June 23, 2006

Mr. David H. Hinds, Manager, ESBWR
General Electric Company
P.O. Box 780, M/C L60
Wilmington, NC 28402-0780

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 31 RELATED TO ESBWR DESIGN CERTIFICATION APPLICATION

Dear Mr. Hinds:

By letter dated August 24, 2005, General Electric Company (GE) submitted an application for final design approval and standard design certification of the economic simplified boiling water reactor (ESBWR) standard plant design pursuant to 10 CFR Part 52. The Nuclear Regulatory Commission (NRC) staff is performing a detailed review of this application to enable the staff to reach a conclusion on the safety of the proposed design.

The NRC staff has identified that additional information is needed to continue portions of the review. The staff's request for additional information (RAI) is contained in the enclosures to this letter. Enclosure 1 includes Proprietary Information which is indicated by brackets and underlines. We have prepared a Non-Proprietary version of the RAI (Enclosure 2) that does not contain Proprietary Information.

This RAI concerns the TRACG application for ESBWR anticipated transient without scram (ATWS) analysis discussed in Chapter 21 of the ESBWR design control document and the Isolation Condenser test program as discussed in Chapter 14. Questions 21.6-4 through 35 and 21.6-37 through 52 were sent to you via electronic mail on April 4 and April 17, 2006, and were discussed with your staff during telecons on April 24 and April 27, 2006. Questions 14.2-3 and 21.5-1 regarding the testing program were sent to you via electronic mail on April 18, 2006, and were discussed with your staff during a telecon on May 10, 2006. You agreed to respond to this RAI on the following schedule:

June 30, 2006: 14.2-3, 21.5-1, 21.6-4 thru 7, 21.6-9 thru 33, 21.6-42, and 21.6-45 thru 49.
July 21, 2006: 21.6-8, 21.6-34, 21.6-35, 21.6-37 thru 41, 21.6-43, 21.6-44, and 21.6-50 thru 52.

If you have any questions or comments concerning this matter, you may contact me at (301) 415-4115 or mcb@nrc.gov or you may contact Lawrence Rossbach at (301) 415-2863 or lwr@nrc.gov.

Sincerely,

/RA/

Martha Barillas, Project Manager
ESBWR/ABWR Projects Branch
Division of New Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 52-010

Enclosures: 1. Request for Additional Information (Proprietary)
2. Request for Additional Information (Non-Proprietary)

cc: (with Non-Proprietary Enclosure 2 only)
See next page

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Request for Additional Information (RAI)
ESBWR Design Control Document (DCD) Chapter 14 and 21
ESBWR Testing Program

RAI Number	Reviewer	Question Summary	Full Text
14.2-3	Razzaque M	Perform power ascension test at high power level for the Isolation Condenser.	In GE letter to NRC dated September 20, 2005, "Summary of September 9, 2005 NRC/GE Conference Call on TRACG LOCA SER Confirmatory Items," GE action to address the SER Confirmatory Item # 6 was discussed. The specific concern was leakage in the ice condenser (IC) during testing at the PANTHER-IC facility, which is considered an IC structural integrity issue that needs to be resolved for the ESBWR design certification. GE stated in the letter that the O-ring design has been changed to a Helicoflex self energizing O-ring design that is more resilient to distortion. GE further stated that closing of the condensate return valve will be controlled to limit the gradients associated with shutdown and cooldown of the IC heat exchanger. However, in Table 14.2-1 of the DCD, "Power Ascension Test Matrix," it is indicated that IC performance test will be conducted at medium power (MP) level, but not at high power (HP) level. Since one of the objectives of the test should be to demonstrate IC structural integrity, the staff believes that IC performance test at HP will be better justified because the operating conditions at HP are expected to be more challenging to the structural integrity of IC. The staff, therefore, requests that the IC performance test be conducted at HP, rather than MP level.

