

RS-10-163

October 25, 2010

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 Large Break Loss-of-Coolant Accident Analysis Methodology

- References:
1. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "License Amendment Request Regarding Large Break Loss-of-Coolant Accident Analysis Methodology," dated December 16, 2009
  2. Letter from M. J. David (U.S. NRC) to M. J. Pacilio (Exelon Nuclear), "Braidwood Station, Units 1 and 2, and Byron Station, Unit Nos. 1 and 2 – Request for Additional Information Related to Large Break Loss-of-Coolant Accident Analysis Using ASTRUM (TAC Nos. ME2941, ME2942, ME2943, and ME2944)," dated September 10, 2010

In Reference 1, Exelon Generation Company, LLC (EGC) requested an amendment to Facility Operating License Nos. NPF-72 and NPF-77 for Braidwood Station, Units 1 and 2, and Facility Operating License Nos. NPF-37 and NPF-66 for Byron Station, Units 1 and 2. The proposed change revises Technical Specifications (TS) Section 5.6.5, "Core Operating Limits Report (COLR)," to replace the existing reference for the large break loss-of-coolant accident (LOCA) analysis methodology with a reference to WCAP-16009-P-A, "Realistic Large Break LOCA Evaluation Methodology Using Automated Statistical Treatment of Uncertainty Method (ASTRUM)." The NRC requested additional information to support review of the proposed change in Reference 2. In response to this request, EGC is providing the attached information.

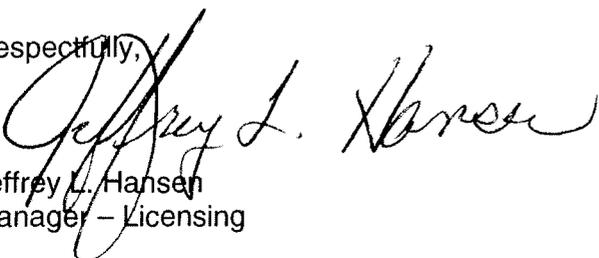
EGC has reviewed the information supporting a finding of no significant hazards consideration, and the environmental consideration, that were previously provided to the NRC in Attachment 1

of 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. In addition, 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 Mr. Richard W. McIntosh at (630) 657-2816.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 25th day of October 2010.

Respectfully,



Jeffrey L. Hansen  
Manager – Licensing

Attachment 1: Response to Request for Additional Information

cc: NRC Regional Administrator, Region III  
NRC Senior Resident Inspector – Braidwood Station  
NRC Senior Resident Inspector – Byron Station  
Illinois Emergency Management Agency – Division of Nuclear Safety

ATTACHMENT 1REQUEST FOR ADDITIONAL INFORMATIONBACKGROUND

The NRC approved ASTRUM Evaluation Model (EM) (Reference 1) allows for the assumed accumulator pressure range and Safety Injection (SI) temperature range to be partly outside the Technical Specifications (TS) range, as discussed in its Table 1-11. Exelon Generation Company, LLC (EGC), in the ASTRUM License Amendment Request (LAR), dated December 16, 2009, (Reference 2), elected to symmetrically widen the accumulator pressure range assumed in the analysis to facilitate evaluations of the significance of unanticipated events where accumulator pressure or temperature are outside the TS range, and to support potential future TS changes associated with accumulator pressure and temperature. EGC stated in a letter dated April 26, 2010, (Reference 3), that the widening of the accumulator pressure and SI temperature ranges for the analysis are reasonable and are consistent with the ASTRUM EM (Reference 1).

The NRC letter dated September 10, 2010, (Reference 4), was issued as a Request for Additional Information (RAI) regarding the conclusion that widening of the accumulator pressure and SI temperature ranges for the analysis are reasonable. The NRC request, excerpted and shown below as bold and italicized text, and a response to the request are included in the balance of this attachment.

