Location	Comment	NRC Resolution
Generic	The SE uses the terminology AOOs and ATWS overpressure. Please make sure that it is clear that the NRC approval includes the American Society of Mechanical Engineers (ASME) overpressure event (MSIV closure with flux scram), which is a variation of an AOO with an additional failure and is clearly within the scope of applicability of the methodology.	Comment accepted. <u>Staff comment:</u> The ASME overpressure transient evaluation is much akin to pressurization AOO evaluations. The ASME overpressure event is a variation of an AOO with an additional failure of the MSIV position SCRAM and conservative input assumptions. Therefore, the staff finds that its conclusions regarding the acceptability of TRACG04 for AOOs and ATWS overpressure clearly form a valid basis for the staff acceptance of the use of TRACG04 for ASME overpressure calculations. <u>SE Revisions:</u> Section 1.1 “Similarly the NRC staff review is limited to the application of the methodology to AOO and ATWS overpressure transient analyses” Revised as: “Similarly the NRC staff review is limited to the application of the methodology to AOO and, American Society of Mechanical Engineers (ASME) overpressure, and ATWS overpressure transient analyses”

ATTACHMENT

		Section 2 “GEH uses the TRACG code to calculate the peak vessel pressure to ensure vessel integrity during ATWS pressurization events” Revised as: “GEH uses the TRACG code to calculate the peak vessel pressure to ensure vessel integrity during ASME and ATWS overpressure events” Section 5 Added following paragraph at beginning of Section 5: “On the basis of its review the staff has found that the TRACG04 methodology is acceptable for use in licensing evaluations of AOOs, ASME overpressure events, and ATWS overpressure events.” Appendix E Add to acronym list: ASME – American Society of Mechanical Engineers
Section 3.3.1.3, Lines 31-34	Suggest simplifying complex sentence. “TRACG04 in transient mode will calculate the transient fuel temperature, but the Doppler coefficient is based on the PANAC11-predicted Doppler response to temperature, which is based on the PANAC11-predicted steady-state temperature.” to	Comment partially accepted. Section revised as: The Doppler response is based on the transient fuel temperature from TRACG04 and the reactivity coefficients developed from PANAC11. The PANAC11 reactivity coefficients are calculated at the PANAC11-predicted steady-state temperature.

	The Doppler response is based on the transient fuel temperature from TRACG04 using the coefficients developed from PANAC11.	
Section 3.3.1.5 Line 28	"The infinite eigenvalue used for………" Should be The infinite lattice eigenvalue used for………	Comment incorporated.
Section 3.4.1.1 Lines 29-32	May want to clarify. "For power calculations for AOOs, the contribution from the decay heat is conservatively increased, therefore, increasing the integrated thermal energy deposited into the reactor coolant system (RCS) for AOO evaluations terminated by a SCRAM." The use of the May Witt accomplishes this, but there is no standard adjustment that does this.	Comment not applicable in final SE. Sentence has been deleted.
Section 3.4.1.6 Lines 20 - 21	The heat from metal-water reaction is included in the energy balance for the core. It is not include in the edit for the total power, which is limited to fission and decay heat power. The edit of energy generation from metal-water reaction is included for each channel component.	Comment accepted. First sentence revised as: The heat produced as a result of water-zirconium reactions in the core during transients is not included in the power edit. It is treated separately for each channel component.
Section 3.4.1.7 Footnote 2	The energy release by fission is calculated by TGBLA when the kinetics solver is activated. TRACG alternatively uses NEDO-23739 values for the energy released per fission when the kinetics solver is disabled (see response to RAI 22). The 4 parent chains are always determined from NEDO-23739.	Comment incorporated. Section revised as: TRACG uses NEDO-23739 values for the energy released per fission (see response to RAI 22)
Section 3.7.4 Line 8	Typo Berenson	Comment incorporated.
Section 3.9.1 Lines 20-22	Potentially Confusing. The models for flow regime transitions in TRACG02 had only been qualified at high pressure. GEH	Comment accepted. First sentence has been deleted.

