NRR-PMDAPEm Resource

From: Wang, Alan
Sent: Monday, May 19, 2014 11:10 AM
To: SEITER, JEFFERY ALAN
Cc: Burkhardt, Janet
Subject: Grand Gulf Nuclear Station, Unit 1, Request for Additional Information Regarding Maximum Load Line Limit Analysis Plus (TAC No. MF2798)
Attachments: RSB RAIS 5-12-14.docx

Jeff,
by letter dated September 25, 2013 (Agencywide Document Access and Management System (ADAMS) Accession No. ML13269A140), Entergy (the licensee) submitted a License Amendment Request (LAR) for Maximum Extended Load Line Limit Analysis plus (MELLLA+) for Grand Gulf Nuclear Station (GGNS). The proposed amendment request would allow operation in the expanded MELLLA+ domain.

Upon review of the Attachment 4 to the LAR titled "Safety Analysis Report for Grand Gulf Nuclear Station-Maximum Extended Load Line Limit Analysis Plus" (ADAMS Accession No. ML13269A139), the US Nuclear Regulatory Commission (NRC) staff has determined additional information is needed to completes its review. Attached is the NRC staff's Request Additional Information.

This request was discussed with Mr. Jeffery Seiter of your staff on May 19, 2014, and it was agreed that a response would be provided within 31 days from the issuance of this email. If circumstances result in the need to revise the requested response date, please contact me at (301) 415-1445 or via e-mail at Alan.Wang@nrc.gov.

Alan B. Wang

Project Manager (Grand Gulf Nuclear Station)

Nuclear Regulatory Commission

Division of Operating Reactor Licensing

Hearing Identifier: NRR_PMDA
Email Number: 1289

Mail Envelope Properties (Alan.Wang@nrc.gov20140519111000)

Subject: Grand Gulf Nuclear Station, Unit 1, Request for Additional Information Regarding Maximum Load Line Limit Analysis Plus (TAC No. MF2798)
Sent Date: 5/19/2014 11:10:10 AM
Received Date: 5/19/2014 11:10:00 AM
From: Wang, Alan

Created By: Alan.Wang@nrc.gov

Recipients:
"Burkhardt, Janet" <Janet.Burkhardt@nrc.gov>
Tracking Status: None
"SEITER, JEFFERY ALAN" <jseiter@entergy.com>
Tracking Status: None

Post Office:

Files	Size	Date & Time
MESSAGE	1280	5/19/2014 11:10:00 AM
RSB RAIS 5-12-14.docx	42732	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received: ZZZ

REQUEST FOR ADDITIONAL INFORMATION RELATED TO
MAXIMUM EXTENDED LOAD LINE LIMIT ANALYSIS PLUS
ENTERGY GRAND GULF NUCLEAR STATION, UNIT 1

By letter dated September 25, 2013 (Agencywide Document Access and Management System (ADAMS) Accession No. ML13269A140), Entergy (the licensee) submitted a License Amendment Request (LAR) for Maximum Extended Load Line Limit Analysis plus (MELLLA+) for Grand Gulf Nuclear Station (GGNS). The proposed amendment request would allow operation in the expanded MELLLA+ domain.

Upon review of Attachment 4 to the submittal titled "Safety Analysis Report for Grand Gulf Nuclear Station-Maximum Extended Load Line Limit Analysis Plus" (ADAMS Accession No. ML13269A139), the staff has the following requests for additional information:

1.0 Power density > 50 MEGAWATT THERMAL/Mlbm/hr

Section 2.2.1 "Safety Limit Minimum Critical Power Ratio" states that "The currently approved off-Rated Core flow (CF) uncertainty applied to the Single Loop Operation (SLO) is used for the minimum CF statepoint D and at 55.0% of CF statepoint C." Section 2.2.5 "Power-to-Flow Ratio" states that statepoint C has a power density of 57.42 Megawatts Thermal/Million Pounds/Hour (MWt/Mlbm/hr), which is larger than the MELLLA+ Licensed Topical Report (LTR) limit of 50 MWt/Mlbm/hr, and states "this limitation is resolved in the near-term by applying additional conservatism to the cycle-Specific Safety Limit Minimum Critical Power Ratio (SLMCPR)." This "additional conservatism" is not documented in Section 2.2.5 of the Safety Analysis Report (SAR). Provide:

1. Definition of the "additional conservatism" method.
2. A numerical example of the application of this conservatism.
3. A justification that the power distribution uncertainties at the higher power density are covered by the proposed method.

