52-003

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 31, 1996

Mr. Nicholas J. Liparulo, Manager
Nuclear Safety and Regulatory Activities
Nuclear and Advanced Technology Division
Westinghouse Electric Corporation
P. O. Box 355
Pittsburgh, Pennsylvania 15230

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION (RAI) ON WCAP-14407, "WGOTHIC APPLICATION TO AP600"

Dear Mr. Liparulo:

The Nuclear Regulatory Commission (NRC) Containment Systems and Severe Accident Branch (SCSB) staff has determined that it needs additional information in order to complete its review of the Westinghouse AP600 passive containment cooling system (PCS) and WGOTHIC computer code. The enclosures are questions and concerns, identified as RAIs# 480.596 to 480.668 regarding Sections 1 2, 3, 5, 8, 10, and 11 of WCAP-14407, "WGOTHIC Application to AP600."

You have requested that portions of the information submitted in the June 1992 application for design certification be exempt from mandatory public disclosure. While the staff has not completed its review of your request in accordance with the requirements of 10 CFR 2.790, that portion of the submitted information is being withheld from public disclosure pending the staff's final determination. The staff concludes that these questions and comments do not contain those portions of the information for which exemption is sought. However, the staff will withhold this letter from public disclosure for 30 calendar days from the date of this letter to allow Westinghouse the opportunity to verify the staff's conclusions. If, after that time, you do not request that all or portions of the information in the enclosures be withheld from public disclosure in accordance with 10 CFR 2.790, this letter will be placed in the NRC Public Document Room.

DF03

If you have any questions regarding this matter, you may contact me at (301) 415-8548.

Sincerely,

Diane T. Jackson

Diane T. Jackson, Project Manager
Standardization Project Directorate
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Docket No. 52-003

Enclosures:
1. RAIs on WCAP-14407, Section 1, "Introduction"
2. RAIs on WCAP-14407, Section 2, "Containment Phenomena Identification and Ranking Table"
3. RAIs on WCAP-14407, Section 3, "Overview of WGOTHIC"
4. RAIs on WCAP-14407, Section 5, "Initial Conditions"
5. RAIs on WCAP-14407, Section 8, "AP600 PCS Sensitivity to Blowdown"
6. RAIs on WCAP-14407, Section 10, "Nominal Inputs and Correlations Sensitivities"
7. RAIs on WCAP-14407, Section 11, "Timestep Sensitivity"

cc w/enclosures:
See next page

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Original Signed By:

Diane T. Jackson, Project Manager
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AP600 - REQUEST FOR ADDITIONAL INFORMATION ON WCAP-14407,
SECTION 1, "INTRODUCTION"

480.596 In WCAP-14407, Section 1 (p. 1-3), the last sentence of the paragraph states, ".... it is seen that there is over 10 psi of margin to the peak predicted pressure when most, but not all, conservatism is taken out of the input."

Please identify the remaining conservatisms introduced by specified input data and provide an estimate of their contribution. Are there other conservatism not included in the study which are ranked medium or high that could add to the conservatism?

480.597 In regards to WCAP-14407, Section 1, aside from the conservatism introduced by the input data selection, the AP600 design basis accident (DBA) evaluation model setup introduces another level of conservatism by applying a network of lumped-parameter nodes.

Please quantify the conservatism induced by the model choice in comparison to those introduced by input data.

480.598 In WCAP-14407, Section 1, Westinghouse states, "The justifications for the input and modeling assumptions that have been made in creating the bounding DBA model of the AP600 containment are provided, and sensitivities on the WGOTHIC evaluation model to important input parameters are included."

However, careful examination of the text in Section 1 or in the following sections indicates that Westinghouse never states that the bounding DBA model described in Section 4 was indeed exercised and applied for all of the sensitivity studied listed and documented in WCAP-14407.

Please state whether the WGOTHIC DBA evaluation model described in section 4 was used to obtain the results of the various sensitivity studies documented in the later sections 5, 6, 7, 8, 9, 10, 11 and 13.

480.599 It is a general practice to validate modeling assumptions by direct comparisons with experimental data which covers the spectrum of applicable phenomena and conditions. These comparisons are not provided in WCAP-14407 for the AP600 DBA evaluation model.

Provide a summary of the comparisons between experimental data and the specific model described in Section 4 which justify the claims cited above from WCAP-14407.

