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10 CFR 50.90

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

SUBJECT:
Perry Nuclear Power Plant
Docket Number 50-440, License Number NPF-58
Response to Request For Additional Information Regarding License Amendment to Adopt Technical Specification Task Force Traveler-425 (TAC No. MF3720)

By correspondence dated March 25, 2014 (Accession No. ML14084A165), FirstEnergy Nuclear Operating Company (FENOC) submitted a license amendment request for the Perry Nuclear Power Plant (PNPP). The proposed amendment would modify the PNPP Technical Specifications by relocating specific surveillance frequencies to a licensee controlled program with the implementation of Nuclear Energy Institute (NEI) 04-10, "Risk-Informed Technical Specifications Initiative 5b, Risk-Informed Method for Control of Surveillance Frequencies." The proposed amendment is consistent with Nuclear Regulatory Commission (NRC)-approved Technical Specification Task Force (TSTF) Traveler TSTF-425, Revision 3, "Relocate Surveillance Frequencies to Licensee Control – Risk Informed Technical Specification Task Force (RITSTF) Initiative 5b," with certain proposed deviations.

By correspondence dated September 9, 2014 (Accession No. ML14232A225), NRC requested additional information to complete the staff's review. FENOC's response to this request is attached.

There are no regulatory commitments established in this submittal. If there are any questions or additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at (330) 315-6810.

I declare under penalty of perjury that the foregoing is true and correct. Executed on October 7, 2014.

Sincerely,

Ernest J. Harkness

Attachment: Response to September 9, 2014 Request for Additional Information

cc: NRC Region III Administrator
NRC Resident Inspector
NRC Project Manager
Executive Director, Ohio Emergency Management Agency, State of Ohio (NRC Liaison)
Utility Radiological Safety Board

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By correspondence dated September 9, 2014, Nuclear Regulatory Commission (NRC) staff requested additional information to complete its review. The request for additional information (RAI) is presented in bold type, followed by the FENOC response.

1. **In Regulatory Position 4.2 of Regulatory Guide 1.200, Revision 2 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML090410014), the U.S. Nuclear Regulatory Commission staff stated that it expects licensees to submit "a discussion of the resolution of the peer review (or self-assessment, for peer reviews performed using the criteria in Nuclear Energy Institute 00-02) findings and observations that are applicable to the parts of the probabilistic risk assessment (PRA) required for the application." In Enclosure B to the submittal dated March 25, 2014 ADAMS Accession No. ML14084A165), the licensee provided a summary of the results for the following:**

    - **1997 probabilistic safety assessment peer review certification;**
    - **2008 gap analysis self-assessment to American Society of Mechanical Engineers/American Nuclear Society (ASME/ANS) for PRA Standard RA-Sb-2005, "Addenda to ASME RA-S-2002 Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications";**
    - **2011 focused-scope peer review for the Large Early Release Frequency portion of the PRA model; and**
    - **2012 focused-scope peer review for the internal flooding portion of the PRA model.**

    Provide a list of the Facts and Observations (F&Os) from the peer reviews and self-assessment listed above, relevant to this submittal, and explain how the F&Os were dispositioned for this application.

Response:

A list of Facts and Observations (F&Os) from the 2008 Gap Analysis, the 2011 focused scope peer review, and the 2012 focused peer review are listed below. The Facts and Observations (F&Os) are listed in order of the most recently performed and are documented in the Documentation Roadmap (PRA Notebook DR-001) as Appendices G, E, and C respectively. The F&Os represent F&Os (findings/suggestions) against the PRA standard for the internal flooding focused scope peer review as a result of PRA upgrade to ASME-ANS-RA-Sa-2009, the Level 2 focused scope Peer Review as a result of PRA upgrade to ASME-ANS-RA-Sa-2009, and the 2008 GAP Self-Assessment to ASME PRA Standard RA-Sb-2005. The 1997 PSA Peer Review Certification F&Os were not included as the follow-on reviews were a complete reevaluation to the PRA standard in effect and supersede this information. Therefore, the 1997 PSA Peer Review Certification F&Os are not considered relevant to the application.

No open or outstanding F&Os exist as the F&Os originating from these reviews have been addressed. A formal process is utilized under the FENOC PRA Program to capture, disposition, and track items that may have an impact upon the PRA models. Disposition of the individual F&O's was performed to ensure that the model satisfies the PRA standard requirements. Through satisfaction of these requirements, the technical adequacy of the model serves as the foundation for performing PRA assessments pertaining to the surveillance frequency control program. Sensitivity studies, in support of individual frequency changes, will be performed, as necessary, when model limitations are encountered. Analyses performed in support of the surveillance frequency control program will be formally prepared, reviewed, and retained in accordance with the applicable FENOC procedures associated with the PRA program.

