Exelon Generation.

4300 Winfield Road
Warrenville, IL 60555
630 657 2000 Office

RS-13-189

10 CFR 50.90

July 5, 2013

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 Power Uprate," dated June 23, 2011
2. Letter from Nicholas J. DiFrancesco (U. S. NRC) to M. J. Pacilio (Exelon Generation Company, LLC), "Braidwood Station, Units 1 and 2, and Byron Station, Units Nos. 1 and 2 – Acceptance Review of License Amendment Request (LAR) Re: Measurement Uncertainty Recapture (MUR) Power Uprate (TAC Nos. ME6587, ME6588, ME6589, and ME6590)," dated September 19, 2011 [ML112231574]
3. 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]
4. Letter from Kevin F. Borton (Exelon Generation Company, LLC) to U. S. NRC, "Supplemental Information Supporting Request for License Amendment Regarding Measurement Uncertainty Recapture Power Uprate," dated August 25, 2011 [RS 11-137] [ML11255A332]
5. 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 April 27, 2012 [RS12-047] [ML12121A496]

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 staff indicated that the satisfactory disposition of the known nonconformance with turbine high-energy line break (HELB) would be required prior to implementation. In Reference 3, the NRC requested additional information (RAI) to support resolution of the HELB nonconformance to complete their detailed review of the power uprate application. The response to this RAI is provided in the Attachment to this letter.

As previously indicated in Reference 4, EGC has maintained the design basis for the Turbine Building HELB (i.e., the qualification of Class 1E electrical equipment in the identified auxiliary building rooms are not adversely impacted by a TB HELB) and confirmed that the conclusions stated in the MUR Power Uprate LAR HELB analyses remain valid. As stated in Reference 5, no new high or moderate energy systems were added as a result of evaluation at MUR power uprate conditions, and no new high energy line break or moderate energy line crack locations were identified.

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 July 2013.

Respectfully,

David M. Gullott
Manager - Licensing

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

ATTACHMENT

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
NRC Letter dated December 6, 2012
[ML12271A308]

(NON-PROPRIETARY)

NRC Request

1. ***Provide a summary of the results of your extent-of-condition review related to the high energy line break (HELB) non-conformance.***

Response

In 2011 and 2012, Exelon Generation Company (EGC) identified some design non-conformances associated with the Braidwood and Byron Turbine Building (TB) High Energy Line Break (HELB) analyses. The TB HELB analyses address HELBs in the TB where safety related equipment in adjoining Auxiliary Building rooms could be impacted.

The TB HELB non-conformances were determined to be:

- Inadequacy in the design of HELB barriers credited to maintain the designated environment, and
- HELB structural loadings were not appropriately applied.

As a result of these non-conformances, the TB HELB mitigation strategy and associated methodologies were revised, and new analyses were performed to address the Auxiliary Building areas impacted by the TB HELBs. While the mitigation strategy changed and some different methodologies were applied, the overall success criterion was maintained such that the adjoining Auxiliary Building areas are maintained as mild environments following a TB HELB. The response to Request 3 provides a discussion of the mitigation strategy and methodologies, as well as a discussion of the plant modifications performed to support the revised strategy. The development of these new TB HELB analyses included resolution of the identified inadequate HELB barriers and inappropriate application of HELB structural loadings.

As a result of these non-conformances identified with the TB HELB analyses, EGC has performed extensive reviews to identify the extent-of-condition of these specific non-conformances within the other Braidwood and Byron Station HELB analyses. This extent-of-condition review initially involved identifying the plant areas that contained high energy lines and required a HELB analysis.

To support the extent-of-condition review, EGC performed a detailed review the HELB analyses of other plant structures containing high-energy lines that could impact safety related equipment. The structures reviewed were:

- Auxiliary Building (other than those areas impacted by the TB HELBs),
- Main Steam Isolation Valve (MSIV) Room/Main Steam (MS) Tunnel, and
- Containment Building

The extent-of-condition review determined that the HELB analyses supporting these structures have been performed consistent with the current Braidwood and Byron licensing basis. Based on this extent-of-condition review, EGC concluded that the supporting HELB analyses for the above identified structures were not impacted by the non-conformances identified in the TB HELB analyses. The details of this review are provided in the response to Request 2.

NRC Request

2. *For those HELB analyses that were not affected by the non-conformance:*

a. *Identify the HELB area(s) that is the subject of the analysis.*

Response

As stated in Response 1, the structures included in the HELB extent-of-condition review were the Auxiliary Building (other than those areas impacted by the TB HELBs), MSIV Room/MS Tunnel, and the Containment Building. A summary of the review of these structures is provided below.

NRC Request

b. *Provide confirmation that:*

i. *The analyses of record are in conformance with the licensing and design basis of the plant.*

Response

The extent-of-condition review confirmed that the current HELB analyses of record (AORs) supporting the Auxiliary Building (other than those areas impacted by the TB HELBs), MSIV Room/MS Tunnel, and the Containment Building conform with the current Braidwood and Byron licensing basis. This conclusion is based on the application of the methodology summarized below.

The initial step involved reviewing the Updated Final Safety Analysis Report (UFSAR), NRC Safety Evaluation Reports (SERs) and supplements, and referenced regulatory guidance (i.e., Standard Review Plans (SRPs) and Regulatory Guides (RGs)) to identify the documents that define the Braidwood and Byron HELB licensing basis requirements and associated NRC approved analysis methodologies. In parallel, a detailed search was performed to compile a comprehensive list of the Auxiliary Building, MSIV Room/MS Tunnel, and Containment Building AORs. A copy of each of the AORs was then obtained for further review.

Using the criteria identified in the current licensing basis each HELB AOR was reviewed with the goal of identifying gaps where the applied methodologies were not consistent with the licensing basis. The specific design considerations assessed for this review were jet impingement, pipe whip, flooding, and environmental conditions.

This review was performed as follows:

- If the AOR referenced or documented one of the licensing basis documents previously identified, the AOR was reviewed to determine if the licensing bases document was applied appropriately.
- If the AOR did not reference one of the licensing basis documents previously identified, the AOR was reviewed to determine the basis for the inputs, assumption, and methodology used. The inputs, assumptions, and methods were then reviewed to determine if the proper licensing bases requirements were applied.

The review using this approach determined that the HELB analyses reviewed for the Auxiliary Building, Containment Building, and MSIV Rooms/MS Tunnels were found to be in compliance with the current licensing basis as approved by the NRC. Therefore, the non-conformances found in the TB HELB analysis do not exist for the structures evaluated.

NRC Request

ii. ***The analyses of record either have been previously approved by the NRC or were conducted using methods or processes that were previously approved by the NRC.***

Response

The references and methodologies identified in the HELB AORs were compared to the methods or processes previously approved by the NRC. The review concluded that the identified references and methodologies in HELB AORs were either in compliance with methods or processes previously approved by the NRC, or the actual Byron/Braidwood HELB analyses had been previously approved by the NRC.

NRC Request

c. ***Confirm that the equipment environmental qualification parameters continue to be bounded.***

Response

EGC has concluded that the Auxiliary Building, MSIV Rooms/MS Tunnels, and Containment Building HELB AORs are consistent with the current licensing basis and were performed in accordance with approved methodologies, and do not contain the non-conformances identified in the TB HELB analyses. Therefore, the environmental qualification parameters previously evaluated have not changed and the conclusions of the MUR Power Uprate submittal(s) (References A-1, A-2, A-3, and A-4) related to the equipment environmental qualifications resulting from a postulated HELB continue to be valid .

Note, during the course of this extent-of-condition review, some gaps or document deficiencies were identified. These gaps and deficiencies, summarized below, have been entered into the Braidwood and Byron Corrective Action Program for evaluation and disposition. These deficiencies do not impact the extent-of-condition conclusions or the conclusions of the MUR analyses related to equipment environmental qualifications.

- High Energy Leakage Crack evaluations were not performed during original plant design due to inconsistencies between the design and licensing basis requirements. Corrective Actions (Byron IR 1311582 and Braidwood IR 1312365) are in progress to address this condition. Considering that the general design approach for HELB was based on analyzing the plant in terms of compartments/hazard zones and the effects of HELB in each compartment/zones were conservatively evaluated by worst case scenario or total loss of the equipment in the particular compartment/hazard zone, the less severe impact of a high energy leakage crack generally is expected to be bounded by the HELB considerations.
- Design analysis supporting UFSAR statements regarding the insignificant environmental effects from a postulated Chemical Volume and Control System (CVCS) letdown line break in the Auxiliary Building Containment Piping Penetration area and an Auxiliary Steam (AS) line break in the Auxiliary Building General Area (401' elevation) could not be located. Actions are in place to develop these analyses (CVCS Issue, Byron IR 1531404, and Braidwood IR 1532142), (AS Issue, Byron IR 1532225 and Braidwood IR 1532130). There is no evidence that the UFSAR qualitative disposition is invalid.

