NRR-PMDAPEm Resource

From: Holden, Leslie E.:(GenCo-Nuc) [Leslie.Holden@exeloncorp.com]
Sent: Thursday, January 30, 2014 6:55 PM
To: Wiebe, Joel
Cc: Borton, Kevin F:(GenCo-Nuc); Gullott, David M.:(GenCo-Nuc)
Subject: RE: Braidwood/Byron MUR Package for Proprietary and Factual Error Review - Part 3
Attachments: MUR Package for Proprietary and Factual Error Review - Part 3 LEH.docx

Joel,

We really appreciate you providing us the draft and also the opportunity to comment. I know it adds to your work load, but we are glad to be able to work with you on this.

Based on our review this afternoon we would like to offer you the following comments for your consideration:

Page 2/7 - 1st full ¶ 3rd sentence - The flow rates given are approximate values (not maximum) and the increased value was update in our 8/8/12 supplemental letter Attachment 2 (revised page II-8 to Attachment 5a) to be 540,000 lbs/hr (form 736,000 lbs/hr).
1st full ¶ 2nd to last sentence – The current section 3.3.1 doesn't discuss the off-site dose assessment from the increased steam release.
1st full ¶ last sentence – Suggest using "restore" analysis flow rates (rather than "achieve") to indicate that we didn't change the flow rate but restored it to what we previously assumed.
Page 3/7 - Under Condensate and Main Feedwater – clarified that we have the ability to make the adjustments, to maintain them near their current position. Our intent is that we want to keep them near their current position for best flow control, not the adjustment itself.
Page 4/7 - Under Auxiliary Feedwater 2nd ¶ - Add footnote to clarify that only the AFW flow to Unit 1 needs to be throttled; Unit 2 analysis conservatively assumes that the AFW flow values fail open. (Attachment 5a, page II-4)
Page 6/7 - Under Spent Fuel Pool (SFP) Storage and Cooling 1st ¶ - The 3 scenarios pertain to the cooling system, based on the last paragraph in this section it appears that the author was using SFP cycle (FC) to represent a broader context (cooling and criticality) than just cooling.
Under Spent Fuel Pool (SFP) Storage and Cooling 2nd ¶ - Suggest simplifying fuel types since there is a mix of fuel assembly types (Westinghouse Optimized Fuel Assembly (OFA) and additionally Areva Lead Use Assemblies (LUAs) at Braidwood)
Page 7/7 - 1st ¶ - There is only one MSIV to close per SG.
2nd ¶ - Clarify that the actions are implemented "within" the LOFTRAN model and that the model does not take an action.

These comments, as well as other minor editorial comments are indicated in "track changes" in Word "Review" mode on the attached.

Please feel free to give me a call if you have any questions.

Thank you,

Leslie

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From: Wiebe, Joel [mailto:Joel.Wiebe@nrc.gov]
Sent: Thursday, January 30, 2014 12:05 PM
To: Holden, Leslie E.:(GenCo-Nuc)
Subject: Braidwood/Byron MUR Package for Proprietary and Factual Error Review - Part 3

Leslie,

Here is Part 3 of the MUR package for Proprietary and Factual Error Review.

Joel

Hearing Identifier: NRR_PMDA
Email Number: 1085

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3.3 Plant Systems

This section focuses on the structural integrity of major plant components as discussed in RIS 2002-03.

3.3.1 Regulatory Evaluation

The NRC staff's review focused on verifying that the licensee has provided reasonable assurance that plant systems will continue to operate safely at the uprated power level. The impact of the proposed licensed power on the structural integrity of major plant components using the criteria noted in RIS 2002-03, Attachment 1, Sections II and III.

