NRR-DRMAPEm Resource

From: Wiebe, Joel
Sent: Wednesday, August 7, 2019 12:39 PM
To: Lisa Simpson (Lisa.Simpson@exeloncorp.com)
Subject: Partial Issuance of Final RAIs for Braidwood/Byron TSTF-505 Application
Attachments: Braidwood and Byron TSTF 505 RAIs from APLA and APLB (Final).docx

Lisa,

This is a partial issuance of RAIs. As we discussed, a response is requested within 45 days of this email for APLA-02 and APLA-03. A response is requested within 30 days of this email for the rest of the RAIs listed in the attachment to this email.

Joel

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REQUEST FOR ADDITIONAL INFORMATION

BYRON STATION, UNIT NOS. 1 AND 2,

AND BRAIDWOOD STATION, UNITS 1 AND 2

DOCKET NOS. STN 50-454, STN 50-455,

STN 50-456 AND STN 50-457

In reviewing the Exelon Generation Company, LLC (Exelon) submittal dated December 13, 2018 (Agencywide Document Access and Management System (ADAMS) Accession No ML18352B063), as supplemented by letter dated February 14, 2019 (ADAMS Accession No. ML19050A399), related to adoption of Technical Specification Task Force Traveler (TSTF)-505, "Provide Risk-Informed Extended Completion Times," Revision 2 (ADAMS Accession No. ML18267A259), for the Braidwood Station (Braidwood), Units 1 and 2, and Byron Station (Byron), Unit Nos. 1 and 2, the NRC staff has determined that the following information is needed in order to complete its review:

Probabilistic Risk Analysis (PRA)
Acceptability and Risk-informed Approach

APLA RAI 01 - PRA Facts and Observations (F&Os)

Regulatory Guide (RG) 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-informed Activities," Revision 2 (ADAMS Accession No. ML090410014), provides guidance for addressing PRA acceptability. RG 1.200 describes a peer review process utilizing the ASME/ANS PRA standard (currently ASME/ANS-RA-Sa-2009, "Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications"[1]) as one acceptable approach for determining the technical adequacy of the PRA, once acceptable consensus approaches or models have been established for evaluations that could influence the regulatory decision. The primary result of a peer review are the findings and observations (F&Os) recorded by the peer review and the subsequent resolution of these F&Os. A process to close-out Finding-level F&Os is documented in Appendix X to Nuclear Energy Institute (NEI) 05-04, NEI 07-12, and NEI 12-13, "Close-out of Facts and Observations" (ADAMS Accession No. ML17086A431) dated February 21, 2017 accepted by the NRC in the letter from Joseph Giitter and Mary Jane Ross-Lee, NRC to Greg Krueger, NEI, dated May 3, 2017 (ADAMS Accession Number ML17079A427).

In Exelon's letter dated December 13, 2018, Tables E2-1 and E2-2 provides the F&Os that remain open after an F&O closure review performed in 2015 for the Byron and Braidwood Stations fire PRAs, along with dispositions of those F&Os for this application. The NRC staff reviewed the dispositions to these F&Os and noted that several F&Os did not include the updates to the F&O resolutions that were documented in Exelon's letter dated June 13, 2018 (ADAMS Accession No. ML18165A181). In its letter dated June 13, 2018, Exelon committed to

[1] Available from the International Organization for Standardization at https://www.iso.org/store.html.

update the fire PRAs to resolve three of these F&Os prior to implementation of the 10 CFR 50.69 categorization process and to perform a sensitivity study for one of these F&Os as part of the categorization process. In its letter dated December 13, 2018, Exelon identified in Attachment 5 the items that are required to be completed prior to implementation of the Risk Informed Completion Time (RICT) Program at Braidwood Station, Units 1 and 2, and Byron Station, Units 1 and 2. In its letter dated December 13, 2018, Exelon further states that all issues identified in Attachment 5 will be addressed and any associated changes will be made, focused-scope peer reviews will be performed on changes that are PRA upgrades as defined in the PRA standard (ASME/ANS RA-Sa-2009, as endorsed by RG 1.200, Revision 2), and any findings will be resolved and reflected in the PRA of record prior to implementation of the RICT Program. Considering these observations address the following:

a. Concerning internal events F&O 1035 and fire F&Os 16-4, 25-11, and 26-9, Exelon stated it would update the PRA model to incorporate the F&O resolutions prior to implementation of the 10 CFR 50.69 categorization process.