	qualified TRACG against low pressure data to extend the applicability of TRACG to LOCA applications. The TRACG qualification report NEDE-32177 includes high and low pressure simulations.	
Section 3.10.5.1 Lines 8-10	The dynamic gas gap conductance inputs for both TRACG02 and TRACG04 are based on upstream GESTR-M calculations. Suggest also mentioning PRIME, as we will be transitioning to PRIME inputs.	Comment accepted. Section revised to include a footnote at end of sentence. GESTR-M is used for this purpose currently. It is the understanding of the NRC staff that if PRIME is approved that the PRIME method will be used for this purpose.
Section 3.10.5.2 Pg 40 Lines 8-11	According to Reference 22, [ ] Ref 22, pg. 1-44 says that the correlation parameters consider this, but not that PANAC11 solves it. P11 correlates the fuel temperature to the nodal power	Comment accepted. Section revised as: According to Reference 22, [ ]
Section 3.10.5.2 Pg 40 Lines 25-34	The NRC staff found that the new fuel conductivity model in TRACG04 predicts lower fuel thermal conductivities with increasing fuel exposure and agrees to a large extent with the FRAPCON3 model in terms of variation with temperature and exposure. However, the NRC staff finds that the improved model appears to misrepresent the impact of gadolinia on fuel thermal conductivity at high exposure. The NRC staff cannot conclude that the improved thermal conductivity model represents a best estimate of the fuel thermal conductivity over the full range of gadolinia loadings and exposures.	Comment accepted. "However, the NRC staff finds that the improved model appears to misrepresent the impact of gadolinia on fuel thermal conductivity at high exposure. The NRC staff cannot conclude that the improved thermal conductivity model represents a best estimate of the fuel thermal conductivity over the full range of gadolinia loadings and exposures." Replaced with:

	These conclusions from the PRIME review may reflect preliminary conclusions given that the PRIME review is not completed. This seems like evaluation verbiage that would be better placed in the PRIME SE. Especially with the PRIME review not yet complete. Other limitations and conditions direct us to use PRIME when it is approved.	"However, the staff defers its detailed review of the PRIME thermal conductivity model to its separate review of PRIME"
Section 3.10.5.3	Similar statements from 10.5.3. Same comment. The NRC staff similarly reviewed the PRIME03-based thermal conductivity model and found that gadolinia bearing pellet temperatures will be under predicted at high exposure. Furthermore, while the NRC staff does not find that the improved model accurately captures the impact of gadolinia on fuel thermal conductivity, particularly for high exposure, the NRC staff notes (based on its preliminary review)……….	Comment accepted. Both sentences deleted.
3.12.3 Pg 46 Lines 9-12 Also, Lines 39-40	While the oxide layer thickness affects cladding heat transfer characteristics, the NRC staff notes that the initial oxide layer thickness in TRACG04 is either directly input for bounding calculations or is calculated according to the same empirical model based on plant data as in TRACG02. The NRC staff notes that the option to predict the initial clad oxide thickness in TRACG02 and TRACG04 remains unchanged. The TRACG04 model is similar to TRACG02 but different. It has been updated to reflect current data.	Comment accepted. First sentence revised as: While the oxide layer thickness affects cladding heat transfer characteristics, the NRC staff notes that the initial oxide layer thickness in TRACG04 is either directly input for bounding calculations or is calculated according to an empirical model based on plant data. Second sentence revised as: The NRC staff notes that the option to predict the initial clad oxide thickness in TRACG04 remains similar to TRACG02 except that it has been updated to reflect current plant data.

3.13.3 Lines 23-35	The second set of curves is based on the Bingham pump curves and is consistent with the curves used as the default in RETRAN02 and RELAP/5-MOD1. The second set of curves is based on Westinghouse not Bingham.	Comment incorporated.
3.13.4 Lines 32-33	The NRC staff will require that plant-specific pump data be verified and input for transient calculations. It should be clear that the pump data is the rated pump information not plant specific homologous curves. Also, the rated pump information is normally provided by the utility for a specific project or reload. GEH and GNF must assume that the utility has provided the data according to their quality procedures. We obviously consistency check the information based on our experience, but we don't literally verify the utility data.	Comment accepted. Section revised as: The NRC staff will require that plant-specific rated pump data be used for transient calculations
3.15.2 Lines 7-8	These TRACG04 cases were run using program library Version 40. The version is not relevant to the approval of TRACG04 for AOOs and ATWS overpressure. Also, the cases were repeated several times with newer versions and the final validated code.	Comment accepted. Sentence deleted.
3.15.5.3 Lines 25-26	While the ICS is not credited in Appendix K LOCA analyses, it is an important system for mitigating AOOs. The LOFW is the only BWR2 AOO in which the ICS is important. The actuation logic is such that the transient duration for other AOOs is not be long enough to see actuation.	Comment accepted. Section revised as: While ICS is not credited in Appendix K LOCA analyses, it is an important system for mitigating the loss of feedwater AOO.
3.19.2.1 Line 3	Shouldn't (Reference 3) go up by ATWS overpressure instead of being at the end of the sentence. Also, Reference 2 should be cited after the AOO.	Comment incorporated
3.19.2.1-X	Generic question. Reference 3 is cited in numerous	Comment accepted.