21.5-1	Razzaque M	Clarify long term phenomena identification and ranking table (PIRT) ranking of the suppression pool equalization line and appropriate testing.	The NRC SER approving NEDE-33083P, *TRACG Application for ESBWR*, Confirmatory Item 1 stated that an appropriate long term cooling PIRT must be provided at the design certification stage. ESBWR DCD, Tier 2, Tables 6.3-7 through 10 indicate that the reactor pressure vessel (RPV) level will remain above Level 0.5 for the feedwater line break (FWLB), main steam line break (MSLB), gravity driven cooling system line break (GDLB), bottom drain line break (BDLB) and, therefore, the suppression pool equalizing line valves are not expected to open. GE submittal MFN 05-096, states that a long term PIRT will be provided. GE submittal MFN 05-105, provides a long term PIRT which lists the equalizing line (EQ) importance as "N/A". GE submittal MFN 05-109, indicates in Table 2, "Containment/LOCA long term PIRT," that the equalizing line (EQ1) friction is ranked "High". Clarify the importance of the equalizing line for long term cooling in the DCD and describe appropriate testing (i.e., qualification testing and inspection test analyses and acceptance criteria (ITAAC)).

RAI Number	Reviewer	Question Summary	Full Text
21.6-4	Landry R Klein V	Provide more detailed information about depressurization operations in the ATWS analysis.	On Page 3-2 you state that the ATWS EOPs may direct the operator to depressurize the reactor during an ATWS and that this is considered in the ESBWR ATWS analysis. Explain how depressurization operations are approached during an ATWS. Discuss how the phenomena are similar to or different from that resulting from a LOCA. Explain the approach taken to add depressurization phenomena to the PIRT for ATWS.
21.6-5	Landry R Klein V	State and justify the value used for the temperature of the injected boron solution.	On page 5-2 you compare the specific gravity of the injected boron solution to water at 18 ^{o}C. Is this what you assumed as the temperature of injected solution? If not, what temperature did you assume? Justify this temperature. How does this compare to Technical Specification (TS) values for the sodium pentaborate solution tank?
21.6-6	Landry R Klein V	Provide a sensitivity study for the density of the injected boron solution.	You state on page 5-2 that you assume that the density of the injected solution is approximately 40% higher than the bypass water. What is the sensitivity to the density of the injected solution? Define the allowed range of density differences before the assumptions carried out in the TRACG calculations are no longer valid in relation to Boron mixing and transport. Compare this to the allowed TS values for sodium pentaborate solution concentration and temperature.
21.6-7	Landry R Klein V	Provide detailed justification as to how neglecting the Coanda effect is conservative.	On page 5-2 you state that the Coanda effect is neglected. It is not clear to the staff how neglecting this phenomenon is conservative. Since the Coanda effect would result in a greater degree of azimuthal solution flow, it may take longer for the borated solution to settle to the bottom of the bypass region for two reasons: (1) the fluid is traveling azimuthally and is not interacting with the channel box to form a plume, and (2) the fluid is interacting with a larger portion of the bypass and may heat up as a result, such that the temperature difference between the fluids is smaller. Provide detailed justification as to how neglecting the Coanda effect is conservative.

21.6-8	Landry R Klein V Spore J, ISL	Justify the azimuthal vessel noding of the SLCS injection in the TRACG model.	You state on page 5-8 (there is a similar statement on page 5-2) that [[ ]] Which azimuthal sectors is the SLCS injecting into? Explain how the azimuthal noding is conservative even though the smallest node it could inject into is much larger than 1m. Even with radial and azimuthal flow blocked off in the TRACG model, the TRACG calculated dilution rate will depend upon these theta sector node sizes.
21.6-9	Landry R Klein V	Explain and provide sensitivity studies on how the amount of boron escaping through the guide tubes is calculated.	On page 5-2, you state that "some of the solution could sink into the guide tubes and be lost from the viewpoint of achieving shutdown of the nuclear fission reaction of the core." How is the fraction of solution that leaks into the guide tubes determined? If solution is removed from the active region via this process, how is it accounted for? What is the lost fraction dependent on (i.e., CRD purge flow rate)? Provide sensitivity analyses that confirm that the lost fraction down the guide tubes is, in fact, very small.
21.6-10	Landry R Klein V	Explain the implications of having a difference between the estimated and actual distances between the fuel channel box and jet nozzle.	On page 5-3, using Figure 5.1-1, you state that the distance from the jet inlet nozzle to the fuel channel box is estimated based on concentric circles. Has this distance been explicitly calculated based on the core orientation relative to the inlet nozzles? What is the difference between the estimate and the exact values? How does this difference affect the calculated jet parameters?

