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10 CFR 50.90

September 5, 2013

U. S. Nuclear Regulatory Commission
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Braidwood Station, Units 1 and 2
Facility Operating License Nos. NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and STN 50-457

Byron Station, Units 1 and 2
Facility Operating License Nos. NPF-37 and NPF-66
NRC Docket Nos. STN 50-454 and STN 50-455

Subject: Response to NRC HELB Audit Request for Information Supporting Request for License Amendment Regarding Measurement Uncertainty Recapture Power Uprate

References:

1. Letter from Craig Lambert (Exelon Generation Company, LLC) to U. S. NRC, "Request for License Amendment Regarding Measurement Uncertainty Recapture Power Uprate," dated June 23, 2011 [ML111790030]
2. Letter from J. S. Wiebe (U. S. NRC) to M. J. Pacilio (Exelon Generation Company, LLC), "Byron Station, Unit Nos. 1 and 2, and Braidwood Station, Units 1 and 2 - Request for Additional Information and Suspension of Review of License Amendment Request for Power Uprate (TAC Nos. ME6587, ME6588, ME6589, and ME6590)," dated December 6, 2012 [ML12271A308]
3. Letter from David M. Gullott (Exelon Generation Company, LLC) to U. S. NRC, "Additional Information Supporting Request for License Amendment Regarding Measurement Uncertainty Recapture Power Uprate," dated July 5, 2013 [RS 13-189] [ML13186A178]
4. E-Mail from J. S. Wiebe (U. S. NRC) to David M. Gullott (Exelon Generation Company, LLC), "Preliminary RAI Regarding TB Bldg HELB," dated August 29, 2013

In Reference 1, Exelon Generation Company, LLC (EGC) requested an amendment to Facility Operating License Nos. NPF-72, NPF-77, NPF-37 and NPF-66 for Braidwood Station, Units 1 and 2, and Byron Station, Units 1 and 2, respectively. Specifically, the proposed changes revise the Operating License and Technical Specifications to implement an increase in rated thermal power of approximately 1.63% based on increased feedwater flow measurement accuracy.

In Reference 2, the NRC requested additional information (RAI) pertaining to the High Energy Line Break (HELB) analysis and an audit to complete their detailed review of the power uprate. The response to this RAI was provided in Reference 3. On July 17 and 18, 2013 the NRC conducted the audit. As follow-up to this audit, in Reference 4 the NRC requested additional information regarding the assumed Turbine Building HELB break locations. The response to this request is provided in the Attachment.

EGC has reviewed the information supporting a finding of no significant hazards consideration and the environmental consideration provided to the NRC in Reference 1. The additional information provided in this submittal does not affect the bases for concluding that the proposed license amendment does not involve a significant hazards consideration. Furthermore, the additional information provided in this submittal does not affect the bases for concluding that neither an environmental impact statement nor an environmental assessment needs to be prepared in connection with the proposed amendment.

There are no regulatory commitments contained in this letter.

Should you have any questions concerning this letter, please contact Leslie E. Holden at (630) 657-3316.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 5th day of September 2013.

Respectfully,

David M. Gullott
Manager - Licensing

Attachment: Response to NRC Request for Additional Information (Non-Proprietary)

ATTACHMENT

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION

September 5, 2013

(NON-PROPRIETARY)

NRC Request

According to Byron and Braidwood (B/B) UFSAR Section 3.6, piping failures postulated in B/B include high energy (HE) line breaks (HELBs), HE line cracks (HELCs) and moderate energy line cracks (MELCs).

With regard to postulated piping failures, B/B-UFSAR Section 3.6 states that:

> ***The effects of high energy line breaks in the turbine building have been evaluated with respect to potential impact on safety-related equipment located in adjoining auxiliary building rooms.***

and that:

> ***The possible effects associated with the postulated break of piping considered are structural loads due to pressurization, increases in pressure and temperature which could affect environmental qualification of equipment, and damage due to pipe whip and jet impingement.***

B/B-UFSAR Section 3.6.1, Postulated Piping Failures in Fluid Systems Outside the Containment, provides the criteria for postulating locations of piping failures (HELBs, HELCs and MELCs) outside containment.