	locations at the end of paragraphs. We do not see a specific relationship back to Reference 3 in these instances.	Staff Comment: Reference 3 is a typographical error in these instances. The actual reference is Reference 2 (NEDE-32906P-A Rev. 3). In particular the staff cites Section 2.6 “Review Requirements for Updates.” Revised as: “Reference 3” has been replaced with “Section 2.6 of Reference 2.”
3.19.2.2 Lines 19-21	Updates to the TRACG nuclear methods to ensure compatibility with the NRC-approved PANACEA family of steady-state nuclear methods (e.g., PANAC11) **would not be considered by the NRC staff to constitute a departure from a method of evaluation in the safety analysis and such changes** may be used for AOO or ATWS Suggest adding words consistent with 50.59 as was done in the ODYSY-1D SE.	Comment incorporated.
3.19.2.3 Lines 30-33	Changes in the numerical methods to improve code **convergence would not be considered by the NRC staff to constitute a departure from a method of evaluation in the safety analysis and such changes** may be used in AOO and ATWS overpressure licensing calculations without NRC staff review and approval.	Comment incorporated.
3.19.2.4	Features that support effective code input/output **would not be considered by the NRC staff to constitute a departure from a method of evaluation in the safety analysis and such changes may** be added without NRC staff review and approval. (Reference 3)	Comment incorporated.
3.19.2.6	As a result, changes to the statistical methodology	Comment incorporated.

	directly affect the results of safety **analyses and constitute a departure from a method of evaluation used in establishing the design bases or in the safety analysis**.	
3.20.1 Lines 47 - 48	While the power distribution in the core is flatter for EPU, the SLMCPR continues to be based on 0.1% of the number of rods in the core experiencing BT.	Comment accepted. Section revised as: These void fractions are close to void fractions predicted for critical power tests indicating that the margin to boiling transitions may be degraded for the hot bundles. The staff notes that when compared to pre-EPU core designs that EPU cores generally contain a higher number of higher powered bundles. Therefore the thermal margin may be degraded for a significant number of bundles.
3.20.1 Page 62 Line 1	The NRC staff notes that interfacial phenomena have not been extensively studied……. This is not a precise statement. The two-phase industry has studied phase interface phenomena extensively. It is true that the two-phase data is largely limited to engineering level measurements that do not provide information that can uniquely qualify phasic models.	Comment accepted. Section revised as: The NRC staff notes that interfacial phenomena have not been studied in a manner to yield qualification data for phasic models. Previous experimental data has been aimed at assessing the prediction of gross parameters, such as void fraction and pressure
3.20.1 Page 62 Line 35	The TRACG04 analysis initialization, however, is based on steady-state power distribution calculations performed using PANAC11. Editorial suggestion.	Comment incorporated.
3.20.3 Page 67	Clarification. While the TOP limit does ensure the fuel melt limit is met, the TOP does not correspond to the limit. The TOP limit is a screening criterion that is generically established on a fuel product basis to provide a conservative method to evaluate transient response. The same thing is true of the MOP limit. It does not correspond to the strain limit but to a conservative	Comment accepted. Staff comment: The staff agrees that the TOP and MOP limits are conservative screening criteria that are used in lieu of detailed evaluations of the associated figures of merit against the applicable regulatory criteria.