2012 Perry Focused-Scope Peer Review for Internal Flooding F&Os

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 1-2 **Associated Supporting Requirements: IFPP-B, IF-SO-A3**
Table 3-1 lists plant buildings initially considered for the internal flooding PRA. In that table, two columns, "Contain Flood Susceptible PRA Equipment?" and "Flood Threat to Other Buildings?" are used. Each of these columns is answered "Yes" or "No," however the basis for answering each question is not provided. The PRA staff was asked for additional clarification and responded that the basis is not in the current documentation. (This F&O originated from SR IFPP-B2)
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
The documentation does now allow the reviewers to duplicate or confirm the screening performed. Therefore, this issue is considered a finding.
POSSIBLE RESOLUTION
Update the documentation to clearly delineate the basis for screening buildings.
PLANT RESPONSE OR RESOLUTION
Table 3-1 and text of Section 3 has been expanded to provide additional detail for each building, and, if screened, the justification for screening. Closing this finding did not affect the PRA model. This was for completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 1-4 **Associated Supporting Requirements: IFSN-A1, IFSN-A8**
Propagation pathways through failed barriers are not described.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
Propagation through failed barriers can result in significant changes in the accident scenarios. Therefore, this is considered a finding.
POSSIBLE RESOLUTION
Detail propagation pathways through failure of closed barriers such as floor penetration fire seals and doors.
PLANT RESPONSE OR RESOLUTION
The model has been updated to incorporate propagation through failed barriers. Section 7.3 has been updated to incorporate propagation through failed floor penetration seals. Section 7.5 discusses propagation through failed or inadvertently open doors. Section 7.6 discusses propagation via floor plugs that are removed for maintenance purposes. Section 7.7 discusses drain failures. Section 9.1 has also been updated to account for floor penetration seal failure. Table 9-1 identifies potential areas of concern regarding floor penetration seal failure, and how its impacts are accounted for in the model. Closing this finding did not affect the PRA model. This was for completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 1-7 **Associated Supporting Requirements: IFSN-A6, IFQU-A9, IFEV-A3**
The internal flooding PRA documentation states that HELBs are not considered because they are included as part of the internal events PRA model. However, no evaluation of the equipment failures expected from the HELB was documented. Also, pipe whip and other failures were not addressed. The potential for sprinklers to actuate as a result of the environmental conditions was not addressed. (This F&O originated from SR IFSN-A6)
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
Consideration of HELB effects is required by RG 1.200.
POSSIBLE RESOLUTION
Evaluate and document the potential effects of HELBs.
PLANT RESPONSE OR RESOLUTION
The model and documentation have been updated to include the effects of HELB. Likely sources of HELBs include G33 (reactor water clean-up), N11 (main steam), N36 (extraction steam), N21 (condensate), and N27 (feedwater). Failure of these piping systems are included in the model, and equipment failure modes due to high temperature, humidity, pipe whip and jet impingement, and fire protection sprinkler activation, have been incorporated. The majority of these HELB-susceptible systems are located primarily in the Turbine Building and Heater Bay, and the additional impacts associated with HELBs can be captured by including loss of feedwater in the given scenarios. HELB-susceptible systems, and any additional impacts, are clearly identified in Table G-1.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 1-8 **Associated Supporting Requirements:** **IFSN-A8**
The potential for a flood source within a HVAC duct to impact equipment was not addressed. (This F&O originated from SR IFSN-A8)
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
Consideration of sources inside HVAC ducts is required by the SR. Such scenarios could be significantly different than other sources in the room and may be significant. Therefore, this is considered a finding.
POSSIBLE RESOLUTION
Identify all fluid sources inside HVAC ducts and evaluate the potential propagation path and equipment failures.
PLANT RESPONSE OR RESOLUTION
The documentation have been updated to include the potential of a flood source within an HVAC duct to impact equipment. Section 7 and Table 7-5 identify HVAC system that contain potential flood sources. Section 9-4 and Table 9-4 identify the potential impacts of a flood occurring within a given HVAC duct. The results of this analysis have added no new scenarios to the internal flooding model, so the resolution of this finding was a documentation issue, only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 1-9 **Associated Supporting Requirements: IFEV-A1**
The basis for grouping each initiating event to the assigned internal events PRA initiator group was not provided in the analysis. SR IE-A1 requires that a structured, systematic approach be used to identify initiating event groups. Because no structured, systematic approach is shown in the documentation, this SR is considered not met. (This F&O originated from SR IFEV-A1)
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
Use of a structured, systematic approach is required by the SR.
POSSIBLE RESOLUTION
For each initiating event, identify the likely and modelled cause of the expected reactor trip and associated equipment failures. Include this information in the documentation.
PLANT RESPONSE OR RESOLUTION
All internal flooding scenarios were reviewed using a structured, systematic process to determine if a general transient (IE-T3A) was appropriate to represent the given internal flood scenario. Based on the equipment failures and loss of the given piping system, many scenarios have been identified as being more appropriately modeled using other initiating events, such as a loss of service water (IE-TSW), loss of nuclear closed cooling (IE-NCC), loss of condenser (IE-T2), or loss of instrument air (IE-TIA). This review, and the initiating event the scenario is grouped with (if different than IE-T3A), is documented in Table G-2. Closing this finding did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 1-10 **Associated Supporting Requirements: IFEV-A2, IFEV-B2, IFQU-A3**
