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Subject: AP1000 Responses to Requests for Additional Information (SRP15)

Westinghouse is submitting responses to the NRC request for additional information (RAI) on SRP Section 15. These RAI responses are submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in the responses is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Enclosure 1 provides the response for the following RAIs:

RAI-SRP15.6.5-SRSB-01
RAI-SRP15.6.5-SRSB-02
RAI-SRP15.6.5-SRSB-03
RAI-SRP15.6.5-SRSB-04
RAI-SRP15.6.5-SRSB-05
RAI-SRP15.6.5-SRSB-06
RAI-SRP15.6.5-SRSB-09
RAI-SRP15.6.5-SRSB-11
RAI-SRP15.6.5-SRSB-18

Questions or requests for additional information related to the content and preparation of this response should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

Robert Sisk, Manager
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/Enclosure

1. Responses to Requests for Additional Information on SRP Section 15

D063
NRO

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ENCLOSURE 1

Responses to Requests for Additional Information on SRP Section 15

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP15.6.5-SRSB-01
Revision: 0

Question:

10 CFR 50.46(a)(1)(i) specifies that ECCS cooling performance must be calculated in accordance with an acceptable evaluation model. The NRC safety evaluation report (SER) for WCAP-16009-P-A approved WCOBRA/TRAC version MOD7 Revision 6. A version identified as M7AR4_AP was modified to create version M7AR7_AP with the incorporation of the code modifications documented in APP-GW-GLE-026, "Application of ASTRUM Methodology for Best Estimate Large Break Loss of Coolant Accident Analysis for AP1000."

Provide a reference for the NRC approval of the M7AR4_AP version of WCOBRA/TRAC, and clarify the "2004 ASTRUM Evaluation Model," as identified in Appendix A of APP-GW-GLE-026, e.g., which code versions were used and when were they approved by the NRC. Also clarify the "2000 formulation", used for the AP600 SSAR analyses as identified on page 2-4 of WCAP-15664-P, Rev. 2, "AP1000 Code Applicability Report," with respect to its application to AP1000.

Westinghouse Response:

The '2000 formulation' of the WCOBRA/TRAC code referenced in WCAP-15644-P Revision 2 page 2-4 constitutes the code version approved in the AP600 SSAR analysis with the subsequent discretionary and non-discretionary changes reported to the NRC by Westinghouse, as presented in Appendix A of WCAP-15644-P Revision 2. This '2000 formulation' was used in the approved AP1000 DCD Revision 15 analysis. The text in APP-GW-GLE-026 was not intended to imply that the NRC staff had explicitly approved application of WCOBRA/TRAC M7AR4_AP for the AP1000.

Per WCAP-15644-P Revision 2 pg 2-4, Appendix A of the document provides the details of the code changes made in 1998, 1999 and 2000 after the AP600 analysis was performed. In the interest of completeness, Appendix A to APP-GW-GLE-026 similarly provides the reported evaluation model changes applicable to the AP1000 ASTRUM analysis since the AP600 analysis was approved. Therefore, Appendix A to APP-GW-GLE-026 presents applicable evaluation model changes reported for 1998 through 2007. As discussed in response to RAI-SRP 15.6.5-SRSB-02, the WCOBRA/TRAC and ASTRUM code versions used in the AP1000 ASTRUM analysis incorporated the non-discretionary changes presented in Appendix A to APP-GW-GLE-026.

The 2004 ASTRUM Evaluation Model consists of the codes approved by the NRC per the staff approval of WCAP-16009-P-A, with discretionary and non-discretionary changes as reported through the 10CFR50.46 reporting process. The NRC SER for WCAP-16009-P-A approved WCOBRA/TRAC MOD7A Revision 6 in 2004.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP15.6.5-SRSB-02
Revision: 0

Question:

10 CFR 50.46 specifies that each applicant for a standard design certification shall estimate the effect of any change to or error in an acceptable evaluation model to determine if the change or error is significant, and provide a report (annually or within 30 days depending on its significance) to NRC with a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with 10 CFR 50.46 requirements. Appendix A of APP-GW-GLE-026 indicates that the non-discretionary errors regarding the "Oxidation Thickness Index Error for Best Estimate WCOBRA/TRAC," and "Neutronics Calculation Moderator Density Weighting Factor Error," (10 CFR 50.46 letter LTR-NRC-02-10), will be corrected during the next revision of the Best Estimate WCOBRA/TRAC code.