	screening criterion to assure the limit is met.	Section revised as: Original: “As stated in Section 3.2.6 of Reference 5, the fuel T-M design criteria require, in part, that:” Revised: “Consistent with Section 3.2.6 of Reference 5, the fuel T-M design criteria require, in part, that:” Original: [ ] Revised as: [ ] Original: [ ] Revised as: [ ]
3.20.3	Grammar correction.	Comment incorporated

Page 69 Line 10		
4.6 Lines 30-33	Until the NRC staff approves PRIME03 or approves the GESTR-M benchmarks per Appendix F of Reference 5, the NRC staff will require ATWS overpressure analyses and AOO analyses be performed using the GESTR-M model. 3 comments. (1) Should and be or, (2) clarify where the subject benchmarks are coming from, and (3) the performance of the GESTR-M benchmarks per the Reference 5 Appendix F are not related to the GESTR-M parameters that are used in TRACG04.	Comment accepted. Section revised as: Until the NRC staff approves PRIME03, the NRC staff will require ASME overpressure analyses, ATWS overpressure analyses and AOO analyses be performed using the GESTR-M model
4.8	See Comment 3.13.4 Lines 32-33 above.	Comment accepted. Section revised as: Licensing calculations require plant-specific rated pump data to be used in the TRACG model
4.13	Suggest using the same wording as 3.19.2.1.	Comment incorporated.
4.14	Suggest using the same wording as 3.19.2.2.	Comment incorporated.
4.15	Suggest using the same wording as 3.19.2.3.	Comment incorporated.
4.16	Suggest using the same wording as 3.19.2.4.	Comment incorporated.
4.18	Suggest using the same wording as 3.19.2.6.	Comment incorporated.
4.21	This statement from 3.20.3 clearly states the condition for releasing the 10% margin requirement or penalty when the conditions of 4.21 and 4.22 are met. The conditions specified in Section 4.21 and Section 4.22 of this SE complement Transient LHGR Limitation 3. Therefore, a 10 percent penalty is not required for TRACG04 methods when the conditions specified in Section 4.21 and Section 4.22 of this SE are met. Also, this is a quote from the Methods LTR SE, "If the void history bias is incorporated into the coupled neutronic and transient code set, then the additional 10 percent margin to the fuel centerline melt and the 1	Comment accepted. Added Section below Section 4.22 and revised numbering of conditions and limitations in Section 4, added a corresponding section in the executive summary, and renumbered the conditions. The section added: 4.23 Transient LHGR Limitation 3 To account for the impact of the void history bias, plant-specific EPU and MELLLA+ applications using either TRACG or ODYN will demonstrate an equivalent to 10 percent margin

	percent cladding strain is no longer required." It is suggested that the release, including the strain term, be added to the limitations and conditions for clarity.	to the fuel centerline melt and the 1 percent cladding circumferential plastic strain acceptance criteria due to pellet-cladding mechanical interaction for all of limiting AOO transient events, including equipment out-of-service. Limiting transients in this case, refers to transients where the void reactivity coefficient plays a significant role (such as pressurization events). When the Void Reactivity Coefficient Correction Model Condition (Section 4.21) and the Void Reactivity Coefficient Correction Model Basis Condition (Section 4.22) specified in this SE are met, the additional 10 percent margin to the fuel centerline melt and the 1 percent cladding circumferential plastic strain criteria is no longer required for TRACG04. (Section 3.20.3)
	Related to the previous comment. The Methods SE has this statement concluding Limitation 10, "However, if GE does not adequately address the methodology deficiencies identified in LTR NEDC-33173P in the review of Supplement 3 of NEDE-32906P, the additional margins as described in this SE apply as appropriate." For clarity, Is it not appropriate to reference limitation 10 of the Methods SE and state in the TRACG04 SE, that the subject deficiencies have been met and no margins as described in the SE for NEDC-33173 apply. The limitation should be that the 10% margin should be applied if the historical void is not used. This is an input option.	Comment not incorporated. Staff comment: Conditions 4.21 and 4.22 in Section 4 of the draft SE specifically require the historical void to be used. For additional clarification on mixed-core analyses see NRC resolution for comments on Section 4.30
4.23, 24, and 26	Why is it considered necessary to repeat these limitations from Reference 5? Limitation 4.2 reminds us generally that the SEs for Methods LTR and the MELLLA+ LTR must be met.	Comment accepted. Sections 4.23, 4.24, and 4.26 deleted from Section 4 of the SE. Conditions 23, 24, and 26 deleted from executive summary. Other sections and conditions are renumbered accordingly.