- Design analysis for MSIV Room (also referred to as the MS Safety Valve Room) pressurization is being revised to apply a refined mass and energy release, more accurately reflect the configuration of the MSIV rooms and vent paths, and to use state of the art software. This update is in progress to address a condition indentified prior to the HELB issue. Actions are in place to track completion (Byron IR 1531420, Braidwood IR 792215).

NRC Request

3. For those HELB area(s) that were affected by the non-conformance:

Response

B/B Stations are implementing a revised HELB mitigation strategy to better protect against the consequences of a HELB in the Turbine Building. In summary this strategy involves:

- Keeping the TB HELB environment out of the adjacent rooms/areas with safety-related equipment.
  - Auxiliary Building (AB) rooms/areas by installing single–failure proof HELB dampers in the ventilation openings and HELB-resistant doors to the rooms.
  - Main Control Room by installing a HELB sensor to prevent make-up air being taken from TB following HELB.
- Keeping the adjacent AB rooms within their design basis temperature limits following a TB HELB by:
  - Automatically restart the AB room ventilation fans, and
  - Configuring the fire dampers to close only in the event of a fire (maintains ventilation exhaust path following HELB).
- Performing a new TB HELB analysis to better predict environmental conditions following the HELB.
  - Use of GOTHIC thermal-hydraulic event analysis
  - Maximized enthalpy release
  - Considered larger spectrum of line breaks
  - Added rooms/areas to the analysis
  - Included new HELB modifications (see Response 3.i)
    - HELB dampers and doors
    - Automatic restoration of room cooling
    - Divisional block wall modifications

Additional details on the revised TB HELB strategy are provided in response 3.f. The new analysis and modifications that support the revised HELB mitigation strategy will be reviewed and implemented in accordance with 10 CFR 50.59.

The Turbine Building also contains safety-related equipment such as limit switches on the turbine throttle valves, pressure switches on the turbine electro-hydraulic control system, and pressure transmitters that sense turbine impulse pressure. These components provide inputs into the Solid State Protection System. In addition, there are solenoids which actuate to initiate feedwater isolation signals. These components, however, are not required to establish and maintain a safe shutdown condition following a HELB and are not impacted by the non-conformance.

NRC Request

a. Identify the HELB area(s) that is the subject of the analysis.

Response

The new analysis and revised TB HELB mitigation strategy focuses on the impact of a HELB originating on the 401', 426', and 451' Elevations in the TB on the following rooms/areas of concern within the Auxiliary Building:

373'-6" Elevation:

- Diesel Oil Storage Tank Rooms (DOST) 1A, 1B, 2A, and 2B[1]

401' Elevation:

- Emergency Diesel Generator (EDG) Rooms 1A, 1B, 2A, and 2B
- Braidwood Only - Auxiliary Building General Area (in the vicinity of the TB/AB pressure balancing damper)[1]

415' Elevation:

- Unit 1 and Unit 2 Electrical Pipe Tunnels[1]

426' Elevation:

- Division 11, 12, 21, and 22 Engineered Safeguards Feature (ESF) Switchgear Rooms

439' Elevation:

- Division 12 and 22 Lower Cable Spreading Rooms[1]

451' Elevation:

- Division 11, 12, 21, and 22 Miscellaneous Electrical Equipment Rooms (MEER)
- Unit 1 and Unit 2 Non-ESF Switchgear Rooms (6.9 KV Switchgear Rooms)[1]

NRC Request

b. *Identify the important analysis inputs and assumptions (including their values), and explicitly identify those that changed as a result of the resolution of the nonconformance.*

Response

A new analysis was performed to model and evaluate the plant response to a TB HELB and the resulting environmental parameters for the areas listed above using the GOTHIC computer program. This analysis considers and bounds MUR uprate conditions.

The new analysis includes the following key changes in inputs and assumptions from the previous analyses of record:

- Instead of four separate KITTY models, as used in the existing analyses of record, a single GOTHIC model has been developed that combines the MEER, ESF Switchgear Room, EDG Room and TB Elevations 369', 401', 426', and 451'. The single GOTHIC model also integrates the initial response to the HELB and the subsequent room heat-up. The GOTHIC model has been expanded to include the identified Turbine Building Elevations and flow paths to more accurately model pressurization throughout the Turbine Building following a HELB. The GOTHIC model has also been expanded to include both ESF divisions of Auxiliary Building rooms and other Auxiliary Building areas as listed in the response to question 3.a. The integrated nature of the GOTHIC model permits determining differential pressures across the walls separating the rooms and areas such that the structural impact from a HELB may be evaluated.

---

1 These rooms/areas were not previously addressed in the TB HELB analysis but have been included in the new TB HELB analysis.

- The new analysis incorporates the modifications discussed in the response to question 3.i that implement the revised TB HELB mitigation strategy.
- Consideration of a broader spectrum of breaks (size and location) for conservatism. This includes small breaks that could result in an extended pressurization of the Turbine Building.
- For main steam line breaks, the use of transient mass and energy releases that maximize superheat, instead of using constant mass and energy releases based on initial conditions.
- For liquid line breaks, the use of mass and energy releases that maximize enthalpy, instead of minimize enthalpy. Maximizing enthalpy is conservative because it maximizes steam quality at atmospheric pressure, which in turn maximizes the liquid break mass flow that flashes to steam in the Turbine Building.
- Control volume and flowpath modeling improvements were incorporated such that the computer model in the new analysis provides a very accurate representation of the plant physical layout, and therefore provides a more accurate prediction of the plant response to a TB HELB event.
- Initial room temperatures and heat loads have been conservatively applied to the additional rooms evaluated in the new analysis (as indicated in response 3.a).

NRC Request

c. Confirm that the equipment environmental qualification parameters continue to be bounded.

Response

The new analysis demonstrates that the environmental parameters within these zones will remain mild. The new analysis credits the modifications installed (see response to 3.i) to support the revised TB HELB mitigation strategy and results in lower peak temperatures and much shorter durations than determined in the previous analyses.

As discussed further in response 3.h, the new analysis results in transient temperature profiles that are consistent with the requirements of Technical Requirements Manual (TRM) 3.7.d for the affected rooms/areas. Temperatures approach normal operating limits[2] within a few minutes of the HELB event and do not exceed the temperature limits in TRM 3.7.d by more than the 30°F action level requirement.[3]

NRC Request

d. Identify the methodologies used to perform the analyses, and describe any changes in those methodologies.

Response

The previous analyses performed to determine the environmental parameters currently presented in the UFSAR for the ESF Switchgear Rooms, the MEERs, and for the EDG Rooms are essentially two-part analyses. The first part determines the HELB event in

---

[2] Even though the Electrical Pipe Tunnel temperature limit is not included in the TRM it can be assumed that a reasonable temperature limit similar to the TRM limits for the Division 1 and 2 ESF Switchgear Rooms (108°F) would be applicable since they are physically connected.

[3] TRM 3.7.d allows the temperature to be greater than the limit for 8 hours as long as the temperature is <30°F above that limit.

the Turbine Building and rooms of interest until the fire dampers are credited to close. Following this, the second part is analyzed as a loss-of-HVAC event in each room of interest for a two-hour time period. The analysis is based on a limited number of line breaks in the Turbine Building, the mass and energy releases are analyzed in a way that does not maximize enthalpy, and the analysis utilizes a proprietary software program.

For steam line breaks, the previous analysis used constant mass and energy releases based on initial conditions for steam-line breaks. The new HELB analysis uses transient mass and energy releases consistent with Westinghouse WCAP-10961, "Steamline Break Mass/Energy Releases for Equipment Environment Qualification Outside Containment," (Reference A-5) that maximizes superheat. Specifically, WCAP-10961 transient mass and energy releases maximize superheat by progressively increasing enthalpies with progressively decreasing mass flow rates. Maximizing enthalpies maximizes Turbine Building environmental temperatures, which in turn maximizes the environmental temperatures in the Auxiliary Building rooms of interest. The use of WCAP-10961 mass and energy releases is consistent with the current licensing basis for analyzing the environmental effects of HELBs outside containment as discussed in Byron SSER 7 and Braidwood SSER 2 (References A- 6 and A-7, respectively).

Additionally, liquid line mass and energy releases were analyzed to maximize enthalpy, instead of minimize enthalpy. Maximizing enthalpy maximizes steam quality at atmospheric pressure, which in turn maximizes the liquid break flow that flashes to steam in the Turbine Building.

In order to determine the environmental profiles for the new TB HELB mitigation strategy, a larger spectrum of line breaks is considered, mass and energy releases are analyzed in a way that maximizes enthalpy, and the thermal-hydraulic event is analyzed utilizing GOTHIC. The modeling improvements incorporated in the new analysis are conservative and improve the accuracy of the predicted plant response to the transient consistent with the capabilities of the GOTHIC program.