   Provide the status of the implementation items and confirm that the proposed resolutions from the 50.69 implementation items remain consistent with the proposed disposition/resolution in the TSTF-505 submittal.

b. The resolution to F&O 20-8 states that three "scaling factors" are used to credit alternate shutdown given abandonment of the main control room (MCR) upon loss of habitability to account for degrees of fire-induced damage. The resolution refers to NRC safety evaluations (SEs) issuing the NFPA 805 amendments for Turkey Point (ADAMS ML15061A237), St. Lucie (ADAMS ML15344A346) and Farley (ADAMS ML14308A048) power plants. The SEs and associated documents refer to three "bounding values" to be assigned to abandonment scenarios depending on the complexity of the abandonment scenarios. The resolution to F&O 20-8 clarifies that an adjustment factor is applied as a multiplier to the control room abandonment cut sets. The SEs and associated documents do not clarify how the bounding scenario values are applied at the cut set level and does not explain how these scaling factors remain bounding when systems, structures, and components are taken out of service during a RICT application.

   i. Describe and justify how the evaluation is developed and applied and how it can be maintained when the plant or the PRA models change and during the translation to the Real-Time risk (RTR) Model.

   ii. Provide descriptions of the methodology that was incorporated into the Byron and Braidwood PRAs.

   iii. Explain how the bounding scaling factors remain valid when SSCs are taken out of service during a RICT.

APLA RAI 02 - Key Assumptions and Sources of Uncertainty

Regulatory Position C of RG 1.174, Revision 3 (ADAMS Accession Number ML17317A256) states:

> "In risk-informed decisionmaking, licensing basis changes are expected to meet a set of key principles… In implementing these principles, the staff expects the following… Uncertainty receives appropriate consideration in the analyses and interpretation of

findings… NUREG-1855 provides acceptable guidance for the treatment of uncertainties in risk-informed decision making”

NUREG-1855, Revision 1 (ADAMS Accession No. ML17062A466) provides guidance on screening sources of uncertainty and determining those that are key sources of uncertainty for the application. NUREG-1855, Revision 1 identifies Electric Power Research Institute (EPRI) Topical Report (TR) 1016737[2] and EPRI TR 1026511[2] as providing additional guidance for identifying and characterizing key sources of uncertainty.

Section 2.3.4 of Nuclear Energy Institute (NEI) 06-09, “Risk-Informed Technical Specifications Initiative 4B, Risk-Managed Technical Specifications (RMTS) Guidelines,” Revision 0-A (ADAMS Accession No. ML12286A322), states that PRA modeling uncertainties be considered in application of the PRA base model results to the RICT program. The NRC Safety Evaluation (SE) for NEI 06-09, Revision 0, states that this consideration is consistent with Section 2.3.5 of RG 1.177, Revision 1 (ADAMS Accession No. ML100910008). NEI 06-09, Revision 0-A, further states that sensitivity studies should be performed on the base model prior to initial implementation of the RICT program on uncertainties which could potentially impact the results of a RICT calculation. These sensitivity studies should be used to develop appropriate compensatory Risk Management Actions (RMAs) such as highlighting risk significant operator actions, confirming availability and operability of important standby equipment, and assessing the presence of severe or unusual environmental conditions.

In its December 13, 2018, letter Exelon states that the internal events PRA uncertainty analysis was performed based on guidance from NUREG-1885, Revision 1, (ADAMS Accession No. ML17062A466) and EPRI Topical Report (TR) 1016737, “Treatment of Parameter and Modeling Uncertainty for Probabilistic Risk Assessments” dated 2008. Exelon indicates that key plant-specific assumptions and modeling uncertainties from the internal events PRA documentation were considered, as well as generic sources of uncertainty from EPRI TR 1016737. However, in its letter dated December 13, 2018, as supplemented by letter dated June 19, 2019, Exelon does not discuss the sources of modeling uncertainty that were identified for the fire PRA or explain whether both plant-specific and generic modeling issues were considered. The NRC staff notes that generic modelling uncertainties for fire PRA are identified in EPRI TR 1026511, “Practical Guidance on the Use of Probabilistic Risk Assessment in Risk-Informed Applications with a Focus on the Treatment of Uncertainty”, dated 2012 and cited by NUREG-1855, Revision 1.

In addition, based on RG 1.174 and Section 6.4 of NUREG-1855, Revision 1, for a Capability Category II risk evaluation, the mean values of the risk metrics (total and incremental values) need to be compared against the risk acceptance guidelines. The mean values referred to are the means of the probability distributions that result from the propagation of the uncertainties on the PRA input parameters and model uncertainties explicitly reflected in the PRA models. In general, the point estimate core damage frequency (CDF) and large early release frequency (LERF) obtained by quantification of the cut set probabilities using mean values for each basic event probability does not produce a true mean of the CDF/LERF. Under certain circumstances, a formal propagation of uncertainty may not be required if it can be demonstrated that the state of knowledge correlation (SOKC) is unimportant (i.e., the risk results are well below the acceptance guidelines). Enclosure 4 of Exelon’s December 13, 2018, letter shows that for the Braidwood Station, Unit 2, the total CDF is 8.2E-05 per year and for

[2] Available from EPRI, 5637 Gulfstream Row, Columbia, MD 21044

Byron Station, Unit 2, the CDF is 8.0E-05 per year. Therefore, an increase in CDF and LERF due to SOKC could possibly impact the conclusions of this application.