3.3.2 Technical Evaluation

Main Steam

Main Steam Safety Valves (MSSVs)

The licensee evaluated the performance of the MSSVs at a 1.7 percent increase in RTP. One primary function of the MSSVs is to protect the SGs and main steam piping and components from overpressure. The design pressure rating of the SGs did not change at the new power level and the licensee concluded that the existing MSSV lift setpoints remain in accordance with the guidance provided in the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code). The licensee also evaluated the steam relieving capacity of each MSSV for mitigating accidents and transients. The licensee found the capacity to be "acceptable relative to the sizing criteria." Since the new operating power level and maximum power remain within the current analyzed limits, the NRC staff finds that the current design bounds operation at the increased power level.

Main Steam Isolation Valves (MSIVs)

The licensee evaluated the performance of the MSIVs at a 1.7 percent increase in RTP. The critical safety function for the MSIVs is to rapidly isolate a SG in the event of a downstream steam line rupture. The licensee evaluation at the higher steam flow rate found that there was no impact upon the critical variables used in calculating the design loads and associated stresses resulting from rapid closure of the MSIVs, consequently, the licensee concluded that operating at the increased power had no significant impact on the nuclear steam supply system (NSSS) and balance of plant (BOP) interface requirements for the MSIVs.

Steam Generator (SG) Power Operated Relief Valves (PORVs)

The licensee evaluated the capacity of the SG PORVs, atmospheric relief valves. The licensee stated that the PORVs are sized to have a capacity equal to approximately 10 percent of rated steam flow at no-load pressure. The SG PORVs in Byron and Braidwood, Units 1, meet this capacity, but the PORVs in Byron and Braidwood, Units 2, have a capacity of 9.3 percent at uprated conditions. An evaluation of the installed capacity concluded that the original design bases, in terms of plant cooldown capability, can still be achieved for the range of power uprate NSSS design parameters. Therefore, the SG PORVs are acceptable for operation at uprate conditions. Note that the Units 1 and 2, PORV trim will be modified to address SG margin to overfill concerns as noted in Attachment 5a of Exelon's letter to the NRC dated June 23, 2011 (ADAMS Accession No. ML111790026), as supplemented by Exelon's letter to the NRC dated

August 8, 2012 (ADAMS Accession No. ML12222A037). This modification will increase the PORV steam relief capacity.

The licensee concluded that the SG PORV relief capacity needed to be increased in order to provide adequate margin in the design basis cooldown rate for mitigating a SGTR. In order to increase the capacity of the SG PORVs, the licensee proposed to install a larger size valve trim on Unit 1 (Braidwood and Byron) SG PORVs. The ~~maximum~~ flow rate will increase from approximately 420,000 lbs/hr to approximately ~~736~~540,000 lbs/hr. The increase flow rate permits operators to release steam at higher rate, allowing the operators to quickly cool down and depressurize the RCS. The time to terminate the primary to secondary leakage is critical to maintaining an adequate margin to overfill. The increased steam release rate adversely affects the off-site dose calculations, resulting from a SGTR. Therefore, the modification to increase the trim size on the Unit 1 SG PORV requires prior NRC approval. The impact on the off-site dose assessment from the increase in steam rate released is addressed in Section 3.3.1 of this SE report. The modification to the Unit 2 PORVs was needed to restore the ~~achieve~~ analysis flow rates and, therefore, there was no impact on the analyzed off-site dose calculations and prior NRC approval is not required.

In addition to the PORV trim modification, the licensee identified the need to install uninterruptable power supplies (UPS) to the SG PORVs controllers. In the event of a loss of either Division 1 or Division 2 electrical power, two of the four SG PORVs would lose their control power and could no longer be operated remotely. Certain accidents can cause the loss of the function of a remaining SG; the associated SG PORV would also be lost. In such an event, the remaining single SG PORV would not be sufficient to meet the design basis cool down rate. The licensee opted to install UPS on only two of the four SG PORVs (1/2-MS018J-C and D) on each of the four units. Since the licensee opted to only install UPS on two o~~r~~f the four SG PORVs, the NRC staff requested additional information on each of the SG PORV component's power sources to verify independence. In a letter dated, February 20, 2012 (ADAMS Accession No. ML12052A113), the licensee provided a list of the electrical power supplies to each of the SG PORVs and controllers. The staff reviewed the information provided and confirmed each pair of SG PORVs was powered from separate electrical divisions. With the installation of the UPS, in the event of a loss of an electrical division, one of the two SG PORVs powered from that division would remain functional with power. Therefore, only one SG PORV would lose its functionality. The staff concurs with the licensee's assessment that the installation of a UPS to two of the four SG PORVs will improve the plant's capabilities to mitigate accidents by removing a vulnerability that could cause the loss of two SG PORVs with a single-failure of an electrical division.

Steam Dumps (SDs)

The licensee performed an analysis of the SD performance at a 1.7-percent increase in RTP. The licensee confirmed the ability of the SDs to work in conjunction with the reactor control system to withstand an external load reduction of up to 50 percent of plant-rated electrical load without a reactor trip. Therefore, the licensee found the SDs would continue to function at the increased power level similar to the manner they perform at current power level.

Moisture Separator Reheaters (MSRs)

The licensee performed an analysis of the MSRs shell and tube bundle at a 1.7-percent increase in RTP. The licensee found the new operating conditions were within the accepted

Comment [LEH1]: RAI response 8/12/12, revised Attachment 5a, page II-8 - Value updated.

Comment [LEH2]: Not currently in this section

Comment [LEH3]: Suggestion to indicate that we didn't change the flow rate but restored it to what we previously assumed.

limits of the original design of the MSR constructed under the provision of ASME Code, Section-VIII, Division 1.

Moisture Separator Reheater Safety Relief Valves (SRVs)

The licensee performed an analysis of the total relief valve capacity of MSR SRVs at a 1.7 percent increase in RTP. The licensee determined the current relief capacity of 12,267,000 lb/hr at 275 psia will encompass the maximum flow at the increased power level of 11,244,391 lb/hr. Therefore, the licensee concluded the MSR SRV capacities remain within the requirements of ASME Code, Section-VIII, Division 1.

Extraction Steam

The licensee performed an analysis of the extraction steam system at a 1.7 percent increase in RTP. The licensee's evaluation of the operating parameters (pressure, temperature, flow, velocity) in the extraction steam system would not be significantly impacted at the new conditions and would operate within the current design limits of the components in the extraction steam system.

Condensate and Main Feedwater

The licensee calculates that condensate flow will increase approximately 1.9 percent at the new operating power. The licensee evaluated the relevant parameters in the condensate and feedwater systems and determined that operating at the new power level would not exceed the piping design specifications. The additional feedwa~~y~~ter and extraction steam flow through the feedwater heaters will result in a small temperature increase in the feedwater supplied to the SGs. The licensee found that the small temperature increase is within the current design operating range for the feedwater system and SGs. The licensee is capable of making ~~proposed~~ adjustments to the main feedwater pump speed program to achieve the 1.9 percent flow increase. This adjustment will maintain the feedwater control valves near their current position for 100 percent power. The increased flow rates will remain within the capabilities of the current condensate and feedwater pumps. With respect to these minor changes in the main FW system, the licensee stated that the primary safety function to isolate main FW will not be adversely impacted while operating at the increased power level.

Feedwater Heaters

The licensee reviewed the relevant parameters associated with the feedwater heater trains. The licensee concluded that operating at the new power level will not exceed any of the feedwater heaters design specifications. The licensee will monitor wall thickness through its flow accelerated corrosion (FAC) program.

Feedwater Heaters and Moisture Separator Reheater Vents and Drains

The licensee evaluated the vents and drains for the feedwater heaters and MSRs at a 1.7 percent increase in RTP. The licensee determined that ~~the~~ several flow control valves (FCVs) did not have adequate operating margins. To resolve the issue, the licensee proposed changes to the flow control valve trim for heater No. 2 normal (all four units), heater No. 2 emergency (B~~r~~yron, Unit Nos. 1 and 2), and heater No. ~~-~~3 emergency (B~~r~~yron, Unit Nos. 1 and 2). Based upon the licensee's resolution of the issue, the staff finds the vent and drain system for the

Comment [LEH4]: LAR, Attachment 5, §VI.1.A.iv.b ,page VI-4 – "Adjustment of the feedwater pump speed control program to accommodate the minor increase in flow due to the MUR will help maintain the feedwater control valves (FCVs) near their current full power stroke positions without significantly affecting system performance."

feedwater heaters and moisture separat~~e~~or reheaters acceptable for the 1.7 percent increase in RTP.

Auxiliary Feedwater (AFW)

The licensee evaluated the interface of the AFW system with NSSS system. One of the safety functions for the AFW system is to provide a minimum flow during accidents and transients. The licensee does not propose any changes to the AFW pumps' design or performance; therefore, the minimum required flow capacities will remain the same. The licensee's analysis for the PU conditions confirmed that the current AFW system flow capacities are acceptable to meet the minimum flow requirements. Therefore, the licensee concluded that the current AFW system flow and pressure requirements and capabilities remain bounding for operating at the increased power level. Since the proposed power increase remains within the current design maximum core power of 102 percent (3658.3 MWt), the licensee found that the current inventory requirement in the condensate storage tank (CST) of 212,000 gallons remains bounding for the new higher power operating condition.

However, the licensee does intend to make changes to the current AFW system. The licensee found it necessary ~~for~~ to add air accumulators to the AFW FCVs to adequately support the SGTR analysis. The licensee discovered a vulnerability in isolating flow during a SGTR. The AFW FCVs are normally controlled by station instrument air (IA); however, IA is not available in the event of a loss of off-site power. Upon loss of the IA, the FCVs would go full-open. In the event of failure of the AFW motor-operated isolation valve to close, the FCV would need to close in order to isolate AFW flow to a ruptured SG. The air accumulators are designed to supply 30 minutes of air to keep the valve closed, giving the operators time to implement local manual actions. In the analysis of a SGTR, the licensee states that AFW flow control is maintained throughout the event[1]. The staff asked the licensee to provide justification of having only 30 minutes of air supply. In a letter dated February 20, 2012 (ADAMS Accession No ML12052A113), the licensee credited 30 minutes of air as a sufficient time for an operator to be dispatched to locally close the FCV by using its manual hand wheel. The licensee calculated 27.3 cubic feet of air is required to supply the FCVs for 30 minutes. The licensee is installing an air accumulator with 33.4 cubic feet, allowing a sufficient margin to maintain the FCVs function for at least 30 minutes. The NRC staff reviewed the licensee's response and finds the modification will assist the licensee with mitigating a SGTR by reducing a vulnerability in the event one of the electrical isolation valves fails to function.

Comment [LEH5]: Attachment 5a, page II-4 Unit 1 AFW flow was limited to the throttled flow value based on the installation of safety related air accumulators (as discussed in Section II.2.f). Since the Unit 2 SGs have sufficient MTO, the Unit 2 AFW flow values were conservatively assumed to fail open even though the throttled flow could have been assumed in the analysis based on the installation of safety related air accumulators

Safety-Related Cooling Water

The licensee performed evaluations of capabilities of the safety-related cooling water systems at the 1.63 percent PU conditions or 3645 MWt. These included a review of the component cooling (CC) water system, essential service water (~~-~~ESX) system, ultimate heat sink (UHS), and residual heat removal (RHR).

Component Cooling (CC) Water System

[1] Unit 1 AFW flow was limited to the throttled flow value based on the installation of the safety related air accumulators. Since the Unit 2 SGs have sufficient MTO, the Unit 2 AFW flow values were conservatively assumed to fail open even though the throttled flow could have been assumed in the analysis based on the installation of the safety related air accumulators.

The licensee evaluation of the CC water system confirmed that the heat removal capabilities are sufficient to accomplish a required plant cooldown to support operation at the increased power conditions for normal plant operation, plant shutdown, and following an accident. Based upon the information and evaluations performed by the licensee to show the design of the CC system at the increased power level is bounded by existing plant analyses, the staff finds the CC system acceptable for the 1.63 percent increase in power.

Essential Service Water (ESX) System

The licensee's evaluation of the ESX system confirmed that the normal and accident heat loads for operation at the proposed increased power level are bounded by the current design basis analyses with additional margin for calorimetric uncertainty. The licensee review of the existing ESX flows will continue to support the heat removal requirements at PU conditions; therefore, the ESX system and component design parameters remain bounding for operations at the increased power level. Based upon the information and evaluations performed by the licensee to show the design of the ESX system at increase power level is bounded by existing plant analyses, the staff finds the ESX system acceptable for the 1.63 percent increase in power.

Ultimate Heat Sink (UHS)

The UHS must be capable of providing cooling water to the ESX system in order to prevent the inlet temperature from exceeding its limits during operating conditions. The licensee's evaluation determined the current ESX system inlet temperature is bounding for the increased power condition. Based upon the information and evaluations performed by the licensee to show the design of the UHS system at increase power level is bounded by existing plant analyses, the staff finds the UHS system acceptable for the 1.63 percent increase in power.

Residual Heat Removal (RHR) System/Shutdown Cooling

The licensee performed an analysis of the RHR system to assess the impact of the increased heat load on the cooldown time. The licensee's evaluation of the RHR system confirmed that the cooldown times will increase at the higher power level due to the associated increase in the decay heat load. Using two trains, the time to cool down from 350 degree Fahrenheit (°F) to 140 °F increased from 39.9 hours to 42.3 hours, considering no spent fuel pool (SFP) heat load. Considering a minimum SFP heat load, the time increased from 43.6 hours to 46.7 hours. For the single-train case, the licensee calculated the time to cooldown from 350 °F to 200 °F increased from 47.6 hours to 50.3 hours, considering no SFP heat load. Hence, the licensee concluded that the current time for single-train cooldown of 72 hours continues to meet design requirements at the increased power conditions.

The licensee concluded that the cooldown time assuming various design conditions for the RHR system is adequately sized for normal cooldown heat loads associated with the power uprate. Based upon the information and evaluations performed by the licensee to show the design of the RHR system at increased power level is bounded by existing plant analyses, the staff finds the system acceptable for the 1.63 percent increase in power.

Conclusion for Safety-Related Cooling Water Systems

Based upon the information and evaluations performed by the licensee showing the design of the CC, ESX, UHS, and RHR systems at the proposed power level is bounded by existing plant analyses, the staff finds these systems acceptable.

Spent Fuel Pool (SFP) Storage and Cooling

The licensee evaluated three scenarios for the SFP fuel ~~cycle~~ cooling ~~(FC)~~ system for operation at the proposed power conditions. Operating at the proposed power will slightly increase the decay heat load in the SFP. The licensee's calculation show an increase of approximately 3.5 °F in the expected peak SFP water temperature for each of the three scenarios. For each scenario, the peak SFP water temperature remains well below the FC system design maximum temperature of 200 °F. Therefore, the licensee determined that the current FC system capacity for the SFP bounds the requirements under MUR conditions for all three scenarios, with significant margin; and all existing components, including associated pressures and flow rates, have been evaluated as acceptable for operation at the increased power level.

Comment [LEH6]: The 3 scenarios pertain to the cooling system, based on the last paragraph in this section it appears that the author was using SFP cycle (FC) to represent a broader context (cooling and criticality) than just cooling.

