constant until the internal heat generation rate falls below the reduced heat removal rate. This occurs at about 20,000 seconds.

At about 40,000 seconds, the IRWST is assumed to empty. After the IRWST empties, the flow for core cooling is provided by the sump, which quickly reaches saturation. Since most of the internal heat sinks (except concrete) are saturated, the PCS is the primary heat sink at this time and must now absorb the energy that had previously been absorbed by sensible heat addition to the cool IRWST water. The containment pressure increases until the heat removal rate (primarily evaporation from the PCS) exceeds the heat generation rate. The pressure for the 20 percent coverage case continued to increase and exceeded the 24-hour guideline, the others did not.

The level in the PCS water storage tank drops below the second standpipe at about 80,000 seconds. This results in a further reduction in the PCS flow rate and the evaporative heat removal rate. The effect on the containment pressure response is shown in the third case, which was run out to 200,000 seconds.

The transient runoff flow rate for these three cases is shown in Figure 7-13. The runoff flow rate for the 20 percent coverage case is highest. The lower evaporative heat removal in this case results in a sustained higher containment energy content and subsequently higher pressure.

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Enclosure 1

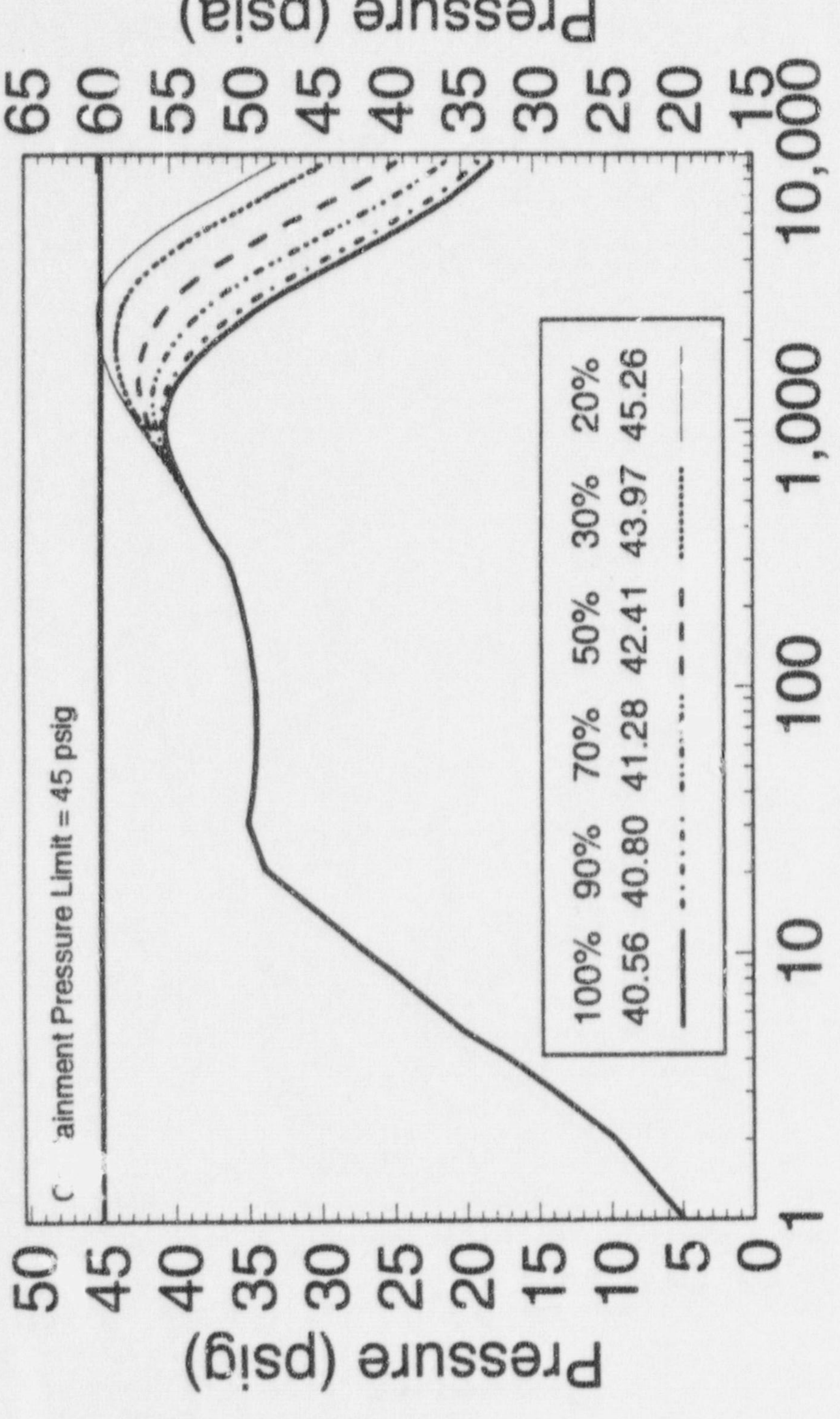

Figure 7-10 Comparison of Peak Containment Pressure as Function of PCS Coverage Area

[redacted]