The revised analysis did not alter the overall Licensing Basis methodology. As described in B/B UFSAR (Reference A- 8), Section 3.6.1.1.2, the criteria for protection against the dynamic effects associated with postulated pipe breaks is NRC Regulatory Guide 1.46, "Protection Against Pipe Whip Inside Containment" (Reference A- 9) and the NRC's letter from A. Giambusso, dated December 1972 (Reference A-10), for designs inside and outside the containment, respectively. Based on the Byron and Braidwood Construction Permit date, the above guidance constitutes the minimum requirements for HELB design and analysis. Additional criteria, including the NRC's letter from J.F. O'Leary (Reference A-11), and Branch Technical Positions APCSB 3-1 (Reference A-12) and MEB 3-1 (Reference A-13), have been employed to the extent possible and practical.

NRC Request

e. ***Confirm that the analyses were performed in accordance with any limitations and restrictions included in the NRC's approval of the methodology.***

Response

GOTHIC is a computer program that has been used industry-wide for containment temperature and pressure analysis. It is capable of modeling bi-directional flow due to temperature-driven buoyancy-induced flow through wall openings. Applications of the GOTHIC code have been previously approved by the NRC for determining environmental conditions following HELBs inside and outside containment, including for Turbine Buildings. GOTHIC underwent an extensive verification and benchmarking process against both analytic solutions and special effects and integral heat transfer and containment data. It is subject to 10 CFR Part 50, Appendix B and 10 CFR Part 21 requirements.

Point Beach submitted a License Amendment Request for an Extended Power Uprate and received an SER (Reference A-14) which describes the use of GOTHIC for evaluating the effect of various HELBs, including HELBs within the Turbine Building. The use of the GOTHIC code for analyzing HELBs in the Turbine Building for B/B Stations has been verified to be consistent with the GOTHIC User Manual in terms of its limitations and restrictions. No user-controlled enhancements available in GOTHIC Version 7.2a were utilized, consistent with the manner applied by Point Beach as noted by the NRC in the SER. Additionally, the GOTHIC model developed for B/B is "plant–specific" in terms of geometry, flow paths, etc., and thereby meets the provisions of 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants" (Reference A-15) and Regulatory Guide 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants" (Reference A-16) for the use of a plant-specific model for environmental qualification of equipment outside containment. Evaluation of the attached rooms resulting from the conditions in the Turbine Building follows in a like manner to that for the previous analysis, with the rooms of interest being exposed to the TB HELB conditions for a shorter duration (in the previous analysis, the rooms of interest were exposed to the Turbine Building conditions until the fire dampers closed, while in the new analysis, the HELB dampers close rapidly) and the ventilation is restored significantly faster (in the previous analysis the safety-related room ventilation systems were not credited to be manually restarted for two hours, while in the new analysis the ventilation is auto restarted.)

Therefore, the new analysis was performed in accordance with any limitations and restrictions included in the NRC's previous approval of the GOTHIC and WCAP-10961 methodologies for HELBs outside containment.

<u>NRC Request</u>

f. ***Describe the sequence of events and explicitly identify those that changed as a result of the resolution of the nonconformance.***

<u>Response</u>

The previous TB HELB mitigation strategy involved:

- Allowing the TB HELB environment into the affected Auxiliary Building rooms for a short period of time (no HELB dampers in the ventilation intake/exhaust opening to the Turbine Building),
- Isolating the affected rooms with the actuation of the fire damper in the ventilation exhaust opening,
- Room cooling manually restored in two hours by operator action (fans trip due to isolation of the flowpath, with subsequent loss of- ventilation), and
- Thermal-hydraulic event analyzed to predict room temperature conditions (vendor proprietary software with mass and energy releases determined for the assumed line breaks)

The revised HELB mitigation strategy that is being implemented is one that involves:

- Keeping the TB HELB environment out of the Auxiliary Building rooms (isolating the rooms by means of new normally open, reverse flow HELB dampers)and the Main Control Room (installing HELB sensor that prevents make-up air being taken in subsequent to a TB HELB),
- Configuring the fire dampers to close only in the event of a fire,
- Room ventilation automatically restored (auto-restart of the room ventilation fans to keep the rooms within their design basis temperature limits), and
- Performing a new analysis of the thermal-hydraulic event to predict room environmental conditions following the HELB (GOTHIC analysis with updated mass and energy releases, and additional line breaks considered).

NRC Request

g. Describe and justify the chosen single-failure assumption.

Response

Each of the modifications that implement the new TB HELB mitigation strategy, as discussed in the Response 3.i, includes consideration for single failures.

- The new HELB damper assemblies include two normally open backdraft/reverse flow dampers arranged in series with the allowed direction of air flow from the room to the TB. A failure of a single HELB damper to close will not prevent isolation of the flow path during a HELB. The opposite train of ESF equipment would also remain available if the either of the HELB dampers, or the fire damper, in the assembly failed closed preventing the ventilation fan auto restart.
- The failure of a high differential pressure trip time delay relay for a single ventilation system train will not prevent the opposite ESF train from supporting the safe shutdown of the unit.
- The failure of instrumentation for the automatic high room temperature auto start feature for a single EDG Room supply fan will not prevent the opposite ESF train from supporting the safe shutdown of the unit.
- The modification for the Control Room Emergency Make-Up HELB sensors includes fail safe logic for the intake damper from the Turbine Building. In addition, a single failure of a Control Room ventilation train will not impact the ability to support establishing safe shutdown.
- A failure of the instrumentation for the DOST exhaust fan trip on high Turbine Building temperature modification will also only impact a single train.
- The structural modifications preserve divisional separation and the structural integrity of the rooms affected by a TB HELB.

From an analytical standpoint, the new thermal-hydraulic analysis considers,

- The failure of a MSIV for steam line breaks to maximize the overall mass and energy release.
- For a feedwater line break, there is no single failure that will prevent the isolation of the feedwater system or the functioning of the reactor protection system (i.e., single failure evaluations have previously been performed for these systems).
- For heater drain line breaks, all available water volume is assumed to be discharged into the Turbine Building such that no equipment is credited with limiting the mass and energy release from that system.

NRC Request

h. *Provide plots of important parameters and explicitly identify those that changed as a result of the resolution of the nonconformance.*

Response

The operability evaluations that address the non-conformances only address the transient temperature conditions in the EDG Rooms, the ESF Switchgear Rooms, and the MEER. A comparison is provided for the transient temperature profiles for these rooms under the previous analyses and the analyses which implement the revised TB HELB mitigation strategy.

In the previous analysis, the initial temperature increases rapidly in the rooms until the fire dampers are assumed to close, once the fire damper is assumed closed the rooms continue to heat up due to the loss of ventilation but at a slower rate until the ventilation is assumed to be manually restored after 2 hours. The temperature profile for the EDG Rooms (Figure 3-1a) rapidly increases to approximately 158°F until the fire damper closes then the room trends to 167°F until ventilation is restored (Figure 3-1b). The temperature profile for the ESF Switchgear rooms (Figure 3-3a) rapidly increases to approximately 165°F until the fire damper closes then the room trends to 160°F until ventilation is restored (Figure 3-3b). The temperature profile for the MEER rapidly increases to approximately 175°F for the Division 11 room and to approximately 140°F for the Division 12 room (Figure 3-5a) until the fire damper closes then the Division 11 room trends to 128°F (Figure 3-5b) and the Division 12 room trends to 132°F (Figure 3-5c) until ventilation is restored.

The new analysis credits the backdraft/reverse flow dampers and other modifications installed to implement the revised TB HELB mitigation strategy. These changes minimize the introduction of hot air and steam into the rooms and permit the rapid automatic restoration of ventilation to restore room temperatures. The resulting worst case temperature profiles for the EDG Rooms, ESF Switchgear Rooms, and MEER are provided in Figures 3-2, 3-4 and 3-6, respectively. These temperature profiles indicate that the peak temperatures are consistent with the requirements of Technical Requirements Manual (TRM) 3.7.d (as shown in Table 3-1), in that the temperatures are rapidly restored to below the Operating Limit well within the allowed 8 hours specified in the TRM, and remain well below the TRM Operating Limit +30°F.

In addition to the EDG Rooms, ESF Switchgear Rooms, and MEER, the new analysis also includes the DOST Rooms, the Electrical Pipe Tunnel Temperatures, and Division 12/22 Lower Cable Spreading Room. Worst case temperature profiles for these rooms are provided in Figures 3-8 through 10.