NRC REQUEST (Reference 4)

***By letter to the Nuclear Regulatory Commission (NRC) dated December 16, 2009, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML09351 0099), as supplemented by letter dated April 26, 2010 (ADAMS Accession No. ML 101160431), Exelon Generation Company, LLC (the licensee), submitted a license amendment request to revise Technical Specification (TS) Section 5.6.5, "Core Operating Limits Report (COLR)," to replace the existing reference for the large break loss-of-coolant accident (LOCA) analysis methodology with a reference to WCAP-16009-P-A, "Realistic Large Break LOCA Evaluation Methodology Using Automated Statistical Treatment of Uncertainty Method (ASTRUM)."***

***The NRC staff has identified the following concerns with the licensee's responses to NRC Requests 1 and 2, which were provided to the NRC staff on April 26, 2010.***

***Although the range extends 30 pounds per square inch (psi) below the TS-allowed range, and 30 psi above the TS-allowed range, if the sampling is performed using a flat distribution, this means that 28.6 percent of cases would have pressures lower than allowed at the plant, 42.8 percent would be within the TS-allowed range, and 28.6 percent would be too high. Greater than half of the sampled cases, therefore, are reflective of plant operation in a forbidden range.***

***Furthermore, the sampled range for accumulator pressure exceeds the NRC staff's recent experience with ASTRUM implementation. Based on study of recently-approved ASTRUM implementation requests, the NRC staff observes that none of the studied licensees had proposed a sampling range of accumulator pressures that exceeded TS***

**limits by more than 48 percent. For the case of the Byron and Braidwood Stations, the sampled accumulator injection pressures exceed the TS-allowable range by 57 percent.**

**The NRC staff does not conclude that the proposed range of sampled accumulator pressures is acceptable in light of the requirements of Title 10 of the Code of Federal Regulations (10 CFR) 50.36, "Technical specifications," insofar as it establishes the requirements for limiting conditions for operation, nor does the NRC staff conclude that the proposed ranges provide analytic results that demonstrate compliance with the requirements of 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," because a large portion of sampled cases reflect assumed plant parameters that are not permissible at the plant.**

**The NRC staff believes that similar findings are applicable to the assumed range of safety injection temperature.**

**Please provide additional information demonstrating that this parametric widening produces a conservative or insignificant effect on the analytic results.**

RESPONSE

The accumulator pressure range in the analysis was previously contrasted to the Technical Specification in RAI #1 of Reference 3. EGC agrees with the NRC's numeric appraisal given in the current RAI, with one point of confirmation being that the sampling process is uniform (flat) for this sampled parameter (Attribute). The 57% value is best characterized as 'the theoretical percentage of sampled cases that are outside the Tech Spec range'  $\frac{[(617-587) + (692-662)]}{(692-587)} = \frac{(30+30)}{105}$ . The range supported in the current analysis of record (AOR) (extracted from Reference 5) is added to the prior comparison presented in Reference 3 to result in comparison Table 1 below.

Table 1 Accumulator Pressure Range		
Case	Range (psia)	Notes
ASTRUM LAR Table 1 Analysis Range (Ref. 2)	587 - 692	(+/- 15 psi wider than AOR)
Current AOR (Ref. 5) Table 1	602 - 677	
Tech Spec Surveillance Requirement (SR) 3.5.1.3	602 -647 psig ==> 617 - 662 psia	

EGC judges that it is pertinent to consider only the incremental +/- 15 psi reflected in the ASTRUM analysis in comparison to the AOR as the subject of the requested supplemental justification.

In the context of an ASTRUM methodology analysis, a widening of +/- 15 psi does not mean, had the analysis been instead performed using the AOR range, that every case would be shifted by 15 psi. The cases uniformly sampled near the center value would be only very slightly changed, and the cases sampled at the edges would approach a maximum 15 psi difference, etc.

Additionally, Westinghouse has inspected the transient results of the representative transients given in Figures 4-1 and 4-2 of the ASTRUM analysis LAR (Reference 2) and concludes that the RCS depressurization rate is such that the maximum 15 psi shift corresponds to a change in Accumulator discharge onset of about 0.2 seconds which is hypothesized to result in a similar timing shift for the end of accumulator discharge. This is a small difference in timing.

Furthermore, it is generally conservative to increase the ranges in the sampled Attributes with this argument being most sensible when the widening is symmetric, as it is for the accumulator pressure, and the analysis results are governed by the 95<sup>th</sup> percentile statistically. The widened ranges provide for the opportunity to draw in a wider dispersion/range of results promoting a higher 95<sup>th</sup> percentile overall result. This position is perhaps less persuasive if it is hypothesized that the center point in the range is in fact the most limiting point (an inverted bathtub shaped response surface). However, the most generalized response surface for accumulator pressure would be a bathtub shape, as the most limiting values would be either a hypothetical very low value (near containment pressure, in which case the accumulator would never discharge) or at near-RCS steady state pressure (in which case the accumulators would completely discharge and be swept out the break due to bypass during the blowdown period, leaving no accumulator liquid for refill and reflood). Further, the relative sensitivity to the accumulator pressure would be highly inter-related to some of the other key attributes which are also being sampled (e.g. discharge coefficient, accumulator line loss coefficient, RCS pressure, etc).