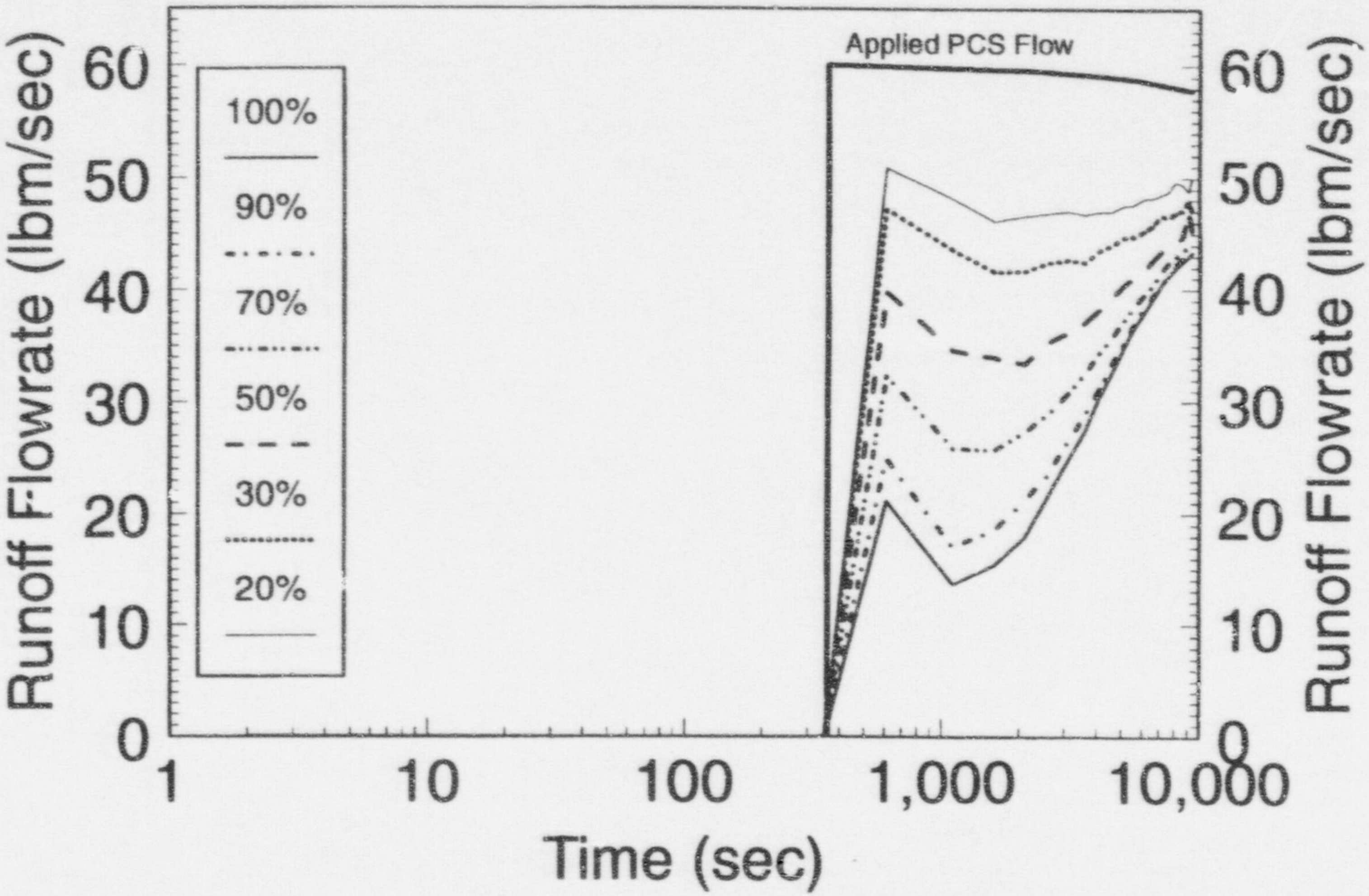

Figure 7-11 PCS Runoff Flowrates as a Function of Coverage Area

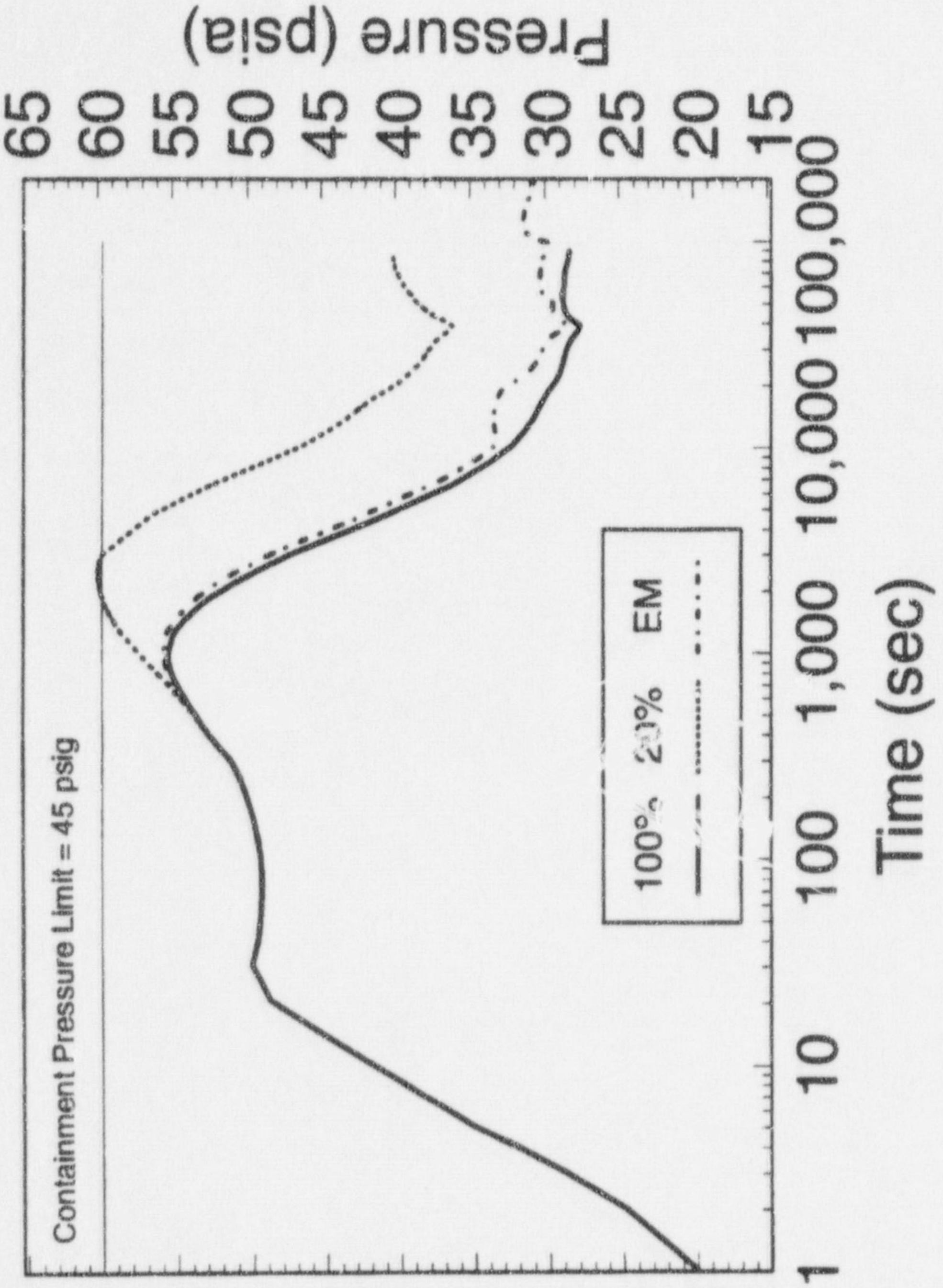

Figure 7-12 Comparison of Evaporation Model Peak Pressure with 100% and 20% Constant Coverage Models

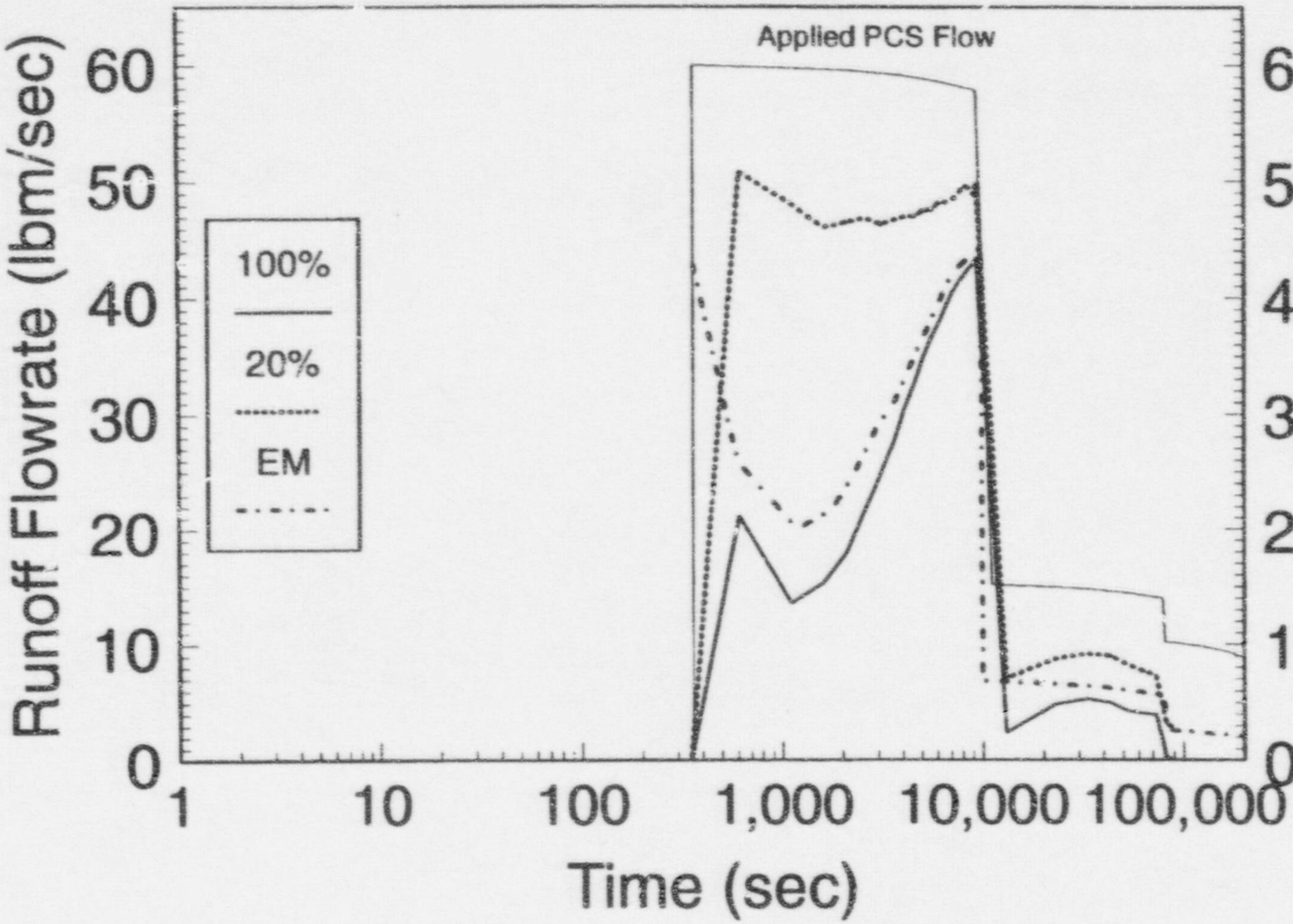

Figure 7-13 Comparison of Evaporation Model PCS Runoff Flow Rate with 100% and 20% Constant Coverage Models

[redacted]

7.5.4 Conservatism in the Assumed Time Delay for Application of the PCS Film

A delay in application of the PCS film is assumed in the DBA evaluation model to cover the time it takes to fill the weirs and establish a steady-state coverage, as described in Section 7.3. The coverage delay time is conservative in that it neglects energy removal from the shell while steady-state film coverage is being developed. An assessment of the amount of conservatism in the predicted energy removal is provided in the calculations that follow.

To quantify the amount of energy removal neglected during the development of steady-state film coverage, the WGOTHIC case described in Section 7.3 was extended out to 1,800 seconds. The shell temperature and heat removal results from this case were compared to the results from a second case in which the assumed water coverage delay time (for the top of the dome) was reduced to a more realistic value. For the base case, the water film was applied at 660 seconds and for the second case, the water film was applied at 60 seconds. The same input water coverage fractions were used in both cases.