4.28	Same as above. 4.25 requires the use of the PRIME models when approved. 4.28 is different than 4.25 in that it applies a condition that, if necessary, should be specified in the PRIME SE. The specification of when PRIME must be used should be in the PRIME SE.	Comment not incorporated. Staff comment: The intent of the condition is to specify that future EPU and MELLLA+ applications referencing TRACG04 methods that utilize TOP/MOP limits in lieu of detailed transient LHGR analyses that directly compare the figure of merit against the applicable specified acceptable fuel design limits must utilize TOP/MOP limits generated using the revised T-M methods or conservative limits. Section 4.28 and corresponding Condition 28 in the executive summary revised as: If PRIME is approved, future license applications for EPU and MELLLA+ referencing LTR NEDE-32906P, Supplement 3, must utilize these revised T-M methods to determine, or confirm, conservative TOP and MOP limits as applicable.
4.30	This is a pure TGBLA methods limitation stated in the SE for the Methods LTR. There is no need to repeat it here.	Comment not incorporated. Staff comment: The condition is maintained in the TRACG04 SE as the staff's consideration of the information supplied to support the mixed core application must include the use of MCNP/TGBLA calculations within the framework of the TRACG04 transient analysis methodology to establish the void reactivity coefficient biases and uncertainties. In short, the staff would review this information to ensure that the Void Reactivity Coefficient Correction Model Condition (Section 4.21) and the Void Reactivity Coefficient Correction Model Basis Condition (Section 4.22) are met when legacy mixed-vendor fuel is loaded in the core. The staff understands that implementing the Void Reactivity

		Coefficient Correction Model with lattice bases to reflect the other fuel designs may not be justified based on the information provided to satisfy this condition. However, in these cases licensees may elect to account for the impact of the void history bias for plant-specific EPU and MELLLA+ applications using TRACG04 by demonstrating an equivalent to 10 percent margin to the fuel centerline melt and the 1 percent cladding circumferential plastic strain acceptance criteria due to pellet-cladding mechanical interaction for legacy fuel for limiting AOO transient events, including equipment out-of-service. Section revised as: Original: The NRC staff did not assess the TGBLA06 upgrade for use with 11x11 and higher lattices, water crosses, water boxes, gadolinia concentrations greater than 8 weight percent, or MOX fuels at EPU or MELLLA+ conditions. For any plant-specific applications of TGBLA06 with the above fuel types, GEH needs to provide assessment data similar to that provided for the GNF fuels for EPU or MELLLA+ licensing analyses. Revised: The NRC staff did not assess the TGBLA06 upgrade for use with 11x11 and higher lattices, water crosses, water boxes, gadolinia concentrations greater than 8 weight percent, or MOX fuels at EPU or MELLLA+ conditions. For any plant-specific applications of TGBLA06 with the above fuel types, GEH needs to provide assessment data similar to that provided for the GNF fuels for EPU or MELLLA+ licensing

		analyses. If the Void Reactivity Coefficient Correction basis is not updated to include these lattices, and the information provided to meet this condition is insufficient to justify the applicability of the Void Reactivity Coefficient Correction Model basis (i.e. Condition 4.22 is not met for these fuel types), then the plant-specific EPU or MELLLA+ application using TRACG04 must demonstrate an equivalent to 10 percent margin to the fuel centerline melt and the 1 percent cladding circumferential plastic strain acceptance criteria due to pellet-cladding mechanical interaction for these fuel types for limiting AOO transient events, including equipment out-of-service.
4.31	**Discussion** As of December 2008, the GEH standard production analysis TGBLA06 has been updated to TGBLA06AE6. The first suggestion is to modify the limitation such that E5 or later versions are defined to be acceptable. The specific version used for a particular application could span back to TGBLA06AE4 because of the lead time for the design work and schedule delays. The core design work on some EPU and MELLLA+ projects was performed with a TGBLA06AE4 basis. In these cases, while the power uprate SAR is based on an equilibrium core with a TGBLA06AE4 basis, the lattices and core design activities for the cycle implementing the EPU or MELLLA+ change will have a lattice basis of TGBLA06AE5 or later. The core and safety analyses performed with TRACG04 for the SRLR will have a TGBLA06AE5 or later basis. In the time frame of implementation of EPU or MELLLA+ projects, in NRC review or soon to be in	Comment partially accepted. Staff comment: Use of TGBLA06AE4 for generating lattice physics data for EPU applications has been justified on a plant specific basis for GE14 fuel (see References below). Section revised as: The application of TRACG04/PANAC11 is restricted from application to EPU or MELLLA+ plants until TGBLA06 is updated to TGBLA06AE5 or later in the GEH standard production analysis techniques. Should an applicant or licensee reference historical nuclear data generated using TGBLA06AE4 or earlier, the applicant or licensee shall submit justification for their use to the NRC. (Appendix A: RAI 1) References 1. Letter from O’Connor, T. J. (NSPM) to US NRC,