The concept of the general conservatism of widened Attribute ranges can be illustrated with the following simple example. If you hypothesize the extreme circumstance where the input is invariant (range = 0), the results will be the average outcome is equal, or nearly equal, to the 95<sup>th</sup> percentile result. If you then hypothesize an outcome that is variant due to ranging of an input, you have a circumstance where the average outcome would be expected to be equal, or nearly equal, to the invariant case. However the results at the 95<sup>th</sup> percentile would clearly be much higher for the variant case. Viewed even more simply, you execute 1000 cases of an invariant case (Attribute range near zero) whose result is always '3' as there is no variation in the input range. Its results will be average = 95<sup>th</sup> percentile = 3. Conversely, for the variant case, the range of outcomes might be from 1 to 5, reflecting a widened range of sampled input Attribute, such that the average outcome could remain = 3 but the 95<sup>th</sup> percentile result would start to approach 5.

For these reasons, it is judged unnecessary to assign penalties to the analysis results, or perform additional re-analysis activity for the relatively small widening of +/- 15 psi relative to the current licensed AOR range.

The SI temperature range in the analysis was previously contrasted to the Technical Specification in RAI #2 of Reference 3. The range supported in the current analysis of record (AOR) (extracted from Reference 5) is added to the prior comparison to result in Table 2 below.

Table 2 SI Temperature Range		
Case	Range °F	Notes
ASTRUM LAR Table 1 Analysis Range (Ref. 2)	32-120	(-0, +17°F wider than AOR)
Current AOR (Ref. 5) Table 1	32-103	
Tech Spec Surveillance Requirement (SR) 3.5.4.1	35-100	

Although some of the concepts put forth in the accumulator pressure response apply, for the SI temperature, the range was not widened symmetrically. However, the reason for the asymmetric widening is clearly that it is physically impossible for the SI temperature to be below 32°F and therefore not an attempt to bias the results. Further, as a consequence of confirmation that this Attribute is also uniformly sampled, it can be noted that the % of values sampled outside the Tech Spec SR range is only  $((35-32) + (120-100)) / (120-32) = (3+20)/88 = 26\%$  (values from Table 2), which is significantly less than the 57% value that applies to the accumulator pressure. The justification for widening the range in only the higher temperature direction is an outgrowth of the technical point made in the following portions of Reference 6:

Paragraph 1 a) of Section 26-5-2-1  
Table 26-3-2 footnote 3.  
(technical point not repeated for proprietary reasons).

For these reasons, it is judged unnecessary to assign penalties to the analysis results, or perform additional re-analysis activity for the relatively small widening of +17 °F relative to the current licensed AOR range.

## REFERENCES

1. WCAP-16009-P-A, "Realistic Large-Break LOCA Evaluation Methodology Using the Automated Statistical Treatment Of Uncertainty Method (ASTRUM)," Westinghouse, 2005 (includes NRC SER).
2. RS-09-178, "License Amendment Request Regarding Large Break Loss-of-Coolant Accident Analysis Methodology," (EGC LAR Document for Byron/Braidwood) P.R. Simpson (EGC), December 16, 2009.
3. RS-10-083, "Additional Information Supporting Request for License Amendment Regarding Large Break Loss-of-Coolant Accident Analysis Methodology," P.R. Simpson (EGC), April 26, 2010.

4. US NRC RAI Letter: "Braidwood Station, Units 1 and 2, and Byron Station, Unit Nos. 1 and 2 – Request for Additional Information Related to Large Break Loss-of-Coolant Accident Analysis Using ASTRUM (TAC NOS. ME2941, ME2942, ME2943, AND ME2944)," M.J. David (NRC NRR) to M. J Pacilio (Exelon), September 10, 2010, (ADAMS Accession No.: ML102240405). (archived internally by Westinghouse as ML102240405.pdf\_1284989233\_LTR-LIS-10-209).
5. RS-00-112, "Request for a License Amendment for Plant Specific Use of Best Estimate Large Break Loss of Coolant Accident Analysis," R. M. Krich (EGC), October 24, 2000.
6. WCAP-12945-P-A Volume 5 Revision 1, "Code Qualification Document for Best-Estimate LOCA Analysis," Westinghouse, 1998 (includes NRC SER).