Note, the WGOTHIC code assumes that steady-state water coverage develops instantaneously at the time the film is applied, i.e, the time required to fill the weirs and develop steady-state coverage with the 220 gpm water flow rate is bounded by the assumed 660 second time delay in application of the film. Although the second case, with a more realistic estimate of the film application delay time for the top of the dome, will give a more accurate estimate of the heat removal from the top portion of the dome, it will overestimate heat removal from the rest of the dome and sidewall. The code does not model the time required to fill the weirs and establish the steady-state water coverage. Therefore, only the heat removal from the top of the dome will be compared to give a minimum value for the heat removal neglected.

The transient inner and outer shell temperatures of the wet portion on the top of dome down to the first weir for both assumed PCS delay times are shown in Figure 7-14. The wet outer shell temperature increases to only about 165°F in the more accurate, 60-second delay case. It is also interesting to note that about 5 minutes after water is applied in the 660-second delay case, the wet shell temperatures decrease to about the same values as the 60-second water coverage delay case and that the difference in the coverage delay time doesn't seem to have much impact on the containment temperature.

The transient inner and outer shell temperatures for the wet and dry areas at the top of the dome for the 60-second delay case are shown in Figure 7-15. WGOTHIC models 1-D conduction (through the shell) so conduction between the wet and dry areas is neglected. If azimuthal conduction were modeled, the temperature of the dry area would be lower and the temperature of the wet area would be higher. More water would be evaporated at the higher elevations so the amount predicted to reach the lower elevations (or runoff the shell) over time would be lower. Therefore, the use of a 1-D conduction model in the evaluation model results in a higher predicted runoff flow rate and reduces the amount of evaporative heat removal from the shell.

Figures 7-16 and 7-17 compare the transient and integrated energy removal rate from the top of the dome as a function of time. There is very little difference in the energy removal rates for the first 300 seconds (due to the relatively long time constant of the shell), but the earlier application of the water film does significantly increase heat removal after 300 seconds. The heat removal rate for the 660-second delay case increases rapidly after the liquid film is applied and matches the heat removal rate of the 60-second delay case about 5 minutes later. Approximately 350,000 BTUs more energy is absorbed by the top portion of the dome due to the earlier application of water on the dome.

The energy release from the lower portions of the dome and sidewalls (if it could be calculated with the proper weir fill delay times) would cause this value to increase significantly. As an estimate, assume that all of the film applied after the first five minutes evaporates without running off the shell. With this assumption, an additional 10,900,000 BTUs would be absorbed from the shell. If this same amount were assumed to be removed from the containment atmosphere, it would correspond to approximately a 2 psi decrease in the peak containment pressure.

Therefore, the assumed water coverage delay time conservatively neglects the energy removal from containment during the initial water coverage transient.

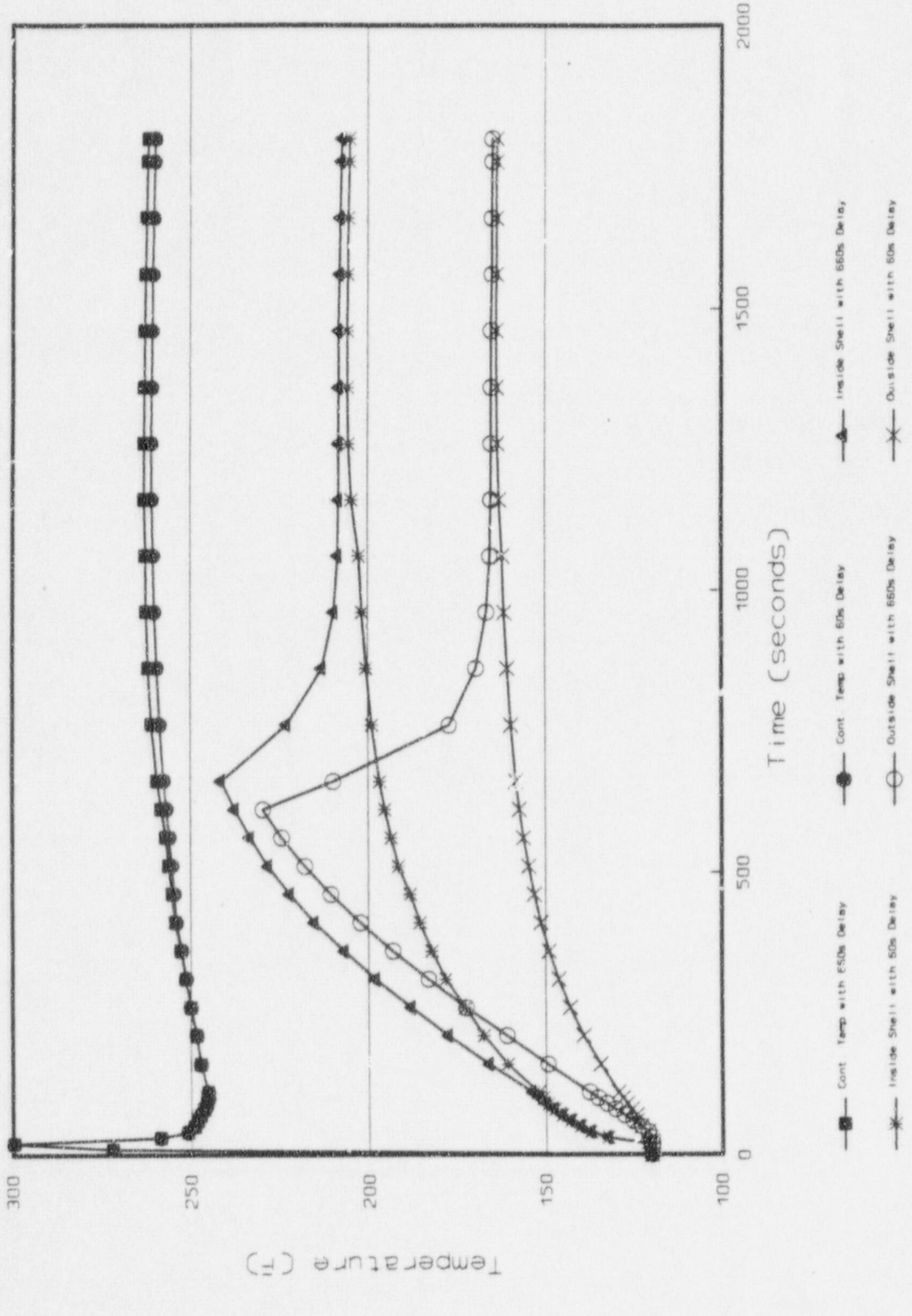

Figure 7-14 **Comparison of Wet Shell Temperatures at the Top of the Dome (with PCS Film Applied at 60 and 660 Seconds)**