Considering the observations above, address the following for the Byron and Braidwood Stations:

a. Describe the process used to identify and evaluate key assumptions and sources of model uncertainty for the fire PRA. Address the following in the response:

    i. Discuss how a comprehensive list of plant-specific and generic industry key assumptions and sources of uncertainty for the fire PRA were identified as a starting point for this evaluation.

    ii. Explain how the comprehensive list of key assumptions and sources of uncertainty sources were screened to a list of uncertainties that were specifically evaluated for their impact on the RICT application.

    iii. Explain what criteria or what additional analysis was used to evaluate the impact of the key assumptions and sources of uncertainty on the RICT application.

    iv. Describe how the evaluation process is consistent with guidance in NUREG-1855, Revision 1, or other NRC-accepted processes.

b. In accordance with the process described in NUREG-1855, Revision 1, describe any additional sources of fire PRA model uncertainty and related assumptions relevant to the application that were not provided in Exelon's letter dated December 13, 2018, Enclosure 9, and describe their impact on the application results.

c. For any additional sources of model uncertainty and related assumptions identified in item b, above:

    i. Provide qualitative or quantitative justification that these uncertainties and assumptions do not challenge the RG 1.174 risk acceptance guidelines.

    ii. Justify that these key uncertainties and assumptions have no impact on the RICT calculations or, if determined to have a significant impact, consistent with the guidance in NEI 06-09-A, discuss the RMAs for each key uncertainty and assumption that will be implemented to minimize their potential adverse impact.

d. Clarify whether the total CDF and LERFs values presented in Exelon's December 13, 2018, letter, Enclosure 5, are consistent with guidance in NUREG-1855, Revision 1 stipulating that the risk estimates should be based on mean values from parametric uncertainty analysis results that considers the SOKC for internal events and fire parameters. If risk values were not estimated in accordance with guidance in NUREG-1855, Revision 1 as described above, then confirm the RG 1.174 total risk acceptance guidelines are still met as a part of RAI 10, below.

APLA RAI 03 - Specific Key Assumptions and Sources of Uncertainty

The NRC SE of NEI 06-09, revision 0-A states:

> "When key assumptions introduce a source of uncertainty to the risk calculations (identified in accordance with the requirements of the ASME standard), TR NEI 06-09, Revision 0, requires analysis of the assumptions and accounting for their impact to the RMTS calculated RICTs."

Exelon's letter dated December 13, 2018, Enclosure 9, Table E9-1 and Table E9-3, provide an assessment of key assumptions and sources of modeling uncertainty for the internal events and fire PRAs, respectively.

The disposition regarding the uncertainty associated with cable routing for the fire PRA states "PRA credited components for which cable routing information was not provided represent a source of uncertainty (conservatism) in that these components are assumed failed unnecessarily." It is not clear from the disposition how many or which systems were assumed failed because of the lack of cable routing information and what impact this assumption may have on the RICT calculations. Though the assumption used in the fire PRA model is conservative, NRC staff notes that conservatism in PRA modeling could have a non-conservative impact on the RICT calculations. If an SSC is part of system not credited in the fire PRA or it is supported by a system that is assumed to always fail, then the risk increase due to taking that SSC out of service could be masked by the conservative modeling. Therefore, address the following for the Byron and Braidwood Stations:

a. Identify the systems or components that are assumed to be always failed in the PRA and justify that this assumption has an inconsequential impact on the RICT calculations.

b. As an alternative to item a, above, propose a mechanism to ensure that a sensitivity study is performed for the RICT calculations for applicable SSCs to determine the impact of the conservative modeling on the RICT. The proposed mechanism should also ensure that any additional risk associated with the modeling is either accounted for in the RICT calculation or is compensated for by applying an additional RMA during the RICT.

APLA RAI 04 - Potential Credit for FLEX Equipment or Actions

The NRC memorandum dated May 30, 2017, "Assessment of the Nuclear Energy Institute 16-06, 'Crediting Mitigating Strategies in Risk-Informed Decision Making,' Guidance for Risk-Informed Changes to Plants Licensing Basis" (ADAMS Accession No. ML17031A269), provides the NRC's staff assessment of the challenges of incorporating diverse and flexible coping strategies and equipment (FLEX) into a PRA model in support of risk-informed decision-making in accordance with the guidance of RG 1.200, Revision 2 (ADAMS Accession No. ML090410014). Though implementation of FLEX procedures is cited in Exelon's December 13, 2018, letter as possible RMAs, the letter and other docketed information do not indicate if Byron and Braidwood have credited FLEX equipment or actions in the internal events, including internal flooding, or fire PRA models. As such, please address the following:

a. Discuss whether Exelon has credited FLEX equipment or FLEX mitigating actions into the Byron and Braidwood Station internal events, including the internal flooding, or fire PRA models. If not incorporated or the inclusion is not expected to impact the PRA results used in the RICT program, no additional response is requested.

b. If FLEX equipment or FLEX mitigating actions have been credited in the PRA, address the following, separately for the internal events, including internal flooding, and fire PRA:

   i. Summarize the supplemental equipment and compensatory actions, including FLEX strategies that have been quantitatively credited for each of the PRA models used to support this application. Include discussion of whether the credited FLEX equipment is portable or permanently installed equipment.