Verify that WCOBRA/TRAC M7AR7_AP has been properly revised, and that the version used for AP1000 best-estimate large-break LOCA analyses has incorporated all non-discretionary changes described in Appendix A of APP-GW-GLE-026.

Westinghouse Response:

WCOBRA/TRAC M7AR7_AP was used for the AP1000 ASTRUM analysis; this version and the associated ASTRUM and HOTSPOT code versions used in the AP1000 ASTRUM analysis incorporate all non-discretionary changes described in Appendix A of APP-GW-GLE-026. The non-discretionary changes incorporated include the corrections for the 'Oxidation Thickness Index Error for Best Estimate WCOBRA/TRAC' and 'Neutronics Calculation Moderator Density Weighting Factor Error.'

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP15.6.5-SRSB-03
Revision: 0

Question:

The non-discretionary change "Revised Blowdown Heatup Uncertainty Distribution" described in Westinghouse's 10 CFR 50.46 Annual Notification and Reporting for 2004, LTR-NRC-05-20, April 11, 2005 (page 82 of APP-GW-GLE-026), describes a correction of modeling inconsistencies and input errors in the LOFT input decks that results in a change to WCOBRA/TRAC and HOTSPOT codes regarding a revised blowdown heatup heat transfer coefficient and a revised cumulative distribution function (CDF). The LTR-NRC-05-02 report indicated that the revised CDF was previously reported to NRC in Westinghouse letter LTR-NRC-04-11. The information provided in this letter was preliminary in nature.

Provide a detailed description on this error including the following information:

(a) Identify the input errors in the LOFT model and the process used to find these errors;

(b) Provide the results of the revised LOFT analyses along with the previous ORNL analyses results, in a tabular form for the predicted, the measured, and the predicted-to-measured ratio for the PCT for each case, and in a graphical form for the predicted-to-measured ratio for the PCT for each case.

(c) Describe the process, and results, used to evaluate the new data set to determine the heat transfer coefficients and modeling uncertainly distribution, as presented in Table 2 of APP-GW-GLE-026;

(d) Provide a plot of the cumulative distribution function (CDF) for the blowdown heatup heat transfer multiplier, similar to Figure 1-3 in WCAP-16009-P-A.

Westinghouse Response:

The input errors were determined when the LOFT model was updated to perform validation calculations with an updated version of WCOBRA/TRAC. The primary input error was the flag for fuel rod gap pressure calculation was set to the steady-state option during the transient calculation. With this flag, CHF calculation was skipped and the transition to film boiling was only due to depletion of liquid. This is the primary input error with impact to the blowdown heatup heat transfer multiplier distribution. Other modeling aspects of the accumulator and break noding were updated for consistency with the final, approved version of WCAP-12945-P-A, 1D/3D connection input was corrected, and errors in the choked flow flag applied to selected components were corrected.

The results of the revised LOFT analyses, the previous ORNL analyses, and the G-2 analyses are documented in a Westinghouse calculation note that is available for audit by the NRC Staff.

The methods approved in WCAP-12945 to generate the blowdown heatup heat transfer multipliers were followed to determine the revised distribution.

The revised cumulative distribution function (CDF) shown in LTR-NRC-04-11 was finalized as presented. The AP1000 ASTRUM analysis employed this revised CDF for the blowdown heatup heat transfer multipliers, consistent with an ASTRUM analysis of a standard Westinghouse pressurized water reactor.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP15.6.5-SRSB-04
Revision: 0

Question:

The discretionary change "Improved Automation of End of Blowdown Time" described in Westinghouse 10 CFR 50.46 letter LTR-NRC-06-8, (Page 88 of APP-GW-GLE-026) states that the automated end of blowdown is based on the time when the collapsed liquid level in the lower plenum reaches a minimum and begins to increase again. As observed in Figure 18 in APP-GW-GLE-026, the level oscillates around the time period of interest. On page 165 of APP-GW-GLE-026, it is stated that "The blowdown phase of the transient ends when the reactor coolant system pressure (initially assumed at 2250 psia) falls to a value approaching that of the containment atmosphere."

Describe the automated procedure used to determine the specific end of blowdown time, and clarify which definition is used for the AP1000 best-estimate large-break LOCA analyses.

Westinghouse Response:

The AP1000 best-estimate large-break LOCA ASTRUM analysis used the improved automated method to define the end of blowdown based on the time at which the collapsed liquid level in the lower plenum reaches a minimum and begins to increase again. The time at which the collapsed liquid level is at its absolute minimum is selected as end of blowdown time. In Figure 18 of APP-GW-GLE-026 this is at 35 seconds after break. For large double-ended guillotine breaks, similar results are obtained whether the end of blowdown is defined by reactor coolant system pressure criteria or at the time of minimum lower plenum collapsed liquid level. For smaller breaks sampled in ASTRUM analyses, the improved definition based on the lower plenum collapsed liquid level is more applicable than the historical pressure criterion. Therefore, in ASTRUM analyses a consistent definition of end of blowdown as the time at which the lower plenum collapsed liquid level is at its absolute minimum is applied for all runs.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP15.6.5-SRSB-05
Revision: 0

Question:

The AP1000 WCOBRA/TRAC loop model is described in Section C.4 of APP-GW-GLE-026, and shown in Figure C-3.

Describe components 301, 302 and 303 shown in Figure C-3. The text should identify these components and the fourth-stage ADS valves, for completeness. The core makeup tanks (CMT), accumulators and passive residual heat removal (PRHR) heat exchanger are noted on the figure, and should be referred to in the text.

Westinghouse Response:

Components 301, 302, and 303 shown in APP-GW-GLE-026 Figure C-3 are one-dimensional PIPE components which model the thimble tube bypass in the low power, support column/open hole, and guide tube assemblies, respectively. This modeling is in accordance with the approved modeling of thimble tube bypass in standard Westinghouse pressurized water reactors, (see, for example, WCAP-16009-P-A Section 12-2 and WCAP-12495 Volume 4 Revision 1 Section 20-2).

In APP-GW-GLE-026 Figure C-3 the fourth-stage ADS valves are modeled by VALVEs 199, 299, 159, and 259. The core makeup tanks (CMTs) are modeled by PIPE components 19 and 20. The accumulators are modeled by ACCUM components 17 and 18. The passive residual heat removal (PRHR) heat exchanger is modeled by STGEN component 27.

Westinghouse will revise APP-GW-GLE-026 to update this description.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP15.6.5-SRSB-06
Revision: 0

Question:

Technical report (TR) 29, APP-GW-GLN-012-NP, Revision 2, WCAP-16716-NP, Rev. 2, "AP1000 Reactor Internals Design Changes," describes the proposed AP1000 design changes regarding (1) a relocation of the radial support keys and tapered peripheral on the lower core support plate (LCSP); (2) the addition of flow skirt to the reactor pressure vessel (RPV) lower head; and (3) addition of neutron panels in the downcomer annulus.

Describe the procedure and modeling changes to the AP1000 RPV model to account for the change in the geometry in the LCSP region to reflect the spherical radius to the sloped change on the outer diameter of the LCSP and the location of the radial support keys. Include a discussion for the flow path(s) model (gap(s)), including the area, forward and reverse losses and inertia terms. Address the model acceptability since the radial support keys are skewed within the azimuthal sectors regions, that is not located on cell centers. Confirm that the steady-state flow and pressure drop for the region are consistent with the computational fluid dynamics (CFD) analysis.

