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10 CFR 50.90

RS-12-081

May 16, 2012

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

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: Additional 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 (MUR) Power Uprate," dated June 23, 2011 [ML111790030]
2. E-mail from B. Mozafari (U. S. NRC) to L. Holden (et. al.) (Exelon Generation Company, LLC), "Clarifications Requested as a Result of Telecon on Friday April 13, 2012," dated April 18, 2012 [ML12109A278]
3. Letter from J. 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 Related to License Application for Measurement Uncertainty Recapture Uprate (TAC NOS. ME6587, ME6588, ME6589, and ME6590)," dated May 10, 2012 [ML12121A694]
4. Letter from Kevin F. Borton (Exelon Generation Company, LLC) to U. S. NRC, "Additional Information Supporting Request for License Amendment Regarding Measurement Uncertainty Recapture Power Uprate," dated February 20, 2012 [ML12052A113]
5. Letter from Kevin F. Borton (Exelon Generation Company, LLC) to U. S. NRC, " Supplemental Information Related to License Amendment Request Regarding Measurement Uncertainty Recapture Power Uprate," dated March 30, 2012 [ML12093A242]
6. Letter from B. Mozafari (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 RE: Measurement Uncertainty Recapture Power Uprate Request (TAC NOS. ME6587, ME6588, ME6589, and ME6590)," dated February 14, 2012 [ML120270146]

7. Letter from Kevin F. Borton (Exelon Generation Company, LLC) to U. S. NRC, "Additional Information Supporting Request for License Amendment Regarding Measurement Uncertainty Recapture Power Uprate," dated March 30, 2012

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 References 2 and 3 the NRC requested additional information (RAI) to support review of the proposed changes. The responses to these RAIs are provided in Attachments 1 and 2, respectively. The requested information in Reference 2 regarding the Unit 1 Replacement Steam Generators (RSGs), is in follow-up to previous information provided by EGC to the NRC in References 4 and 5, in response to NRC request number 12 provided in Reference 6. The requested information in Reference 2 regarding the Spent Fuel Pool (SFPs), is in follow-up to previous information provided by EGC to the NRC in Reference 7, in response to NRC request number 13 provided in Reference 6. The requested information in Reference 3 regarding the piping evaluation is in follow-up to previous information provided by EGC to the NRC in Reference 4, in response to NRC request number 8 provided in Reference 6. The NRC had requested a response to this request by May 14, 2012; in subsequent discussions with the NRC on May 14, 2012, they have agreed to ECG providing this response by May 16, 2012.

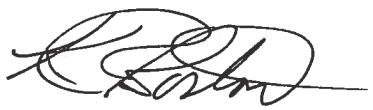
EGC has reviewed the information supporting a finding of no significant hazards consideration and the environmental consideration provided to the NRC in Reference 1. The additional information provided in this submittal does not affect the previously stated bases in Reference 1 for concluding that the proposed license amendment does not involve a significant hazards consideration. In addition, the 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 16th day of May 2012.

Respectfully,



Kevin F. Borton
Manager, Licensing - Power Uprate

Attachment 1 Response to Request for Additional Information, NRC E-mail dated April 18, 2012, (Non-Proprietary)

Attachment 2 Response to Request for Additional Information, NRC Letter dated May 10, 2012 [ML12121A694], (Non-Proprietary)

Braidwood and Byron Stations
Measurement Uncertainty Recapture License Amendment Request (MUR LAR)
May 16, 2012

ATTACHMENT 1

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
NRC E-Mail dated April 18, 2012

(NON-PROPRIETARY)

NRC Request 1

Referring to original RAI-12: Unit 1 steam generator structural evaluation

1. *Referring to Feb 20, 2012 letter, the 1st paragraph states that there are no changes to the calculated stress values because the MUR primary and secondary side temperature and pressure are enveloped by the original analysis. The 2nd paragraph states that a reconciliation analysis was performed due to difference in loads. These two statements are not consistent and the reason for the reconciliation analysis is not clear.*
2. *The summary tables provided in the response to RAI-12 represent values for the MUR conditions versus the values for the original power conditions instead of the current power level (it is expected that, from the review of LAR for 5% power uprate, the analysis of record was updated). It is difficult to discern the effects of MUR power uprate and identify those components that were affected (i.e., not bounded by the current analysis of record).*
3. *For some of the components in Table 12-1, the MUR stress intensity (SI) limits are larger than the original SI limits. As the code of record and methodology is unchanged, the reasons for these changes are not clear and no explanation is given in the response.*
4. *Aux. feedwater nozzle, which was a critical component for 5% stretch power uprate, is not listed in the summary tables included in the response to RAI-12. No explanation is given.*

In summary, the response to RAI-12 should be clarified to reconcile MUR design input parameters against the current analysis of record, and for those components that are not bounded by the current analysis of record, it is expected that the maximum calculated stresses and cumulative fatigue usage factors are updated and included in the response to this RAI.