   ii. Discuss whether the credited equipment (regardless of whether it is portable or permanently-installed) are like other plant equipment (i.e. SSCs with sufficient plant-specific or generic industry data) and whether the credited operator actions are similar to other operator actions evaluated using approaches consistent with the endorsed ASME/ANS RA-Sa-2009 PRA standard.

   iii. If any credited FLEX equipment is dissimilar to other plant equipment credited in the PRA (i.e. SSCs with sufficient plant-specific or generic industry data), discuss the data and failure probabilities used to support the modeling and provide the rationale for using the chosen data. Discuss whether the uncertainties associated with the parameter values are in accordance with the ASME/ANS PRA Standard as endorsed by RG 1.200 Revision 2.

   iv. If any operator actions related to FLEX equipment are evaluated using approaches that are not consistent with the endorsed ASME/ANS RA-Sa-2009 PRA Standard (e.g., using surrogates), discuss the methodology used to assess human error probabilities for these operator actions. The discussion should include:

      1. A summary of how the impact of the plant-specific human error probabilities and associated scenario-specific performance shaping factors listed in (a)-(j) of supporting requirement HR-G3 of the ASME/ANS RA-Sa-2009 PRA Standard were evaluated.

      2. Whether maintenance procedures for the portable equipment were reviewed for possible pre-initiator human failures that renders the equipment unavailable during an event, and if the probabilities of the pre-initiator human failure events were assessed as described in HLR-HR-D of the ASME/ANS RA-Sa-2009 PRA Standard.

      3. If the procedures governing the initiation or entry into mitigating strategies are ambiguous, vague, or not explicit, a discussion detailing the technical bases for probability of failure to initiate mitigating strategies.

c. The ASME/ANS RA-Sa-2009 PRA standard defines PRA upgrade as the incorporation into a PRA model of a new methodology or significant changes in scope or capability that impact the significant accident sequences or the significant accident progression sequences. Section 1-5 of Part 1 of ASME/ANS RA-Sa-2009 PRA Standard states that upgrades of a PRA shall receive a peer review in accordance with the requirements specified in the peer review section of each respective part of this Standard.

   Provide an evaluation of the model changes associated with incorporating mitigating strategies, which demonstrates that none of the following criteria is satisfied: (1) use of new methodology, (2) change in scope that impacts the significant accident sequences or the significant accident progression sequences, and (3) change in capability that impacts the significant accident sequences or the significant accident progression sequences.

d. Section 2.3.4 of NEI 06-09, Revision 0-A, states that PRA modeling uncertainties shall be considered in the application of the PRA base model results to the RICT program. The NRC SE for NEI 06-09 states that this consideration is consistent with Section 2.3.5 of RG 1.177 Revision 1. NEI 06-09, Revision 0-A further states that sensitivity studies should be performed on the base model prior to initial implementation of the RICT program on uncertainties which could potentially impact the results of a RICT calculation. NRC staff notes that the impact of model uncertainty could vary based on the proposed RICTs. NEI 06-09 Revision 0-A also states that the insights from the sensitivity studies should be used to develop appropriate compensatory RMAs, including highlighting risk significant operator actions, confirming availability and operability of important standby equipment, and assessing the presence of severe or unusual environmental conditions. Uncertainty exists in modeling FLEX equipment and actions related to assumptions regarding the failure probabilities for FLEX equipment used in the model, the corresponding operator actions, and pre-initiator failure probabilities. Therefore, FLEX modeling assumptions can be key assumptions and sources of uncertainty for RICTs proposed in this application. In light of these observations:

    i. Describe the sensitivity studies that will be used to identify the RICTs proposed in this application for which FLEX equipment and/or operator actions are key assumptions and sources of uncertainty (e.g., use of generic industry data for non-safety related equipment). Explain and justify the approach used to perform the sensitivity studies.

    ii. Describe how the results of the sensitivity studies which identify FLEX equipment and/or operator actions as key assumptions and sources of uncertainty will be used to identify RMAs prior to implementation of the RICT program, consistent with the guidance in Section 2.3.4 of NEI 06-09, Revision 0-A.

    iii. Demonstrate the approaches described in items (i) and (ii) above using an example sensitivity study for the nominal configuration of a proposed RICT where the FLEX equipment and/or operator actions are identified as key assumptions and sources of uncertainty.

<u>APLA RAI 05 - Real-Time Risk Model (RTR)</u>

Regulatory Position 2.3.3 of RG 1.174, Revision 3, states that the level of detail in the PRA should be sufficient to model the impact of the proposed licensing basis change. The characterization of the problem should include establishing a cause-effect relationship to identify portions of the PRA affected by the issue being evaluated. Full-scale applications of the PRA should reflect this cause-effect relationship in a quantification of the impact of the proposed licensing basis change on the PRA elements.

Section 4.2 of NEI 06-09, Revision 0-A, describes attributes of the configuration risk management tool (CRM). A few of these attributes are listed below:

- Initiating events accurately model external conditions and effects of out-of-service equipment.