Westinghouse Response:

The identified WCOBRA/TRAC VESSEL Channels are as shown in APP-GW-GLE-026 Figure C-1. In this response, the fluid volume, momentum area, and user-specified loss coefficients applied in modeling the lower plenum and downcomer Channels 2 through 8 are described, and the lateral flow area, gap length, and user-specified loss coefficients applied in modeling the azimuthal Gaps 1 through 6 are described. The inertia terms in the WCOBRA/TRAC momentum equations are discussed and the methodology for calibration of the steady state pressure drop in the reactor vessel is referenced.

The lower core support plate (LCSP) and the radial keys are modeled in the appropriate channels in Section 2 Cell 3 between 55.29 inches and 70.29 inches above the bottom inside of vessel. The total lower plenum fluid volume is correct.

The metal volume occupied by the LCSP is accounted for in Channel 8; the detailed change in the geometry of the LCSP from a spherical radius to the sloped change on the outer diameter of the LCSP is outside the resolution of the WCOBRA/TRAC model nodalization. The momentum area and loss coefficients in this cell of Channel 8 are adjusted to calibrate the steady state pressure drop. WCOBRA/TRAC does not have the capability for the user to specify separate forward and reverse loss coefficients.

The radial keys are modeled in the downcomer channels to reflect the physical location of the radial keys and the physical volumes represented by the downcomer channels. One radial key is modeled in each of the downcomer channel stacks connected to the DVI lines (Channels 2 and 5), and one half of a radial key is modeled in each of the downcomer channel stacks connected to a cold leg (Channels 3, 4, 6, and 7); this is reflected in the fluid volumes modeled in these channels and the vertical momentum areas calculated at the channel cell boundaries. The effect of the radial keys in the downcomer channels on the channel vertical momentum area and fluid volume are averaged across each downcomer channel, consistent with the modeling approach for standard plants and the resolution of the WCOBRA/TRAC model nodalization. No user-specified loss coefficients are applied, consistent with the modeling of radial keys in standard plant analyses. The azimuthal flow area at this elevation is modeled as the flow area away from the radial keys, consistent with the modeling approach for standard plants. The lengths of the azimuthal gaps between the downcomer channels are the center to center distances between the connected channels based on the arc length of each azimuthal sector modeled.

Inertial terms are adequately included in the WCOBRA/TRAC subchannel formulation of the momentum equation; vertical and transverse momentum fluxes are included as shown in WCAP-12945-P-A Revision 2 Section 2-2-4. Comparison of WCOBRA/TRAC prediction of core liquid level oscillations during reflood to full scale test data showed that the oscillation period predicted by WCOBRA/TRAC adequately agrees with the test data (Ohkawa and Frepoli). Inspection of APP-GW-GLE-026 Figure 20 shows that for the AP1000 the core collapsed liquid level oscillates with a period of between 3 and 4 seconds in the early stages of reflood between 60 seconds and 80 seconds after break; this is consistent with the period of oscillation WCOBRA/TRAC predicts for three-loop plants and as observed in CCTF 62 (Ohkawa and Frepoli).

The AP1000 ASTRUM analysis steady state calculation was demonstrated to meet the steady state acceptance criteria specified in WCAP-16009-P-A Table 12-6; the vessel pressure drop and the vessel inlet nozzle to mid-core pressure drop were benchmarked against hydraulic calculations to be within the acceptance criteria. These checks are sufficient for the purposes of best estimate large break LOCA analysis; therefore no further, detailed comparison of the WCOBRA/TRAC predicted pressure drop directly against CFD analysis predictions is performed.

Reference:

Ohkawa, K. and C. Frepoli, "Simulation of Faraday Waves in Downcomer Geometry of PWR with WCOBRA/TRAC." 11th International Conference of Nuclear Energy (ICONE 11), Tokyo Japan, April 20-23, 2003.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP15.6.5-SRSB-09
Revision: 0

Question:

Appendix C to APP-GW-GLE-26 describes the AP1000 WCOBRA/TRAC vessel and loop models.

(a) Describe the procedure and modeling changes to the AP1000 RPV model to account for the addition of neutron panels. Provide a description of the arc length for each azimuthal sector modeled. A review of WCAP-16009-P-A did not reveal any guidelines for selecting the number of azimuthal sectors based on relationships to the vessel cold leg nozzles, and the reference case in Section 12 did not provided any further insights. However, in previous models the cold leg nozzles were apparently centrally located within sectors. Include a discussion for the flow path(s) model (gap(s)), including the area, forward and reverse losses and inertia terms.