21.6-11	Landry R Klein V	Explain the measures taken to account for the lack of a density difference in the equations used to calculate the circular turbulent jet characteristics.	While density differences is what drives the downward flow of the borated solution, you state on page 5-3 that the "density difference corresponding to the different temperature is not accounted for in the mass and momentum balances [for the equations describing the circular turbulent jet characteristics, and] Hence, this solution must be considered approximate when there are large differences between the injected and ambient densities." At what value in density difference does this solution become approximate? Compare this with the assumed density differences between the injected solution and the ambient liquid. If the density difference is great enough that the solution is considered "approximate," what uncertainties are added to maintain a conservative solution? Provide clarifying information on what is meant by: "Accordingly, we use only the expression for the entrained volume of ambient liquid, but calculate the temperatures and densities using mass and energy balances."
21.6-12	Landry R Klein V	Justify values for SLCS injection verses time velocity table.	The staff understands that the SLCS injection velocity is fixed by a time dependent FILL component in the TRACG model. Justify the velocity selected for this table. How is the velocity adjusted when the reactor pressure is lower than the SRV set point?
21.6-13	Landry R Klein V	Explain discrepancies between two different values for initial jet velocities.	On page 5-4 you use a value of 34.2 m/s for the jet initial velocity (Uo) however on page 8-1 you state the "average velocity at the flow nozzles that inject the solution into the bypass region is 30.5 m/s during the first half of the injection." Why are these two values different? What is the sensitivity to jet initial velocity to your calculated jet properties? What is the sensitivity to jet initial velocity on your TRACG calculations?
21.6-14	Landry R Klein V	What's the uncertainty on the value calculated to determine the distance along the jet to retain jet-like behavior?	On page 5-4 you calculate the distance along the jet should be less than 1.14m for the jet to retain jet-like behavior. Since you estimate the distance along the jet centerline from the shroud wall to the channel boundary is 0.5m (something less than 1.14m) you assume that the jet retains jet-like behavior. Is this true? What is the uncertainty for the calculation of the 1.14m value?
21.6-15	Landry R Klein V	Has uncertainty due to droop been added to the calculated length of the jet?	On page 5-4 you state that "because the jet fluid is also heavier than the surrounding fluid, the jet will likely droop, resulting in longer distance between the discharge and the channel boundary." Has the uncertainty due to this droop been added to the calculated length of the jet?

21.6-16	Landry R Klein V	Explain how the "well-mixed region" is calculated.	On page 5-4 you calculate the properties of the "well-mixed region" by "averaging the jet conditions at the channel boundary." Explain how this is done. Which conditions are averaged? Define the variables, include definitions for: Mo, Qo, ho, Minduced, Mtotal, Qch.
21.6-17	Landry R Klein V	What is the uncertainty on the calculated average temperature deficit and what is this value used for?	You calculate the average temperature deficit as 13°C on page 5-4. What is the range of this value given all of the uncertainties in the input parameters used to calculate it? It appears as though this value is used to determine that the plume will have negative buoyancy. Is this true? At what value of the temperature deficit will the plume no longer have negative buoyancy?
21.6-18	Landry R Klein V	Justify the applicability of the equation you use to determine if the jet will retain jet-like behavior.	On page 5-4 you use the following relationship to determine if the jet will retain jet-like behavior or behave like a buoyant plume: $X_j < \Pi_o^{3/4} / B^{1/2}$ From reviewing your Reference 36, R.D. Blevins, *Applied Fluid Dynamics Handbook,* the origin of this equation is not clear. Please explain its origin, along with justifying its applicability to ESBWR ATWS conditions (i.e. jet in cross-flow, negatively buoyant jet, etc.)
21.6-19	Landry R Klein V	Justify using test data for counter current gas-liquid flow on co-current liquid-liquid flow.	On page 5-5 you state that "Tests have been performed in large downcomers with upward flow of a light species (gas) and downward flow of liquid. Downward liquid penetration was shut off when the square root of the gas Froude number is of the order of 0.14. If we assume a similar critical Froude number for the situation of liquid/liquid countercurrent flow..." Justify the assumption that the test data is valid for this situation.
21.6-20	Landry R Klein V	Explain the discrepancy in the equation used to calculate specific buoyancy flux with that from your reference.	On page 5-5 you define a value, B, for specific buoyancy flux. You define this as: $Q_{ch} g(\rho_{ave} - \rho_{bypass}) / \rho_{bypass}$ This is similarly defined in equation 9-50 in your Reference 36, R.D. Blevins, *Applied Fluid Dynamics Handbook as:* $Q_o g(\rho_a - \rho_o) / \rho_a$ Please explain the discrepancy. How does the length at which the plume has not spread change if you use ρ_{ave} in the denominator when calculating B? Address this issue for determining the length jet-like behavior will persist for the leakage into the nosepiece calculation on page 5-7.