- Model translation from the PRA to a separate CRM tool is appropriate; CRM fault trees are traceable to the PRA. Appropriate benchmarking of the CRM tool against the PRA model shall be performed to demonstrate consistency.

- Each CRM application tool is verified to adequately reflect the as-built, as-operated plant, including risk contributors which vary by time of year or time in fuel cycle or otherwise demonstrated to be conservative or bounding.

- Application specific risk important uncertainties contained in the CRM model (that are identified via PRA model to CRM took benchmarking) are identified and evaluated prior to use of the CRM tool for RMTS applications.

- CRM application tools and software are accepted and maintained by and appropriate quality program.

- The CRM tool shall be maintained and updated in accordance with approved station procedures to ensure it accurately reflects the as-built, as-operated plant.

Exelon's letter dated December 13, 2018, Enclosure 8, describes the attributes of the RTR Model, or Braidwood and Byron's CRM tool, for use in RICT calculations. Exelon's letter explains that the internal flooding model is integrated into the internal events PRA model, but the fire PRA model is maintained as a separate model. Exelon's letter also describes several changes made to the internal events and fire PRA models to support calculation of configuration-specific risk and identifies approaches for ensuring the fidelity of the RTR to the PRAs including RTR maintenance, documentation of changes, and testing. With regards to development and application of the RTR model, provide the following:

a. Explain how any changes in success criteria based on seasonal variations are accounted for in the RTR Model for use in RICT calculations.

b. Confirm that out-of-service equipment will be properly reflected in the RTR Model initiating event models as well as in the system response models.

c. Describe the process that will be used to maintain the accuracy of any pre-solved cut sets with changes in plant configuration.

d. Describe the benchmarking activities performed to confirm consistency of the RTR model to base PRA model results, including periodicity of RTR updates compared to the base PRA model updates.

APLA RAI 06 - Identification of Compensatory Measures and RMAs

The NRC in its SE for NEI 06-09, Revision 0-A, states that the licensee should provide information that will describe the process to identify and provide compensatory measures and RMAs during extended CTs. Exelon, in its December 13, 2018, letter, Enclosure 12, identifies three kinds of RMAs (i.e., actions to provide increased risk awareness and control, reduction of the duration of maintenance activities, and reduction of the magnitude of risk increase). Enclosure 12 also provides examples of RMAs for an unavailable diesel generator, battery charger, RHR pump, and for loss of off-site power. Enclosure 12 does not describe what criteria or insights (e.g., important fire areas, important operator actions) are used to determine what RMAs to apply in specific instances. Therefore:

a. Describe the criteria and insights (e.g., important fire areas, important operator actions) that are used to determine the compensatory measures and RMAs to apply in specific instances.

b. Explain how RMAs are identified for emergent conditions in which the extent of condition evaluation for inoperable SSCs is not complete prior to exceeding the Completion Time to account for the increased possibility of a common cause failure (CCF). Include explanation of if and how these RMAs are different from other RMAs.

APLA RAI 07 - Evaluation of Common Cause Failures for Planned Maintenance

NEI 06-09, Revision 0-A, states that no common cause failure (CCF) adjustment is required for planned maintenance. The NRC SE for NEI 06-09, Revision 0, is based on conformance with RG 1.177, Revision 1. Specifically, the NRC SE, Section 2.2, states that, "specific methods and guidelines acceptable to the NRC staff are […] outlined in RG 1.177 for assessing risk-informed TS changes." The NRC SE, Section 3.2, further states that compliance with the guidance of RG 1.174, Revision 1, and RG 1.177, Revision 1, "is achieved by evaluation using a comprehensive risk analysis, which assesses the configuration-specific risk by including contributions from human errors and common cause failures."

The guidance in RG 1.177, Revision 1, Section 2.3.3.1, states that, "CCF modeling of components is not only dependent on the number of remaining in-service components but is also dependent on the reason components were removed from service (i.e. whether for preventative or corrective maintenance)." In relation to CCF for preventive maintenance, the guidance in RG 1.177, Appendix A, Section A-1.3.1.1, states:

> If the component is down because it is being brought down for maintenance, the CCF contributions involving the component should be modified to remove the component and to only include failures of the remaining components (also see Regulatory Position 2.3.1 of Regulatory Guide 1.177).

According to RG 1.177, Revision 1, if a component from a CCF group of three or more components is declared inoperable, the CCF of the remaining components should be modified to reflect the reduced number of available components in order to properly model the as-operated plant.

a. Explain how CCFs are included in the PRA model (e.g., with all combinations in the logic models as different basic events or with identification of multiple basic events in the cut sets);

b. Explain how the quantification and/or models will be changed when, for example, one train of a 3×100 percent train system is removed for preventative maintenance and describe how the treatment of CCF meets the guidance in RG 1.177, Revision 1, or meets the intent of this guidance when quantifying a RICT.