(b) Address the model acceptability since two of the neutron panels are located on gaps, between sectors, and address the potential impact on the assessment of local downcomer boiling.

(c) Provide the rationale and justification for not considering a revised nodalization scheme that would capture the full impact of the cumulative reactor internal changes by developing a model with eight sectors in the downcomer, each a 45° arc centered on each neutron panel and each cold leg nozzle. This would result in vessel connections to the downcomer region and internals being located at cell centers and a more understandable means for defining the gap characteristics. Alternatively, perform a study with eight sectors to justify the currently proposed model and describe the model inputs for the azimuthal sectors and gaps.

Westinghouse Response:

(a) The identified WCOBRA/TRAC VESSEL Channels are as shown in APP-GW-GLE-026 Figure C-1. See the response to RAI-SRP 15.6.5-SRSB-6 for discussion of the inertial terms in WCOBRA/TRAC; WCOBRA/TRAC does not have the capability for the user to specify separate forward and reverse loss coefficients.

The neutron pads are modeled in the Section 4 downcomer channels. The neutron pads are modeled in the downcomer channels to reflect the physical location of the neutron pads and the physical volumes represented by the downcomer channels as located in the vessel internals design. One neutron pad is modeled in each of the downcomer channel stacks connected to the DVI lines (Channels 17 and 20), and one half of a neutron pad is modeled in each of the downcomer channel stacks connected to the cold leg (Channels 18, 19, 21, and 22); this is reflected in the fluid volumes modeled in these channels and the vertical momentum areas calculated at the channel cell boundaries. In effect, the fraction of a neutron pad in each downcomer channel is averaged across the channel; the WCOBRA/TRAC code was not designed to reflect more detailed azimuthal modeling than that specified by the user through the nodalization and lateral gap connections. No user-specified loss coefficients are applied for axial flow, consistent with the modeling of neutron pads in standard plant analyses. The azimuthal flow areas are modeled as the flow area away from the neutron pads and the friction factor for azimuthal flow reflects flow between two walls, consistent with the modeling approach for standard plants. The metal mass of the neutron pads was modeled as unheated conductors in the appropriate channels.

In Westinghouse best-estimate large break LOCA analyses with WCOBRA/TRAC, the number of azimuthal sectors in the downcomer is historically defined based on the general plant type and is consistent with validation calculations supporting the application of WCOBRA/TRAC to best-estimate large break LOCA analysis. Two-loop and four-loop pressurized water reactor models have four downcomer channels (see WCAP-14449-P-A Revision 1 Appendix A and WCAP-12945-P-A Volume 4 Revision 1 Section 20-2); three-loop pressurized water reactor models have three downcomer channels (see WCAP-12945-P-A Volume 4 Revision 1 Section 20-4); the AP600 and AP1000 have six downcomer channels for the connections of four cold legs and two direct vessel injection lines (see WCAP-14171 Revision 2 and the validation calculations presented in APP-GW-GLE-026 Appendix B). In standard WCOBRA/TRAC VESSEL cells and loop component cells, fluid present in the cell is homogenous. The connections in WCOBRA/TRAC models between one-dimensional loop components and the three-dimensional vessel component do not have an azimuthal or vertical location within the connecting three-dimensional vessel Cell. The 1D/3D connection is effectively averaged across the azimuthal and vertical spans of the connecting vessel Cell; therefore it is not possible with the WCOBRA/TRAC code to spatially locate the cold leg nozzle connection within the connecting downcomer cell. Note that in a typical four-loop plant, the cold leg nozzles are not equally spaced around the reactor vessel, but the WCOBRA/TRAC model assumes four 90° downcomer channels, each with a 1D/3D connection to a cold leg. This is an acceptable modeling simplification; the downcomer nodalization is supported by WCOBRA/TRAC validation calculations.