Table G-1 shows several scenarios where systems with differing effects on plant response and the PRA model are grouped and analyzed with the worst-case scenario. The analyses used to determine the worst case scenario are not included in the documentation but are contained only in hidden columns of the FRANX database. Conversations with two PRA staff members identified the hidden fields, but there is no documentation of these outside of the hidden fields. In addition, the frequency used to determine the final CDF value in Appendix G is not provided. Further, the calculations used to determine which scenarios are screened quantitatively are not documented. Because these analyses could not be reproduced without recourse to the authors, this SR is considered met at CC-I. (This F&O originated from SR IFEV-A2)
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
To meet CC-II, the basis for grouping the scenarios must be demonstrated. It was not possible for the peer review team to reproduce or review the analyses without recourse to the authors.
POSSIBLE RESOLUTION
Include the analyses from all quantifications in the documentation and then justify the grouping.
PLANT RESPONSE OR RESOLUTION
Flood Scenarios have been reviewed, and flood scenario grouping is only performed if the impacts are nearly identical (i.e., loss of the piping systems grouped do not directly result in the loss of any mitigative capability, and the spill rates for the systems are comparable. For example, scenarios involving a rupture of P21 or P22 may be grouped, as neither system results in the loss of any mitigative capability, and both systems have a maximum runout of approximately 1,500 gpm). Table E-2 has been added to the documentation to identify the worst case scenario CCDP to be used for the quantitative whole area screening analysis. This table, along with Table 9-3, provides the quantitative whole area screening analysis and results. Table F-2 has been added to the documentation to identify the pipe segments and associated failure modes used to calculate the initiating event frequency for each flood scenario. Table F-3 provides the calculation for spray scenarios. Closing this finding did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 2-1 **Associated Supporting Requirements: IFSO-A4**
The IFPRA did not evaluate tank or pool failures as flooding mechanisms.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
This FO is a finding in that tank and pool failures were not evaluated as required by SR IFSO A-4.
POSSIBLE RESOLUTION
Assess the flooding mechanism for tanks and pools
PLANT RESPONSE OR RESOLUTION
Sections 4 and 9 have been updated to account for the impacts of tank and pool failures resulting in flooding. Table 4-4 identifies all tanks contained within flood areas considered in the internal flooding analysis. Table 9-5 shows the inventory of each tank, and the impacts of a tank rupture. This analysis has resulted in one additional scenario being added to the model, the loss of 1N21B0004, the Hot Surge Tank. Section 4 has also been updated to include flooding due to pool failure. The only pools applicable to the internal flooding analysis are the spent fuel pool, and the pools underneath the water treatment building. The Spent Fuel Pool is of robust design (concrete/stainless steel liner), and the structural failure of this pool is assumed to have a negligible frequency unless due to an external event, which is outside the scope of this internal flooding model. The Water Treatment pools are underground, and no failure mechanisms exist that would result in an internal flooding event. The Suppression Pool and the upper fuel pools are part of the containment structure. The Containment has been screened from the internal flooding analysis. Additionally, the Containment is not assumed to fail for the purposes of internal flooding. Closing this finding did not affect the PRA model: this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 2-3 **Associated Supporting Requirements: IFSN-A12, IFSO-A3**
This SR is not met based on the fact that some flood areas were incorrectly screened out as areas with no potential flood source. But sources were listed for these areas in Appendix B. Conversely, flood areas were also found not to be screened when no potential flood sources existed in the area. This is detailed by the fact that Appendix B of the IFPRA Notebook conflicts with Appendix D. Examples of areas screened incorrectly include 1CC-4b, 1CC-4c, 1CC-5b, FH-2a, and FH-3a. Because multiple examples were found in more than one building this is considered a systemic error.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
This FO is a finding based on the potential for the screening to be incorrect.
POSSIBLE RESOLUTION
Compare the conclusions in Appendix D of the IFPRA against Appendix B and resolve conflicts as necessary. Also, resolve the following conflicts: - The comments section for flood area 1CC-4b in Table D-2 details that there is fire piping in the area. However, Table B-1 does not include area 1CC-4b as an area that includes flooding sources. - Flood area 1CC-4c is not screened in Table D-2. However. Table B-1 does not include area 1CC-4c as an area that includes flooding sources. - Flood area 1CC-5b is listed as Deleted in the Qualitative Screening Table D-2. However, Table B-1 details that 1CC-5b should not be screened as it contains flooding sources. - Flood areas FH-2a, and FH-2b are screened out in Table D-5 based on criteria B.2 (no flood sources). However, Table B-1 details that flooding sources exists in these two flooding areas.
PLANT RESPONSE OR RESOLUTION
Inadvertently, the tables provided in the Appendix D, Qualitative Screening of Flood Locations, for the Peer Review were a previous iteration and not the final version. The documentation has been updated with the final tables. Furthermore, these tables have been reviewed to verify their accuracy, and have been compared to Appendix B to ensure that no conflicts exist. Specifically, • 1CC-4b contains flood sources and is not qualitatively screened • 1CC-4c does not contain any flood sources and thus is qualitatively screened per criteria A, • 1CC-5b is a current flood area, contains flood sources, and is not qualitatively screened. The flood area 1CC-5c has been deleted, as this area has been subsumed with flood area 1CC-5a. • FH-2a and FH-2b contain flood sources and are not qualitatively screened Closing this finding did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 2-6 **Associated Supporting Requirements: IFQU-A7**
Results of the quantification of the internal flooding PRA did not include many aspects of the supporting requirements specified in the QU section of the internal events PRA (ASME RA-Sa section 2-2.7).
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
Review of the IFPRA Notebook and interview of PRA engineers found no review of the IFPRA results as detailed in ASME RASa SRs QU-B3, QU-D1, QU-D4, QU-D5, QU-D6, and QU-D7.
POSSIBLE RESOLUTION
Review the supporting requirements for internal events quantification in section 2-2.7 ASME RA-Sa and perform action needed to comply with these SRs. Specifically, perform actions to address SRs QU-B3, QU-D1, QU-D4, QU-D5, QU-D6, and QU-D7.