[redacted]

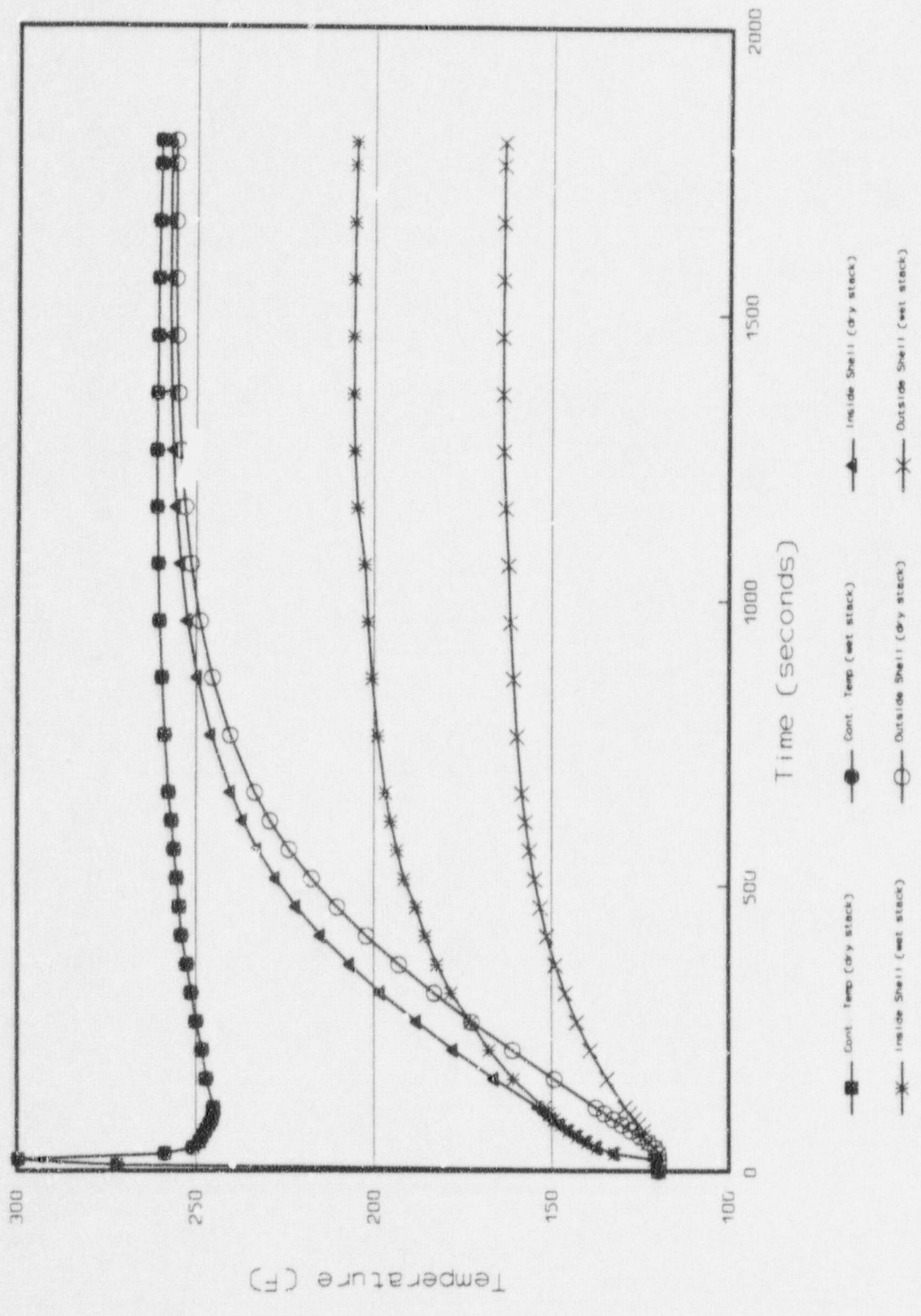

Figure 7-15 Comparison of Wet and Dry Shell Temperatures at the Top of the Dome (with PCS Film Applied at 60 seconds)