Table 3-1: Comparison of Peak Room Temperatures to Operating Limits

	Peak HELB Temperature	TRM Operating Limit
EDG Rooms	150°F	132°F
ESF Switchgear Rooms	131°F	108°F
MEER	114°F	108°F
Division 12/22 Lower Cable Spreading Room	112°F	108°F
DOST	140°F	132°F

Figure 3-1a: Previous Analysis – EDG Temperature Profile – To Fire Damper Closure

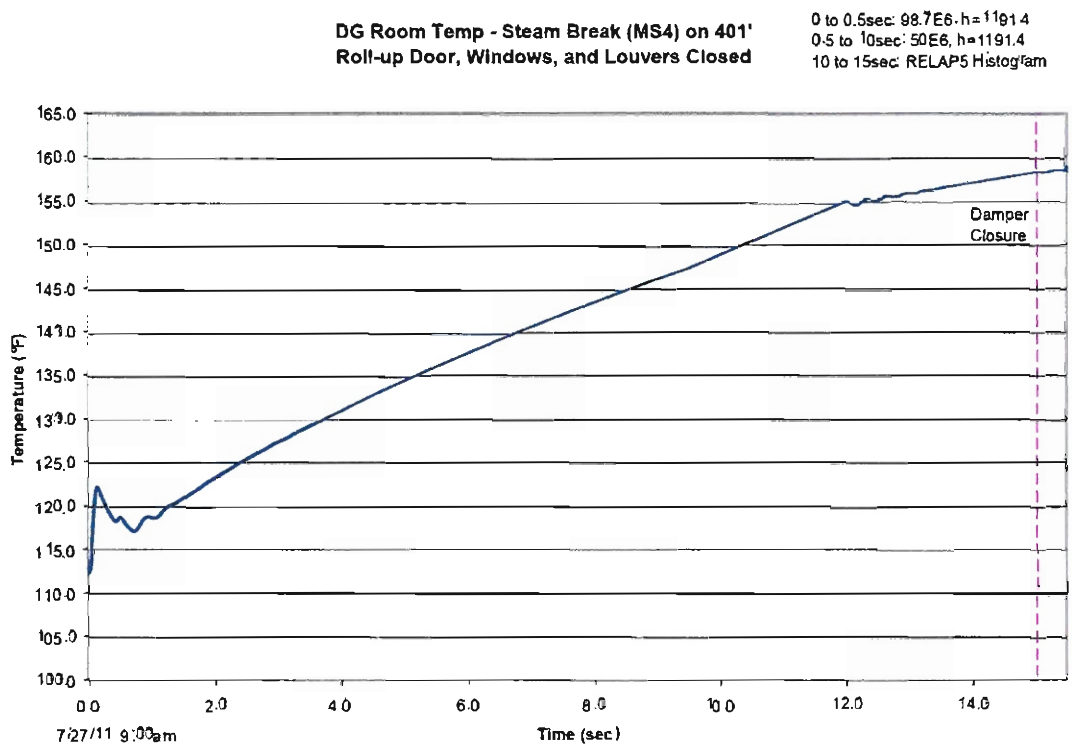


Figure 3-1b: Previous Analysis – EDG Temperature Profile – 2 Hour Profile

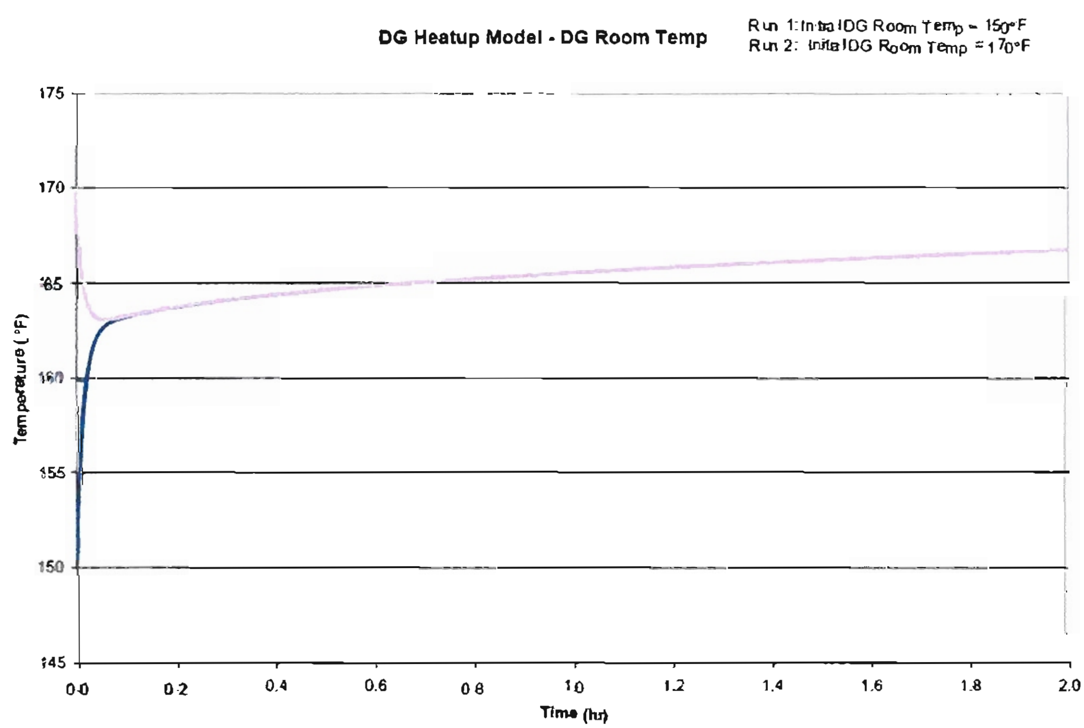


Figure 3- 2: New Analysis – EDG Room Temperatures – Worst Case Following 0.5 ft² MS Break on TB 401' Elevation

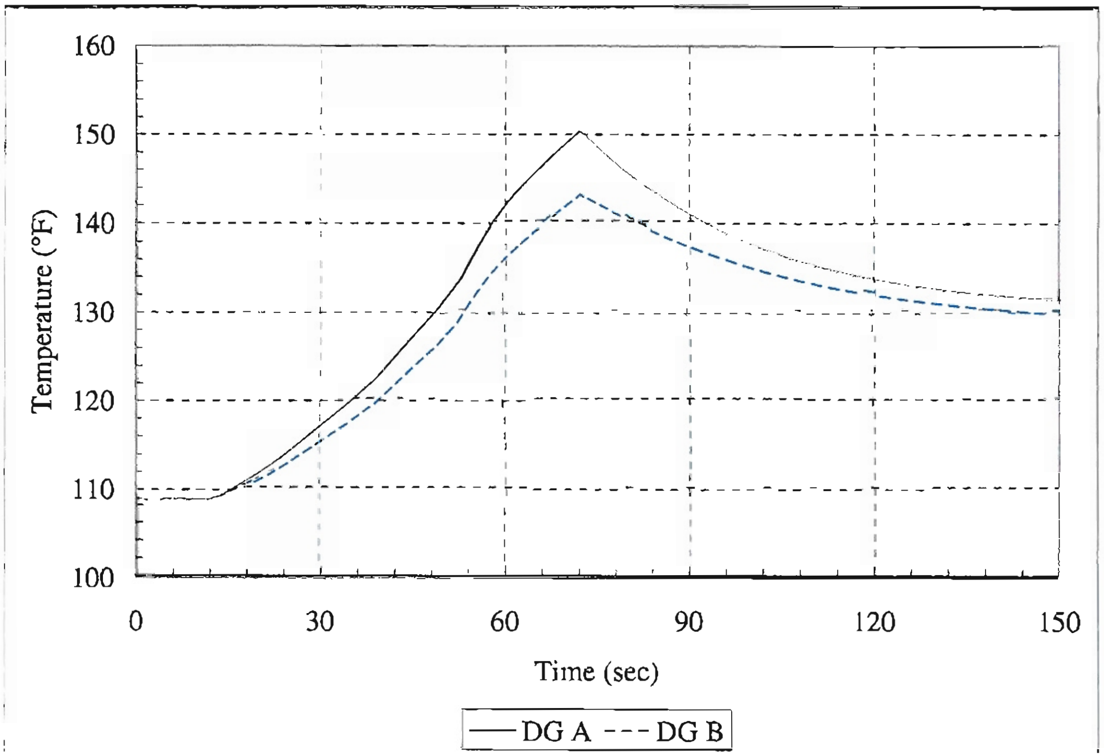


Figure 3-3a: Previous Analysis – ESF Switchgear Temperature Profile – To Fire Damper Closure