Enclosure 1

AP600 - REQUEST FOR ADDITIONAL INFORMATION ON WCAP-14407, SECTION 2, "CONTAINMENT PHENOMENA IDENTIFICATION AND RANKING TABLE"

Section 2 of WCAP-14407 presents a discussion of the Containment phenomena identification and ranking table (PIRT).

480.600 In regards to WCAP-14407, for each item in Table 2-1 and 2-2 identified as requiring scaled tests for resolution, describe which scaled tests are applicable and provide a discussion of how the item was resolved.

PIRT Tables 2-1 and 2-2 have a format which is much simpler than the tables presented in earlier documentation, e.g. NSD-NRC-96-4643. The earlier tables which ranked phenomena by event, event phase, component and the phenomena were more detailed (e.g. break source mass and energy, direction, momentum and density, previously listed separately, are now combined). This simplification has eliminated some items previously ranked as medium for various events or phases, e.g. break pool mixing/stratification and segregation, mass transfer and internal resistance. Also, some phenomena which are now combined may be quite different for the different phases of an event.

480.601 Section 2 references NSD-NRC-96-4643 which has PIRT tables that are very different in structure and content than those presented in Section 2. Please reconcile the differences in the information presented in these documents, and provide explanations for any high or medium ranked items which have been eliminated.

480.602 Please explain how the rankings given in the PIRT were confirmed. What use was made of the scaled test data for this confirmation?

480.603 Tables 2-3 and 2-4 give information on the PIRT application which is organized by module. The PIRT phenomena listed are organized and ranked differently from Tables 2-1 and 2-2. Please explain the relationship between the phenomena and rankings in the PIRT and PIRT application tables.

Enclosure 2

AP600 - REQUEST FOR ADDITIONAL INFORMATION ON WCAP-14407, SECTION 3, "OVERVIEW OF WGOTHIC"

Section 3 of WCAP-14407 presents an overview of WGOTHIC.

480.604 In WCAP-14407, Section 3 (p. 3-1), Westinghouse states, "The GOTHIC code has been developed through a long history from other qualified thermal-hydraulic computer codes (as shown in Figure 3-1)." The codes shown in Figure 3-1 include Cobra-IV, WCOBRA-TRAC and COBRA-NC. Please explain how the qualification histories of these subchannel codes are relevant to validate the use of WGOTHIC for containment calculations using the lumped parameter mode.

480.605 In WCAP-14407, Section 3 (p. 3-1), Westinghouse states, "The GOTHIC code has been developed through a long history from other qualified thermal-hydraulic computer codes (as shown in Figure 3-1)." Please provide a summary of the verification and validation used for the development of WGOTHIC 4.0 to be used for the final standard safety analysis report (SSAR) analyses. What is the role of the EPRI Qualification Report Studies? What is the role of the Small-Scale Test and the Large Scale Test facilities in the verification and validation process? What is the role of other test or experiments on this process? How do these test results validate the lumped parameter evaluation model for AP600?

480.606 In WCAP-14407, the simplified two-conductor clime, shown in Figure 3-3, does not show condensation on the baffle in the air flow channel. Nor does it show the possibility of film condensation occurring on the baffle structure above the highest clime which then flows (and convects heat) onto the lower baffle clime regions. Explain how these mechanisms are modeled by the WGOTHIC clime model. In Westinghouse's response to RAI 393, dated February 16, 1996, (letter NSD-NRC-96-4649), a commitment was made to provided additional information as well as an updated Figure 3-3 and additional figures. The issue of condensation on the baffle, as well as fog in the annulus, has been previously identified as SDSER Open Item 21.6.5-9.

480.607 In WCAP-14407, Section 3 (p. 3-6), Westinghouse states, "Climes may be stacked on top of one another in a model...two stacked sets of climes are used in the PCS model to simulate the wetting of the containment shell..." As the WGOTHIC clime model neglects heat transfer between adjacent dry and wet climes, the possibility exists that WGOTHIC predictions will show points on PCS surface as close as 1 inch apart to have 100 °F different temperatures. This effect will overestimate the effectiveness of dry surface

Enclosure 3

convection and radiation heat transfer, and may not be compensated for by the underprediction of the evaporation rate predicted for the wet clime surfaces. Please address this concern with a sensitivity analysis.

