	RCX-RB-FA

Attachment A to NSD-NRC-96-4913
Enclosed Responses to NRC Requests for Additional Information

Re: IVR

480.440	480.441	480.442
480.443	480.444	480.445
480.446	480.447	480.448
480.449	480.450	480.451
480.452	480.453	480.454
480.455	480.456	480.457
480.458	480.459	480.460
480.461		

Re: Baseline PRA Sensitivity Study

OITS # 3969