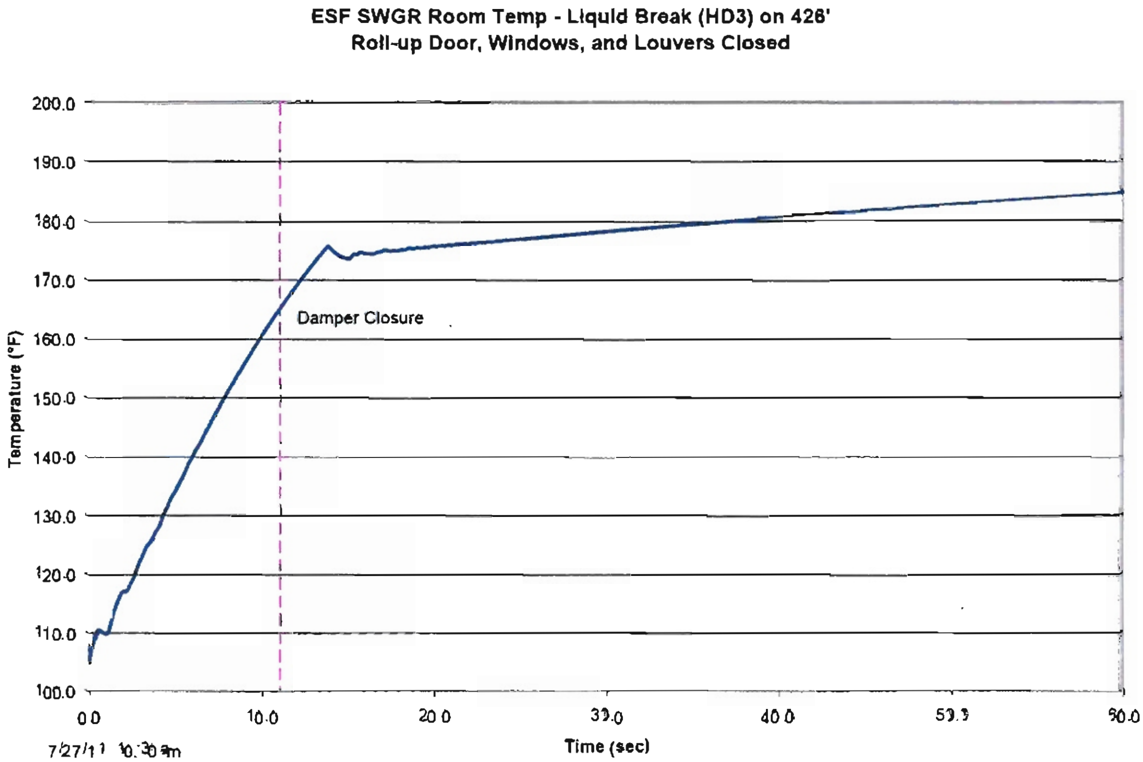


Figure 3-3b: Previous Analysis – ESF Switchgear Temperature Profile –

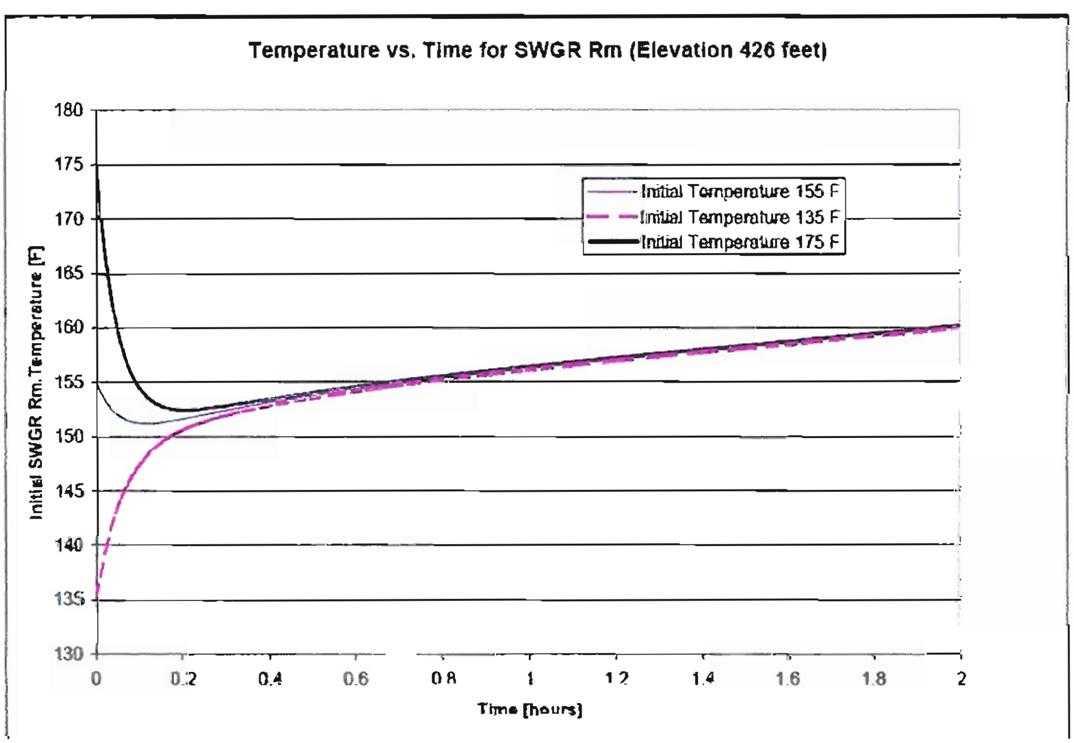


Figure 3-4: New Analysis – ESF Switchgear Room Temperatures – Worst Case Following 0.5 ft² MS Break on TB 426' Elevation

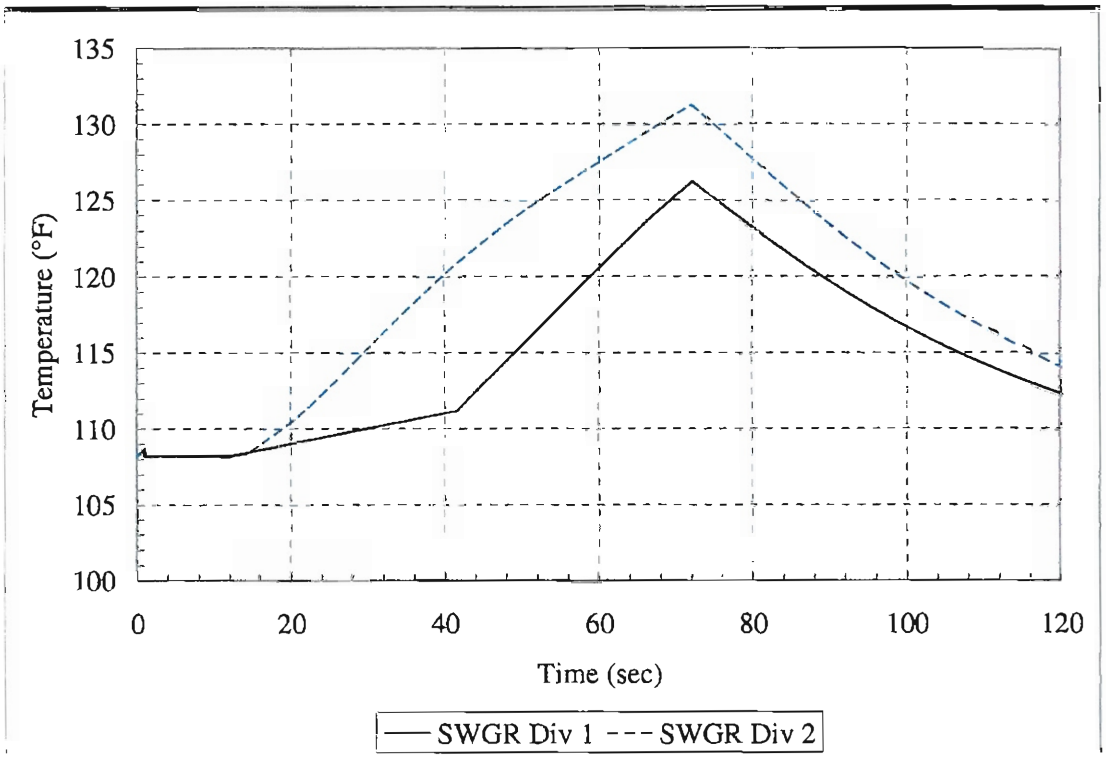


Figure 3-5a: Previous Analysis – MEER Temperature Profile – To Fire Damper Closure