APLA RAI 08 - Evaluation of Common Cause Failure for Emergent Conditions

In its letter dated December 13, 2018, Exelon provides TS Administrative Section constraint d that states:

> For emergent conditions, if the extent of condition evaluation for inoperable structures, systems, or components (SSCs) is not complete prior to exceeding the ACTION allowed outage time, the RICT shall account for the increased possibility of common cause failure (CCF) by either:
>
> 1. Numerically accounting for the increased possibility of CCF in the RICT calculation; or
>
> 2. Risk Management Actions (RMAs) not already credited in the RICT calculation shall be implemented that support redundant or diverse SSCs that perform the function(s) of the inoperable SSCs, and, if practicable, reduce the frequency of initiating events that challenge the function(s) performed by the inoperable SSCs.

Regarding option 1 of constraint d, provide the following:

a. Describe and justify how the numerical adjustment for increased possibility of CCF will be performed, or

b. Confirm that numerically accounting for the increased possibility of CCF in the RICT calculation will be performed in accordance with RG 1.177, Revision 1.

APLA RAI 09 - PRA Modeling of Instrumentation and Controls

The proposed TS limiting conditions for operations (LCOs) in Exelon's December 13, 2018, letter include those related to instrumentation and controls (I&C). These include TS for the reactor trip system (RTS) and the engineered safety features actuation system (ESFAS):

> TS 3.3.1 RTS Instrumentation;
> TS 3.3.2 ESFAS Instrumentation,
> AND,
> TS 3.3.5, Loss of Power (LOP) Diesel Generator (DG) Start Instrumentation.

PRA technical acceptability attributes are provided in Section 2.3.4 of NEI 06-09, Revision 0-A, and in RG 1.200, Revision 2. The licensee has previously received approval for changes to its I&C completion times, bypass test times, and surveillance intervals consistent with guidance in Technical Specifications Task Force (TSTF) traveler TSTF-411 and TSTF-418. However, the licensee does not address whether the I&C are modeled in sufficient detail to support implementation of TSTF-505, Revision 2 (ADAMS Accession No. ML18183A493). The following additional information is requested:

a. Explain how instrumentation is modelled in the PRA. This should include, but not be limited to, the scope of the I&C equipment (e.g., channels, relays, logic) and associated TS functions for which a RICT would be applied, and PRA modeling of the I&C and functions including how these are modeled in sufficient detail and based on plant-specific data, etc.

b. Section 2.3.4 of NEI 06-09, Revision 0-A, states that PRA modeling uncertainties be considered in application of the PRA base model results to the RICT program. The NRC in its SE for NEI 06-09, Revision 0, states that this consideration is consistent with Section 2.3.5 of RG 1.177, Revision 1. NEI 06-09, Revision 0-A, further states that sensitivity studies should be performed on the base model prior to initial implementation of the RICT program on uncertainties which could potentially impact the results of an RICT calculation and that sensitivity studies should be used to develop appropriate compensatory RMAs.

   Regarding digital I&C, the NRC staff notes the lack of consensus industry guidance for modeling these systems for plant PRAs to be used in risk-informed applications. In addition, known modeling challenges exist due to the lack of industry data for digital I&C components and the complexities associated with modeling software failures including common cause software failures. Given these needs and challenges, if the modeling of digital I&C systems are included in the RTR model, then address the following:

   i. Provide the results of a sensitivity study on the SSCs in the RICT program demonstrating that the uncertainty associated with modeling the digital I&C system has inconsequential impact on the RICT calculations.

   ii. Alternatively, identify which LCOs are determined to be impacted by the digital I&C system modeling for which RMAs will applied during a RICT. Explain and justify the criteria used to determine what level of impact to the RICT calculation required additional RMAs.

<u>APLA RAI 10 - Total Risk Estimates Against RG 1.174 Guidelines</u>

RG 1.174 provides the risk acceptance guidance for total CDF (1E-04 per year) and LERF (1E-05 per year). In its letter dated December 13, 2018, Enclosure 4, Exelon shows that for Braidwood the total CDF for Unit 2 is 8.2E-05 per year and for Byron Unit 2 the CDF is 8.0E-05 per year). The NRC staff notes that the implementation items identified in Attachment 5 of Exelon's letter involve updates to the internal events and fire PRA models and the response to some of the RAIs may also involve updates to the internal events and fire PRA models. Accordingly, there appears to be a possibility that the PRA updates could increase the Byron and Braidwood CDF and LERF values above the RG 1.174 risk acceptance guidelines. Therefore, for the Byron and Braidwood Stations, either:

a. Demonstrate that after the internal events and fire PRA models are updated to execute implementation items in response to the RAIs that the total risk for each unit is recalculated from the updated models and confirmed to be in conformance with the RG 1.174 risk acceptance guidance (i.e., CDF < 1E-04 and LERF < 1E-05 per year).

b. Propose a mechanism ensuring that after the internal events and fire PRA models are updated to execute implementation items and in response to RAIs, the total risk for each unit is recalculated from the updated models and confirmed to be in conformance with risk acceptance guidance in RG 1.174 prior to the implementation of the RICT Program.