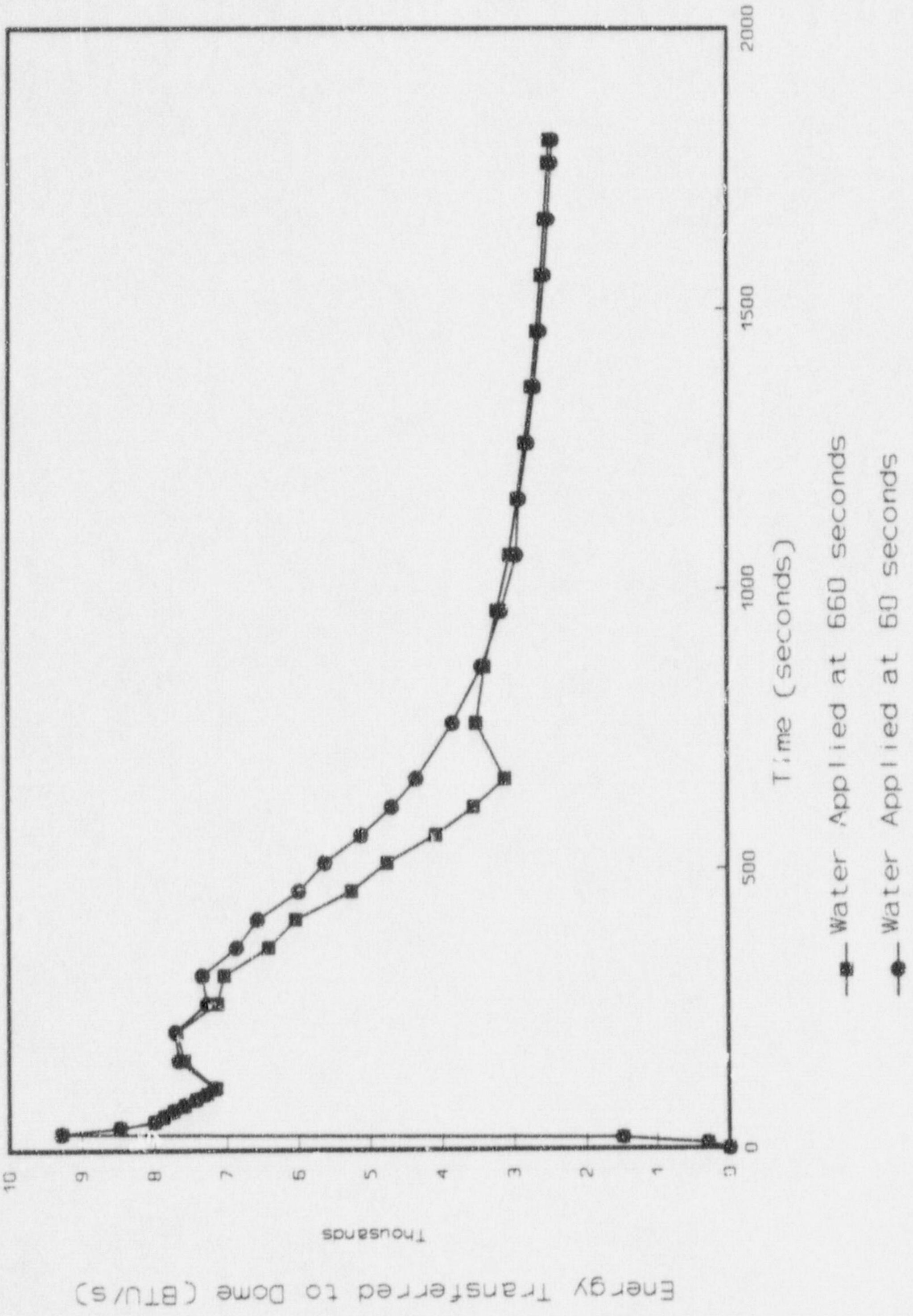

Figure 7-16 **Comparison of Energy Transferred at the Top of the Dome (with PCS Film Applied at 60 and 660 Seconds)**

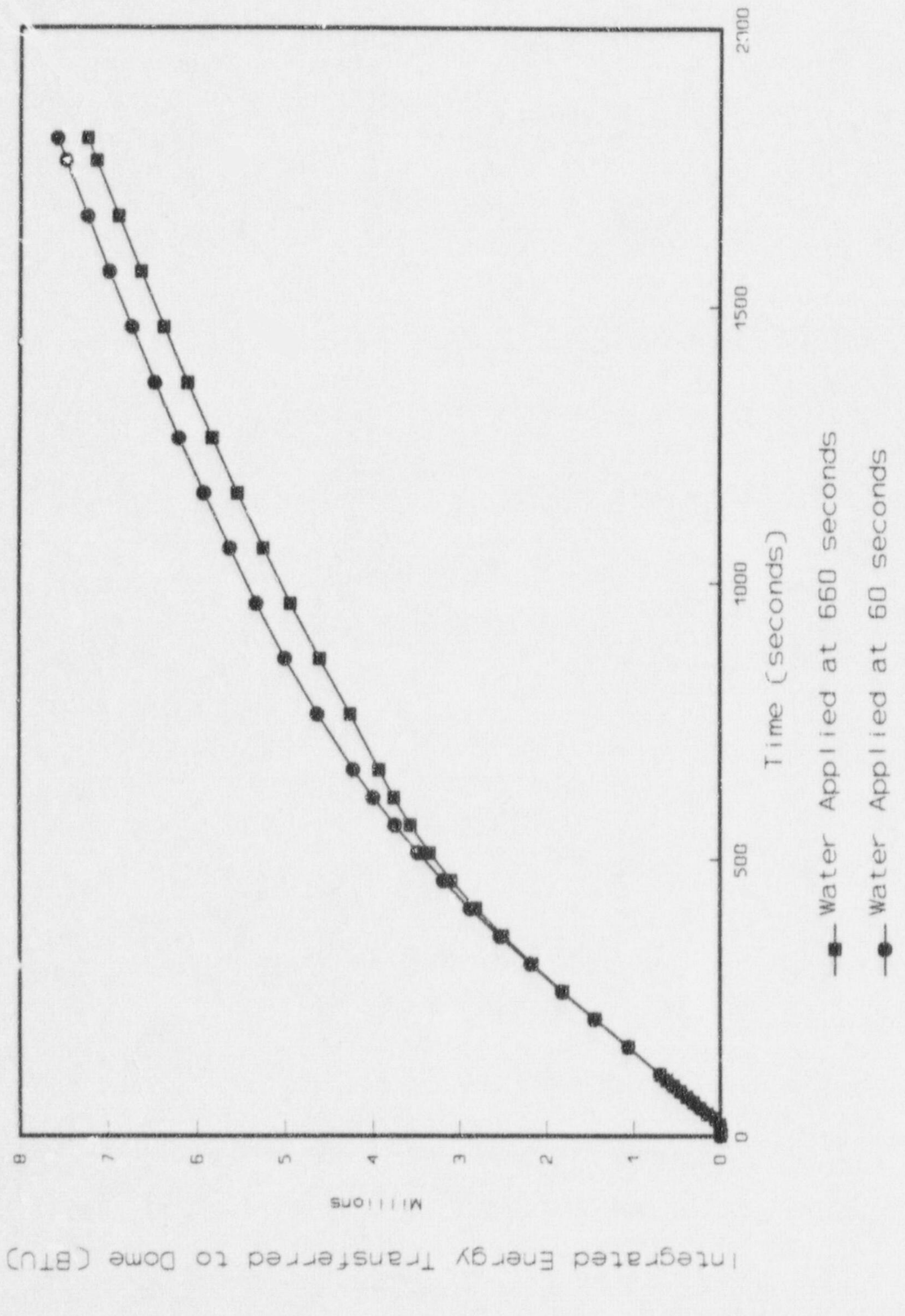

Figure 7-17 **Difference in the Integrated Energy Transferred to the Top of the Dome (with PCS Film Applied at 60 and 660 Seconds)**

7.6 SUMMARY

The range of the PCS film coverage test data parameters is tabulated and compared with the estimated range for the AP600 during a DBA. It is important for the test data to cover the higher range of heat flux and lower range of the sidewall Re_{film} number for evaluating the film stability model. The test data bounds the expected range of the AP600 film parameters and is sufficient for evaluating the film stability model.