Response

1. With regards to the apparent discrepancy between the first and second paragraphs in the February 20, 2012 (Reference A1.1-1), the first paragraph pertains to design conditions while the second paragraph pertains to transient conditions. The following clarification is provided for the first and second paragraphs, respectively:
   - The primary and secondary side ***design*** temperatures and ***design*** pressures for the MUR remain unchanged from the original analysis, therefore there would be no changes to the calculated stress values or limits for the design conditions (i.e., name plate conditions).
   - The MUR power uprate did result in changes to the ***transient load conditions*** (Level A & B (Normal and Upset), Level C (Emergency) and Level D (Faulted)); the reconciliation analysis was performed to address these changes.
2. Since the differences in the transients provided for the Stretch Power Uprate (SPU) power level (3600.6 MWt) and the original RSG power level (3425 MWt) analysis were small, the temperature ranges for the SPU transient load conditions were equal to, or bounded by, nearly all the temperature ranges for the original RSG power level transients. The only SPU transients that were not bounded by the original power

level transients were the Level A/B transients and the only components that were affected were the Main Feed Water (FW) Nozzle Transition Ring/Thermal Sleeve and the Auxiliary FW Nozzle Transition Ring. Therefore, with the exception of the values provided for the Main FW Nozzle Transition Ring/Thermal Sleeve in Table EMBCB R12-1, "Stress Intensity (SI) and Fatigue Usage Factors (FUF) for Level A & B Conditions," (References A1.1-1 and A1.1-2), the Original values presented in the Tables EMCB R12-1 through 4 in the previous submittals (References A1.1-1 and A1.1-2) represent the most current (i.e., SPU) values. As shown in those Tables, the resultant stresses due to the MUR power uprate remain within acceptable limits.

A comparison of the values for the Main Feed Water (FW) Nozzle Transition Ring/Thermal Sleeve is provided in the following Table:

Table A1.1-1 Stress Intensity (SI) and Fatigue Usage Factors (FUF) for the Main Feedwater Nozzle Transition Ring /Thermal Sleeve for Level A & B Conditions

Condition	Orig. SI Range (ksi)	SPU SI Range (ksi)	MUR SI Range (ksi)	SI Limit (ksi)	Orig. FUF	SPU FUF	MUR FUF	FUF Limit
Level A/B	***27.2*** (*)	***27.2*** (*)	***27.2*** (*)	69.9	0.945	0.967	0.985	1.0

The Auxiliary FW Nozzle Transition Ring is addressed in item number 4 below.

3. The stress limits vary with temperature. As the temperature increases, the steel gets weaker, and therefore the limits are lower. The most basic approach is to base the limits on the steam generator maximum transient temperature, since this results in the lowest possible stress limit. For most components the stress limits for the MUR power uprate and Original analysis were based on this approach using the RSG maximum transient temperature.

   For the Primary Head / Tubesheet Juncture the original SI range limit (87.3 ksi) corresponded to 2 Sy at maximum transient temperature (620°F) since the range was between hydrotest and a Level A/B transient. The MUR power uprate SI range limit (80.1 ksi) was set at 3 Sm at 620°F to correspond to the application of elastic plastic methodology in accordance with NB-3228.5.

   However, for the Secondary Shell / Tubesheet Juncture and Tubesheet Perforated Region the most limiting loading condition is the hydrotest condition which is performed at a relatively low temperature (less than 200°F). The stress intensity values provided for these components in Table EMCB R12-1 (Reference A1.1-2) represent those for the hydrotest conditions (200°F). Therefore the stress limits for these components were revised to reflect the corresponding limits at 200°F to correspond to the hydrotest condition.

4. The Auxiliary FW Nozzle Transition Ring was not reconciled since the original analysis bounds the current capped auxiliary nozzle under MUR power uprate condition.

(*) Simplified elastic-plastic analysis in accordance with NB-3228.5 was used.