APLA RAI 11 - Potential Loss of Function Conditions

TSTF-505, Revision 2, July 2, 2018 (ADAMS Accession No. ML18183A493) does not allow for TS loss of function conditions (i.e. those conditions that represent a loss of a specified safety function or inoperability of all required trains of a system required to be OPERABLE) in the RICT program. Address the following:

a. LCO 3.7.9 Ultimate Heat Sink (UHS)

A number of aspects of LCO 3.7.9 (Ultimate Heat Sink) Condition E (One or more basin levels(s) <60%) for the Byron Station as presented in Exelon's letter dated December 13, 2018, Enclosure 1, Table E1-1 are not clear.

First, LCO 3.7.9, Condition E appears to represent a TS loss of function condition with both Ultimate Heat Sink (UHS) basins inoperable (both basins levels are < 60%). Also, if the configuration at the site is such that one basin is aligned to one reactor unit and the other basin is aligned to the other reactor unit, then it is possible that the inoperability of one basin might also represent a TS loss of function if the basin for the opposite unit cannot be realigned in time to respond to a particular event.

Second, the basis for the PRA success criteria for the basins is not clear. Exelon, in its letter dated December 13, 2018, Enclosure 1, Table E1-1, states that the PRA success criteria is "one basin with the ability to receive makeup from: a single [Essential Service Water] SX makeup pump OR single [Circulating Water] CW makeup pump OR both Deep Well pumps." It is not clear what water sources feed the SX and CW makeup paths to the basins to provide an equivalent or greater sink heat capacity as the heat sink capability provided by a basin at 60% level or how this equivalency was established.

In addition, the surrogate modeling that will be used in the PRA models to reflect the unavailability of the basins is not clear. Exelon, in its letter dated December 13, 2018, indicates that the basins are not modelled in the PRA, and so surrogate modelling will be used in RICT calculations to fail all makeup sources to the basins for Condition E. This approach appears to eliminate any credit for UHS for this configuration (i.e., LCO 3.7.9, Condition E).

Considering these observations, address the following for the Byron Station:

i. Justify that LCO 3.7.9, Condition E does not represent TS loss of function. Include discussion of the case in which both basins are TS inoperable and the case in which one basin is TS inoperable. Also, include discussion about how the basins are aligned to each reactor unit.

ii. If in response to item (i) above, it cannot be justified that LCO 3.7.9, Condition E does not represent TS loss of function, then remove this LCO condition from the RICT program and provide an updated TS markup.

iii. If in response to item (i) above, it can be justified that LCO 3.7.9, Condition E does not represent TS loss of function, then:

1. Describe the water sources for the SX and CW makeup paths to the basins that are modelled in PRAs and provide the basis used to determine that those makeup sources provide equivalent or greater sink heat capacity as that provided by a basin at 60% level. Include explanation of what the CW system is and what function it provides.

2. Describe the surrogate modelling that will be used in the PRA to reflect the unavailability of the basins for LCO Condition E. Include clarification of whether the use of the surrogate will conservatively result in loss of UHS for this configuration.

b. LCO 3.4.11.B Pressurizer Power Operated Relief Valves (PORV)

Exelon, in its letter dated December 13, 2018, Enclosure 1, Table E1-1, indicates that the design success criteria for the PORV function is two of two operable PORVs. LCO 3.4.11 (PORVs) Condition B (One PORV inoperable and not capable of being manually cycled) appears to represent a TS loss of function condition for both the Byron and Braidwood Stations. One operating PORV is not enough to satisfy the design basis success criteria. Therefore, for the Byron and Braidwood Stations:

i. Justify that LCO 3.4.11, Condition B does not represent TS loss of function. Include discussion of whether there are other safety related SSCs that can provide the safety function provided by the PORVs.

ii. If in response to item i. above, it cannot be justified that LCO 3.4.11, Condition B does not represent TS loss of function, then remove this LCO condition from the RICT program and provide an updated TS markup.

c. LCO 3.7.9.B One required Service Water Cooling Tower (SXCT) fan inoperable

Exelon, in its letter dated December 13, 2018, Enclosure 1, Table E1-1 for the Byron Station, states that the design criteria for this condition is "6-8 out of 8 fans depending on [Service Water] SX pump discharge water temperature and if the SX trains on each unit are cross-tied" and "8/8 fans no crosstie." Accordingly, the success criteria varies depending on SX pump discharge water temperature and whether the SX trains have been cross-tied. Furthermore, it appears that one required SXCT fan inoperable can create a TS loss of function depending on the SX pump discharge water temperature or if the SX trains are not cross-tied. Therefore, for the Byron Braidwood Stations:

i. Justify that LCO 3.7.9, Condition B does not represent TS loss of function.

ii. If in response to part (i) above, it cannot be justified that LCO 3.7.9, Condition B does not represent TS loss of function, then remove this LCO condition from the RICT program.