480.608 In WCAP-14407, Section 3, the last paragraph on page 3-7 states: "The convection heat transfer in any large containment vessel will primarily be turbulent rather than laminar." On page 3-8, the second paragraph states: "Approximately 95 percent of the condensing shell surface is expected to operate in the turbulent ($Gr > 10^{10}$) free convection range." Please provide quantitative justification for these statements, particularly for long term conditions hours after the blowdown phase of a loss-of-coolant-accident (LOCA) event has finished.

480.609 In WCAP-14407, Section 3 (p. 3-10), Westinghouse states that GOTHIC applies a single heat transfer correlation which combines turbulent forced convection and free convection. The turbulent forced convection component will be computed using the flat plate correlation. However, Westinghouse has stated (Ref: NTD-NRC-95-4545, August 31, 1996) that it will bound forced convection inside containment by using free convection only. Please explain.

Supplemental Draft Safety Evaluation Report (SDSER) Open Item 21.6.5-2
In WCAP-14407, Section 3 (p. 3-11), Westinghouse states that the Chun and Seban correlation will be used for wavy laminar films. This correlation has been reviewed previously (see SDSER Open Item No. 21.6.5-2) and was discussed with Westinghouse during a January 22, 1996 telephone conference. In the SDSER and in these discussions, the staff identified concerns that the Chun and Seban correlation has insufficient supporting data and a questionable theoretical basis for (nearly) horizontal flows. Please provide further justification which supports this use of the Chun and Seban model. As discussed in the SDSER:

- Westinghouse has not presented sufficient data to support use of the Chun and Seban correlation for the external (evaporating) surface of AP600.

- Westinghouse has not explained the apparent trend with angle of inclination for the Wisconsin Condensation Test Data, nor have they provided sufficient information to judge test uncertainties.

- Westinghouse should provide a discussion of the theoretical basis for the extension of the Chun and Seban correlation to horizontal surfaces.

Use of this model cannot be approved without additional supporting data.

AP600 - REQUEST FOR ADDITIONAL INFORMATION ON WCAP-14407,
SECTION 5, "INITIAL CONDITIONS"

Section 5 of WCAP-14407 presents a sensitivity study on initial conditions. In Section 10 of WCAP-14407, a second set of sensitivities is presented.

480.610 In WCAP-14407, Section 5 (p. 5-1), a reference design basis WGOTHIC model is referred to but no reference is provided. Please provide this reference. Identify which WGOTHIC model is to be considered the "Design Basis Model" that Westinghouse is submitting for review and approval. Is it:

(a) the "Reference Design Basis Model",
(b) the "Reference Model" of Tables 5-1 and 5-2,
(c) the "Base Evaluation Model" described in Section 4, or
(d) the model used in the Section 10 studies?

For each of these models, please identify: the number of nodes, the flow paths, climes, WGOTHIC computer code version used, break size and location, etc. If any differences exist, please discuss modeling differences and their impact on the sensitivity results provided. If the computer program version differs from WGOTHIC 4.0 version to be used for the final SSAR analyses, discuss the differences and their impact on the results provided.

480.611 In WCAP-14407, Section 5, do the sensitivity studies cover both LOCA and main steam line break (MSLB) accident scenarios for all phases of the accident? If not, please discuss the significance of this omission. Are all the high and medium ranked phenomena concerning initial conditions for LOCAs and the MSLBs addressed by these studies? Are the WGOTHIC results consistent with the PIRT?

480.612 When changing one of the parameters from its reference value to the sensitivity value, have all other parameters been kept at their reference values as listed in Table 5-1?

480.613 In WCAP-14407, Section 5, how is water coverage treated when parameters or transient characteristics (water temperature, heat flux, etc.) influencing the coverage fraction and runoff calculation are modified? Does the water coverage fraction change with time?

Enclosure 4

480.614 In WCAP-14407, Section 5 (p. 5-1), the second paragraph states that the initial reference design basis values were conservatively set to maximize containment pressure (consistent with technical specifications and site interface parameter limits). The initial conditions assumed in the parametric sensitivity study were set at the opposing end of the technical specifications and site interface parameter limits.