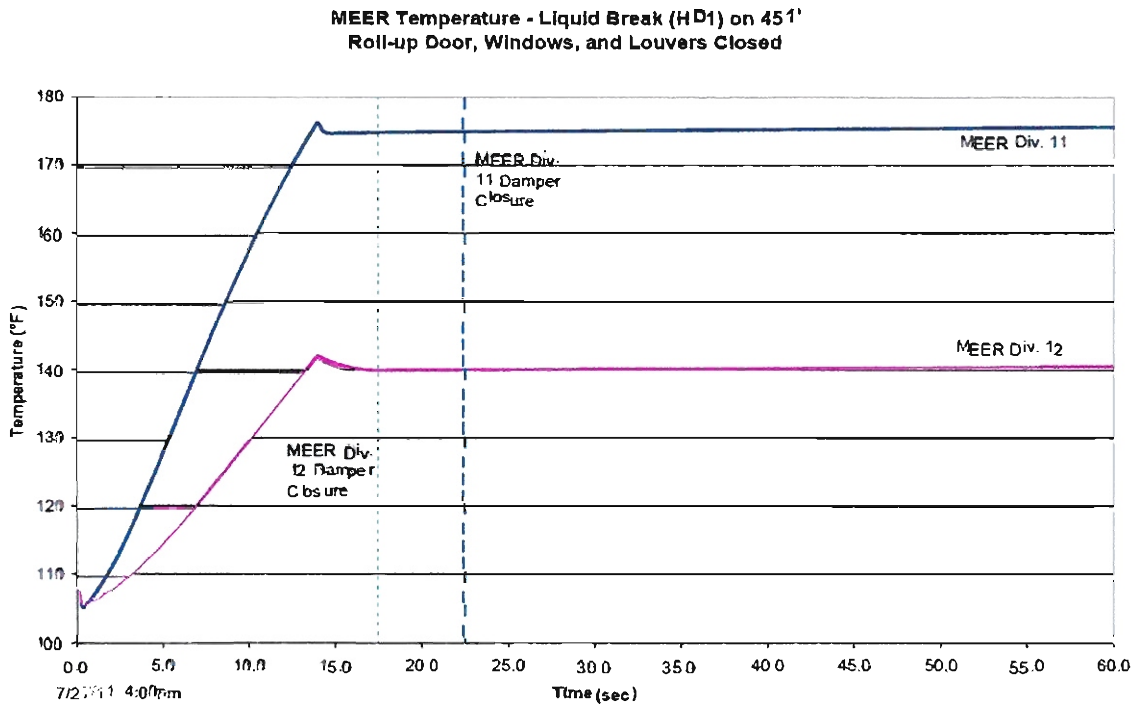


Figure 3-5b: Previous Analysis – MEER Division 11 Temperature Profile – 2 Hour Profile

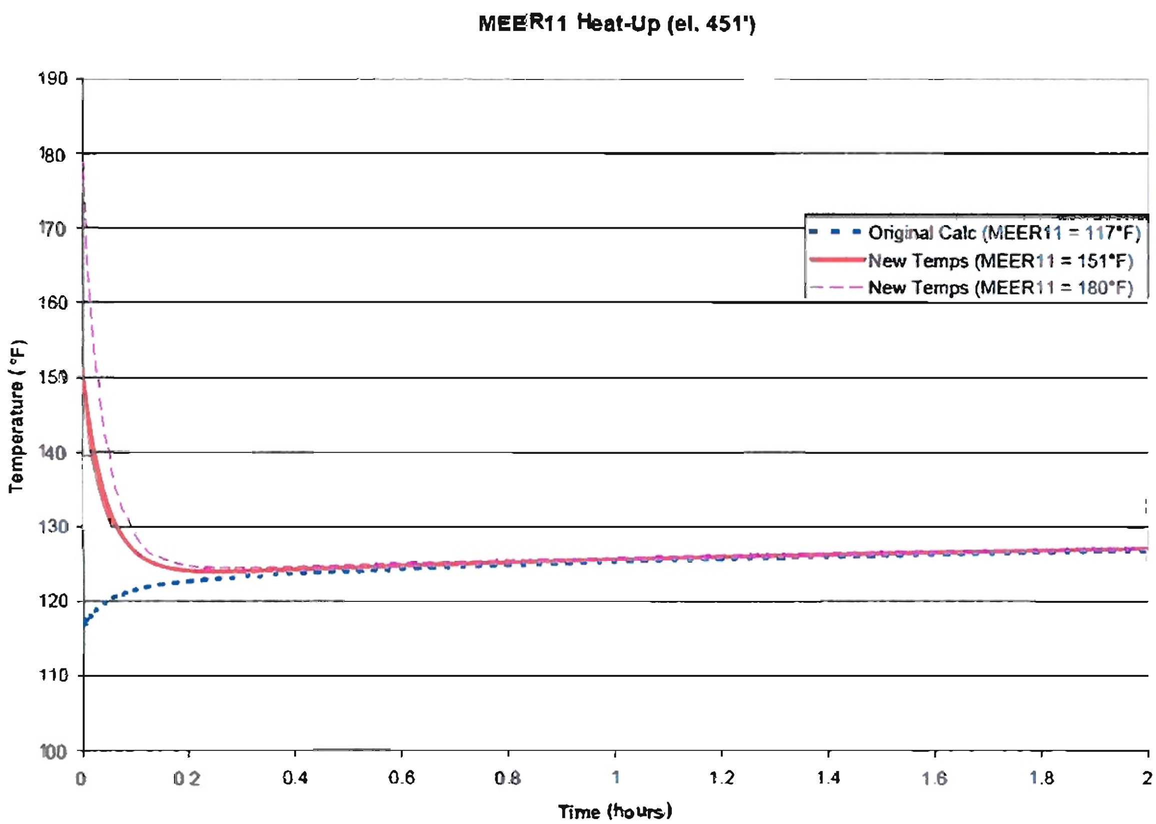


Figure 3-5c: Previous Analysis – MEER Division 12 Temperature Profiles – 2 Hour Profile

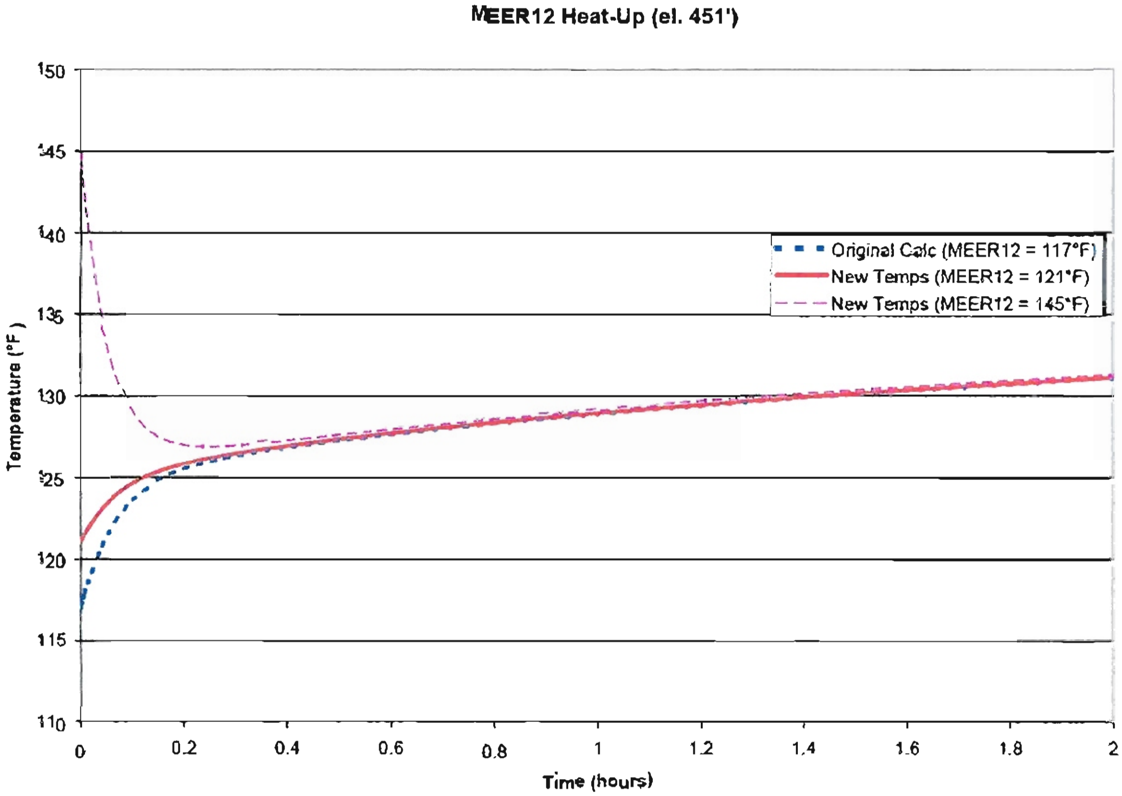


Figure 3-6: New Analysis - MEER Temperatures – Worst Case Following 26" HD Break on TB 451' Elevation