PLANT RESPONSE OR RESOLUTION
Quantification of the model has been updated in accordance with the requirements of the ASME Standard. The Quantification Notebook, QU-001, contains the results of the integrated Level 1 and Level 2 models, including internal flooding. Closing this finding did not impact the PRA model or its results, this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 1-1 **Associated Supporting Requirements: IFPP-A4**
Section 3.6 lists the USAR and Fire Protection Evaluation Drawings as sources of information. However, the version or revision used is not provided.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
The documents used appear to be the latest version and, therefore, this appears to be a documentation issue.
POSSIBLE RESOLUTION
Add revision number to all references used.
PLANT RESPONSE OR RESOLUTION
The references listed in Section 3.6 were updated to include revisions. The USAR is listed as a reference, however, this document is for informational purposes only. The drawings listed in the USAR Chapter 9A are based off the E-023 series drawings which have current revisions listed. Closing this finding did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 1-6 **Associated Supporting Requirements: IFSN-A2**
Lack of a clear summary of all flood mitigation features made review difficult. (This F&O originated from SR IFSN-A2)
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
This is considered a suggestion because the information appears to be contained in the documentation.
POSSIBLE RESOLUTION
Provide a summary table for flood mitigation features by flood area.
PLANT RESPONSE OR RESOLUTION
Flood mitigation features are shown in Table I-1 based on building location. For ease of connecting the building locations to flood zones, the flood zone has been added to the location where applicable. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 1-11 **Associated Supporting Requirements: IFEV-A2, IFEV-A5, IFEV-B2**
The final initiating event frequency values summarized in Table 8-11 include only spray frequency. Other calculations in the internal flooding analyses use the total failure frequency. No summary of the frequency values used in the calculations is provided. (This F&O originated from SR IFEV-A2)
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
Spot checks of the initiating event frequency values used in Table G-1 show that the proper frequency values were used. Therefore, this appears to be a documentation issue.
POSSIBLE RESOLUTION
Provide a table of the initiating event frequency values used for the various analyses in the IF study.
PLANT RESPONSE OR RESOLUTION
Table 8-10 provides a summary of the flood scenario frequencies. Tables F-1 and F-2 of Appendix F provide the development of the flood scenario frequencies. Table F-1 gives the mean pipe failure frequency for each pipe segment, while Table F-2 identifies the final frequency for each pipe failure scenario, based on the pipe failures considered in that scenario, and the combination of flood and major flood flow rates. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 1-12 **Associated Supporting Requirements: IFEV-A6**
While a search of plant data sources was performed, the specific search criteria used are not documented. Therefore, to duplicate or update the information would be difficult. (This F&O originated from SR IFEV-A6)
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
Because the search results look reasonable, this appears to be a documentation issue only.
POSSIBLE RESOLUTION
Add the specific search criteria used to the documentation.
PLANT RESPONSE OR RESOLUTION
Added words that were used in the Condition Report Database search to Section 7.9. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 2-2 **Associated Supporting Requirements: IFSO-A4, IFEV-A7**
Identification of human-induced flooding mechanisms using review of site condition reports as detailed in Section 7.6 of the IFPRA Notebook would be further improved through inclusion of events that involved mispositioning of components like valves and breakers.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
This FO is a suggestion as it further enhances the existing use of internal operating experience to address identification of human-induced flooding mechanisms.
POSSIBLE RESOLUTION
Include review of condition reports that identify component mispositioning events as part of the evaluation of relevance of human induced flooding mechanisms.
PLANT RESPONSE OR RESOLUTION
The review performed for identifying human-induced flooding mechanisms included any failure potential. The discussion of the waterleg pump and check valve cold shutdown operability tests was an event that involved a controlled mispositioning event. Unless an actual flooding event or significant release of inventory occurred, the search of mispositioned events would not provide any meaningful results. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
F&O Number: 2-5 **Associated Supporting Requirements: IFSQU-A1, IFQU-A10**
In most cases, internal flooding accident sequences were modelled using the general transient event tree. Flooding events involving service water pipe breaks were modelled using the loss of service water initiating event. This treatment was determined to be the most conservative treatment of internal flooding accident sequences. While the association of accident sequence appears to be appropriate, the basis for the association is documented sparsely in Section 8.1.4.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
Review of IFPRA section 8.1.4 discusses application of accident sequencing T3A, and TSW. This discussion details that this was done as a general approach with no review of each of the scenarios to confirm the T3A or TSW accident sequences were applicable. Based on a review of the quantification results, no errors were noted in this treatment. Therefore, this appears to be a documentation issue.
POSSIBLE RESOLUTION
Review each flood scenario against the chosen internal events CDF and LERF accident sequence to confirm that the sequence is applicable. Document this basis.
PLANT RESPONSE OR RESOLUTION
All internal flooding scenarios were reviewed using a structured, systematic process to determine if a general transient (IE-T3A) was appropriate to represent the given internal flood scenario. Based on the equipment failures and loss of the given piping system, many scenarios have been identified as being more appropriately modeled using other initiating events, such as a loss of service water (IE-TSW), loss of nuclear closed cooling (IE-NCC), loss of condenser (IE-T2), or loss of instrument air (IE-TIA). This review, and the initiating event the scenario is grouped with (if different than IE-T3A), is documented in Table G-2. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