2.0 SPECIFIC SAFETY LIMIT MINIMUM CRITICAL POWER RATIO Adders

Section 2.2.1 "Safety Limit Minimum Critical Power Ratio" states that "a +0.02 SLMCPR adder will be added to the cycle-specific SLMCPR."

1. Provide a list of SLMCPR adders in MELLLA+ with respect to Operating Licensed Thermal Power (OLTP) conditions.
2. Specify which adders are part of the Extended Power Uprate (EPU), and which are MELLLA+ specific.

ENCLOSURE

3.0 Void fraction

Figures 2-3, 2-4, and 2-5 of the SAR indicate that GGNS is an outlier with respect to core exit void fraction. GGNS has the highest exit void fraction of all the plants considered, and it approaches ~88% at some points during the cycle.

1. Provide justification about the applicability of General Electric, Hitachi (GEH) methods at this high void fraction.

2. Provide justification that TGBLA06 generates accurate lattice cross sections at void fractions as high as 87%. Please refer to previous approvals that evaluated void fraction levels this high, when applicable.

4.0 STANDBY LIQUID CONTROL SYSTEM Shutdown Margin

Section 2.3.3 “Standby Liquid Control System Shutdown Margin (SLCS) Shutdown Margin” states that “The MELLLA+ operating conditions do not change the methods used to evaluate the SLCS shutdown margin.”

1. Is SLCS shutdown margin evaluated with all rods out or with a pre-planned rod sequence pattern?

2. Does operation with initial conditions consistent with statepoints C or D (which correspond to the highest rod line) affect the SLCS shutdown margin?

5.0 Detect and supress solution-confirmation density

1. Have the Backup Stability Protection (BSP) regions been evaluated for the GGNS equilibrium cycle? Provide them if available. If not, where will they be documented? Will they be part of the Supplemental Reload Licensing Report (SRLR)?

2. Describe the criteria used to set the Oscillation Power Range Monitor (OPRM) armed region.

3. Provide justification that the OPRM armed region defined as 75% drive flow shown in Figure 2-18 is conservative for GGNS MELLLA+ operation.

6.0 Increased moisture carry over

Section 3.3.4 “Steam Line Moisture Performance Specification” states that “The highest Moisture Carryover (MCO) predicted under MELLLA+ conditions is less than 0.2 wt %” … “The amount of time GGNS is operated with higher than the original design moisture content (0.10 wt %) is minimized by operations” … “The maximum permissible MCO leaving the Reactor Pressure Vessel (RPV), above which Mainsteam Line (MSL) components could begin to degrade as a result of the high moisture content in the steam, was found to be 0.33 wt %”.

Provide a summary explanation of:

1. What analyses were performed to determine the 0.33% permissible limit?

2. What analyses were performed to determine the 0.2% MCO under MELLLA+ conditions?

3. What plant operations are used in GGNS to minimize the MCO?

4. Provide a short physical explanation of what causes the increased MCO at lower flow. Is this mechanism predicted using an experimental correlation or a first principle analytical tool?

5. How is the MCO monitored during operation? What is the typical surveillance period?

7.0 Reactor Core isolation cooling net positive suction head

Section 3.9.3 “Reactor Core Isolation Cooling (RCIC) Net Positive Suction Head (NPSH)” states that “The RCIC system has the capability of using the Condensate Storage Tank (CST) or the Suppression Pool (SP) as a suction source” … “GGNS calculations demonstrate that the RCIC pump would have adequate NPSH and low suction pressure trip margins given a SP water temperature of 140°F”.

1. Is the CST available for RCIC even under containment isolation conditions?

2. If the SP temperature reaches >140˚F, what indication/training does the operator have to switch from SP to CST inlet?

8.0 LARGE BREAK and Small Break LOCA

Section 4.3.1 “Break Spectrum Response and Limiting Single Failure” states that “A number of small break sizes were evaluated at the rated Current Licensed Thermal Power (CLTP)/Rated Core Flow (RCF).”