Please explain the selection process according to these principles and clarify the level of conservatisms embedded in Westinghouse's choice of reference and sensitivity values. For example, why is 40 °F a lower limit for the outside air temperature in this sensitivity study when the Westinghouse site interface parameters limits on ambient air temperature (page 5-9) are 115 °F to -40 °F? Why are outside humidity studies performed only at high ambient temperatures, and not at low temperatures?

480.615 In WCAP-14407, Section 5 (p. 5-2), why are the initial conditions space-independent? Atmospheric and structural temperatures as well as relative humidity are at least dependent upon the axial coordinate. The WGOTHIC evaluation model allows a differentiated input of initial conditions. Why has this not been done?

Subsections 5.2 - 5.9 give results for parameter changes without describing the study approach. Subsection 5.3 describes the impact of the selected input value for the relative humidity (inside containment) and Figure 5-1 reveals that the reference case generates a higher containment pressure response than the sensitivity limit value of 100% relative humidity. Westinghouse explains this by the maximum amount of non-condensible gas present for the reference limit value of 0% relative humidity.

480.616 In WCAP-14407, Section 5, for what accident scenarios are results shown in Figure 5-1 (as well in all of the following figures)?

480.617 In WCAP-14407, Section 5, what driving forcing functions (break mass flow rate, energy addition) were used to obtain the computational results? What blowdown computer program was used to predict break flow and associated energy? Provide a plot of the mass and energy profiles used, or a reference location.

480.618 In WCAP-14407, Section 5, what correlation controls the impact of non-condensibles on heat transfer? Is it the Uchida-correlation for the heat sinks below the operating deck or is it controlled by PCS energy and mass transfer?

480.619 All figures (5-1 through -8) clearly indicate a pronounced and continuous increase of the containment pressure starting at about 30,000 seconds. This is of concern as it indicates the potential to challenge the containment criteria after 24 hours into the accident. Please explain why containment pressure begins rise after 30,000 seconds and continues to rise 24 hours into the event.

What phenomena exacerbates, and what phenomena limits, the

magnitude of this third pressure peak. Please extend the design basis calculation to beyond the time where the third pressure peak returns to its initial starting value.

480.620 In WCAP-14407, Subsection 5.4 presents the impact of the reduction in initial containment pressure versus the reference limit case of 15.7 psia according to the maximum technical specifications limit. Westinghouse analyzes a worst possible external pressure load of 3.0 psig as a simple translation into an internal pressure reduction.

What is the rationale to simply translate this 3.0 psig external pressure into an internal pressure reduction?

480.621 For this parametric study an increase in containment pressure (see Figures 5-1 and 5-2) occurs late in the transient (greater than 40,000 seconds).

What is the reason for this containment repressurization? What factors would cause it to occur earlier?

480.622 For this parametric study an increase in containment pressure (see Figures 5-1 and 5-2) occurs late in the transient (greater than 40,000 seconds).

Will the increasing containment pressure eventually turnaround? What mechanism will cause this turnaround and how long will it take?

480.623 In WCAP-14407, Subsection 5.5, Westinghouse discusses the simultaneous change of containment atmosphere and heat sink initial temperatures. The results, as presented in Figure 5-3, clearly indicate the complexity of interdependencies with respect to the initial containment temperature.

Why would the internal heat sinks become more important after PCS initiation as the PCS has always been portrayed as the major, ultimate heat sink for AP600 for long-term transient behavior?

480.624 As Figure 5-3 shows, the reference case pressure response drops below the sensitivity case at around 3,500 seconds which is explained by Westinghouse as the result of thermally saturated heat sinks.

What heat sinks are thermally saturated after 1 hour? What fraction of the total available heat sinks is that?

480.625 Figure 5-3 reveals that around 80,000 seconds the reference case pressure increases steeply while the sensitivity case levels off.

What is the reason for this containment pressure gradient difference around 80,000 seconds?

Subsection 5.6 presents the impact of initial inlet humidity in the atmosphere and shows nearly no differences between the reference and sensitivity cases other than very small ones very late into the transient.

480.626 In WCAP-14407, Subsection 5.6, what initial structural temperatures for downcomer, riser and baffle were used for the reference and sensitivity cases?

480.627 In WCAP-14407, Subsection 5.6, what potential exists for supersaturation effects in the riser section? Is this accounted for in the WGOTHIC model?

480.628 In WCAP-14407, Subsection 5.6, what would the sensitivities be to initial humidity at lower temperatures, including subfreezing temperatures, where the atmosphere has a lower capability to hold evaporated water?