2011 Focused-Scope Peer Review for the Large Early Release Frequency F&Os

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-A1-01) / / Other Supporting Requirements:
The ASME PRA Standard SR LE-A1 lists several examples of core damage sequence characteristics to consider for potential LERF impact. Table 1 of the L2 notebook lists items to consider from the Perry IPE and from an IAEA document. It is suggested that the Table be updated to include the ASME PRA Standard as a source to ensure that all items from the Standard are addressed.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
The items from the ASME standard appear to have been addressed, so the SR was considered met. This is presented as a suggestion to facilitate review against the Standard to and to ensure each of the items from the Standard has been explicitly addressed and documented.
POSSIBLE RESOLUTION
Update Table 1 to specifically denote where the items from SR LE-A1 are met.
PLANT RESPONSE OR RESOLUTION
Table 1 was updated to include references from the PRA Standard. DR-001 was updated to denote where the items from SR LE-A1 are met. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-B1-01) **/ / Other Supporting Requirements:**
HPME effects are considered in CET event MCCI for debris dispersal impacts on MCCI, but potential impacts to the drywell/containment from Direct Containment Heating (DCH) were not considered. DCH is noted in NUREG-6595 as a contributor to containment failure at vessel breach for Mark III containments - it might not be significant but should at least be addressed. Hydrodynamic loads are listed Table 2.2.8-9 of the ASME PRA Standard as a potential LERF contributor for Mark III containments. They have not been addressed in the Perry Level 2, although it is not clear that they will have any appreciable impact on the Mark III. Nonetheless, the phenomenon should be addressed to meet the requirement, in particular for potential effects on the drywell. Note that if these issues are determined to not be credible at PNPP, then they could be treated with documentation enhancement.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
This is presented as a suggestion because it is not expected that addressing these items will have a significant impact on the LERF.
POSSIBLE RESOLUTION
Consider the potential effects of DCH and hydrodynamic loading on the drywell (and possibly containment). If found to be negligible, provide a basis for excluding it. Also, the table in the Standard does not indicate core debris impingement on the containment shell as a concern for Mark III containments, so it is not included above in the evaluation. However, although it is not an issue on the outer containment, it is suggested that it be evaluated for drywell impacts.
PLANT RESPONSE OR RESOLUTION
Table 1 of the L2 Notebook was modified to discuss Direct Containment Heating and Hydrodynamic Loads. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-C2-01)   /   / **Other Supporting Requirements:**
The Level 2 notebook creates operator actions for the Level 2 in an appropriate manner, and evaluates the HEPs in Appendix E. To facilitate reviews and future updates, it would be useful to present a summary table in the L2 notebook that lists the Level 2 operator actions, their description and HEP.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
This is presented as a suggested documentation enhancement, since the SR has been fully met.
POSSIBLE RESOLUTION
Present a summary table in the L2 notebook that lists the Level 2 operator actions, their description and HEP.
PLANT RESPONSE OR RESOLUTION
A table in Section 3.4.6 in L2 notebook was added giving the six L2 operator actions, their HEPs, the Fussell-Vesely and RAW, and their descriptions. PRA-PY1-FP-R1 update: Table 4-2 of HI-001 lists the six L2 operator actions and descriptions. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-C2-02) / / Other Supporting Requirements:
Probability for event CPHIEOP1HC-ISOLATION assumes core damage time of 30 minutes, whereas the core damage time is shorter for LBLOCA, MBLOCA, and ATWS. This would increase the probability of failure to isolate containment for these scenarios. While this might not affect the ATWS results since containment failure is assumed for ATWS, this could impact LBLOCA or MBLOCA results.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
Affects model for probability of successful containment isolation for specific scenarios which are measurable contributors but not the major contributions to CDF.
POSSIBLE RESOLUTION
Consider creating a separate HFE event which is scenario specific for LBLOCA and/or MBLOCA.
PLANT RESPONSE OR RESOLUTION
For IEs A (Large LOCA), S1 (Medium LOCA) and R' (Excessive LOCA), it is assumed that the operators would not verify containment isolation in the time frame from the initiator to core damage, therefore the HEP CPHIEOP1HC-ISOLATION would be guaranteed failure for those IEs. This was a change to the PRA model. To model this scenario, HEP CPHIEOP1HC-ISOLATION is placed under an 'OR' gate, GCI-ISOL, with another 'OR' gate, GCI-LOCA, with developed events, GIEA (Large LOCA IE fault tree), GIES1 (Medium LOCA IE fault tree) and GIER (Excessive LOCA IE fault tree). This arrangement allows CPHIEOP1HC-ISOLATION to be a viable HEP in all initiators except the LOCA initiators given, where the time frame for containment isolation would be greater than the time frame available with those LOCA initiators. The following write-up was added to SM-052, Containment Isolation, in Section 2.3.2: Due to the expected timeframe of Core Damage for a Large LOCA, Medium LOCA or Excessive LOCA initiating event being less than required for the verification of the automatic isolation signals, given that the Control Room operators would have a higher priority on controlling Reactor Power, Reactor Level and Reactor Pressure such that the human interaction for isolating the Containment is not credited for such initiators.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
***OBSERVATION (ID: LE-C3-01)* / / Other Supporting Requirements: <u>LE-C10, LE-C12</u>**
This ASME PRA Standard calls for a review of the significant accident progression sequences to consider possible repairs (LE-C3), engineering analyses to support continued equipment operation or operator actions during the accident progression (LE-C10), or engineering analyses to support continued equipment operation or operator actions after containment failure (LE-C12) to reduce the LERF. Appendix H of the Level 2 notebook presented the significant Level 1 (accident progression) sequences contributing to LERF in Section 3.2.3, but not the significant Level 2 (accident progression sequences). Of the significant Level 1 sequences contributing to LERF, there is no documentation of a review to address the LE-C3, C10 or C12 requirements of consideration of ways to reduce conservatism in the LERF calculation.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
Although these reviews might not alter the results, the requirement to perform them has not been documented.
POSSIBLE RESOLUTION
Identify the significant accident progression sequences (CET sequences). Review each to consider potential repairs or evaluations to reduce conservative assumptions that might be driving the LERF.
PLANT RESPONSE OR RESOLUTION
Significant accident progression sequences are now documented in Section 5.1.3 (for LERF) and 6.1.3 (for Level 2) in QU-001 (Appendix H has been moved into QU-001). No change to the PRA model was made. Repairs are not credited in the PRA, as given in HI-001 Section 3.2 bullet 4. Credited operator actions have been validated by Operations as achievable prior to containment failure and no in-field operator actions are credited after containment failure. Operator actions viewed to be procedurally directed to enter hazardous areas (e.g., containment while containment is being pressurized) have not been credited. Equipment operation prior to and after containment failure is captured in observation LE-C9-01. Sections 3.2.1, 3.3.2 and 3.3.6 describe that unmitigated releases for sequences in which the RPV was at high pressure prior to vessel failure would be considered LERF but sequences with low RPV pressure would not be considered LERF based on MAAP results. This removes some conservatism regarding an unmitigated release and LERF.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-C6-01) / / **Other Supporting Requirements:**
Under a delayed Station Blackout scenario, Inside Containment MOV's in the containment venting flow paths may have isolated (e.g., Level 2 signal on initial LOOP) due to short term operation of diesel generators prior to failure of operating DG's resulting in SBO (Div.2 power is supplied to the inside containment MOV's). While outside containment MOV's could be manually opened, entry into containment would be required to manually open the inside containment MOV's in the venting flow path; this would involve questionable environmental conditions and the current PRA model does not credit this. Thus, a delayed SBO scenario could disable the venting flow path which is credited for SBO. This issue was found to be previously identified by the Perry PRA staff and entered into their Model Tracking Notification System. As documented in Notification 600669544, Item #72: The model currently assumes that in the case of a LOOP, if Div 2 power is lost, the inboard FPCC isolation valve, 1G41F0140, will not close on an isolation signal since power is unavailable to close the valve. If the failure of div 2 power is based on a fail-to-run failure mechanism or other delayed failure (failure of diesel fuel transfer, for example), the level 2 isolation signal may close the valve prior to the loss of Div 2 power. Since no manual action is credited for opening the inboard isolation valve, this condition would prevent operators from aligning FPCC for venting purposes and prevent any Containment Heat Removal in the case of a SBO.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