The SFP provides for storage of various ~~Westinghouse Optimized F~~fuel ~~A~~assembly types of different initial fuel enrichments and exposure histories. Of the six assumptions identified in the SFP criticality calculation, the licensee identified that only two parameters will be affected by operating at a higher power level. First, a higher SFP temperature will impact the moderator reactivity coefficient. Secondly, the amount of uranium depleted in the fuel during power operation will be impacted at increased power conditions. The licensee's criticality analysis conservatively uses a SFP temperature of 39.2 °F, which is the maximum possible density of the water in the SFP. Therefore, the actual SFP reactivity resulting from a higher temperature will be lower than the design maximum calculated value regardless of SFP water temperature. The licensee maintains spent fuel in zones in the SFP based on fuel burn-up. Operating at a higher power level should not impact the SPF criticality analysis as long as the licensee stores fuel in designated regions allowed by current license basis. Based on this evaluation, the licensee concluded that the current criticality calculation remains valid and will not be impacted by operating at the proposed power.

Comment [LEH7]: LAR, Attachment 5, §VI.1.D.i (page VI-9 & 10) - There is a mix of fuel assembly types (Westinghouse Optimized Fuel Assembly (OFA) and additionally Areva Lead Use Assemblies (LUAs) at Braidwood)

For SFP storage and cooling, based upon the information and evaluations performed by the licensee to show the design of the spent fuel cycle (FC) system at increase power level is bounded by existing plant analyses, the staff finds the FC system acceptable for the proposed power.

Radioactive Waste

The licensee evaluated the liquid and gaseous radioactive waste systems for operating at the proposed power. The licensee determined that there was an insignificant impact on the gaseous and liquid waste volumes at the increased power level. The licensee found the liquid and gaseous waste systems are bounded by the existing system design parameters and are acceptable at the proposed power conditions.

For the radioactive waste systems, based upon the information and evaluations performed by the licensee to show the design of the liquid and gaseous radioactive waste systems at increase power level is bounded by existing plant analyses, the staff finds the liquid and gaseous radioactive waste systems acceptable for the proposed power.

Steam Generator Tube Rupture (SGTR) Methodology

In its June 23, 2011, (ADAMS Accession No. ML111790026) the licensee changed the methodology used to mitigate a SGTR accident summarized in FSAR, Section 15.6.3. The new methodology follows the NRC-approved methodology described in Westinghouse Commercial

Atomic Power (WCAP)-10698-P-A, "SGTR Analysis Methodology to Determine the Margin to Steam Generator Overfill." Within this new methodology are critical operator actions that must be performed within a specified time period. These operator actions are: (1) isolate AFW flow to the ruptured SG, (2) close the MSIV~~s~~ on the ruptured SG, (3) initiate a RCS cooldown and depressurization, and (4) terminate SI flow.

The staff noted that two SG PORVs were opened late in the event to stop overfill from occurring. The staff asked the licensee to justify whether this activity should be a time critical operator action. In a letter dated February 20, 2012 (ADAMS Accession No. ML12052A113), the licensee explained that the WCAP analysis does not identify specific operator actions after SI termination. The licensee states that any required operator actions after SI termination are implemented at the required time ~~by~~ within the LOFTRAN computer model.

Comment [LEH8]: Clarifies that the model does not take actual actions.

Flooding analysis

Operating at the proposed power requires approximately a 1.9 percent increase in flow rates in the condensate, main feedwater and main steam systems (MSSs). The licensee evaluated the impact of the increased flow rates on the current flooding analysis and determined that the current flood levels were not affected by operating at an increase power level. Based upon the information and evaluations performed by the licensee to show the effects on internal flooding at the proposed power are bounded by existing plant analyses, the NRC staff finds the internal flooding analysis acceptable for operation at the proposed power.

3.3.3 Conclusion

Based on the above, the NRC staff finds the licensee's request to be acceptable with respect to the balance of plant systems affected by the power uprate. This acceptance is based on the licensee's indication that the design capability of the BOP systems will continue to bound the impacts of the uprate.