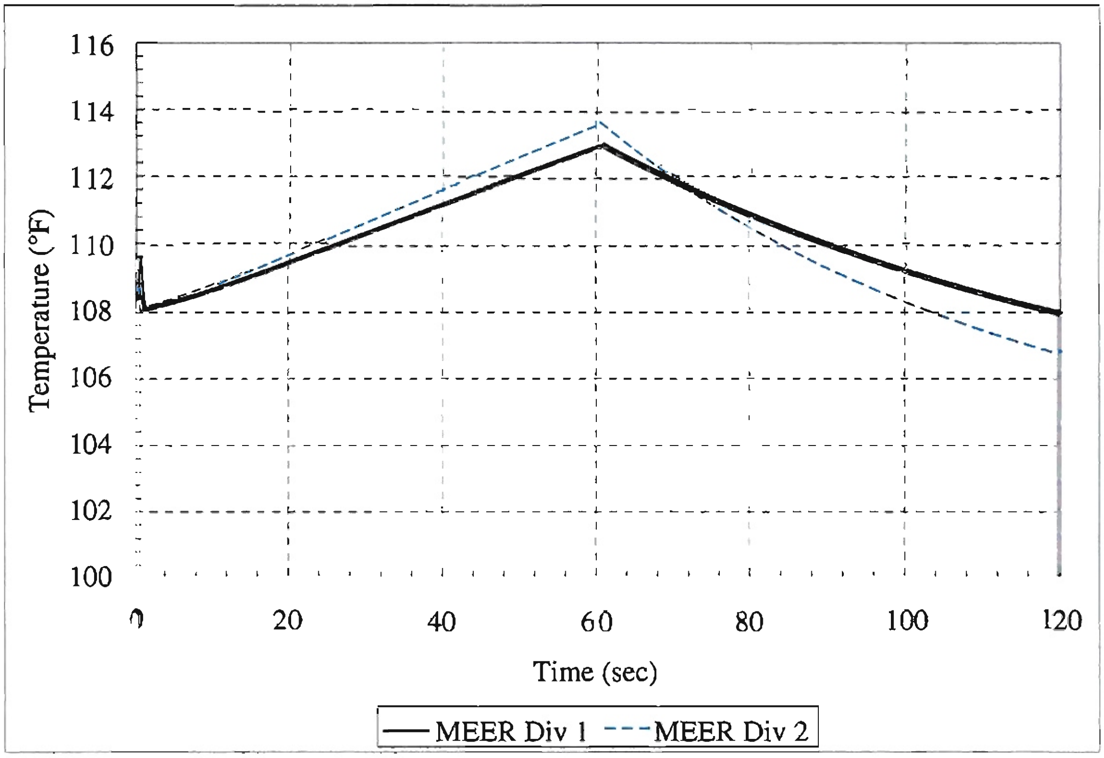


Figure 3-7: New Analysis – Braidwood 401' Auxiliary Bldg. Temperatures – Worst Case Following 0.3 ft^2 MS Break on TB 401' Elevation

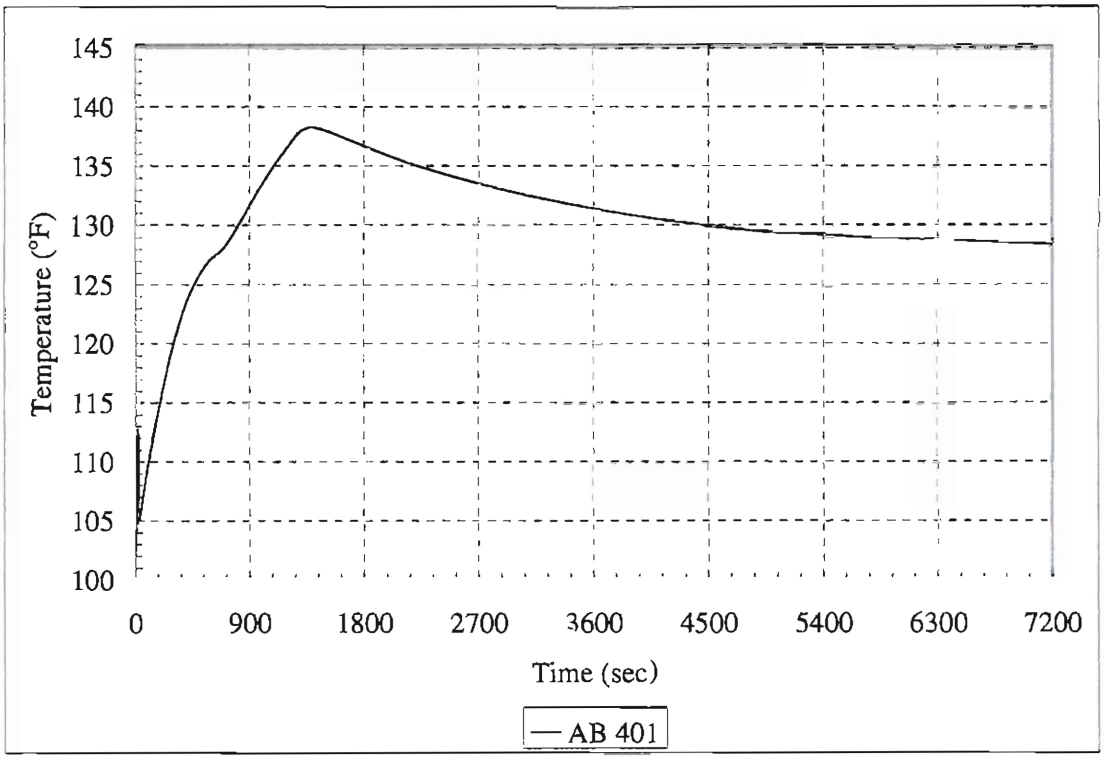


Figure 3-8: New Analysis – Diesel Oil Storage Tank Room Temperatures – Worst Case Following 1.4 ft^2 MS Break on TB 401' Elevation

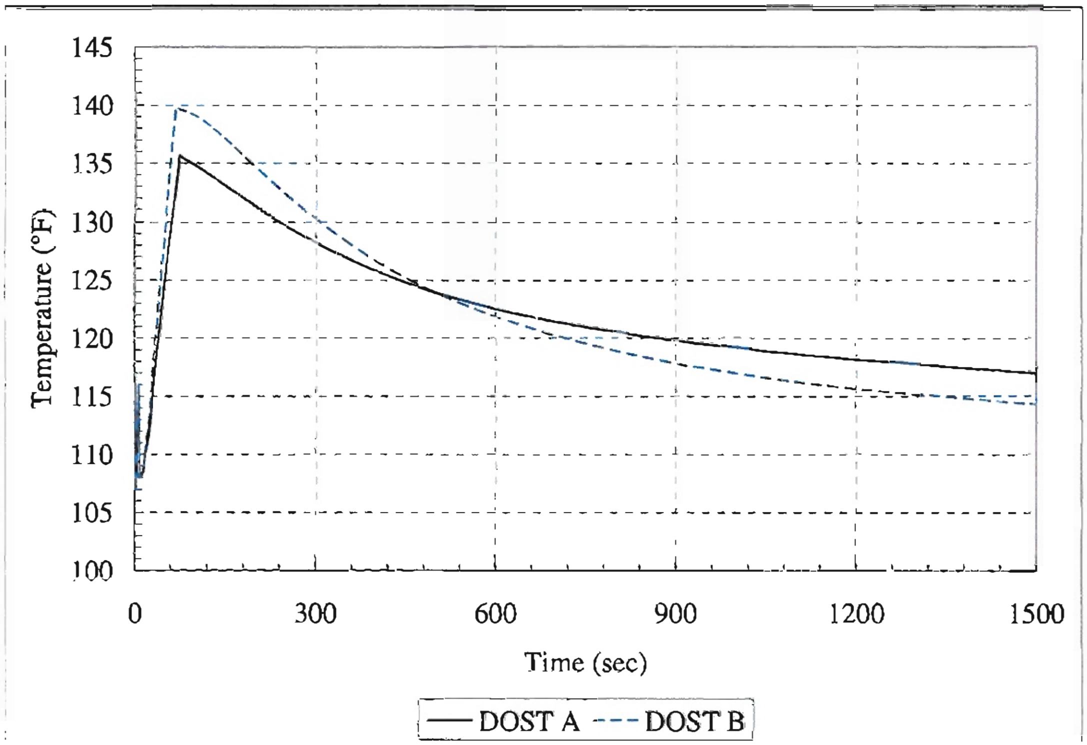


Figure 3-9: New Analysis – Electrical Pipe Tunnel Temperatures – Worst Case Following 0.5 ft^2 MS Break on TB 401' Elevation