This is considered a Suggestion as it would not significantly change overall results since the specific scenario is relatively low probability and the change in containment failure mode may not significantly impact LERF results. Also, it has been previously self-identified and is being tracked.
POSSIBLE RESOLUTION
Consider revising model or determining if impact is small and documenting this.
PLANT RESPONSE OR RESOLUTION
Notification 600669544 Item #72 has been addressed in the Level 1 fault tree CVAN0.caf. Gate GCVA002 has been added to fault tree CVAN0 for failure to open valve 1G41-F0140 after it closed due to its isolation signal during a delayed LOOP/SBO. To facilitate the delay in the loss of Div 2 power, a mutually exclusive rule was created to eliminate cutsets containing the flag for closure of 1G41-F0140, and instantaneous failure of Div 2 power (a failure in which the Div 2 diesel never loads the electrical bus). An additional change is a new operator action, CPHIEOPSPI73-VLVPWR, for cross-tying Div 3 power to Div 2, as manual actuation of 1G41-F0140 may not be possible during a transient due to conditions inside the containment. Due to the addition of the Level 1 operator action, the Level 1 HEP Dependency Analysis was redone prior to performing the Level1/Level 2 HEP Dependency Analysis per LE-C7.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-C7-01) / / Other Supporting Requirements: LE-E4
The HEP dependency analysis only considered dependencies between the Level 2 HEPs and not between level 1/Level 2 events. The justification for this is not documented in the analysis, but the PRA staff indicated that since the Level 2 actions are initiated by EPGs by emergency response personnel, there should not be a cognitive dependency. If true, then there is still the potential for dependency between the events if they would occur in a similar time window as the Level 1 HEP(s), if there are not adequate resources, or if there is a common manipulation error. The combinations of significant Level 1 and Level 2 HEPs should be examined for such dependency.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
There can be a dependency between the Level 1 and Level 2 actions that has not been considered.
POSSIBLE RESOLUTION
Examine at least the significant Level 1/Level 2 HEP combinations for potential dependencies. It is important to consider that the time window of the Level 1 HEPs is generally based on the time to core damage, which can place them in a similar time frame as Level 2 actions, especially for sequences with containment failure prior to core damage, at core damage, or soon after core damage.
PLANT RESPONSE OR RESOLUTION
The Level 1 to Level 2 HEP dependency has been evaluated and documented in HI-001, Section 4.2.4. This change to the model explicitly considers all Level 1 and Level 2 HEP dependencies.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-C8-01) **/ / Other Supporting Requirements:**
Inter-system dependencies are captured throughout the accident sequence because of the linked Level 1/Level 2 approach developed in the CAFTA model. Functional dependencies, such as failure to depressurize after core damage, given early success or failure are generally accounted for by use of the same basic events pre and post core damage. However, it is noted that the approach or having a small number of PDSs and questioning system logic in the CETs has the potential to lose some functional information about the core damage sequence and must be performed carefully. For example, the Level 2 CET event that questions injection uses gate LATEINJ that is low pressure ECCS (level 1 logic) AND Level 2 HEP CPHISAG1-INJLATE. For Level 1 sequences with successful injection, this should not be considered a failure. It is acceptable to have the conservative modeling if it is documented and noted to be insignificant, but this was not noted in the L2 notebook.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
This is noted here as a documentation enhancement because the only instance identified in the peer review was the ECCS status which was found to have a negligible conservative effect.
POSSIBLE RESOLUTION
Document an examination of the system modeling performed in the CET to ensure that it does not contradict the successes/failures of any of the Level 1 sequences that feed into it. For ECCS, either address the modeling so that ECCS status from the Level 1 is retained or document that the conservative modeling is performed but that the conservatism has a negligible impact on the LERF. Perform a review of any other such systems that might have been questioned in the Level 1 event trees (e.g., containment vent and containment sprays).
PLANT RESPONSE OR RESOLUTION
Documentation is added to Section 3.2.4 discussing the Level 2 fault trees that use Level 1 fault trees, and how success or failure in the Level 1 fault trees are used in Level 2. No changes to the PRA model were made. This was performed for completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-C9-01) **/ / Other Supporting Requirements:**
Appendix F of the Level 2 notebook documents the qualitative judgment applied to the systems credited in the Level 2 analysis. The table judges that none of the systems credited in the Level 2 analysis would be impaired by severe accident conditions except for systems failed due to containment anchorage failure (sprays & injection). The Level 2 also does not credit sprays if the suppression pool was bypassed due to drywell failure. Therefore, it appears that consideration was given to equipment survivability in a severe accident, and no credit was given to the systems where it was believed that there would be an impact. The justification provided in Appendix H could be improved if the equipment located within containment were examined for their EQ temperatures and pressures to confirm that they are indeed capable of operating in the beyond design basis conditions.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
Equipment survivability has been considered, and the ASME Standard does not prescribe a method to perform the assessment. Therefore, this is only presented as a suggestion of a more rigorous method to address the issue.
POSSIBLE RESOLUTION
Consider examining equipment located within containment for their EQ temperatures and pressures to confirm that they are indeed capable of operating in the beyond design basis conditions. Additional information on equipment survivability, beyond EQ requirements and EQ envelopes, may be available in the Equipment Survivability information compiled as part of BWR/6 Hydrogen Control Owner's Group (HCOG) work in the early 1990's. This is presented as a suggestion F&O because it appears that the important impacts on containment systems have been captured.
PLANT RESPONSE OR RESOLUTION
The EQ temperatures and pressures of MOV actuators, MSIV actuators, SRV solenoids and Hydrogen Igniters have been added to Appendix D (formally Appendix F) of the Level 2 notebook. This was performed for completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-C13-01) / / Other Supporting Requirements:
The ISLOCA evaluation is documented in Appendix G of the Initiating Event notebook (DB-004) and in the ISLOCA notebook (AS-022). An initiating event fault tree exists under gate GIEISLOCA. The DB-004 appendix calculates the initiating frequency of all the ISLOCA pathways. The AS-022 notebook develops an event tree to model response to the initiator. The fault tree does not appear to be documented, but it appears that negligible contributors from DB-004 were eliminated. Some consideration was given to common cause modeling, but was not documented.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
Although this is not expected to alter the ISLOCA model, this F&O is presented as a finding because of the need for the ISLOCA evaluation to be better documented.
POSSIBLE RESOLUTION
Document the screening criteria applied to the ISLOCA pathways and the development of the ISLOCA fault tree. Document any assumptions regarding common cause treatment in the ISLOCA lines. Common cause of the components might not be appropriate to model if the components experience different operating conditions, but any assumptions and analyses should be documented.
PLANT RESPONSE OR RESOLUTION
Calculation IE-005, which presents the screening criteria in the assumptions section, was presented to the peer review team. The common cause of the components were removed from the model, as they were deemed inappropriate due to the different operating conditions experienced by the individual valves (e.g. inboard valve sees RPV pressure and outboard valve does not).