	review, that implement TRACG04 it is highly unlikely that any TGBLA06AE4 based bundles will remain. However, there are remote situations where a plant may need to install an older bundle which may have a TGBLA06AE4 basis. **Proposed** The application of TRACG04/PANAC11 is restricted from application to EPU or MELLLA+ plants until TGBLA06 is updated to TGBLA06AE5 or later in the GEH standard production analysis techniques. TGBLA06AE5 or later should be used for all new lattice physics constant generation. For core design activities in support of EPU or MELLLA+ submittals initiated after the date of this SE, TGBLA06AE5 or later should be used. TGBLA06AE5 or later should be used for all cycles implementing EPU or MELLLA+ based on application of TRACG04/PANAC11 for transient or ATWS overpressure analysis. (Appendix A. RAI 1)	"Monticello Extended Power Uprate: Response to NRC Reactor Systems Branch and Nuclear Performance & Code Review Branch Request for Additional Information (RAI) dated January 16, 2009 (TAC No. MD9990)," dated March 19, 2009. 2. Letter from GEH to USNRC, MFN 06-297 Supplement 1, "Supplemental Response to Portion of NRC Request for Additional Information Letter No. 53 Related to ESBWR Design Certification Application – DCD Chapter 4 and GNF Topical Reports – RAI Number 4.3-3," November 8, 2006 (ADAMS Accession No. ML063400067).
Executive Summary	Section 4 Comments also apply to the Executive Summary.	See previous NRC resolutions
References	Added MFN numbers for some GEH to NRC references where they were missing.	Comment incorporated.
Appendix A RAI-1 Lines 37-39	Same comment as 4.31 above	Comment accepted. Following text added to end of Section RAI 1: On a cycle specific basis the use of TGBLA06AE4 nuclear parameters for legacy GEH/GNF fuel may be justified. This justification may be provided to the NRC on an application specific basis to demonstrate for the fuel design that the nodal parameters are negligibly impacted by the code differences between TGBLA06AE4 and TGBLA06AE5. GEH

		has previously provided similar justification to the NRC for GE14 fuel lattices in Reference 9. It is expected that licensees or applicants that reference historical TGBLA06AE4 calculations likely utilize GE14 fuel and will reference those calculations previously reviewed by the NRC. A new reference 9 is added to the references section of Appendix A 9. Letter from GEH to USNRC, MFN 06-297 Supplement 1, "Supplemental Response to Portion of NRC Request for Additional Information Letter No. 53 Related to ESBWR Design Certification Application – DCD Chapter 4 and GNF Topical Reports – RAI Number 4.3-3," November 8, 2006 (ADAMS Accession No. ML063400067)
Appendix A RAI-16 Pg A-10 Lines 27-30	The NRC staff finds that at high exposure, the TRACG04 model does not predict any influence on thermal conductivity by the gadolinia, whereas the FRAPCON3 model consistently predicts degradation in thermal conductivity with increasing gadolinia concentration. The figures in MFN 08-053 show the gadolinia dependency.	Comment accepted. Section revised as: The NRC staff finds that at very high exposure, the TRACG04 model predicts only a minor influence on thermal conductivity by the gadolinia, whereas the FRAPCON3 model consistently predicts a much greater degradation in thermal conductivity with increasing gadolina concentration.
Appendix A RAI-16 Pg A-10 Lines 35-37	Therefore, the NRC staff does not accept the conclusion that gadolinia depletion under irradiation results in a negligible impact on fuel thermal conductivity at the end of life for the fuel,….. We did not make such a concluding statement.	Comment accepted. Section revised as: Therefore, the NRC staff has deferred the review of the PRIME thermal conductivity model to the specific review of PRIME and herein makes no statements regarding the veracity of the model for gadolinia bearing fuel near the end of life,…
Appendix A RAI-16 Pg A-10	(2) there is evidence that the new fuel thermal conductivity model remains non-conservative in the prediction of pellet temperature for gadolinia loaded	Comment accepted. Section revised as: (2) when compared to the staff's FRAPCON model, the