21.6-21	Landry R Klein V	Justify the applicability of the equation you used to calculate the length at which the plume does not spread.	You use the following equation on page 5-5 to calculate the length at which the plume has not spread $X_j = \Pi^{3/4} / B^{1/2}$ From reviewing your Reference 36, R.D. Blevins, *Applied Fluid Dynamics Handbook,* the origin of this equation is not clear. Please explain its origin, along with justifying its applicability to ESBWR ATWS conditions. Are you using this to calculate the length of the non-spreading plume after it has impinged on the channel wall? Is this equation applicable for those conditions?
21.6-22	Landry R Klein V	Explain how the value calculated for the distance at which the plumes would not spread is used and is conservative.	On page 5-5 you calculate the distance at which the plumes would not spread. You calculate this distance to be 1.08 m, this is a sizeable fraction of the total core height (~ 3m). How is this value used in the TRACG calculations? Assuming the plumes do not spread for this distance appears to be non-conservative as a greater degree of spreading of the plume will slow the transport of boron to the lower core plate as well as further reduce the temperature deficit. Please provide justification that this value is being used in a conservative manor.
21.6-23	Landry R Klein V	Justify the assumption that the plumes do not interact with each other and explain how the assumption is implemented in the TRACG model.	On page 5-6 you state that "if the plumes from the four different elevations are assumed not to interact with each other, the volumetric flow rates in the plumes when they reach the bottom of the bypass can be calculated from the above table." The above table then references equations for "circular plume characteristics." This is contradictory to a statement on 5-2 where you state "the plumes sinking from the top injection point will interact with those directly below." Justify the assumption that the plumes do not interact with each other. Provide details explaining the conservative or non-conservative nature of this assumption.
21.6-24	Landry R Klein V	Why is the volumetric flow highest for the top plume?	On page 5-6 you calculate the volume flow rate for the four plumes. Why is the volumetric flow rate highest for the top plume?

21.6-25	Landry R Klein V	Explain how the equations on page 5-6 are applicable to ESBWR.	It appears as though the equations you used on page 5-6 from Reference 36, R.D. Blevins, *Applied Fluid Dynamics Handbook* from Table 9-7, p. 250 were developed for a vertical buoyant plume. Please explain how this is applicable for the ESBWR ATWS conditions in which the plumes form after the jet impinges on the channel wall and travels downward.
21.6-26	Landry R Klein V	Why do you calculate values for the average of the plumes if you assume they do not interact with each other?	On page 5-6 you make the assumption that the plumes do not interact however you average them and calculate an "average temperature deficit" to determine if the borated solution will spread at the bottom of the bypass. Explain this discrepancy. Explain in more detail how the calculated density difference determines if the borated solution will spread peripherally and radially. How does this change if you do not average the plumes?
21.6-27	Landry R Klein V	Provide further explanation of how the critical velocity at which no boron will settle into the guide tubes was determined.	On page 5-7 you evaluate the critical velocity that should prevent settling of boron into the guide tubes. You assume a temperature deficit of 10^{o}C. Justify this assumption. What is the CRD purge flow velocity? How is this taken into consideration in your calculation? What is the actual velocity at the top of the guide tubes and how is that determined?
21.6-28	Landry R Klein V	What is done to account for non-conservatism in TRACG related to the boron settling at low velocity?	On page 5-7 you state that "In a range of velocities between zero and a critical upward velocity, boron could settle downwards due to the density difference between the borated solution and the ambient liquid in the inlet region. TRACG would not calculate this settling behavior and would therefore be non-conservative in this range of velocities." You then calculate the velocity at which this would occur and on page 5-8 you state that [[ ]] Explain exactly what adjustment will be made? What is the uncertainty on your calculated critical velocity ([[ ]])?
21.6-29	Landry R Klein V	Provide a diagram of the lower tieplate, the nosepiece and the lower plenum.	Provide a diagram of the lower tieplate, the nose piece and the lower plenum to better illustrate the discussion on page 5-7 about settling of boron into the lower plenum from the channel inlet nosepieces. Show the boron flow paths.