Describe in detail the postulated piping failures and their locations utilized for the analyses of M&E release from piping located in the turbine building that could affect safety-related equipment located in adjoining auxiliary building rooms and how this information was used to provide input to the Gothic analysis. If bounding conditions have been utilized for these analyses identify the piping failures utilized, their bounding M&E and the bounding locations that would envelop the resulting effects on the safety-related equipment located in adjoining auxiliary building rooms. In addition, justify how this/these M&Es and location(s) bound others. This justification should include, but is not limited to, consideration of a HE release near a HELB damper that would allow pressurization of a room while the damper is closing while another room is not yet pressurizing because its damper is farther away from the HE release, thereby creating a differential pressure across the wall that separates the two rooms.

Response

As discussed on July 17, 2013 during the audit, the Turbine Building (TB) High Energy Line Break (HELB) mitigation strategy and associated methodologies were revised, and a new TB HELB analysis was performed to address the Auxiliary Building (AB) rooms/areas impacted by TB HELBs. However, the overall equipment qualification design bases were maintained (i.e., the qualification of Class 1E electrical equipment in the identified AB rooms/areas are not adversely impacted by a TB HELB). The new TB HELB analysis confirms that the adjacent AB rooms/areas are maintained as mild Environmental Qualification (EQ) environments based on the bounding TB HELBs.

The Byron and Braidwood Updated Final Safety Analysis Report (UFSAR) does not explicitly identify or discuss the locations of the TB HELBs that need to be considered or analyzed for their environmental impacts on the safety-related equipment in the adjacent AB rooms/areas.

As part of our efforts to evaluate and resolve the non-conformances associated with the existing TB HELB analysis, EGC reviewed the existing analysis and determined that additional line breaks should be considered for conservatism and to verify that the postulated breaks in the new TB HELB analysis would be bounding. For the new TB HELB analysis, breaks were chosen based on the resulting severity of the break (i.e., highest energy release) and not the potential of the pipe to break (i.e., piping analysis results were not used to determine break locations).

In order to determine and verify that the bounding conditions have been properly identified, a broader spectrum of line breaks than previously considered were postulated for each elevation, conservative mass and energy (M&E) releases were determined for the postulated line breaks, and evaluations were performed to determine how the postulated breaks would impact the environmental parameters in the adjacent AB rooms/areas. Consideration of this broader spectrum of TB pipe breaks, along with maximizing the M&E releases, provides assurance that the most challenging environments for the safety-related equipment in the adjacent AB rooms/areas are determined. The methods employed are briefly discussed below.

Postulated Bounding Line Breaks

The new TB HELB analysis considered a broad spectrum of main steam (MS) line breaks and high energy liquid line breaks in the TB. The breaks specifically analyzed resulted in the highest combination of mass flow rates and enthalpies, which in turn resulted in the highest temperatures in the TB and adjacent AB rooms/areas. The bounding line breaks used in the new TB HELB analysis are shown in Table A.1.

To fully assess what breaks would be bounding, MS breaks from the largest to the smallest line size were considered for each elevation of the TB. The largest MS line break size analyzed was limited to 1.4 ft^2 due to the integral flow restrictors in the steam generators. The smallest MS line break size analyzed was 0.3 ft^2, since the mass flow rates for this break represent the lowest mass flow rates for the smallest steam line and liquid line breaks considered in the TB. Additionally, the 0.3 ft^2 break is the smallest MS line break that would result in an automatic reactor trip that requires actuation of the safety-related equipment in adjacent AB rooms/areas.

Intermediate break sizes were considered and a break size of 0.5 ft^2 concurrent with a loss of offsite power (LOOP) was determined to be the limiting intermediate break. This break size results in the maximum TB pressure occurring as the AB rooms fans attempt to start when the EDG starts, resulting in a high differential trip. This scenario represents the highest M&E release associated with the longest time that the AB room ventilation is not operating, which in turn leads to the highest room temperatures.

These three MS main steam line breaks are postulated to occur on each TB elevation that communicates with an adjacent AB room/area (401', 426' and 451' elevations).

The liquid lines breaks evaluated represent the liquid lines on each elevation that produce the highest combination of mass flow rates and enthalpies. Although these breaks do not result in higher enthalpies than the MS line breaks, they may result in higher mass flow rates, which in some cases result in faster initial temperature increases in the TB and adjacent AB rooms/areas.

M&E Releases to Maximize TB Environmental Conditions

For each MS line break analyzed in the new TB HELB analysis, the transient M&E releases consistent with Westinghouse WCAP-10961, "Steamline Break Mass/Energy Releases for Equipment Environment Qualification Outside Containment," (Reference A.1) were used. Specifically, the Westinghouse transient M&E releases involve progressively increasing enthalpies with progressively decreasing mass flow rates and conservatively maximize enthalpies to maximize the effect of M&E releases on environmental qualification of equipment located outside containment. Westinghouse transient M&E releases were developed to bound Byron and Braidwood Stations, Units 1 and 2, and include additional conservatisms. The Westinghouse approach has been approved for Byron and Braidwood Stations by the NRC for maximizing the effect of M&E releases on environmental qualification of equipment located outside containment (References A.2, p. 3-4 and A.3, p. 3-18).