The PCS tests show that the applied water film is able to wet and rewet a hot surface (temperature exceeding 240°F) painted with the inorganic zinc coating to be used on the AP600 containment shell. Calculations of the AP600 shell temperature response, during the 6-minute time period to establish steady-state water coverage, show the dry, external shell surface temperature will increase by less than 10°F at the time water first reaches the shell and by less than 70°F at the time the weirs are filled and steady-state coverage is established.

A modified form of the Zuber-Staub model (for determining dry spot stability) is used to conservatively estimate a maximum value for the minimum stable film flow rate. The sensitivity of the model to contact angle, film temperature, and heat flux is presented. The minimum stable film flow rate predicted by the model decreases with increasing film temperature. The minimum stable film flow rate is not sensitive to heat flux at the measured contact angle for the inorganic zinc surface.

Measurements of the film contact angle show the wettability of the inorganic zinc surface improves as it oxidizes with age. The effect of surface contamination on wettability cannot be accurately quantified, so in-service inspection and cleaning procedures will be developed to maintain surface wettability above an acceptable minimum level.

Comparisons with test data on the prototypical, inorganic, zinc-coated surface show the AP600 film stability model conservatively over-predicts the minimum stable film flow rates measured on the vertical test section. A multiplier, which is determined by bounding test data from the unheated Water Distribution Tests and the heated baseline and Phase 2 LSTs, is applied to the model prediction of the minimum stable film flow rate to conservatively account for subcooled film breakdown on the AP600 dome surface.

The input film flow rate is calculated to minimize the evaporation rate in the DBA evaluation model. A conservatively high film runoff flow rate is calculated using the AP600 film stability model. The difference between the gravity-driven PCS flow rate and the runoff flow rate is input to the evaluation model. A sample calculation is provided to illustrate the method.

Sensitivity studies to the various water coverage input values were made using the WGOTHIC AP600 model to demonstrate that using an evaporation-limited PCS film flow rate is equivalent to using the actual PCS film flow rate and varying the coverage fraction with time and elevation. The calculated peak pressure was not sensitive to coverage area (down to 36 percent of the total shell surface area) or location at the evaporation-limited PCS flow rate. The calculated peak pressure decreased as the PCS flow rate and time of application was increased (with constant coverage area input). As expected, when the actual PCS flow rate was used (not the evaporation-limited flow rate), the calculated peak pressure increased as the coverage area was decreased.

7.7 REFERENCES

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Westinghouse Electric Corporation **Energy Systems**

Box 355
Pittsburgh Pennsylvania 15230-0355

DCP/NRC1413
NSD-NRC-98-5757
Docket No.: 52-003

August 14, 1998

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

ATTENTION: T. R. Quay

SUBJECT: RESPONSE TO NRC LETTERS CONCERNING REQUEST FOR WITHHOLDING INFORMATION

Reference:

1. Letter, Sebrosky to McIntyre, "Request for withholding information from public disclosure for Westinghouse AP600 design letter of October 20, 1993," dated June 18, 1998.

2. Letter, Sebrosky to McIntyre, "Request for withholding information from public disclosure for Westinghouse AP600 design letter of January 17, 1994," dated June 18, 1998.

3. Letter, Sebrosky to McIntyre, "Request for withholding information from public disclosure for Westinghouse AP600 letters of September 30, 1993, January 21, 1994, and February 3, 1994," dated July 10, 1998.

4. Letter, Sebrosky to McIntyre, "Request for withholding proprietary information for Westinghouse letters dated April 18, 1995," dated July 15, 1998.

5. Letter, Huffman to McIntyre, "Request for withholding information from public disclosure of Westinghouse report on AP600 function based task analysis," dated July 17, 1998.

Dear Mr. Quay:

Reference 1 provided the NRC assessment of the Westinghouse claim that proprietary information was provided in a letter dated October 20, 1993, that contained the response to a staff request for additional information regarding the AP600 probabilistic risk assessment. The NRC assessment was that the material was similar to material that exists in the current (1998) nonproprietary version of the AP600 probabilistic risk assessment (PRA) report. In addition, the staff indicated the material was used by the staff in the development of the AP600 draft safety evaluation report and therefore should remain on the docket. At the time this request for additional information response was provided to the

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Enclosure 2

NRC technical staff, the information was considered to be proprietary by Westinghouse since it contained information that had commercial value to Westinghouse. If this request for additional information response was indeed used by the staff in development of the AP600 draft final safety evaluation report in November 30, 1994, then at this time, almost five years later, this information is no longer considered to be proprietary by Westinghouse.

Reference 2 provided the NRC assessment of the Westinghouse claim that proprietary information was provided in a letter dated January 17, 1994, that contained the response to a staff request for additional information regarding the AP600 instrumentation and control system. The NRC assessment was that the material was similar to material that exists in the current (1998) nonproprietary version of the AP600 standard safety analysis report. In addition, the staff indicated the material was used by the staff in the development of the AP600 draft safety evaluation report and therefore should remain on the docket. At the time this request for additional information response was provided to the NRC technical staff, the information was considered to be proprietary by Westinghouse since it contained information that had commercial value to Westinghouse. If this request for additional information response was indeed used by the staff in development of the AP600 draft final safety evaluation report in November 30, 1994, then at this time, over four years later, this information is no longer considered to be proprietary by Westinghouse.