21.6-30	Landry R Klein V	Justify the assumption that the flow will be jet-like in the leakage paths into the nosepiece.	On page 5-7 when discussing the leakage flow entering the channel inlet region you make reference to jet-like behavior and use the equation: $$X_j = \Pi^{3/4} / B^{1/2}$$ to determine the length jet-like behavior will persist. Please clarify exactly where this jet-like behavior will occur and justify the assumption that it will indeed be jet-like. Justify the use of the equation above given the conditions in the ESBWR leakage into the nosepiece.
21.6-31	Landry R Klein V	Justify the use of the equation for circular jets used to calculate the volumetric flow rate for the leakage into the nosepiece.	On page 5-7 you calculate the volumetric flow rate, Q, using the equation: $Q = 16(x / r_0)Q_0$ You state that this formula is for circular jets from "Section 3 above." Please clarify the origin of this equation, it is not clear to the staff where "Section 3 above" is. In addition, justify the use of this equation by justifying that the conditions in which it was derived are similar to those in which it is applied.
21.6-32	Landry R Klein V	What is the uncertainty of the velocity calculated at the inlet to the fuel bundle at which settling of boron into the lower plenum will be prevented?	On page 5-7 you calculate that velocities on the order of 7 cm/s at the inlet to the fuel bundle should prevent any settling of boron into the lower plenum. This calculated value is based upon many different input parameters. Please evaluate the uncertainty of this value based upon the approximate values used for the lower tie plate opening as well as the pressure drop / hydraulic diameter of the nosepiece. What is the sensitivity to the assumptions about the geometry and flow characteristics at the interface between the bypass and the fuel support piece?
21.6-33	Landry R Klein V	Demonstrate that the axial variation in bypass temperature is not significant.	On page 5-8 you assume the entrained by-pass liquid will have the same temperature as that in Level 7 in the TRACG model (which is above the SLCS injection point). Provide a plot showing the temperatures in Levels 4, 5, 6 and 7 just prior to the SLCS injection to demonstrate that the axial variation in temperature is not significant. Provide further justification that this value would remain constant until shutdown by boron as the calculated velocity that prevents settling into the lower plenum is based upon a very small temperature difference (2.3°C). Discuss how certain effects such as a reduction in direct moderator heating following the decrease in reactor power from boron mixing, or direct moderator heating of the poison solution impact this result.