Lines 42-43	fuel pins. The evidence is only that FRAPCON shows a steeper reduction in thermal conductivity as gadolinia increases.	PRIME thermal conductivity model predicts a lesser degree of degradation with increasing gadolinia concentration.
Appendix A RAI-22 Pg A-16 Lines 1-2	For evaluations where the kinetics solver is disabled, the decay heat fission energy release values are based on historical values reported in GEH LTR NEDO-23729. The decay heat values are always based on values from NEDO-23729. The reason for this was provided in the RAI response.	Comment accepted. Section revised as: For evaluations the decay heat fission energy release values are based on historical values reported in GEH LTR NEDO-23729.
Appendix A RAI-28 Pg A-18 Line 13	(Bingham) The TRACG04 default homologous pump curves are for a large Westinghouse pump manufactured in Cheswick, PA. The Bingham pump is only slightly different.	Comment accepted. "(Bingham)" is deleted.
Appendix A RAI-29 Pg A-18 Line 39	The NRC staff evaluation of the applicability of TRACG04 to EPU and MELLLA+ mixed core analysis was reviewed separately and is documented in Section 4.20.5 of the subject LTR. May want to clarify the "subject LTR" more specifically.	Comment accepted. Section revised as: The NRC staff evaluation of the applicability of TRACG04 to EPU and MELLLA+ mixed core analysis was reviewed separately and is documented in Section 3.20.5 of this SE.
Appendix A RAI-32b	PANCEA should be PANACEA	Comment incorporated.
Appendix A RAI-32c Pg A-26 Line 39-43	………, the NRC staff is concerned that the inter bundle nuclear coupling may amplify the impact of errors in the predicted nodal reactivity feedback characteristics. The bundles are coupled by internodal neutron leakage. Potentially increased errors in neighboring bundle void reactivity feedback will have a direct effect on the efficacy of the code to accurately determine the limiting bundle transient response. This concern leaves the reader with no closure with respect to the importance of the concern. This	Comment accepted. Section revised as: …, the NRC staff was concerned that the inter bundle nuclear coupling may amplify the impact of errors in the predicted nodal reactivity feedback characteristics at EPU or MELLLA+ conditions. The bundles are coupled by internodal neutron leakage. Potentially increased errors in neighboring bundle void reactivity feedback will have a direct effect on the efficacy of the code to accurately determine the limiting bundle transient response. Therefore, the staff requested in

	discussion is tangential to the issue of the RAI regarding TRACG initialization. The concern by the NRC is new and should not be written into the SE. BWR operation is strongly coupled between the nuclear and thermal-hydraulics field. If the staff concern is retained, the reviewer should document its resolution by consideration that steady-state methods qualification (TIPs, gamma scans, eigenvalues) indicate that the coupled nuclear/thermal-hydraulics solution in GEH/GNF methods is satisfactory.	RAI 32 that GEH specifically evaluate the impact of the void fraction mismatch at MELLLA+ conditions.
Appendix A RAI-32c Pg A-29 Line 14	Therefore, the NRC staff maintains that a threshold of significance of 0.005 remains appropriate when evaluating a potential bias. The cited 0.005 is the steady state level of significance. The transient basis has always been 0.01. The [ ] change in D/I for CPR is what was agreed to by the NRC staff in NEDE-32906P-A as being the appropriate level of significance for triggering additional NRC review.	Comment accepted. Sentence revised as: Therefore, the NRC staff considered a threshold of significance in its review of the current RAI response of 0.005. Values greater than 0.005 approach the one sigma deviation difference considered significant in Section 2.6.1 of NEDE-32906P-A.
Appendix A RAI-32c Pg A-30 Line 40-41	The NRC staff's conclusions here are predicated on pressurization transients being the limiting transients in reload licensing analyses. While pressurization transients are often the most limiting, it is not always the case. The conclusions based on the example where the pressurization transient is limiting also apply for other AOO transients.	Comment accepted. Section revised as: Paragraph deleted. Following added above the former second to last paragraph: The staff considered the relevancy of the sensitivity studies to the broad range of anticipated operational occurrences that may occur for operating BWR plants. Licensees analyze a host of transients each operating cycle to determine thermal operating limits. The potentially limiting AOO events are determined and analyzed. The potentially limiting transient events analyzed on a cycle specific basis include: generator load rejection or turbine trip without bypass, loss of feedwater