PRA External Hazards

APLB Question 01 – Bounding Seismic Risk Analysis

Section 2.3.1, Item 7, of NEI 06-09, Revision 0-A (ADAMS Accession No. ML12286A322), states that the "impact of other external events risk shall be addressed in the RMTS program," and explains that one method to do this is by "performing a reasonable bounding analysis and applying it along with the internal events risk contribution in calculating the configuration risk and the associated RICT." The NRC staff's safety evaluation for NEI 06-09 (ADAMS Accession No. ML071200238) states that "[w]here [probabilistic risk assessment] PRA models are not available, conservative or bounding analyses may be performed to quantify the risk impact and support the calculation of the RICT."

Seismic PRAs are not available for either Braidwood (BWD) or Byron (BYR). Exelon, in its letter dated December 13, 2018, Enclosure 4, Section 3, states that a seismic core damage frequency (CDF) and large early release frequency (LERF) "penalty" was determined separately for Braidwood and Byron for this application using the recent seismic hazard curves developed in response to Recommendation 2.1 of the Near-Term Task Force (NTTF) (ADAMS Accession No. ML14091A005 and ML14091A010, respectively).

Details of the approach for determining the seismic "penalty" are provided in Section 3 of Enclosure 4 to Exelon's letter dated December 13, 2018. Exelon calculated the seismic LERF using the ratio between LERF and CDF, based on the internal events, including internal flooding. Exelon explained that the ratio was adjusted by removing the risk contribution of certain accident scenarios because they would not be expected to be induced by a seismic event. In Section 3 of Enclosure 4 to its letter dated December 13, 2018, Exelon stated that the chosen conditional large early release probability (CLERP) value for seismic events was "adequately conservative." As noted earlier the NEI 06-09, Revision 0-A as well as the corresponding NRC staff SE calls for a "bounding analysis." In addition, NRC staff has generically observed that LERF-to-CDF ratio for seismic events can be significantly higher than the LERF-to-CDF ratio for internal events due to the unique nature of seismically-induced failures. It is unclear that the selected CLERP of 15% can be considered as a bounding value for use in the RICT calculation.

a. Justify that the seismic LERF "penalties" provided in the submittal to support RICT calculations for the Byron and Braidwood are bounding. Include the rationale that deriving seismic LERF to CDF ratio using the internal events LERF to CDF ratio is bounding for seismically induced events, given that internal events random failures do not capture seismically-induced failures that may uniquely contribute to LERF.

b. If the approach to estimating seismic LERF cannot be justified as bounding for this application in response to part (a) above, then provide, with justification, the bounding seismic LERF "penalties" for use in calculating the proposed RICTs for Byron and Braidwood.

APLB Question 02 – Extreme Winds Analysis

Section 2.3.1, Item 7, of NEI 06-09, Revision 0-A, states that the "impact of other external events risk shall be addressed in the RMTS program," and explains that one method to do this is by documenting prior to the RMTS program that external events that are not modeled in the

PRA are not significant contributors to configuration risk. The NRC staff's SE for NEI 06-09 (ADAMS Accession No. ML071200238) states that, "[o]ther external events are also treated quantitatively, unless it is demonstrated that these risk sources are insignificant contributors to configuration-specific risk." Section 1.2.5 of Regulatory Guide (RG) 1.200, "*An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-informed Activities*," Revision 2 (ADAMS Accession No. ML090410014), states that the contribution of many external events to CDF and LERF can be screened out "(1) if it meets the criteria in NRC's 1975 Standard Review Plan (SRP) or later revision; or (2) if it can be shown using a demonstrably conservative analysis that the mean value of the design-basis hazard used in the plant design is less than 10^{-5} per year and that the conditional core damage probability is less than 10^{-1}, given the occurrence of the design-basis-hazard event; or (3) if it can be shown using demonstrably conservative analysis that the CDF is less than 10^{-6} per year." The screening criteria listed in Section 1.2.5 of RG 1.200 are consistent with those in Section 6-2.3 of the 2009 American Society of Mechanical Engineers/American Nuclear Society (ASME/ANS) PRA Standard (RA-Sa-2009), "*Addenda to ASME/ANS RA-S-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications*."

In Section 4 of Enclosure 4 to its letter dated December 13, 2018, Exelon addresses the risk from extreme winds. The licensee stated that the tornado generated missile damage is evaluated using a plant specific TORMIS analysis and concluded that the tornado missile hazard can be screened out from consideration. However, a recent study mentioned in its December 13, 2018, letter (Reference 24 of Enclosure 4) Exelon shows that, for Byron, certain combinations of unavailable components and/or trains could result in CDF and/or LERF exceeding the screening criteria of CDF=10^{-6} per year and LERF=10^{-7} per year. Therefore, conservative penalty factors are developed to account for tornado missile risk in the RICT calculations, as ΔCDF = 5×10^{-6} /yr and ΔLERF = 1×10^{-7} /yr based on that study. It is unclear to the NRC staff how the bounding values were determined for the tornado missile risk "penalty" at Byron.

a. Discuss the approach for determination of the tornado missile risk "penalty" for Byron and justify that the penalty is bounding for calculating the proposed RICTs.

b. Provide justification for the lack of a tornado missile risk "penalty" for calculating the proposed RICTs at Braidwood.