21.6-34	Landry R Klein V	Provide further justification that B10 cross-sections are not sensitive to void history and exposure.	On page 5-15 you state that as a result of evaluations using TGBLA06, "B10 cross-sections were not sensitive to the void history and that the TRACG modeling error had a weak dependence on the exposure, boron concentration and fuel temperature." Please provide more detailed information about this evaluation as the staff believes that the boron cross section would likely be sensitive to void history and exposure since it is likely at high voids that plutonium buildup will have a substantial impact on the void coefficient.
21.6-35	Landry R Klein V	Further justify why the change in neutron spectrum with voids is not captured.	On page 5-15 you state that "The lattice calculations do not capture the effect of change in neutron spectrum with voids." The staff believes that the spectral change as a result of the addition of boron will have an impact on the void coefficient. It will also have an impact on boron energy self shielding. Provide further justification as to why the spectral change was not considered. Additionally, explain why the cross section is modeled as 1/v as opposed to using TGBLA to calculate lattice parameters for various boron concentrations directly for use within the PANACEA Wrap up file.
21.6-37	Landry R Klein V	Further explain a statement about the subcooled flow regime being insensitive to heat transfer coefficients.	On page 5-23 you state that "the void fraction in the subcooled flow regime is quite insensitive to the magnitude of the heat transfer coefficients at the interface between the bubbles and the subcooled liquid, as long as a reasonable value is used." Does this statement mean that over a range of coefficients the void fraction is insensitive? What is the process for determining a reasonable coefficient?
21.6-38	Landry R Klein V	Explain the basis for how the pellet conductivity was increased to account for the uncertainty in dynamic gap conductance.	On page 5-25 you state [[ ]] Please explain how the uncertainties were combined and how the value of [[ ]] was selected. Comment on the range of applicability, is the approach conservative for all times in core life?
21.6-39	Landry R Klein V	Discuss the mitigation capability of this SLCS injection location during non-isolation ATWS events.	The staff understands that the SLCS injection point (into the bypass) was selected based upon the projected natural circulation patterns during an isolation ATWS. Discuss the mitigation capability of this injection location during non-isolation ATWS events.

21.6-40	Landry R Klein V Spore J, ISL	Provide a nodalization diagram of the TRACG SLCS modeling.	Provide a nodalization diagram of the TRACG SLCS modeling. What component is used to model the SLCS? Specifically show how and where (which cells, axially and azimuthally) the SLCS nozzles are connected to the vessel. With the six theta sector TRACG VESSEL model, the user must decide which theta sectors to locate the boron injection. Describe the procedures for selecting these cells. How sensitive is the calculation to the selection of cells where the SLCS injects?
21.6-41	Landry R Klein V	Provide information justifying that the uniform boron concentration within the TRACG nodes is conservative.	When SLCS injects boron into the outer ring of the TRACG model, a uniform boron concentration is smeared throughout the entire fluid volume. Provide additional information justifying how this is conservative.
21.6-42	Landry R Klein V	Provide plots showing the path of boron flow through the bypass, lower plenum and core as calculated by TRACG	Provide plots showing the path of boron flow through the bypass, lower plenum and core as calculated by TRACG from the time of SLCS injection. Provide boron concentrations and flow rates.
21.6-43	Landry R Klein V	What is the value of the boron reactivity coefficients?	On page 9.2-2 of NEDE-32176P Revision 2 “TRACG Model Description” Equation 9.2-5 has a Δk/k factor that includes “boron reactivity coefficients.” What is the value of these coefficients? Explain the basis for determining these coefficients.
21.6-44	Landry R Klein V	Explain how injection points from qualification data would bound SLCS injection for ESBWR.	Pg. 5.4-2 of your Reference 15, NEDC-32725P Revision 1 “TRACG Qualification for SBWR Vol. 1 and 2,” states that “The test model provided for boron injection at one of three locations: HPCS sparger, Jet Pump Injection (JPI) lines in 16 of 20 jet pumps or SLCS injection line in the lower plenum.” Explain how these injection points would bound SLCS injection for ESBWR which injects into the lower half of the core bypass. Explain how the analysis you describe in terms of scaling, mixing coefficients, etc. applies to ESBWR.