Subsection 5.7 presents the results of simultaneous changes of initial air inlet and film temperatures with Figure 5-5 demonstrating rather small differences between reference and sensitivity cases beyond 1,000 seconds. The subsection title as well as the figure caption of Figure 5-5 should be expanded to include the simultaneous change of film temperature. Figure 5-5, as the others before, also indicate a step containment pressure increase starting at about 80,000 seconds.

480.629 In WCAP-14407, Subsection 5.7 (p. 5-9), what is the rationale to set both inlet atmosphere and film temperatures at the same values? What does film temperature mean in this context?

480.630 In WCAP-14407, Subsection 5.7 (p.5-9), is the film temperature also 115 °F for the reference case?

480.631 In WCAP-14407, at the end of Subsection 5.7, Westinghouse quotes a source water temperature of 40 °F.Is the source water temperature the same as the film temperature?

Subsection 5.8 presents the impact of a change in the downcomer-riser annulus loss coefficient versus the reference case with Figure 5-6 revealing no effect. Reference is made to test data obtained from a 14-degree 1/6 scale model.

480.632 In WCAP-14407, Subsection 5.8 (p. 5-11), what is technical basis and relevant reference for hydraulic resistance coefficients and flow regimes?

480.633 In WCAP-14407, Subsection 5.8 (p. 5-11), what does this loss coefficient encompass?

480.634 In WCAP-14407, Subsection 5.8 (p. 5-11), what is the technical basis for increasing the loss coefficient by 20%? Why not a factor of 40%, 60% or 100%, or greater? Does this value reflect the data spread of the experimental data cited above?

WCAP-14407, Subsection 5.9 (p. 5-11) presents the effect of changes in the steel jacket-to-concrete air gap thickness, results of which are displayed in Figures 5-7 and 5-8. The following questions arise from the information presented.

480.635 Inspection of Table 5-1 reveals that all steel jacket-to-concrete air gap thicknesses have been set to zero (perfect thermal contact) for the reference design basis computation. Please explain why a zero gap thickness was expected to result in a conservative maximum containment pressure response, as required by Westinghouse's parameter selection principles?

480.636 In WCAP-14407, Subsection 5.9, the staff considers the Westinghouse 5 mil estimate of the steel jacket-to-concrete air gap (based on an assumed shrinkage length) to be questionable. Five mils is the approximate thickness of a human hair. As Westinghouse has noted, local variation in aggregates and curing conditions may cause variations in the void content and ultimate shrinkage the structural concrete. Westinghouse should provide data on observed air gap values for structural concrete which span the range of composition and curing practices expected for AP600. Why was 20 mils selected as a conservative upper bound for the gap thickness value? The staff requests Westinghouse provide additional justification for this value as well.

480.637 In WCAP-14407, Subsection 5.9, how large is the fraction of affected surfaces compared to the total heat sink surface area? How much of heat sink volume is associated with these surfaces?

480.638 In WCAP-14407, Subsection 5.9, why is the effect of air gap resistance on containment pressure only noticeable between 400 and 5000 seconds and not at later times?

480.639 In WCAP-14407, Subsection 5.9, the temperature profiles displayed in Figure 5-8 cannot be identified with the respective air gap thickness because of the graphical display chosen. Please replot this figure so that the information presented can be understood.

AP600 - REQUEST FOR ADDITIONAL INFORMATION ON WCAP-14407,
SECTION 8, "AP600 PCS SENSITIVITY TO BLOWDOWN"

480.640 In WCAP-14407, Section 8, update the comparison study to reflect the AP600 DBA evaluation model described in Section 4 in place of the SSAR Rev. 5 preliminary markup. Discuss any differences between the data in Section 4 and the data used to develop the single node model. Update the single-node model as needed to reflect changes in the heat structures (mass, area, etc.) Identical forcing functions should be used for the comparison.

Enclosure 5

AP600 - REQUEST FOR ADDITIONAL INFORMATION ON WCAP-14407, SECTION 10, "NOMINAL INPUTS AND CORRELATIONS SENSITIVITIES"

Section 10 of WCAP-14407 presents a sensitivity study on Nominal Inputs and Correlation Sensitivities conditions.