1. Provide a list of cases evaluated and indicate the limiting case.

2. The evaluation was performed at RCF. Provide an explanation why the results will not be significantly different at minimum (80%) or maximum (105%) core flow.

3. The Small-Break Loss-Of-Coolant Accident (SBLOCA) results in Table 4-4 show the top-peaked axial power shape is limiting compared to the mid-peaked power shape. The results for Large-Break Loss-Of-Coolant Accident (LBLOCA) in Table 4-3 show the mid-peaked axial power shape being limiting. Explain the difference in these results.

4. In Section 4.3.2, explain the following regarding Table 4-3:

    a. Why the mid-peaked axial power shape is analyzed and a calculation for the top-peaked or bottom-peaked axial power shape is not shown.

b. Why the mid-peaked axial power shape is limiting in terms of the Peak Cladding Temperature (PCT) difference between the value of first peak at mid-peak and the value at top-peaked axial power shape.

c. Why the first peak is lower than the second peak for the mid-peaked axial power shape calculation at 100% power MELLLA+ condition and the second peak is higher than first peak at the Appendix K condition.

d. Provide a plot of PCT versus time for the LBLOCA top- and mid-peaked axial power shape cases.

9.0 anticipated operational occurance (AOO) impact of Flow

On a separate MELLLA+ submittal (GEH Report Spec: 000N2436, dated 1/12/2014), data was provided to justify that Anticipated Operational Occurrences (AOOs) have smaller ΔMCPR at 80% core flow than at 105% core flow. However, in Table 9.1 of the SAR, most AOOs, but not the limiting one, have a larger ΔMCPR at 80% flow than at 105%. The argument presented in the past is a shift in power towards the bottom as the voids increase for then 80% flow case, which results in increased control rod performance.

1. Provide the initial axial power shapes for the events in Table 9-1 at 80% and 105% flow.

2. For all cases in Table 9.1, the transient peak power is lower at 80% than at 105% flow yet the ΔMCPR is larger. This is counterintuitive. Please provide an explanation.

10.0 Bi-Stable Flow

Is GGNS susceptible to bi-stable flow in the recirculation loops? If so, what is the maximum achievable recirculation flow used in normal operation to minimize bi-stable flow concerns?

11.0 Plant Design Parameters

1. Provide plant design parameters relevant to the Anticipated Transient without Scram (ATWS) calculations in Section 9 of the SAR. Specifically: turbine bypass capacity, sources of high pressure injection and their operability issues (e.g., steam is lost after isolation …), sources of low pressure injection and their operability issues (e.g. CST pumps …).

2. Provide vessel component elevations in units comparable to the ones used for water level in the Section 9 figures (include separators, feedwater (FW) spargers, nominal level, level setpoints for actuations, top of active fuel (TAF) …).

3. What is “ATWS water level” in Figure 9-8 of the SAR?

12.0 ATWS Sequence of Events

Provide tables of the assumed sequence of events for the ODYN licensing calculation, the ATWS best estimate calculation, and the ATWS/Stability calculation.

13.0 ATWS Calculations

1. Table 9-5 specifies a Boron SLCS concentration of 269%. Please, describe the units (i.e., percent of what?).

2. The SLCS initiation time has been increased from 120 seconds at CLTP to 300 seconds at MELLLA+. Table 9-6 specifies that this increase is the main reason why the calculated ultimate suppression pool temperature increases significantly (165.3˚F vs 197.5˚F). Is there a specific reason for the increase? Is the 300 seconds consistent with operator actions in the simulator?

3. The Licensing Basis ODYN ATWS Analysis calculates a suppression pool temperature of 197.5˚F. Are NPSH limits satisfied by all the equipment assumed operable by the ODYN calculation? If a transfer to CST as the source of Emergency Core Cooling System (ECCS) cooling is assumed, provide the timing of the transfer.

14.0 safety releif valve Setpoints and Out Of Service Allowance

Table 9-5 specifies that the ATWS transient was run with 20 total Safety Relief Valves (SRVs) with five SRVs out of service for both CLTP and MELLLA+, and Section 9.3.1.1 states “With the safety function of at least nine SRVs and the relief function of at least six SRVs operable”.