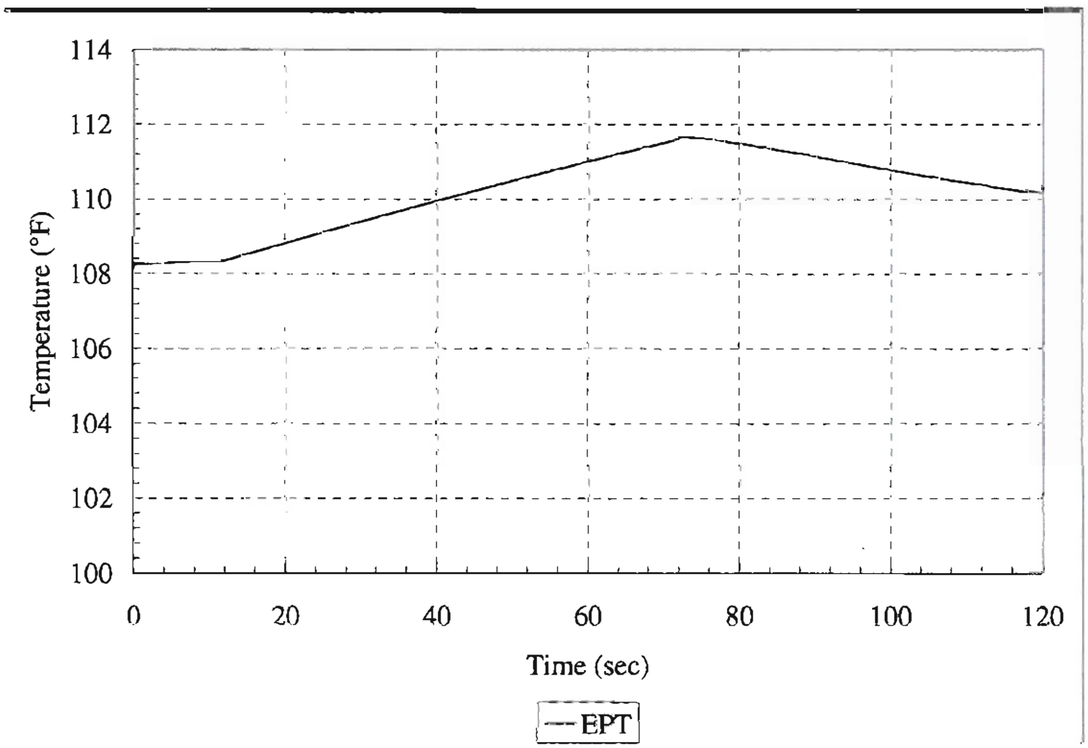
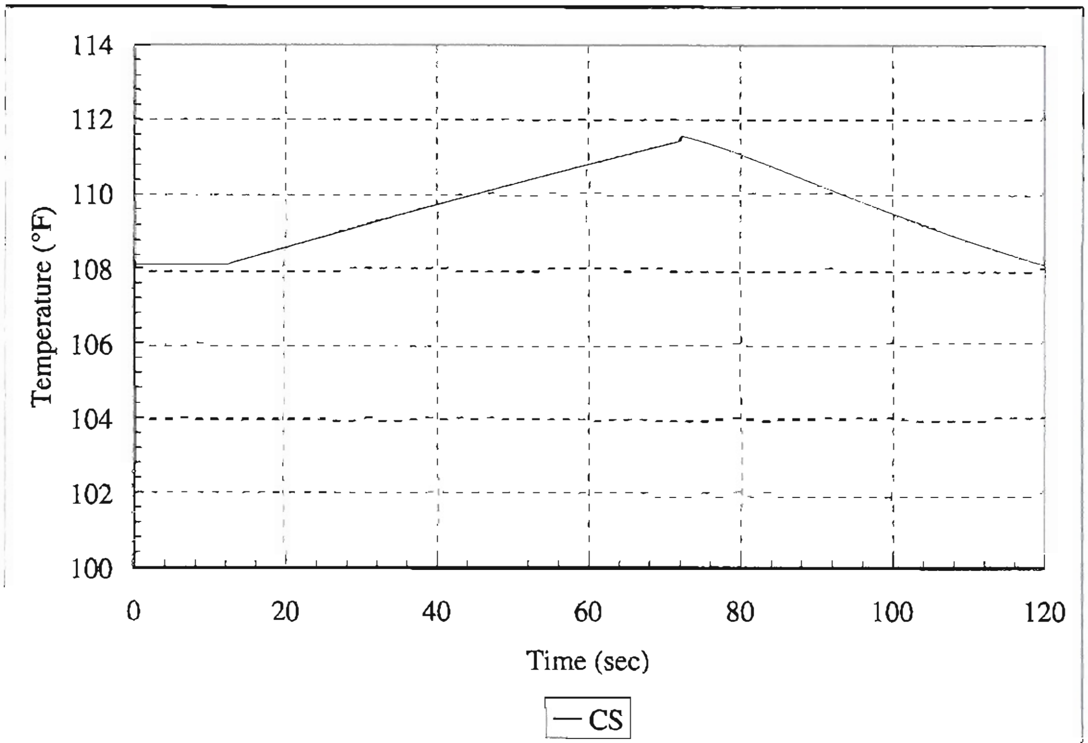


Figure 3-10: New Analysis – Division 12/22 Lower Cable Spreading Room Temperatures – Worst Case Following 0.5 ft^2 MS Break on TB 401' Elevation



NRC Request

i. ***Discuss any plant modifications required to support the analysis.***

Response

The standalone modifications supporting the revised TB HELB mitigation strategy are those that:

1) Install a single-failure proof HELB damper and fire damper assembly in place of the fire damper in the ventilation exhaust openings from the EDG Rooms, the Electrical Cable Tunnel, the ESF Switchgear Rooms, the Division 12/22 Lower Cable Spreading Rooms, the MEERs and the non-ESF Switchgear Rooms.
2) Change the fire damper links for the fire dampers in the ventilation exhaust opening to the Turbine Building for the EDG rooms, the ESF Switchgear rooms, and the Division 12/22 Cable Spreading rooms to a higher temperature link, such that the dampers will only close in the event of a fire and not as a result of a HELB in the Turbine Building.
3) Install relays that will allow the ventilation fans serving the EDG Rooms, the Electrical Cable Tunnel, the ESF Switchgear Rooms, the Division 12/22 Cable Spreading Rooms, and the MEERs that will automatically re-start the fans after a suitable period of time following a trip on high fan differential pressure.
4) Install an automatic high room temperature start feature for the ventilation supply fans serving the EDG Rooms.
5) Install a HELB sensor to prevent the Control Room emergency make-up air filtration unit Turbine Building intake from opening in the event of a TB HELB.
6) Install a HELB sensor to automatically shut-off the DOST Room exhaust fans. During normal operation, the DOST Room exhaust fans draw air into the rooms from the Turbine Building and shutting down the fans limits the introduction of hot air and steam following a HELB. The DOST Rooms do not require HELB dampers to maintain acceptable environmental conditions in the rooms.
7) Implement modifications to the divisional separation walls to withstand the additional loading of a small HELB-induced load resulting from the HELB environment entering the rooms prior to the HELB dampers closing.
8) Implement modifications to affected L-row wall doors to withstand the maximum HELB pressure. This includes reinforcing existing doors or creating protected alcoves to existing doors. Access to the new alcoves is through HELB resistant doors.
9) Install jet impingement shields to protect the Control Room HVAC purge exhaust dampers.
10) Re-routing Station Heating system lines to minimize the potential for the failure of these lines to impact the HELB dampers

NRC Request

j. ***Discuss the results and acceptance criteria for the analysis, including any changes from the previous analysis.***

Response

The acceptance criterion for the TB HELB design has been and remains to prevent exposing the safety-related equipment and components in the adjacent auxiliary building rooms from an environment that could challenge its ability to perform its safety function. The overall design objective of the revised TB HELB mitigation strategy is to keep the Turbine Building environment out of the Auxiliary Building Rooms, to provide a mechanism to rapidly restore cooling to the rooms, to minimize the temperature peak, and to minimize the time that the room temperatures are elevated; this objective is demonstrated in the new analysis. In this respect, the design criterion is no different from that of the previous analysis.

The new analysis credits the modifications installed to support the revised TB HELB mitigation strategy and results in lower temperatures and much shorter exposure durations than determined in the previous analysis for the subject areas. The revised analysis demonstrates that the environmental parameters within these areas would not be significantly more severe than the environment that would occur during normal plant operation.

NRC Request

4. ***Provide confirmation that you are ready for an NRC staff audit to confirm that your resolution of the HELB non-conformance has restored the licensing and design basis of the plants and bound operation at the uprated power level. The audit is expected to include an extent-of-condition review, analyses, and installed modifications.***

Response

EGC is ready to support an NRC staff audit at Cantera and both Braidwood and Byron Station on or after July 15, 2013. This timeframe has previously been discussed with the NRC Project Manager.

REFERENCES

A-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

A-2 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 November 1, 2011 [RS 11-169]

A-3 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 December 9, 2011 [RS 11-178] [ML113430811]

A-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 April 27, 2012 [RS 12-047] [ML12121A496]

A-5 WCAP-10961 Revision 1, Steamline Break Mass/Energy Releases for Equipment Environment Qualification Outside Containment, October 1985

A-6 Byron SSER 7, 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-7 Braidwood SSER 2, 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.

A-8 Byron/Braidwood Updated Final Safety Analysis Report (UFSAR), Revision 14, December 2011

A-9 Regulatory Guide 1.46, "Protection Against Pipe Whip Inside Containment"

A-10 A. Giambusso Letter, December 1972

A-11 NRC's letter from J.F. O'Leary, dated July 1973

A-12 BTP APCSB 3-1, "Protection Against Postulated Piping Failures in Fluid System Outside Containment"

A-13 BTP MEB 3-1, "Postulated Rupture Locations in Fluid System Piping Inside and Outside Containment"

A-14 Point Beach SER, Point Beach Nuclear Plant (PBNP), Units 1 and 2 -Issuance of License Amendments Regarding Extended Power Uprate, dated May 3, 2011

A-15 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants"

A-16 Regulatory Guide 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants"