October 14, 2014

Mr. James A. Gresham, Manager
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
1000 Westinghouse Drive
Cranberry Township, PA 16066

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION RE: WESTINGHOUSE ELECTRIC COMPANY TOPICAL REPORT WCAP-17721-P, REVISION 0, AND WCAP-17721-NP, REVISION 0, "WESTINGHOUSE CONTAINMENT ANALYSIS METHODOLOGY - PWR [PRESSURIZED WATER REACTOR] LOCA [LOSS-OF-COOLANT ACCIDENT] MASS AND ENERGY RELEASE CALCULATION METHODOLOGY," - SET 2 (SAFETY AND CODE REVIEW BRANCH) (TAC NO. MF1797)

Dear Mr. Gresham:

By letter dated May 3, 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13133A066), Westinghouse Electric Company (Westinghouse) submitted for U.S. Nuclear Regulatory Commission (NRC) staff review Topical Report WCAP-17721-P, Revision 0, and WCAP-17721-NP, Revision 0, "Westinghouse Containment Analysis Methodology - PWR LOCA Mass and Energy Release Calculation Methodology." Upon review of the information provided, the NRC staff has determined that additional information is needed to complete the review. Enclosed with this letter, the NRC staff is formally issuing Set 2 of request for additional information (RAI) questions to Westinghouse on WCAP-17721-P, Revision 0, and WCAP-17721-NP, Revision 0. On September 5, 2014, Debbie Sommer, Westinghouse, Project Manager, Software & Systems Technology, and I agreed that NRC staff will receive your response to the enclosed RAI questions by March 18, 2014.

If you have any questions regarding the enclosed RAI questions, please contact me at 301-415-3151.

Sincerely,

/RA/

Ekaterina Lenning, Project Manager
Licensing Processes Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 700

Enclosure:
RAI Questions

October 14, 2014

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Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
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ADAMS Accession No.: ML14254A251 *concurred via email **NRR-106**

OFFICE	PLPB/PM	PLPB/LA	SNPB/BC*	PLPB/BC	PLPB/PM
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DATE	9/11/2014	9/23/2014	10/07/2014	10/08/2014	10/14/2014

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U. S. NUCLEAR REGULATORY COMMISSION

OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ADDITIONAL INFORMATION REGARDING THE REVIEW OF THE WESTINGHOUSE ELECTRIC COMPANY TOPICAL REPORT WCAP-17721-P, REVISION 0, AND WCAP-17721-NP, REVISION 0

SET 2 (SAFETY AND CODE REVIEW BRANCH)

By letter dated May 3, 2013, Westinghouse Electric Company (Westinghouse) submitted topical report (TR) WCAP-17721-P, Revision 0, and WCAP-17721-NP, Revision 0, "Westinghouse Containment Analysis Methodology - PWR [pressurized water reactor] LOCA [loss-of-coolant accident] Mass and Energy Release Calculation Methodology," for review and approval. The NRC staff in Safety and Code Review Branch (SNPB) of the Division of Safety Systems in the Office of Nuclear Reactor Regulation has reviewed the submittal and is requesting responses to the following items to complete its review.

To facilitate better communication, each of the request for additional information (RAI) questions is assigned to a specific class by the U.S. Nuclear Regulatory Commission (NRC) staff which corresponds to the staff's view of the level of disagreement for that RAI. That level of disagreement is quantified using the definitions provided in Table 1 below.

Table 1: RAI Question Classes

Class	Description	Definition
RAI-1	Disagreement	RAI questions which are asked to provide details about the logical basis for a statement. These RAI questions are used when the NRC staff disagrees with a statement being made.
RAI-2	Skepticism	RAI questions which are asked to provided justification for a statement. These RAI questions are used when the NRC staff is skeptical about a statement being true and require further justification for that statement.
RAI-3	Documentation Needed	RAI questions which are asked to provided additional documentation for a statement. These RAI questions are used when the NRC staff either agrees or does not disagree with a statement, but believes the statement is unsupported.
RAI-4	Clarification	RAI questions which are asked to clarify a statement. These RAI questions are used when the NRC staff does not understand the statement being made.
RAI-5	Basic Information	RAI questions which request some basic level of information that is deemed easy to provide.

ENCLOSURE

RAI-6	Editorial	RAI questions which request an editorial change that does not change the meaning of the statement.

It is important to note that the level of disagreement of an RAI is not necessarily correlated to the importance of the RAI question or the work that may be needed to resolve the RAI question. The RAI questions which have high levels of disagreement may, in the big picture, be relatively unimportant or may also be easily resolved. Further research into this area is needed and while those additional metrics would be useful, the NRC staff has yet to develop a way to quantify them.

Table 2 below provides a summary of the classifications for this round of RAI questions.

Table 2: RAI Question Classes

Class	# of RAI Questions
RAI-1	0
RAI-2	3
RAI-3	29
RAI-4	1
RAI-5	1
RAI-6	1

This summary indicates that, overall, the NRC staff does not disagree with the methodology, but do believe more documentation is needed. This is an accurate reflection of the reviewer's perception of this TR. A listing of all of the RAI questions and their associated classification can be found in Table 3 below.

Table 3: Listing of all RAI Questions

RAI Question Listing	
RAI #	**Title**
2.1	RAI-3 – Downcomer stored energy release
2.2	RAI-3 – Break size
2.3	RAI-3 – Break flow model
0	RAI-3 – Refill
2.5	RAI-3 – Core flooding
2.6	RAI-3 – Liquid Entrainment
2.7	RAI-3 – Upper plenum entrainment
2.8	**RAI-2 – Hot leg entrainment**
2.9	RAI-3 – Steam Quenching
2.10	RAI-3 – Equipment Qualification (EQ) and Net Positive Suction Head analysis (NPSHa

2.11	RAI-3 – Long term boil-off
2.12	RAI-3 – Event definitions
2.13	RAI-3 – Main feedwater
2.14	**RAI-2 – Auxiliary feedwater**
2.15	RAI-3 – Steady state steam generator pressure
2.16	RAI-3 – Safety Injection (SI) water volume and temperature
2.17	RAI-3 – Nodalization
2.18	RAI-5 – Steam tables
2.19	RAI-3 – Flow modeling
2.20	RAI-3 – Cold leg/accumulator condensation
2.21	RAI-3 – Downcomer condensation
2.22	RAI-3 – Loop flow split
2.23	RAI-3 – Hot leg condensation in NPSHa and EQ
2.24	RAI-3 – Dynamic pump model
2.25	RAI-3 – GOTHIC time step sensitivity
2.26	RAI-3 – WC/T coupled vs. standalone
2.27	RAI-3 – Heat transfer correlations
2.28	RAI-3 – Heat transfer directly to containment
2.29	RAI-3 – Inactive metal
2.30	RAI-3 – Unal's correlation
2.31	RAI-3 – Biasi Range
2.32	**RAI-2 – FLEACHT heat release rate**
2.33	RAI-3 – Secondary side heat transfer
2.34	RAI-6 – Definitions for acronyms
2.35	RAI-4 – Clarification on quench front paragraph

2.1 RAI-3 – Downcomer stored energy release

RAI: Demonstrate that the method for modeling the downcomer stored energy release in WCOBAR/TRAC (WC/T) is appropriate for the Mass and Energy (M&E) evaluation model such that the mass and energy release is adequately predicted.

Comment: In section 2.11 of their initial submittal, Westinghouse stated that the same downcomer stored energy release model was used for the emergency core cooler system evaluation model as were used in the M&E evaluation model. However, the ECCS evaluation model is focused on obtaining an adequate prediction of peak cladding temperature. On the other hand, the M&E evaluation model is focused on obtaining an adequate prediction of the mass and energy release rates to obtain an adequate prediction of containment pressures and temperatures. Because the figure of merit between the two evaluation models is substantial different, what may be conservative or adequate in one evaluation model may be non-conservative or inadequate in the other. For example, the M&E release is generally decreased to generate a conservative PCT calculation. On the other hand, the M&E release rate is generally increased to generate a conservative containment pressure calculation.

2.2 RAI-3 – Break size

RAI: Westinghouse stated that the break size used for the M&E evaluation model is the double ended break. Provide information on the consideration of slot breaks. If the breaks are considered, when are they used? If the breaks are not considered, what is the justification for ignoring them?

Comment: In table 4-1, row 9 of their initial submittal [1], Westinghouse stated that their previous M&E evaluation model used a slot break to maximize M&E release in the Combustion Engineering (CE) Nuclear Steam Supply System (NSSS) designs. For the proposed Evaluation Model (EM), they did not specify if they considered slot breaks.

2.3 RAI-3 – Break flow model

RAI: Demonstrate that break flow model used in WC/T provides an appropriate prediction of the break flow for the M&E evaluation model such that the mass and energy release is adequately predicted.

Comment: In table 4-1, row 12 of their initial submittal [1], Westinghouse stated that the same break flow model was used for the ECCS evaluation model as were used in the M&E evaluation model. However, the ECCS evaluation model is focused on obtaining an adequate prediction of PCT. On the other hand, the M&E evaluation model is focused on obtaining an adequate prediction of the mass and energy release rates to obtain an adequate prediction of containment pressures and temperatures. Because the figure of merit between the two evaluation models is substantial different, what may be conservative or adequate in one evaluation model may be non-conservative or inadequate in the other. For example, the M&E release is generally decreased to generate a conservative PCT calculation. On the other hand, the M&E release rate is generally increased to generate a conservative containment pressure calculation.

2.4 RAI-3 – Refill

RAI: Describe the validation data which supports WC/T ability to model the refill phase and demonstrate that this data justifies WC/T ability to predict the RCS transient response during the refill phase for the M&E evaluation model.

Comment: In table 4-1 row 15 of their initial submittal [1], Westinghouse stated ECCS evaluation model had been validated for refill calculations by comparison with experimental data. However, the ECCS evaluation model is focused on obtaining an adequate prediction of PCT. On the other hand, the M&E evaluation model is focused on obtaining an adequate prediction of the mass and energy release rates to obtain an adequate prediction of containment pressures and temperatures. Because the figure of merit between the two evaluation models is substantial different, what may be conservative or adequate in one evaluation model may be non-conservative or inadequate in the other. For example, the M&E release is generally decreased to generate a conservative PCT calculation. On the other hand, the M&E release rate is generally increased to generate a conservative containment pressure calculation.

2.5 RAI-3 – Core flooding

RAI: Describe the validation data which supports WC/T ability to model the core flooding rate and demonstrate that this data justifies WC/T ability to predict the Reactor Coolant System (RCS) transient response for the M&E evaluation model.

Comment: In table 4-1 row 16 of their initial submittal [1], Westinghouse stated ECCS evaluation model had been validated for the core flooding rate by comparison with experimental data. However, the ECCS evaluation model is focused on obtaining an adequate prediction of PCT. On the other hand, the M&E evaluation model is focused on obtaining an adequate prediction of the mass and energy release rates to obtain an adequate prediction of containment pressures and temperatures. Because the figure of merit between the two evaluation models is substantial different, what may be conservative or adequate in one evaluation model may be non-conservative or inadequate in the other. For example, the M&E release is generally decreased to generate a conservative PCT calculation. On the other hand, the M&E release rate is generally increased to generate a conservative containment pressure calculation.

2.6 RAI-3 – Liquid Entrainment

RAI: Describe the validation data which supports WC/T ability to model liquid entrainment and demonstrate that this data justifies WC/T ability to predict the RCS transient response for the M&E evaluation model.

Comment: In table 4-1 row 16 of their initial submittal [1], Westinghouse stated ECCS evaluation model had been validated for liquid entrainment by comparison with experimental data. However, the ECCS evaluation model is focused on obtaining an adequate prediction of PCT. On the other hand, the M&E evaluation model is focused on obtaining an adequate prediction of the mass and energy release rates to obtain an adequate prediction of containment pressures and temperatures. Because the figure of merit between the two evaluation models is substantial different, what may be conservative or adequate in one evaluation model may be non-conservative or inadequate in the other. For example, the M&E release is generally decreased to generate a conservative PCT calculation. On the other hand, the M&E release rate is generally increased to generate a conservative containment pressure calculation.

2.7 RAI-3 – Upper plenum entrainment

RAI: Demonstrate that method for modeling the upper plenum entrainment/de-entrainment and condensation in WC/T is appropriate for the M&E evaluation model such that the mass and energy release is adequately predicted.

Comment: In section 2.5 of their initial submittal [1], Westinghouse stated that the same upper plenum entrainment/de-entrainment and condensation model was used for the ECCS evaluation model as were used in the M&E evaluation model. However, the ECCS evaluation model is focused on obtaining an adequate prediction of PCT. On the other hand, the M&E evaluation model is focused on obtaining an adequate prediction of the mass and energy release rates to obtain an adequate prediction of containment pressures and temperatures. Because the figure of merit between the two evaluation models is substantial different, what may be conservative or adequate in one evaluation model may be non-conservative or inadequate in the other. For example, the M&E release is generally decreased to generate a conservative PCT calculation. On the other hand, the M&E release rate is generally increased to generate a conservative containment pressure calculation.

2.8 RAI-2 – Hot leg entrainment

RAI: The justification for the hot leg entrainment/de-entrainment being independent of the pressure seems to suggest that all entrainment/de-entrainment modeling is independent of the final pressure calculation as the RCS steam temperatures will match those on the secondary side within minutes after event initiation. However, this concept seems to be in contradiction with the M&E Phenomena Identification and Ranking Table (PIRT) which has entrainment and de-entrainment as high ranked phenomena as well as the other changes to the M&E model to better model the heat transfer from the secondary side to the primary side in the steam generators. Provide further clarification on this topic.

Comment: In section 2.7 of their initial submittal [1], Westinghouse stated that the sensitivity study performed which varied the slip in the hot leg demonstrated that the mass and energy release (i.e., peak pressure) was relatively insensitive to the hot leg entrainment/de-entrainment. This was verified through a sensitivity which varied the slip ratio in the hot leg.

2.9 RAI-3 – Steam Quenching

RAI: Describe the validation data which supports WC/T ability to model steam quenching and demonstrate that this data justifies WC/T ability to predict the RCS transient response for the M&E evaluation model. Both the steam quenching during reflood and post-reflood should be considered.

Comment: In table 4-1 row 18 of their initial submittal [1], Westinghouse stated ECCS evaluation model had been validated for steam quenching by comparison with experimental data. However, the ECCS evaluation model is focused on obtaining an adequate prediction of PCT. On the other hand, the M&E evaluation model is focused on obtaining an adequate prediction of the mass and energy release rates to obtain an adequate prediction of containment pressures and temperatures. Because the figure of merit between the two evaluation models is substantial different, what may be conservative or adequate in one evaluation model may be non-conservative or inadequate in the other. For example, the M&E release is generally decreased to generate a conservative PCT calculation. On the other hand, the M&E release rate is generally increased to generate a conservative containment pressure calculation.

2.10 RAI-3 – Equipment Qualification (EQ) and Net Positive Suction Head analysis (NPSHa)

RAI: Provide an explanation of the methodology for EQ and NPSHa analysis. With this methodology, define the acceptance criteria which are used, how those criteria are demonstrated to be met. Provide this explanation for each of the three containment types (large dry, sub-atmospheric, and ice-condenser). Additionally, address the relevant phases of each methodology, including the post-reflood phase and the decay heat phase. Also address the determination of the single active failure for both types of analyses.

Comment: In table 4-1 row 20 their initial submittal [1], Westinghouse stated that they would assume no steam-water mixing during the long-term containment pressure and temperature analysis for EQ and complete steam-water mixing for minimum NPSHa analysis. However, Westinghouse did not provide an explanation of the methodology for EQ or NPSHa analysis, what acceptance criteria were used, and how those criteria were demonstrated to be met.

2.11 RAI-3 – Long term boil-off

RAI: Describe how the steam-water mixing is calculated in this long-term boil off calculation.

Comment: In table 4-1 row 22 of their initial submittal [1], Westinghouse discussed the long-term phases of the event, but the definitions of each phase were not entirely clear. Additionally, some additional phases were discussed, but not defined. Also, further documentation was needed to clarify the differences between the event itself and how that event was simulated. During an audit at Westinghouse, the information requested above was discussed and the NRC staff believed the information helped to provide a clearer understanding of the event and how the event was simulated.

2.12 RAI-3 – Event definitions

RAI: Provide a table which contains the following:

1. The phase of the event (e.g., Blowdown, Refill, Reflood)
2. The conditions which define the beginning of that phase.
3. The conditions which define the end of that phase
4. An approximate duration of that phase (in seconds)
5. An approximate starting time of that phase (in seconds – with 0 being the event initiation)
6. A description of how the phase is simulated (e.g., mechanistically in WC/T, conservatively using certain approximations)

Additionally, provide a second table which contains a description of the energy sources which impact each of the phases listed in the above table:

1. List each major energy source. The sources of energy should include, but not be limited to: Initial stored energy in the fuel, primary water, water in the broken loop SG, water in the intact SGs, primary metal, metal in the broken loop SG, metal in the intact loop SGs, decay heat.
2. The approximate initial energy of that energy source at the beginning of the event (in kW).

3. The approximate amount of energy which is released during phase 1 (include both kW and %)
4. The approximate amount of energy which is released during phase 2 (include both kW and %)
5. The approximate amount of energy which is released during every other phase of the event (include both kW and %)

Comment: In their initial submittal [1], Westinghouse discussed the different phases of the event, but the definitions of each phase were not entirely clear. Additionally, some additional phases were discussed, but not defined. Also, further documentation was needed to clarify the differences between the event itself and how that event was simulated. During an audit at Westinghouse, the information requested above was discussed and the NRC staff believed the information helped to provide a clearer understanding of the event and how the event was simulated.

2.13 RAI-3 – Main feedwater

RAI: Provide an estimate of the additional energy which the inclusion of main feedwater flow would add to the secondary side of the steam generator and demonstrate that including this additional energy is negligible compared to the total energy already stored in the steam generator.

Comment: In table 4-2 row 9 of their submittal [1], Westinghouse discussed how the main feedwater flow would be ignored in the modeling of the event. Main feedwater flow is relatively hot and will increase the energy stored in the steam generators, which will also increase the mass and energy released to containment and could increase the peak containment pressure and temperature. Therefore, ANS 56.4 suggests that this flow should be considered during analysis. Westinghouse stated that they did not need to consider this flow for their analysis as the additional energy was negligible, but did not any quantitative analysis.

2.14 RAI-2 – Auxiliary feedwater

RAI: Clarify the modeling of the auxiliary feedwater and extraction steam. If both of these systems are being modeled in the M&E evaluation model, justify the modeling of both of these systems when the modeling of the main feedwater has been deemed negligible.

Comment: In table 4-2 row 10 of their submittal [1], Westinghouse discussed how the auxiliary feedwater flow would be modeled in the event. Auxiliary feedwater flow is relatively cool and will decrease the energy stored in the steam generators, as will extraction steam. In turn, this could decrease the calculated mass and energy released to containment which would decrease the calculated peak containment pressure and temperature. While modeling of these system can be appropriate, the NRC staff questioned the validity of modeling extraction steam and auxiliary feedwater (which would reduce the mass and energy released to containment) but ignoring main feedwater flow (which would increase the mass and energy released to containment).

2.15 RAI-3 – Steady state steam generator pressure

RAI: Justify the use of the steam generator pressure calculated from the steady state calculation. Is this initial pressure always greater than or equal to the initial measured pressure in the steam generator plus uncertainty? If not, provide justification for using a pressure below the steam generator pressure plus uncertainty.

Comment: In table 4-2 row 17 of their initial submittal [1], Westinghouse discussed how the steam generator pressure was calculated from the steady state calculation, but did not confirm that they will ensure this calculated value would be greater than or equal to the expected value plus uncertainty.

2.16 RAI-3 – Safety Injection (SI) water volume and temperature

RAI: Are measurement uncertainties considered for the values of the initial safety injection tank water volume and water temperature?

Comment: In table 4-2 row 21 of their initial submittal [1], Westinghouse stated that measurement uncertainties were considered in the modeling of the accumulator pressure, but did not state whether measurement uncertainties were considered in the model of the water volume and temperature in the accumulator.

2.17 RAI-3 – Nodalization

RAI: Provide justification which demonstrates that the nodalization used in WC/T results in appropriate predictions of the break flow and flow in the broken and intact loops such that the resulting predictions of mass and energy release will result in appropriate calculations of containment temperature and pressure. Additionally, provide a sensitivity study which demonstrates that the noding sensitivity in the steam generator.

Comment: In table 4-2 row 25 of their initial submittal [1], Westinghouse stated that the same nodalization was used for the ECCS evaluation model as was used in the M&E evaluation model. However, the in section 2.8 of their submittal, Westinghouse stated that the noding was increased to account for physical phenomena. However, there is no data which demonstrates that the solution is not sensitive to the noding chosen and a further increase in noding may be needed.

2.18 RAI-5 – Steam tables

RAI: Which steam tables are used in the M&E evaluation model? Are those steam tables consistent with the 1967 ASME Steam Tables?

Comment: In table 4-2 row 26 of their initial submittal [1], Westinghouse stated that the same steam tables were used for the ECCS evaluation model as was used in the M&E evaluation model. However, the ECCS evaluation model is focused on obtaining an adequate prediction of PCT. On the other hand, the M&E evaluation model is focused on obtaining an adequate prediction of the mass and energy release rates to obtain an adequate prediction of containment pressures and temperatures. Because the figure of merit between the two evaluation models is substantial different, what may be conservative or adequate in one evaluation model may be non-conservative or inadequate in the other. For example, the M&E release is generally decreased to generate a conservative PCT calculation. On the other hand, the M&E release rate is generally increased to generate a conservative containment pressure calculation.

2.19 RAI-3 – Flow modeling

RAI: Confirm that the following effects have been taken into account in the flow modeling used in the M&E evaluation model:

(1) temporal change of momentum,
(2) momentum convection,
(3) forces due to wall friction,
(4) forces due to fluid pressure,
(5) forces due to gravity, and
(6) forces due to geometric head loss effects (for example, contractions, expansions, bends, and pump losses).

Additionally confirm that the frictional losses in pipes and other components are calculated using models that include realistic variation of friction factor with Reynolds number, and realistic two-phase friction multipliers that have been adequately verified by comparison with experimental data.

Additionally confirm that if an uncertainty in a pressure loss exists, the pressure loss shall be conservatively minimized.

Comment: In table 4-2 row 27 of their initial submittal [1], Westinghouse stated that the same flow modeling was used for the ECCS evaluation model as was used in the M&E evaluation model. However, they did not provide details on that flow modeling.

2.20 RAI-3 – Cold leg/accumulator condensation

RAI: Describe the validation data which supports WC/T ability to model cold leg/accumulator condensation and demonstrate that this data justifies WC/T ability to predict the RCS transient response for the M&E evaluation model.

Comment: In section 2.9 of their initial submittal [1], Westinghouse stated that the same cold leg/accumulator condensation model was used for the ECCS evaluation model as were used in the M&E evaluation model. However, the ECCS evaluation model is focused on obtaining an adequate prediction of PCT. On the other hand, the M&E evaluation model is focused on obtaining an adequate prediction of the mass and energy release rates to obtain an adequate prediction of containment pressures and temperatures. Because the figure of merit between the two evaluation models is substantial different, what may be conservative or adequate in one evaluation model may be non-conservative or inadequate in the other. For example, the M&E release is generally decreased to generate a conservative PCT calculation. On the other hand, the M&E release rate is generally increased to generate a conservative containment pressure calculation.

2.21 RAI-3 – Downcomer condensation

RAI: Describe the validation data which supports WC/T ability to model downcomer condensation and demonstrate that this data justifies WC/T ability to predict the RCS transient response for the M&E evaluation model.

Comment: In section 2.10 of their initial submittal [1], Westinghouse stated that the same downcomer condensation model was used for the ECCS evaluation model as were used in the M&E evaluation model. However, the ECCS evaluation model is focused on obtaining an adequate prediction of PCT. On the other hand, the M&E evaluation model is focused on obtaining an adequate prediction of the mass and energy release rates to obtain an adequate prediction of containment pressures and temperatures. Because the figure of merit between the two evaluation models is substantial different, what may be conservative or adequate in one evaluation model may be non-conservative or inadequate in the other. For example, the M&E release is generally decreased to generate a conservative PCT calculation. On the other hand, the M&E release rate is generally increased to generate a conservative containment pressure calculation.

2.22 RAI-3 – Loop flow split

RAI: Describe the validation data which supports WC/T ability to model the loop flow split and demonstrate that this data justifies WC/T ability to predict the RCS transient response for the M&E evaluation model.

Comment: In section 2.13 of their initial submittal [1], Westinghouse stated that the same loop flow split modeling was used for the ECCS evaluation model as were used in the M&E evaluation model. However, the ECCS evaluation model is focused on obtaining an adequate prediction of PCT. On the other hand, the M&E evaluation model is focused on obtaining an adequate prediction of the mass and energy release rates to obtain an adequate prediction of containment pressures and temperatures. Because the figure of merit between the two evaluation models is substantial different, what may be conservative or adequate in one evaluation model may be non-conservative or inadequate in the other. For example, the M&E release is generally decreased to generate a conservative PCT calculation. On the other hand, the M&E release rate is generally increased to generate a conservative containment pressure calculation.

2.23 RAI-3 – Hot leg condensation in NPSHa and EQ

RAI: Demonstrate that the assumption to ignore any hot leg condensation is also appropriate for NPSHa and EQ analysis.

Comment: In section 2.6 of their initial submittal [1], Westinghouse stated that the hot leg condensation would be ignored as this was conservative for a contaminant pressure as it insured the maximum amount of steam to containment. However, Westinghouse did not address how this assumption would impact the other two purposes of an M&E analysis, NPSHa and EQ analysis.

2.24 RAI-3 – Dynamic pump model

RAI: Demonstrate that the dynamic pump model used in WC/T provides an appropriate prediction of the pump dynamics for the M&E evaluation model such that the mass and energy release is adequately predicted. Additionally, justify the rationale for assuming the rotor remains locked following the flow reversal during blowdown in a double ended pump suction break.

Comment: In table 4-2 row 28 of their initial submittal [1], Westinghouse stated that the same dynamic pump was used for the ECCS evaluation model as was used in the M&E evaluation model. However, the ECCS evaluation model is focused on obtaining an adequate prediction of PCT. On the other hand, the M&E evaluation model is focused on obtaining an adequate prediction of the mass and energy release rates to obtain an adequate prediction of containment pressures and temperatures. Because the figure of merit between the two evaluation models is substantial different, what may be conservative or adequate in one evaluation model may be non-conservative or inadequate in the other. For example, the M&E release is generally decreased to generate a conservative PCT calculation. On the other hand, the M&E release rate is generally increased to generate a conservative containment pressure calculation. Additionally, Westinghouse did not provide justification for the assumption of a locked rotor.

2.25 RAI-3 – GOTHIC time step sensitivity

RAI: Provide justification that WC/T mass and energy predictions are not sensitive to all possible time steps which are able to be used in GOTHIC in the M&E evaluation model. Additionally, demonstrate that the mass and energy are conserved between codes under all possible times steps and that no time step will result in numerical instabilities. Additionally, provide clarification on how the GOTHIC and WC/T time steps interface and when information is passed from code to code.

Comment: In sections 3.3 and 3.4 of their initial submittal [1], Westinghouse described the interface between WC/T and GOTHIC, but the NRC staff was not able to understand this description. Additionally, because of this coupling, there is a possibility that the mass and energy passed between WC/T and GOTHIC is not conserved and the NRC staff wanted to ensure this was not the case.

2.26 RAI-3 – WC/T coupled vs. standalone

RAI: Provide a comparison between results from a WC/T analysis which has been coupled to GOTHIC and a WC/T analysis which is run in standalone mode. Demonstrate that the results of the WC/T run in standalone mode are conservative compared to those coupled with GOTHIC.

Comment: In section 3.4 of their initial submittal [1], Westinghouse stated that using WC/T in standalone mode was conservative compared to the more mechanistic calculation of using it coupled to GOTHIC. However, Westinghouse did not provide any supporting analysis.

2.27 RAI-3 – Heat transfer correlations

RAI: Demonstrate that the heat transfer correlations used in WC/T provide an appropriate prediction of the heat transfer for the M&E evaluation model such that the mass and energy release is adequately predicted. Both the primary and secondary side heat transfer correlations should be considered.

Comment: In table 4-1 row 13 and 14 and table 4-2 row 33 of their initial submittal [1], Westinghouse stated that the same heat transfer correlations were used for the ECCS evaluation model as were used in the M&E evaluation model. However, the ECCS evaluation model is focused on obtaining an adequate prediction of PCT. On the other hand, the M&E evaluation model is focused on obtaining an adequate prediction of the mass and energy release rates to obtain an adequate prediction of containment pressures and temperatures. Because the figure of merit between the two evaluation models is substantial different, what may be conservative or adequate in one evaluation model may be non-conservative or inadequate in the other. For example, the M&E release is generally decreased to generate a conservative PCT calculation. On the other hand, the M&E release rate is generally increased to generate a conservative containment pressure calculation.

2.28 RAI-3 – Heat transfer directly to containment

RAI: Is heat transfer from the primary and secondary metal to containment directly calculated and if not why is this appropriate?

Comment: None

2.29 RAI-3 – Inactive metal

RAI: Define inactive metal and discuss how it is treated.

Comment: None.

2.30 RAI-3 – Unal's correlation

RAI: Provide validation for Unal's correlation over its application domain as used in the M&E evaluation model.

Comment: Unal's correlation is a highly empirical correlation fitted to a specific range of data. Therefore, validation is needed to justify the use of the correlation.

2.31 RAI-3 – Biasi Range

RAI: Demonstrate that the Biasi critical heat flux correlation will provide a conservative estimate of the critical heat flux (which in this case is used to determine the when rewet occurs) for the range over which the correlation is being applied.

Comment: In section 3.1.1 of their initial submittal [1], Westinghouse stated that the condition for rewet was going to be based on the critical heat flux calculated from the Biasi correlation. However, in the original paper for the Biasi correlation [2], the correlation's predictive capability was only validated over a small range of application domain due to the current state of computational resources. Therefore, the NRC staff questioned the correlation's predictive capability over its entire application domain.

2.32 RAI-2 – FLEACHT heat release rate

RAI: Provide plots of the integrated secondary heat release rate as a function of time for the FLEACHT-SEASET data and for the WC/T prediction (with the proposed interfacial heat transfer and steam generator heat transfer changes) for the seven FLECHT-SEASET cases described in the topical. Provide a discussion which demonstrates that WC/T with the proposed changes provides an adequate prediction of the FLECHT data.

Comment: In section 3.2 of their initial submittal [1], Westinghouse provided plots of the secondary heat release rate. However, those plots seemed to indicate that WC/T with the proposed modifications consistently under predicted the heat release from the steam generator. Under predicting the heat release would be non-conservative and may result in an inadequate prediction of the mass and energy release.

2.33 RAI-3 – Secondary side heat transfer

RAI: Specify how the heat is treated between the secondary side metal to the secondary side coolant, and from the secondary side coolant to the steam generator tubes.

Comment: In their initial submittal [1], Westinghouse did not specify have this heat transfer was treated.

2.34 RAI-6 – Definitions for acronyms

RAI: Provide the definition for the following acronyms: PCWG, DEPSG, EQ, NPSHa, DEHLG, GENF

Comment: None

2.35 RAI-4 – Clarification on quench front paragraph

RAI: The first full paragraph on page 3-5 does not make sense. Revise this paragraph and re-submit it.

Comment: None

REFERENCES

1. Ofstun, R.P., Espinosa, R., Logan, C.P., Genuske, M.E., and Lukas, R.B., "Westinghouse Containment Analysis Methodology – PWR LOCA Mass and Energy Release Calculation Methodology", WCAP-17721-P/NP, April 2013, (ADAMS Accession No. ML13133A065 / ML13133A064 (Non-Publicly Available / Publicly Available)).

2. Biasi, L., Clerici, G.C., Garribba, S., Sala, R., and Tozzi, A., (1967). "Studies on Burnout: Part 3 - A New Model for Round Ducts and Uniform Heating and Its Comparison with World Data", Energia Nucleare 14: 530-536