480.641 For WCAP-14407, describe the "AP600 DBA Model" used for the Section 10 study: number of nodes, flow paths, climes, WGOTHIC computer code version used, etc. If the computer program version differs from WGOTHIC 4.0 version to be used for the final SSAR analyses, discuss the differences and their impact on the results provided. With respect to the model described in Section 4, discuss modeling differences and their impact on the sensitivity results provided.

480.642 In WCAP-14407, Section 10, what driving forcing functions (break mass flow rate, energy addition) were used to obtain the computational results? What blowdown computer program was used to predict break flow and associated energy? Provide a plot of the mass and energy profiles used, or a reference location.

480.643 What was the basis for the decision to examine the 7 cases listed in Table 10-1, while many more case with other input parameters and model choices affect the final results? How did the PIRT and the scaling evaluations enter into this decision?

480.644 In WCAP-14407, Section 10, for each case, provide a comparison (overlay) plot of the pressure response, similar to those provided in Section 5. Discuss trends and results.

480.645 In WCAP-14407, Section 10, do these sensitivity studies cover both LOCA and MSLB accident scenarios for all phases of the accident? If not, please discuss the significance of this omission. Are all the high and medium ranked phenomena for LOCAs and the MSLBs addressed by these studies? Are the WGOTHIC results consistent with the PIRT?

480.646 In WCAP-14407, Section 10, how did Westinghouse define the best-estimate predictions? Removing multipliers from the heat and mass transfer correlations does not lead to "best-estimate" predictions, it only reflects uncertainty in the mass and heat transfer correlations. What is the underlying rationale (PIRT, data sensitivity studies) that Westinghouse used to determine the true, best-estimate case which enables Westinghouse to assess the degree of conservatism attached to the AP600 DBA evaluation model?

480.647 In WCAP-14407, Section 10, how does Westinghouse concluded that the bounding multiplier approach is valid through the whole time period of 24 hours?

Enclosure 6

480.648 In WCAP-14407, Section 10, how does the removal of the multipliers for heat and mass transfer correlations affect other quantities, than pressure, i.e. film coverage, temperatures?

480.649 In WCAP-14407, Section 10, since the first sensitivity case uses the mixed convection correlation which is velocity dependent. How does Westinghouse use the WGOTHIC calculated velocity in the correlation? Address the artificially high velocity attributed to lumped-parameter node networks. What would be the result of a sensitivity for a lumped-parameter network model without credit for the forced convection component, for example only changing the free convection component multiplier?

480.650 In WCAP-14407, Section 10, how is water coverage treated when parameters or transient characteristics (water temperature, heat flux, etc.) influencing the coverage fraction and runoff calculation are modified? Does the water coverage fraction change with time?

480.651 In reference to WCAP-14407, Section 10, it is difficult to assess the sensitivity to model parameters, such as use of heat and mass transfer multipliers, material properties, and treatment of dead-ended nodes, as these runs were intertwined with sensitivity runs which varied the initial conditions. What is the basis for selecting the computational order in which the runs were performed? Is it based on the PIRT?

480.652 In reference to WCAP-14407, Section 10, please explain the rationale underlying the various initial temperatures combinations (i.e., water, surface, film, air) as they evolve from case to case. In case 3 for example, the initial temperature combinations used were not realistic. The calculated change in pressure from these case-to-case sensitivity studies (e.g., the Δp from case 2 to case 3 and the Δp from case 3 to case 4) may also not be realistic.

480.653 In WCAP-14407, Section 10, the fifth case examined changes in the properties of the containment shell coating (emissivity, thermal conductivity) What is the reasoning to change only those two properties? Where these changes applied to inside and outside shell surfaces, or only to the outside surface? Provide the rationale for selecting these values. Is there data to support the values used?

480.654 In WCAP-14407, Section 10, why were the baffle properties kept the same?

480.655 In WCAP-14407, Section 10, Case 6 removed the assumption of no heat sink access of steam in dead-ended compartments. By removing this limitation, how much additional heat sink surface and volume is made accessible to the steam as compared to the previous cases?

480.656 In WCAP-14407, Section 10, describe the methods used to generate the Case 7 "Nominal Mass and Energy Releases." What conservatisms are embedded in the computed nominal mass and energy releases

predicted by the SATAN-code? What would be the results of a best-estimate prediction by WCOBRA/TRAC? Please plot the nominal mass and energy releases and the AP600 DBA Model mass and energy releases.