A1.1-1 Letter from Kevin F. Borton (Exelon Generation Company, LLC) to U. S. NRC, "Additional Information Supporting Request for License Amendment Regarding Measurement Uncertainty Recapture Power Uprate," dated February 20, 2012 [ML12052A113]

A1.1-2 Letter from Kevin F. Borton (Exelon Generation Company, LLC) to U. S. NRC, " Supplemental Information Related to License Amendment Request Regarding Measurement Uncertainty Recapture Power Uprate," dated March 30, 2012 [ML12093A242]

NRC Request 2

Referring to original RAI-13:

1. *The response provides a maximum of 166.6 degrees SFP peak temperature. Knowing that there is a possibility for concrete surface temperature to exceed 150 degrees (the response does not include the code of record and acceptance criteria), 166.6 degrees is an open item and may be inconsistent with the conclusions made in this response.*
2. *The response states that the existing calculations were reviewed (not revised) and concludes that the design basis code of record is satisfied. This implies that MUR input parameters were bounded by the analysis of record and no revision to the existing design basis calculations was required. It is not clear how the MUR increase in SFP temperature has been reconciled.*

In summary, the response to RAI-13 should provide further information to reconcile the MUR input parameters against the SFP design basis acceptance criteria specified in the design code of record. If the analyses of record for the SFP (including the SFP liner and spent fuel racks) are not bounding, then it is expected that a re-evaluation is performed and the analyses of record are updated.

Response

1. As stated in the License Amendment Request (LAR) (Reference A1.2-1), Attachment 5, Section VI.1.D.ii, “Spent Fuel Pool Cooling System,” the decay heat load in the spent fuel pool increases slightly, resulting in an increase of approximately 3.5°F in the expected peak spent fuel pool (SFP) water temperature for each of the three scenarios for the MUR power uprate. For two of the postulated scenarios, the calculated bulk SFP water temperature remains below 150°F.

   For the case of a full core offload with loss of one heat exchanger train, the peak SFP bulk water temperature will increase to 166.6°F. The current design and licensing basis for Byron and Braidwood reflects the fact that SFP temperature will exceed 150°F in this scenario (i.e., the current peak SFP temperature for this scenario is 162.7°F). This existing basis is reflected in the Stretch Power Uprate (SPU) submittal dated December 21, 2000 (Reference A1.2-2), and NRC Safety Evaluation Report dated May 4, 2001 (Reference A1.2-3), Section 4.10.3.2, “Spent Fuel Pool Structural Integrity.”

   The essential elements of the above referenced SPU documents remain valid for the MUR power uprate, specifically: (1) the peak temperature was calculated using conservative assumptions (e.g., no evaporative heat loss); (2) the calculated SFP temperature exceeds the guidance of 150°F described in American Concrete Institute (ACI) 349-97, "Nuclear Safety Structures, " for concrete structures for a limited period (approximately 300 hours for the MUR power uprate), thus this is a short term condition as allowed by ACI 349-97 (§A.4.2) and a similar provision was previously approved by the NRC (Reference A1.2-3); (3) the temperatures during a normal refueling with two heat exchangers operable will not peak above 140°F; (4) the SFP temperature alarm is set at 149°F to alert operators of an abnormal condition, such as loss of SFP cooling; and, (5) considering an ambient temperature of 70°F on the exterior of the pool, the average concrete temperatures of the walls

and bottom slab are well below (i.e., (166.6°F + 70°F)/2 = 118.3°F) the ACI 349-97 guidance of 150°F.

2. The existing calculations for the SFP structure, including the liner and fuel pool racks, have been reviewed for the increased peak temperature. A detailed evaluation was performed to analyze the changes due to the MUR power uprate. The SFP structure was evaluated for flexure, and shear loads as well as moment loads on the reinforcing steel, at a bounding temperature of 167°F. The results of these evaluations include the following:

Compressive Strain - Critical Element	**Acceptance Criteria**
0.00126 in/in	<0.003 in/in
Maximum Rebar Stress - Critical Element	**Acceptance Criteria**
30.32 ksi	<0.9(60) = 54 ksi
Shear Loading Safety Factor (SF)	**Acceptance Criteria**
West wall critical element SF = 1.26	>1.0
North wall critical element SF = 1.01	>1.0

Therefore the SFP structure is acceptable for MUR power uprate conditions. The design basis calculations will be updated to reflect the MUR power uprate changes described above.

The SFP liner and racks were evaluated in the existing analyses of record for a design temperature of 200°F, which bounds the peak MUR SFP temperature of 166.6°F. Therefore the SFP liner and the spent fuel racks remain capable of performing their intended design functions under MUR power uprate conditions.