1. Describe the difference between “safety function” and “relief function.” Describe why the safety valve flow in Figure 9-1 is ~25% of the relief valve flow. How many valves are open in the case of Fig 9-1?

2. Has the number of allowed SRVs out of service been changed as a result of the MELLLA+ operating domain extension?

3. The SRV Analytical Opening Setpoint in Table 9-5 has been increased from 1,183 to 1,246 psig, which is greater than the 3% drift tolerance described in the text? Please elaborate and justify the change.

15.0 ATWS Water Level Strategy

Section 9.3.1.1 “ATWS (Licensing Basis)” specifies “Water level control per procedures.” Section 9.3.1.2 “ATWS (Best-Estimate Calculation)” specifies “Water level control using the designated water level control strategy.” Section 9.3.3 “ATWS with Core Instability” states that “Reactor water level was controlled at approximately TAF after a 90-second delay following indication of no scram.”

1. Provide a detailed description of what water level control strategy (with emphasis on timing) was used for each calculation.

2. Describe the sources of water used to control the level. If FW pumps were used, describe automated actions (i.e., loss of extraction steam), and assumptions about operability (i.e., residual steam volume, if used) after Main Steam Isolation Valve (MSIV) isolation occurs.

3. The best-estimate ATWS calculations (Figures 9-8 and 9-10) show some degree of high-pressure injection before time ~500 sec. Is this injection consistent with the available plant equipment?

4. Has the water level control strategy and timing changed as a result of the MELLLA+ domain extension?

5. Are there any operator training concerns/changes as part of the MELLLA+ domain extension and the 90-second delay?

6. Have the 90-second water level control and 40-second depressurization delays been tested in the plant simulator?

7. Figures 9-8 and 9-10 appear to show flow injection (red line) for times between 500-1000 during the depressurization. Do GGNS Emergency Operator Procedures (EOPs) require the termination of all high pressure flow injection except SLCS during the depressurization phase? Is the calculation consistent with EOPs?

16.0 Pressure Control Strategy

Operators may choose to perform a controlled partial depressurization to: (1) obtain a larger Heat Capacity Temperature Limit (HCTL) margin and avoid emergency depressurization, and (2) allow the use of mid-to-low pressure injection sources like the CST pumps. Have operator actions in the simulator and training been reviewed to ensure that the licensing ATWS calculations are conservative?

17.0 Boron Mixing and Transport

Figure 9-8 shows the boron reactivity stabilizing at ~ 500 seconds, then increasing at ~1000 seconds followed by a significant decrease. However, Figure 9-10 shows a significant decrease in boron reactivity at ~1000 seconds. Please explain the phenomena that lead to such significantly different behavior.

18.0 Detailed Plots

The plots provided in Section 9 are difficult to read.

1. Provide enhanced neutron flux plots, where the axis is limited to 100% CLTP for all best estimate ATWS calculations.

2. The neutron flux provided for the ATWS-Instability (ATWS-I) calculation is core-average. Provide additional plots with hot channel powers at symmetric core locations showing the amplitude of the regional oscillations for the ATWS-I calculation.

19.0 PCT

1. The ATWS plots of PCT (Figures 9-9 and 9-11) show two distinct PCT heat up ramps. One occurs early in the transient, and a second one occurs at ~500 sec in Figure 9-9 and 9-11 when depressurization starts, with a period of low temperature in between. Are the hot rods in dryout condition during the heat up ramps? Describe what phenomena causes the rewetting (low temperature) at ~500 sec.

2. The ATWS-I calculation shows a PCT heat up at ~80 sec when the power oscillations initiate. The PCT recovers and the rods seem to rewet at ~130 sec when the oscillations are mitigated by the flow reduction. What mechanism allows for heatup and rewet?

3. Provide plots similar to Figures 9-9, 9-11, and 9-13 that shows PCT superimposed with the calculated minimum stable film boiling temperature (T_{min}) value.