480.657 In WCAP-14407, Section 10, why did Westinghouse not include the sensitivity upon steel jacket-to-concrete air gap thickness?

480.658 In Table 10.1, The "Reflood" result for Case 3 is shown as 46.51 psia. Shouldn't this be 49.51 psia? If the 46.51 value is correct, please explain the observed trends.

AP600 - REQUEST FOR ADDITIONAL INFORMATION ON WCAP-14407,
SECTION 11, "TIMESTEP SENSITIVITY"

Section 11 of WCAP-14407 presents Timestep Sensitivity studies.

480.659 In WCAP-14407, Section 11 (p.11-1), the modifications which Westinghouse introduced to enforce one-half and one-quarter time step are described. However, there is no discussion of how Westinghouse ensured that none of the timestep stability criteria were invalidated.

How did Westinghouse ensure that none of the timestep stability criteria were invalidated when introducing half- and quarter-size timesteps into GOTHIC_S?

480.660 In WCAP-14407, Section 11 (p.11-2), Westinghouse referred to an AP600 evaluation model input deck which was used for this timestep sensitivity study up to 24 hours into the transient.

Describe the "AP600 evaluation model" used for the Section 11 study: number of nodes, flow paths, climes, WGOTHIC computer code version used, etc. If the computer program version differs from WGOTHIC 4.0 version to be used for the final SSAR analyses, discuss the differences and their impact on the results provided. With respect to the model described in Section 4, discuss modeling differences and their impact on the sensitivity results provided.

480.661 In WCAP-14407, Section 11 (p.11-2), Westinghouse referred to an AP600 evaluation model input deck which was used for this timestep sensitivity study up to 24 hours into the transient.

What driving forcing functions (break mass flow rate, energy addition) were used to obtain the computational results? What blowdown computer program was used to predict break flow and associated energy? Provide a plot of the mass and energy profiles used, or a reference location.

480.662 In WCAP-14407, Section 11 (p.11-2), Westinghouse referred to an AP600 evaluation model input deck which was used for this timestep sensitivity study up to 24 hours into the transient.

Describe the initial conditions used for the "AP600 evaluation model." Are these conditions the same as the quoted reference case in Section 5; or in Section 10?

Enclosure 7

480.663 In WCAP-14407, Section 11 (p.11-2), Westinghouse referred to an AP600 evaluation model input deck which was used for this timestep sensitivity study up to 24 hours into the transient.

Table 11-1 presents the results in terms of peak pressure. Add the pressure at 24 hours, especially since these computational results show a substantially different behavior between 10^4 and 10^5 seconds compared to the results provided in Section 5.

480.664 In WCAP-14407, Section 11 (p.11-2), Westinghouse referred to an AP600 evaluation model input deck which was used for this timestep sensitivity study up to 24 hours into the transient.

Why is the temporal pressure history between 10^4 - 10^5 seconds changing from section to section?

480.665 In WCAP-14407, Section 11 (p.11-2), Westinghouse referred to an AP600 evaluation model input deck which was used for this timestep sensitivity study up to 24 hours into the transient.

What is the reason for the containment pressure increase starting at 80,000 seconds computed by the evaluation model? Does the pressure continuously increase thereafter?

480.666 In WCAP-14407, Section 11 (p.11-2), Westinghouse referred to an AP600 evaluation model input deck which was used for this timestep sensitivity study up to 24 hours into the transient.

Table 11-2 lists the number of occurrences of reaching the timestep limit results without any further comments about their physical meaning. What does Westinghouse conclude from the data presented in Table 11-2 and how are those results guiding future Westinghouse computations with WGOTHIC?

480.667 In WCAP-14407, Section 11 (p.11-2), Westinghouse referred to an AP600 evaluation model input deck which was used for this timestep sensitivity study up to 24 hours into the transient.

Please comment on the reasons for the 5% dip in peak pressure at 20 seconds in the full to half timestep comparison.

480.668 In WCAP-14407, Section 11 (p.11-2), Westinghouse referred to an AP600 evaluation model input deck which was used for this timestep sensitivity study up to 24 hours into the transient.

Did the timestep reduction also involve the solution of transient heat conduction in the heat sinks? What was done in the clime coding?

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Docket No. 52-003
AP600

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