		heat or inadvertent high pressure coolant injection (HPCI), control rod withdrawal error, feedwater controller failure to maximum demand, and pressure regulator failure (for BWR/6 plants). For the operating fleet of BWR plants these events are generally the limiting events. Of these the generator load rejection without bypass, turbine trip without bypass, feedwater controller failure, and pressure regulator failure events are pressurization transients. The sensitivity studies provided in the RAI response provide details of the sensitivity of the transient response to pressurization transients. The staff expects that the sensitivity demonstrated for the pressurization transients would bound that for the other potentially limiting events: control rod withdrawal error, loss of feedwater heat, and inadvertent HPCI. The control rod withdrawal error is a postulated AOO whereby the operator erroneously, continuously withdraws the highest worth control blade above 75 percent of power. The event is terminated by the rod block monitor (RBM). During the transient the local reactor power increases due to the reactivity insertion from the withdrawal. The increased local power is sensed by the LPRMs. The RBM will prohibit further withdrawal of the rod as the power increase because increasingly severe. The negative reactivity feedback from any void formation is modeled in TRACG04; however, the bundle power history is a much stronger function of the control blade reactivity and withdrawal rate. Therefore, the staff finds that the CPR sensitivity to any void mismatch for a control rod withdrawal error would be bound by the pressurization transient results.

		The loss of feedwater heat and the inadvertent HPCI AOOs are similar. These AOOs are postulated events where the core flow inlet subcooling is increased due to cooler water injection to the vessel. These events tend to be slowly evolving transients where the core approaches a new steady-state condition where the power increases to compensate for positive reactivity insertion. Generally, the core will approach a condition where the adjoint-weighted core average void fraction remains the essentially the same. Therefore, the staff does not expect the dynamic response to be sensitive to mild variation in the local void fraction due to void-model differences. On this basis, the staff finds that the CPR sensitivity calculated for the pressurization transients would bound any CPR sensitivity for the loss of feedwater heat or inadvertent HPCI AOOs. Revised Section 3.20.1 Page 65 Lines 20-24 “The NRC staff’s conclusions here are predicated on pressurization transients being the limiting transients in reload licensing analyses. This is true for the operating fleet of BWR/2-6 reactors. Therefore, the NRC staff’s findings in this matter may not be applicable to other BWR designs where pressurization transients are not the limiting transients.” Revised as: “The NRC staff’s conclusions here are predicated on consideration of those transients that are typically limiting transients in reload licensing analyses. The staff considered those potentially limiting events for the operating fleet of

		BWR/2-6 reactors. Therefore, the NRC staff's findings in this matter may not be applicable to other BWR designs." Appendix E Added to acronym list HPCI – High Pressure Coolant Injection
Appendix A References	Added MFN numbers for some GEH to NRC references where they were missing. Also, Reference 9 and 21 are the same.	Comment incorporated
Appendix B	If we are including the list why not include all through 57. Put an A,P after TRACG04 or eliminate the A.	Comment partially accepted. Section revised as: TRACG04A,P Staff comment: The staff considered the audit of GEH quality assurance procedures related to TRACG04. The staff did not base its review of the quality assurance (QA) program on subsequent information provided, audited, or inspected by the staff. The Appendix is consistent with the scope of the audit referenced in the SE. The Appendix is included to demonstrate that code changes have not impacted the analysis methodology while the method was maintained under the GEH QA program.
Appendix E	INEL should be INL	Comment partially accepted. Section revised as: INEL (currently INL) – Idaho National Engineering Laboratory (currently Idaho National Laboratory)