4. Provide plots showing the calculated margin between PCT and T_{min} for Figures 9-9, 9-11, and 9-13.

20.0 CODE-TO-CODE COMPARISON

Events leading to reactor instabilities cause oscillations in PCT over time. The magnitude of these oscillations has been seen to vary from code to code. Analyses completed by the Office of Nuclear Regulatory Research at the NRC have documented TRACE results for ATWS-I that lead to reactor instabilities with high PCT.

1. Develop a synonymous model using TRACG.

2. Compare TRACG results with TRACE results for an ATWS-I turbine trip with 100% bypass event initiated from 120% Originally Licensed Thermal Power (OLTP) and 85% reactor core flow at beginning of cycle and the peak hot excess point in the cycle. Provide discussion of differences between the two calculation results, in particular, wherever possible, identify candidate constitutive models, modeling procedures, input assumptions, or other factors that contribute to the differences.

3. Provide results in tabular form and in plots of the same two cases in RAI 20.2 above (ATWS-I turbine trip with 100% bypass event initiated from 120% Originally Licensed Thermal Power (OLTP) and 85% reactor core flow at beginning of cycle and the peak hot excess point in the cycle) using a constant T_{min} of 900K.

21.0 Steam Dryer Structural Integrity

1. Are the moisture carryover values or steam quality for steam (a) entering the steam separator, (b) exiting the steam separator, (c) entering the steam dryer, and (d) exiting the steam dryer affected by MELLLA+ core flow conditions?

2. Are the boundary conditions used in Acoustic Plant Based Load Evaluation (PBLE) model affected by MELLLA+ flow? Is there any impact on reactor water level & boundary conditions for annular region between dryer skirt and separator stand pipes; and annual region between RPV wall and dryer skirt? Is there any impact on dryer pressure loading used and on dryer structural analysis?

3. Are the stresses in the steam dryer evaluated for EPU conditions bounding for plant operation at EPU conditions combined with MELLLA+ conditions?

22.0 core design

1. The SRLR will validate that the power distribution in the core is achieved while maintaining individual fuel bundles within the allowable limits as defined in the Core Operating limits Report (COLR). When will the SRLR and COLR be available for GGNS MELLLA+ operation?

2. Provide the details to obtain a final loading pattern including procedure, guidance, criteria, and approved methodologies used for this analysis in relation to GESTAR II.

3. Table 2-1 and Figures 2-1 through 2-6 indicate the core design and fuel monitoring parameters for each exposure statepoint. Table 2-1 shows the peak nodal exposures starting from 38.849 to 56.660 GWd/ST (54.272 GWd/ST for GGNS MELLLA+ SAR at equilibrium 115% OLTP) and Figure 2-1 through 2-6 only shows cycle exposure up to 18 GWd/ST.

    a. Why do the figures only show the data up to 18 GWd/ST?

    b. Provide values for maximum bundle power, flow for peak bundle, exit void fraction for peak power bundle, maximum channel exit void fraction, core average exit void fraction, and peak linear heat generation rate (LHGR) at peak nodal exposure.

    c. Why isn't the peak nodal exposure data for GGNS MELLLA+ at equilibrium – 120% OLTP included in Table 2-1?

4. Provide core maps to show the bundles that experienced the 0.1% boiling transition criterion.

5. Provide a detailed description of the GGNS MELLLA+ core design in response to the core instability and fuel bundles which experienced boiling transition. Include any relationship among hot channels, regional instability experienced in Figure 9-13, and core loading pattern.

6. Since the SRLR is not ready at this moment, please provide a detailed description and basis that the operational conditions for GGNS in the MELLLA+ operating domain are within expected parameters based on the data shown in Figures 2-7 through 2-15.

23.0 Technical Specifications

1. Please provide justification for changing the pump discharge pressure of the SLCS from 1340 to 1370 psig in Surveillance Requirement 3.1.7.7.

2. Provide approved methodologies used to support the proposed addition of TS 5.6.5.a.6.

24.0 turbine trip events

Results for TTNBP during an AWTS-I event are not included in the SAR. Provide results for TTNBP in the MELLLA+ operating domain.

25.0 SIMULATOR UPDATE

1. Describe up-to-date training status of the key operator actions credited in the TRACG

2. ATWS instability analysis.

3. Provide the schedule when the GGNS Simulator will be completely updated for operators' training in the MELLLA+ operating domain.