For each liquid line break evaluated, constant M&E releases based on the choked mass flow rate (Henry-Fauske Critical Flow Model) and initial enthalpy were used with one exception; pump runout was credited for the FW line breaks. Additionally, enthalpies were conservatively maximized. Table A.1 shows the constant M&E releases used for the bounding breaks. Specifically, it shows the portion of the break M&E releases that flash to steam in the TB environment and were analyzed for the effects on the adjacent AB areas.

Differential Pressure Between AB Rooms

The divisional block walls (e.g., walls between the Division 11(21) and Division 12(22) ESF equipment), between the AB rooms adjacent to the TB, have been evaluated for the differential pressure that may exist following a TB HELB. The two divisional AB rooms are adjacent to each other and each pair of rooms communicates with the same TB elevation HELB environment. Following a TB HELB, the TB pressurizes, drives flow into the AB rooms, and pressurizes the AB rooms for a short time until HELB dampers between the TB and AB rooms close. By applying the lumped-parameter (i.e., lumped volume) modeling in the GOTHIC analysis, the pressurization of the TB elevation is uniform; therefore the TB HELB environment outside each of the AB rooms was calculated to be the same. However, differential pressurization was calculated between the AB rooms due to variations in the closure characteristics of the HELB dampers, as well as differences in AB room volumes and flow paths. In particular, the closure time of the HELB damper of the AB room for one division was maximized, while the closure time of the HELB damper to the AB room for other division was minimized. This results in one AB room reaching a higher peak pressure than the adjacent room, creating a differential pressure across the divisional block wall. The load due to this differential pressure has been accounted for in the new designs to reinforce the divisional block walls.

If one divisional AB room were postulated to experience higher TB pressure outside the room, the higher TB pressure would result in higher differential pressure across the HELB damper. The dampers are designed to close faster with increasing differential pressure. The peak pressure in the AB room would be expected to be the same as analyzed due to the faster damper closure time. Therefore, based on engineering judgment, the impact of a postulated higher pressure outside one AB room would be encompassed by the HELB damper response times analyzed, (i.e., one damper closes at the minimum time verses the other damper closes at the maximum time).

REFERENCES:

A.1 Westinghouse Report No. WCAP-10961, "Steamline Break Mass/Energy Releases for Equipment Environment Qualification Outside Containment," Rev. 1, October 1985

A.2 NRC Report No. NUREG-76, Supplement No. 7, "Safety Evaluation Report related to the operation of Byron Station, Units 1 and 2, Docket Nos. STN 50-454 and STN 50-455," November 1986

A.3 NRC Report No. NUREG-1002, Supplement No. 2, "Safety Evaluation Report related to the operation of Braidwood Station, Units 1 and 2, Docket Nos. 50-456 and 50-457," October 1986

Table A.1: Bounding Turbine Building HELBs Initial Mass Flow Rates and Enthalpies

TB EL.	Line Type	Line†	Initial Line Enthalpy* (Btu/lbm)	Initial Steam Enthalpy in TB (Btu/lbm)	Initial Steam Mass Flow Rate in TB (lbm/sec)
451	Steam	1.4 ft^2 MS	1199.3	1199.3	2,730
		0.5 ft^2 MS	1199.3	1199.3	1,027
		0.3 ft^2 MS	1199.3	1199.3	621.7
	Liquid	26" HD	353.8	1149.8	5,154
426	Steam	1.4 ft^2 MS	1199.3	1199.3	2,730
		0.5 ft^2 MS	1199.3	1199.3	1,027
		0.3 ft^2 MS	1199.3	1199.3	621.7
	Liquid	20" HD	352.4	1149.8	2,949
401	Steam	1.4 ft^2 MS	1199.3	1199.3	2,730
		0.5 ft^2 MS	1199.3	1199.3	1,027
		0.3 ft^2 MS	1199.3	1199.3	621.7
	Liquid	30"FW	430.0	1149.8	2,398

* For conservatism, the enthalpies for steam line breaks are increased by ~0.78% to reflect Westinghouse NSSS design parameters.

† Acronyms:
MS - Main Steam   HD - Heater drain   FW - Feedwater