REFERENCES:

A1.2-1 Letter from Craig Lambert (Exelon Generation Company, LLC) to U. S. NRC, "Request for License Amendment Regarding Measurement Uncertainty Recapture (MUR) Power Uprate," dated June 23, 2011 [ML111790030]

A1.2-2 Letter from R. M. Krich (Exelon Generation Company, LLC) to U. S. NRC, "Response to Request for Additional Information Regarding the License Amendment Request to Permit Uprated Power Operations at Byron and Braidwood Stations," Letter RS-00-158, dated December 21, 2000 [ML003780801].

A1.2-3 Letter from U. S. NRC to Mr. O. D. Kingsley (Exelon Generation Company, LLC), "Issuance of Amendments; Increase in Reactor Power, Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2 (TAC Nos. MA9428, MA 9429, MA9426, and MA9427)," May 4, 2001 [ML011420274].

Braidwood and Byron Stations
Measurement Uncertainty Recapture License Amendment Request (MUR LAR)
May 16, 2012

ATTACHMENT 2

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
NRC Letter dated May 10, 2012
[ML12121A694]

(NON-PROPRIETARY)

NRC Request

In reviewing the Exelon Generation Company's (Exelon's) response dated February 20, 2012, related to the NRC staff request for additional information dated February 14, 2012, for the Braidwood Station, Units 1 and 2 and Byron Station, Unit Nos. 1 and 2 measurement uncertainty recapture (MUR) power uprate application, and in consideration of the clarification teleconference on April 25, 2012, the NRC staff has determined that the following information is needed in order to complete its review:

> *In your response to NRC/EMCB Request 8, you listed Balance of Plant/Nuclear Steam Supply System piping systems that were assessed for MUR power uprate conditions. For those listed piping systems, provide a summary table including the temperature and associated service conditions used in the analysis of record, under current licensed thermal power and for MUR power uprate conditions.*
>
> *During a phone call on May 7, 2012, the staff clarified that the summary table needed only to include, for each of the listed piping systems, three Temperatures for the worstcase (i.e., largest Temperature increase due to MUR). The Temperatures are the design basis analysis Temperature, the current licensed thermal power Temperature, and MUR Temperature.*

Response

All MUR power uprate operating temperatures evaluated for the Main Steam System were lower than the CLTP operating temperatures; therefore the Main Steam System should have been identified as a non-adversely effected system in the February 20, 2012 response (Reference A2-1). For the Essential Service Water System, the heat loads (normal, shutdown, and design basis accident) were previously evaluated at 3,672.3 MWt which bounds the MUR power uprate conditions; therefore no individual temperature increases due to the MUR power uprate were evaluated.

The following Table A2-1, "Maximum Temperature Increases for Systems with Increased Operating Temperatures Due to MUR Power Uprate Conditions," presents the maximum temperature increases (°F) for each of the remaining systems.

Table A2-1: Maximum Temperature Increases for Systems with Increased Operating Temperatures Due to MUR Power Uprate Conditions

System	Line[a]	Operating[b]		Design/ AOR
		CLTP	MUR	
Extraction Steam System	Byron 2ES02AA	451.18	453.67	450 [c] [e]
Condensate System	Braidwood 2CDA8AA	131.70	132.60	<150 [d]
Condensate Booster System	Braidwood 2CB11AA	409.20	411.30	407 [c] [e]
Heater Drain System	Byron 2HD01AA	442.70	445.70	452 [c]
Feedwater System	Braidwood 2FW03B	443.90	446.10	447 [c]
Auxiliary Steam System	Byron 2AS91A	375.5	378.5	400 [c]
Fuel Pool Cooling System[f]	Braidwood 1FC01A	162.7	166.6	200 [g]
Component Cooling Water System	Braidwood 1CC01AA	162.1	162.7	200 [g]
Non-Essential Service Water	Braidwood 1WS30AB	123.17	124.35	<150 [d]

Notes:

(a) The line number is provided for reference only; there may be additional lines within each system that are at the same temperatures.

(b) For the MUR power uprate an evaluation was performed to determine the temperatures at CLTP (3586.6 MWt) and MUR power uprate conditions.

(c) Temperature values used in thermal stress analyses.

(d) Pipe thermal stress are not typically evaluated for operating temperatures less than 150°F.

(e) The deviation between the operating temperature and design temperature has been evaluated. Sufficient margin exists to increase the design temperature to bound the CLTP and MUR operating temperatures.

(f) Bulk water temperature for full core discharge with one heat exchanger.

(g) System design temperature.

A2-1 Letter from Kevin F. Borton (Exelon Generation Company, LLC) to U. S. NRC, "Additional Information Supporting Request for License Amendment Regarding Measurement Uncertainty Recapture Power Uprate," dated February 20, 2012 [ML12052A113]