Reference 3 provided the NRC assessment of the Westinghouse claim that proprietary information was provided in a letter dated September 20, 1993, that contained information related to the AP600 PRA and WCAP-13795, which provided the PRA uncertainty analysis. The NRC assessment was that the material was similar to material that exists in the current (1998) nonproprietary version of the AP600 probabilistic risk assessment (PRA) report. In addition, the staff indicated the material was used by the staff in the development of the AP600 draft safety evaluation report and therefore should remain on the docket. At the time this information was provided to the NRC technical staff, it was considered to be proprietary by Westinghouse since it contained information that had commercial value to Westinghouse. If the information transmitted by the Westinghouse September 20, 1993, letter was indeed used by the staff in development of the AP600 draft final safety evaluation report in November 30, 1994, then at this time, almost five years later, this information is no longer considered to be proprietary by Westinghouse.

Reference 3 also provided the NRC assessment of the Westinghouse claim that proprietary information was provided in a letter dated January 21, 1994, that contained WCAP-13913, "Framework for AP600 Severe Accident Management Guidance" (SAMG). The NRC assessment was that the material was similar to material that exists in current (1998) nonproprietary AP600 documents (e.g., WCAP-13914, "Framework for AP600 Severe Accident Management Guidance"). In addition, the staff indicated the material was used by the staff in the development of the AP600 draft safety evaluation report and therefore should remain on the docket. At the time this Framework for SAMG was provided to the NRC technical staff, the information was considered to be proprietary by Westinghouse since it contained information that had commercial value to Westinghouse. At this time, over four years later, this information is no longer considered to be proprietary by Westinghouse.

Reference 3 also provided the NRC assessment of the Westinghouse claim that proprietary information was provided in a letter dated February 3, 1994, that contained additional copies of WCAP-13913, "Framework for AP600 Severe Accident Management Guidance" (SAMG). The NRC assessment was that the material was similar to material that exists in current (1998) nonproprietary AP600 documents (e.g., WCAP-13914, "Framework for AP600 Severe Accident Management Guidance"). In addition, the staff indicated the material was used by the staff in the development of the AP600 draft safety evaluation report and therefore should remain on the docket. At the time this Framework for SAMG was provided to the NRC technical staff, the information was considered to be proprietary by Westinghouse since it contained information that had commercial value to Westinghouse. At this time, over four years later, this information is no longer considered to be proprietary by Westinghouse.

Reference 4 provided the NRC assessment of the Westinghouse claim that proprietary information was provided in a letter dated April 18, 1995, that contained information for a MAAP4/RELAP comparison for the AP600 in response to a staff request for additional information. The NRC assessment was that the Westinghouse cover letter indicated that Enclosure 2 is a non-proprietary version of Enclosure 3, however, the staff could not find any portion of the enclosures marked as proprietary. The staff assessment further states the conventional bracketed-superscript notation also appears to be missing. Finally, the NRC assessment states the staff could not determine which part of the material enclosed with the Westinghouse letter was Enclosure 1, 2, or 3. It should be noted that the Westinghouse April 18, 1995, cover letter states "Enclosures 2 (nonproprietary) and 3 (proprietary) provide the requested information." The letter does not indicate that enclosure 2 was a duplicate of enclosure 3 minus the proprietary information. A cover sheet was provided just prior to each of the enclosures to the Westinghouse letter. The enclosures contained the following: Enclosure 1 provided a copy of the NRC's two-page request for information for the MAAP-RELAP comparison. Enclosure 2 provided the requested information, and was titled "Requested Information for AP600 MAAP4/RELAP Comparison." Under section 4, Initial Conditions, of Enclosure 2 it states the initial conditions information (which was proprietary) is provided in Enclosure 3 of the subject Westinghouse letter. Finally, Enclosure 3 contained the list of initial conditions. The information provided in Enclosure 3 was labeled as Westinghouse Proprietary Class 2 at the top of the page, however, the specific proprietary information was not indicated by the bracketed-superscripted notation. In addition to the initial conditions, a mark-up of AP600 PRA Figure K-1 was provided in Enclosure 3. Again, the information was labeled as Westinghouse Proprietary Class 2 at the top of the page, however, the specific proprietary information was not indicated by the bracketed-superscripted notation. At the time the information provided in Enclosure 3 of the subject Westinghouse letter was provided to the NRC technical staff, the information was considered to be proprietary by Westinghouse since it contained information that had commercial value to Westinghouse. At this time, over three years later, this information is no longer considered to be proprietary by Westinghouse.

Reference 5 provided the NRC assessment of the Westinghouse claim that proprietary information was provided in a letter dated February 8, 1994, provided a copy of WCAP-13957, "AP600 Reactor Coolant System Mass Inventory: Function Based Risk Analysis." The NRC assessment was that the material was not "information that the staff customarily accepts as proprietary." In addition, the staff indicated the material was used by the staff in the development of the AP600 final safety evaluation report and therefore should remain on the docket. At the time this report was prepared, the information was considered to be proprietary by Westinghouse since it contained information that had commercial value to Westinghouse and was of the type of information that was customarily held in confidence by Westinghouse. That the material was not information that the staff customarily accepts as proprietary is not relevant to making the proprietary determination. However, in an effort to expedite the issuance of the AP600 Final Safety Evaluation Report and Final Design Approval, Westinghouse agrees to no longer consider this information to be proprietary.

In a telephone call on July 8, 1998, the staff informed Westinghouse of a concern related to WCAP-13288 and WCAP-13289, which were associated with the AP600 check valve testing specification. The concern was that the proprietary report had no proprietary information identified and the nonproprietary report had been placed in the public document room. Westinghouse has reviewed these reports and, at this time, considers none of the information to be proprietary.

This response addresses the proprietary issues delineated in the references.

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

jml

cc: J. W. Roe - NRC/NRR/DRPM
J. M. Sebrosky - NRC/NRR/DRPM
W. C. Huffman - NRC/NRR/DRPM
H. A. Sepp - Westinghouse