(b) As discussed in response to part(a), the neutron pads are modeled as distributed in the downcomer channels to reflect the physical locations of the neutron pads and the physical fluid volumes represented by the downcomer channels as located in the vessel internals design. This is a reasonable and acceptable approach for capturing the effects of the neutron pads in the downcomer, including calculation of downcomer boiling, and is generally consistent with the modeling of neutron pads in standard two-loop, three-loop or four-loop Westinghouse pressurized water reactors.

The AP1000 is not significantly challenged by downcomer boiling during a large break LOCA. The addition of neutron pads does not change this characteristic of the plant, as discussed in response to RAI-TR29-SRSB-01 (transmitted in Westinghouse letter DCP/NRC2128).

(c) As discussed in response to part(a), the downcomer nodalization historically remains constant for a given plant type and is supported by the approved WCOBRA/TRAC validation. For example, a three-loop Westinghouse plant is modeled with three downcomer channels regardless of whether the plant has a thermal shield or neutron pads; the modeling of neutron pads is averaged across the downcomer channels. As discussed in response to part(a), the vessel connections through the downcomer and cold leg are effectively averaged azimuthally and vertically across the VESSEL component cell to which they are connected; there is no means in the WCOBRA/TRAC code to specify the vessel connection at the cell center, or near a cell edge. Therefore, there is no reason nor justification for revising the approved AP1000 downcomer nodalization due to the addition of neutron pads to the design.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP15.6.5-SRSB-11
Revision: 0

Question:

Section 6.5.3 of the response to RAI-TR29-SRSB-01 provides an assessment of the beneficial effect of flow skirt on blowdown de-entrainment, and states that no credit of this phenomenon is taken and so the BE LBLOCA analysis of DCD, Revision 15, is bounding.

Confirm that the potential benefit of de-entrainment on the flow skirt is not considered for AP1000 BE LBLOCA analyses.

Westinghouse Response:

The modeling of the flow skirt is discussed in response to RAI-SRP 15.6.5 – SRSB – 7. For the radial gaps that model flow through the flow skirt, the user-specified de-entrainment fraction is set to 0.0 in the AP1000 ASTRUM analysis. Therefore, no credit is taken for the effect of the flow skirt on blowdown de-entrainment.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP15.6.5-SRSB-18
Revision: 0

Question:

(a) In Revision 17 of DCD Section 15.6.5.4A, it is stated that "Results from the 124 calculations are ranked by PCT from highest to lowest. A similar procedure is repeated for maximum local oxidation (MLO) and core wide oxidation (CWO)."

Describe the procedure used to identify the hot assemble rod case used to establish the CWO limit. Identify the case.

(b) On page 20 of APP-GW-GLE-026 it is stated "a CWO calculation is not needed ...." In Revision 17 of DCD Section 15.6.5.4A.4 it is stated "Further, local and core-wide cladding oxidation values have been determined using the methodology approved in Reference 32 [WCAP-16009-P-A]."

The statement in the DCD section is misleading and should be revised to describe the actual method used.

Westinghouse Response:

Page 20 of APP-GW-GLE-026 states that 'a detailed CWO calculation is not needed ..." The procedure used to identify the limiting core wide oxidation (CWO) case is in accordance with the procedure used for standard ASTRUM analyses. The results of the 124 cases are ranked by the WCOBRA/TRAC-calculated hot assembly average volumetric oxidation from highest to lowest. The case with the maximum hot assembly average volumetric oxidation was examined. In the AP1000 ASTRUM analysis this case is run015 with hot assembly oxidation of 0.2%. As this oxidation is substantially lower than the CWO limit of 1%, a detailed calculation of the CWO as described in WCAP-16009-P-A Section 11-6-2 is not necessary for AP1000. By definition, the CWO fraction is less than the hot assembly average volumetric oxidation, because the many lower power assemblies present will have lower average volumetric oxidation than the hot assembly. Therefore, comparison of the hot assembly average volumetric fraction to the limit shows that the 10CFR50.46 criterion on global hydrogen generation is satisfied. This conservative approach is as presented in the sample plant calculation approved in WCAP-16009-P-A Section 12-7.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None