21.6-45	Landry R Klein V	Provide details on the methodology you used to investigate instability during ESBWR ATWS event.	On page 8-34 you describe the ATWS Stability Study. Please provide information about the methodology you used to perform this study. How is this different from your topical report that describes the methodology for calculating stability margins for ESBWR using TRACG (NEDE-33083P Supplement 1)?
21.6-46	Landry R Klein V	Justify the choice of MSIVC as the limiting event for ATWS instability analysis for ESBWR.	On page 8-34 you use the MSIVC model to determine if there are any power instabilities set in during the ATWS transient. Justify the use of this model. Explain why this is the bounding event for ATWS instability analysis.
21.6-47	Spore J, ISL	What is the impact of reducing the boron concentration in the SLCS flow by 10%?	One of the sensitivity calculations was a 10% reduction in the velocity of the SLCS flow velocity at the nozzle. This has [[ ]] for an ATWS event. A better way to simulate the loss of boron by settling into the lower plenum and guide tubes would be to reduce the boron concentration by 10%. What is the impact of reducing the boron concentration in the SLCS flow by 10%?
21.6-48	Spore J, ISL	How does TRACG handle the boron concentration when the concentration level reaches the saturation value?	How does TRACG handle the boron concentration when the concentration level reaches the saturation value? Does TRACG precipitate as solid particles enough of the boron salts to maintain the boron concentration at or below the saturation value? What saturation curve does TRACG use for the boron salts?
21.6-49	Spore J, ISL	Please provide justification for the uncertainty associated with the film boiling (dispersed flow) heat transfer coefficient.	Page 5-30. C15 Film Boiling (Dispersed Flow) - It should be a droplet diameter based on a critical Weber number to calculate the vapor-side interfacial heat transfer in the dispersed flow regime. Typically, film boiling dispersed flow regime is through a steam boundary layer next to the dry hot walls into a flow of dispersed droplets. So there should be no bubbles present in Film Boiling (Dispersed Flow). Since the heat transfer from the hot dry wall to the steam is across a single-phase steam boundary layer, it has some similarities to Dittus-Boelter type single-phase heat transfer. However, the presence of the dispersed droplet flow tends to effect thermal boundary layer at the hot dry walls, so it's not clear why this film boiling heat transfer would have the same uncertainty as Dittus-Boelter. In general, it would seem that film boiling heat transfer would have a higher uncertainty than Dittus-Boelter. Please provide justification for the uncertainty associated with the film boiling (dispersed flow) heat transfer coefficient.

21.6-50	Spore J, ISL	Provide additional information on the uncertainty for the Interfacial Shear.	Regarding your uncertainty analysis for Interfacial Shear on page 5-18, explain how the uncertainty in Co and entrainment fraction captures all of the uncertainty in interfacial shear? If you considered data from another facility at another set of pressures and flow rates that haven't been tested, would you find that some other parameter needs to be varied to capture the interfacial shear uncertainty for FRIGG, Toshiba, and some third test facility? Provide a plot of actual void fraction data from the Toshiba data rather than just the mean deviations. Does the Toshiba data include more annular mist flow regime void fractions than the FRIGG test facility? Toshiba data is referenced at 5 bar and 10 bar. Is there any void fraction data at 1 bar? Is the uncertainty in entrainment fraction also applied in the chimney region?
21.6-51	Landry R Klein V	Evaluate the stability of the LOFWH and LOFW events with no scram.	On page 8-37 of NEDE-33083P, Supplement 1 "TRACG Application for ESBWR Stability Analysis" you describe your method for evaluating the decay ratio for an anticipated operational occurrence (AOO). You identified two AOOs which result in (1) increased power, Loss of Feedwater Heater (LOFWH), and (2) lower flow, Loss of Feedwater Flow (LOFW). For the LOFWH event you performed a stability analysis at the pre-scram power condition, for the LOFW event, you performed a stability analysis at a level at which a scram would occur. Evaluate the stability for these two AOOs at the conditions which would arise in the event that there were no scram signal, i.e. raise the power and lower the level beyond which the reactor would scram. Justify the power and level used in your analyses.
21.6-52	Landry R Klein V	Have you corrected the error in the quantification of the accuracy of the void coefficient for ESBWR TRACG methodologies and analyses?	On February 14, 2006, you submitted Revision 2 of NEDE-32906P, "TRACG Application for Anticipated Operational Occurrences (AOO) Transient Analyses." In this submittal you correct an error in the quantification of the accuracy of the void coefficient. Explain if this is also being corrected for the ESBWR TRACG methodologies described in NEDE-33083P "Chapter 4, Transient Analysis," NEDE-33083P Supplement 1 "TRACG Application for ESBWR Stability Analysis," and NEDE-33083P Supplement 2, "TRACG Application for ESBWR Anticipated Transient Without Scram Analyses." If this is not being corrected for the ESBWR TRACG methodologies, explain what measures are being taken to ensure that the accuracy of the void coefficient is conservative. How does this error impact the result of the analyses performed using these methodologies? Have you updated the analyses in Chapter 15 and Chapter 4 of the DCD to account for this error?