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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 C. G. Pardee (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 March 11, 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. Kenneth M. Nicely at (630) 657-2803.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 26th day of April 2010.

Respectfully,

Patrick R. Simpson
Manager – Licensing

Attachment: 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
Response to Request for Additional Information

NRC Request 1

The following information concerning safety injection accumulators is abridged from NUREG-1431, Volume 2, "Standard Technical Specifications for Westinghouse Plants," *Bases*:

> The Limiting Condition for Operation (LCO) concerning the operability of the accumulators provides assurance that the [Title 10 of the *Code of Federal Regulations* (10 CFR)] 50.46 acceptance criteria are met. The large and small break loss-of-coolant accident (LOCA) analyses are performed at the minimum nitrogen cover pressure, since sensitivity analyses have demonstrated that higher nitrogen cover pressure results in a computed peak clad temperature benefit. The accumulators satisfy criterion 3 of 10 CFR 50.36(c)(2)(ii). For an accumulator to be considered operable, the limits established in the Surveillance Requirements (SRs) for contained volume, boron concentration, and nitrogen cover pressure must be met.

Although it is clear that the above passage was written with respect to a conservative, bounding LOCA methodology, the net effect of increased cover pressure applies to the statistical approach as well. The overall effect could be a widening of the statistical base of LOCA results, and could potentially result in a lower peak clad temperature (PCT) prediction at the 95/95 upper tolerance limit.

Pursuant to 10 CFR 50.36(c)(2)(ii)(B), an LCO is required for a process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

The range of accumulator nitrogen cover pressure is constrained by SR 3.5.1.3. SR 3.5.1.3 proscribes a peak pressure that is lower than the analyzed range accompanying the subject license amendment request to implement the ASTRUM methodology. Explain how this proposed, increased analytic range remains in compliance with 10 CFR 50.36(c)(2)(ii)(B), since the analyzed range of accumulator pressure falls outside the pressure range specified for TS operability.

Response

The approved WCAP-16009-P-A, "Realistic Large-Break LOCA Evaluation Methodology Using the Automated Statistical Treatment Of Uncertainty Method (ASTRUM)," evaluation model allows for the assumed accumulator pressure range to be partly outside the Technical Specifications (TS) range, as discussed in WCAP-16009-P-A, Table 1-11, "Initial and Boundary Conditions Considered in Uncertainty Methodology." Exelon Generation Company, LLC (EGC) elected to symmetrically widen the accumulator pressure range assumed in the analysis to facilitate evaluations of the significance of unanticipated events where accumulator pressure is outside the TS range, and to support potential future TS changes associated with accumulator pressure. The TS range is bounded by the accumulator pressure range assumed in the analysis.

Due to competing effects associated with Emergency Core Cooling System (ECCS) bypass, and the fact that the accumulator has only a finite water volume, there is no clear direction of conservatism on accumulator pressure in the ranges being discussed herein. In some cases, an earlier accumulator injection could result in less net accumulator injection to the core due to bypass, hence it cannot be concluded that earlier accumulator injection (i.e., higher accumulator pressure) is a benefit. The current TS range is covered, as well as additional data points for which there is no knowledge that would suggest they are non-limiting points. Therefore, a widening of the accumulator pressure range for the analysis is reasonable, especially when symmetric, and is consistent with WCAP-16009-P-A.

NRC Request 2

Provide information analogous to that requested in Item 1, above, for the assumed safety injection temperature range, with respect to SR 3.5.4.1, concerning the refueling water storage tank temperature.

Response

The approved WCAP-16009-P-A evaluation model allows for the assumed Safety Injection (SI) temperature range to be partly outside the TS range, as discussed in WCAP-16009-P-A, Table 1-11. EGC elected to widen the SI temperature range assumed in the analysis to facilitate evaluations of the significance of unanticipated events where SI temperature is outside the TS range, and to support potential future TS changes associated with SI temperature. The TS range is bounded by the SI temperature range assumed in the analysis.

Although it is possible that second or third order effects could exist, the prevailing first order effect is that higher SI temperature is a penalty, as noted in WCAP-12945-P-A, "Code Qualification Document (CQD) for Best-Estimate LOCA Analysis," Volume 4, Table 26-3-2, Footnote 3. The current TS range is covered, as well as additional data points which are predominately in the direction expected to maximize peak clad temperature (PCT). Therefore, the widening of the SI temperature range for the analysis is reasonable, and is consistent with WCAP-16009-P-A.

NRC Request 3

The HOTSPOT PCT elevation for Byron/Braidwood Unit 1, shown in Figure 17-1 of the license amendment request, appears to jump to a height that is above the top of active fuel. Please provide additional discussion clarifying the result depicted in this figure. In this discussion, please explain how the HOTSPOT PCT elevation is determined, the context of the HOTSPOT PCT elevation, and why a PCT elevation that is 12' high in the fuel assembly is an expected result.

Response

The WCOBRA/TRAC hot rod PCT elevation as a function of time, for the ASTRUM runset case that spawned the highest final PCT, is given in Figure 17-1 of the license amendment request.

As shown, from 200 seconds after the break to the end, the PCT elevation is at 12 feet which corresponds to the top of the active core. Figure 17-1 does not depict the HOTSPOT hot rod PCT elevation as a function of time; that parameter is not practically available.

Each of the 124 finalized ASTRUM runset cases has a different power shape as portrayed in the third and fourth rows of WCAP-16009-P-A, Table 1-10. The case that spawned the highest overall HOTSPOT PCT has a power shape that, in the top several feet of active fuel, is flat and at a high relative value. It is typical for the PCT elevation, during the reflood phase, to proceed upwards with time as the core quenches from the bottom up. The bottom up reflood progression, in and of itself, would tend to promote the top of active fuel as the eventual late term PCT location. However, most of the sampled power shapes have a predominate negative slope at the very top of the core which opposes this tendency, often yielding a late reflood PCT elevation of perhaps a foot below the top of the active core (e.g., as is the case in Figure 17-2). However, the fact that the PCT elevation late in reflood is at or approaches the top of the active core is not an indication that it is the overall PCT elevation, as typically the time of the overall PCT is much earlier than this. For example, Figure 15-1 gives the WCOBRA/TRAC hot rod PCT for the same case as Figure 17-1, and starting at about 200 seconds, the highest clad temperature is ~400°F below the overall PCT. The actual HOTSPOT elevation that gives rise to the overall Unit 1 PCT of 1913°F presented in Table 2-1 and Figure 2-1 is not a result presented in the license amendment request, but is determined to be 10.8 feet from inspection of the analysis records. Although the WCOBRA/TRAC and HOTSPOT limiting elevation of a common case are not necessarily expected to be identical, it is instructive to compare them. From HOTSPOT PCT Figure 2-1, the time of overall PCT is about 120 seconds. The corresponding WCOBRA/TRAC PCT elevation of that case is given in Figure 17-1, which shows a WCOBRA/TRAC PCT elevation at 120 seconds of roughly 10.8 feet, so in this case they are a close match.