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-C13-02) **/ / Other Supporting Requirements:**
No evaluation of potential scrubbing of ISLOCA releases was documented.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
The ASME PRA Standard does not require scrubbing to be evaluated in detail unless it is credited, but it is suggested that an evaluation be performed for completeness.
POSSIBLE RESOLUTION
Consider an evaluation of ISLOCA scrubbing for possible reduction in LERF.
PLANT RESPONSE OR RESOLUTION
Sequences that ask about containment heat removal (ISLOCA sequences 4, 7, 9, 13 and 18) imply isolation of the ISLOCA release, therefore those sequences are assigned to Plant Damage State 2, which may be scrubbed. Sequences that lead to core damage and that are not isolated are considered unscrubbed. Discussion of the release pathways for the unscrubbed sequences is given in L2-001, section 3.1.3. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-D1-01) / / Other Supporting Requirements:
Appendix B of the L2 notebook documents the generation of a realistic, plant-specific composite fragility curve for Perry. The evaluation relies on the plant-specific evaluation performed for the Perry IPE and documented in IPE Appendix H. There is some confusion in the documentation regarding the appropriate fragility data presented in the IPE.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
This is noted as a documentation F&O because the approach taken in the L2 notebook appears to be appropriate.
POSSIBLE RESOLUTION
Appendix B, Section 2.4.1 talks about inconsistency between the containment fragility data in the IPE main report and its appendix, and gives justification for which data set is believed to be correct. This suggestion is to confirm the correct data set and update the containment fragility documentation to present it.
PLANT RESPONSE OR RESOLUTION
The data set used in the fragility analysis is given Section 2.2 of Appendix B, in which the data used was given in the IPE main report. Figure B-2 gives the data used compared to the IPE data. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-D2-01)   /   / **Other Supporting Requirements:**
SR LE-D2 requires consideration of the following potential containment failure modes: containment seals, penetrations, hatches, drywell heads (BWRs), and vent pipe bellows. Vent pipe bellows were not mentioned in the Perry evaluation, but do not exist at Perry.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
This is only presented as a suggestion to note that vent pipe bellows do not apply in order to make it clear that all the items in the Standard have been considered.
POSSIBLE RESOLUTION
To make it clear that all the items listed in the Standard were evaluated, consider a note that the vent pipe bellow failure mode does not apply to Perry.
PLANT RESPONSE OR RESOLUTION
A note for Vent Pipe Bellows was added for SR LE-D2 in DR-001 saying that they do not exist at Perry. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-D7-01) / / **Other Supporting Requirements:**
Screening for containment isolation implicitly assumes a 1" line size, thus implicitly defining LERF as corresponding to a 1" diameter line. This is regarded as conservative in comparison with assumptions for other plants, although the basis that this assumption is conservative with respect to the LERF criteria for Large Release is documented only through recognition that one of the MAAP cases in the main report (EI-VF-UNH_CET-1B-072_T1-015) assumed a 1" containment penetration failure and had a release less than the 3% CsI criteria. The containment isolation system notebook uses the 1" line size as a screening criteria. While it appears implicit that this is based on not being a "Large" release, it is recommended that this be clearly documented. There is value in knowing the penetration size which corresponds to a "Large" release. It appears no MAAP analyses have been conducted to determine or estimate that size. Common assumptions on penetration sizes for "Large" releases amongst BWR's are 2" or 3" in diameter, often based on the less rigorous PSA Applications Guide criteria than the detailed MAAP analyses performed for Perry.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion.
BASIS FOR SIGNIFICANCE
This documents a potential conservatism and documentation clarification regarding penetration size criteria related to the definition of "Large" releases. The conservatism is considered acceptable per the Standard but removing it would be expected to reduce the ~1.2% Containment Isolation failure contribution to LERF.
POSSIBLE RESOLUTION
Determine and provide an estimate of the penetration size that corresponds to a Large Release. Document the basis for screening line sizes less than 1" in the containment isolation system notebook.
PLANT RESPONSE OR RESOLUTION
MAAP results, documented in PRA-PY1-11-003, were used to determine the penetration size and the corresponding releases. SM-052, Containment Isolation, documents the screening size based on the MAAP results. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-E2-01) / / **Other Supporting Requirements:**
Looking at the treatment of vessel rupture and bypass (PB), the treatment of the vessel failure as Low Pressure (with lower failure probabilities) vice High Pressure under node PB in the fault tree is questionable. The PB probabilities are assigned based on the Low Pressure LBLOCA scenarios of PDS-3C, thus may be underestimated for the Vessel Rupture (PDS-3A) scenario. For Vessel Rupture, the vessel is failing at high pressure, not a low pressure failure as for LBLOCA or transients with depressurization. Thus there would be some increase in probability of drywell/pedestal damage associated with the vessel failure. Due to the different mechanisms (e.g., core will melt after vessel failure vice before) and potential locations, the probability of damage to the drywell/pedestal might be intermediate for a vessel rupture compared to a long-term later rupture of the vessel but would be higher than for the classic PDS-3C scenarios.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
This is considered a Suggestion as it would not significantly change overall results since Vessel Rupture is only a small contributor to CDF (0.2% contribution) and LERF.
POSSIBLE RESOLUTION
Review and as necessary adjust probabilities assigned for Drywell Bypass associated with the Vessel Rupture event.
PLANT RESPONSE OR RESOLUTION
Probabilities for Drywell Bypass for PDS 3A were changed to the values used in PDS 1A and 1B (the high pressure sequences) from PDS 3C and 3D (the low pressure sequences). The following table shows which basic events were added and removed:

Basic Event Removed	Basic Event Added
L2_PB_1A_1B-IGLM	L2_PB_1A_1B_3A-IGLM
L2_PB_1A_1B-IGLN	L2_PB_1A_1B_3A-IGLN
L2_PB_1A_1B-IFLM	L2_PB_1A_1B_3A-IFLM
L2_PB_1A_1B-IFLN	L2_PB_1A_1B_3A-IFLN
L2_PB_3A_3C_3D-IGLM	L2_PB_3C_3D-IGLM
L2_PB_3A_3C_3D-IGLN	L2_PB_3C_3D-IGLN
L2_PB_3A_3C_3D-IFLM	L2_PB_3C_3D-IFLM
L2_PB_3A_3C_3D-IFLN	L2_PB_3C_3D-IFLN

Additionally, the corresponding success events were changed.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-E4-01) **/ / Other Supporting Requirements:**
Section 3.6.2 of Appendix H of the Level 2 notebook describes an acceptable truncation limit as "When the change in LERF in one decade drops below 5%, then the model has sufficiently converged." This is consistent with a suggested criterion from the ASME PRA Standard. However, the ASME Standard does not prescribe this criterion, and it has not been used in the PNPP LE analysis. The documentation should be updated to reflect exactly what the justification is for PNPP that the LERF has sufficiently converged. It is also noted that the calculation of % change in LERF presented in Table H-47 was not calculated properly (the % change calculation uses the lower truncation LERF in the denominator, but should use the higher truncation LERF.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
This is presented as a suggestion because the LERF truncation is low and should be justifiable, but the documentation should reflect the justification.
POSSIBLE RESOLUTION
Update the table with the proper calculation of change in LERF when the truncation is reduced by an order of magnitude. Reconcile the truncation criterion with the truncation level used. Note that the 5% criterion in QU-B3 is a suggestion and not a hard requirement.
PLANT RESPONSE OR RESOLUTION
The LERF Truncation Sensitivity Evaluation was moved from Appendix H to Section 5.2.4 of QU-001. The truncation level used is 1E-12, chosen to be the same as the truncation for CDF. A truncation sensitivity analysis was performed, with the calculation of % change updated, to show that convergence would be attainable given a lower truncation, though memory limitations make lower truncations impractical. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-F1-01) / / Other Supporting Requirements: **LE-G3**
The Level 2 documentation has PDS contributions to LERF but not contributions from the various Table 2.2.8-9 mechanisms. This is considered a documentation issue, as this information should be able to be extracted from the results and will not change the overall results of the Level 2/LERF models.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Finding
BASIS FOR SIGNIFICANCE
This is considered a Finding since this is a requirement of the Standard for Cat. II.
POSSIBLE RESOLUTION
Provide information on contribution to LERF associated with the various mechanisms listed in Table 2.2.8-9.
PLANT RESPONSE OR RESOLUTION
The contribution to LERF associated with the various mechanisms listed in Table 2.2.8-9 is presented in Table 15 of the L2 Notebook. (Note: as of PRA-PY1-FP-R1, this table is located in Section 5.1.2 of QU-001). Closing this finding did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-F2-01) / / Other Supporting Requirements:
The comparison to other plant results performed as part of the reasonableness check could be improved. Only one other plant compared, and comparison was only of the absolute numbers, no discussion of plant design differences or model differences and what is driving the differences or similarities.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
This is considered a Suggestion as it enhances the check for reasonableness and the overall requirements to check for reasonableness have otherwise been met.
POSSIBLE RESOLUTION
Provide more in-depth comparison to other plants as part of the check of results for reasonableness.
PLANT RESPONSE OR RESOLUTION
An additional comparison to River Bend for LERF was documented in QU-001, Section 7.3. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-F3-01) / / **Other Supporting Requirements:**
Sources of modeling uncertainty and generic modeling uncertainty are considered in Table H-49, although the disposition of the treatment of ex-vessel cooling and hydrogen combustion are not clear as to why they are not a source of uncertainty at Perry. Item #20 in Table H-49 is missing some information. Item #21 discusses MCCI but not debris contact with the drywell/containment. Table H-50 presents a list of plant-specific assumptions that could affect LERF. Section 4.3 compiles the list of modeling uncertainties that could have a noticeable impact on LERF. QU-E4 calls for identifying how the PRA model is affected which has been qualitatively addressed, but this suggestion is presented to further evaluate the impact of these on the LERF results quantitatively.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
This is presented as a suggestion because the qualitative evaluations have been performed and the Standard does not specifically require quantitative evaluation.
POSSIBLE RESOLUTION
Update the documentation for items #20 and 21 in Table H-49. Consider performing sensitivity evaluations on the modeling uncertainties defined in Section 4.3 in order to better quantitatively understand the impact these uncertainties could have on the results. Where the impact is large, the assumptions should be examined for possible overconservatism. Throughout the Level 2 report, there are instances in which modeling was not performed because the analysis stated that the frequency was small/negligible (e.g., not modeling offsite power recovery). Sensitivity analyses are a good way to quantitatively document such statements.
PLANT RESPONSE OR RESOLUTION
The information for Table H-49 was moved to Table 74 of QU-001. Item 20 was updated to include that no credit is given for ex-vessel cooling of the lower head as no procedure is directed to perform that task. Item 21 discusses that core debris would come into contact with the drywell. Item 23 discusses that the HEP for the hydrogen igniters is the dominant basic event and its uncertainty is assessed in Section 7.5. A number of sensitivity studies evaluating the modeling uncertainties defined in Section 8.2 of QU-001 (previously Section 4.3) have been performed and documented in Section 7.5 of QU-001. Closing this suggestion did not affect the PRA model; this was completeness of documentation only.

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID: LE-G5-01) **/ / Other Supporting Requirements:**
Section 3.6.5 of Appendix H of the Level 2 notebook lists eight limitations of the Level 2 analysis that could possibly impact applications, and indicates that applications should address these issues through sensitivity analyses or other measures. It is suggested that some of these issues will be better understood for the applications if some sensitivities are performed as part of the Level 2 notebook.
LEVEL OF SIGNIFICANCE (Finding, Suggestion or Best Practice)
Suggestion
BASIS FOR SIGNIFICANCE
The requirements of the SR have been met – this is only presented as a suggestion as it could reduce the effort involved in performing applications in the future.
POSSIBLE RESOLUTION
Characterize the degree of uncertainties to consider by documenting sensitivity evaluations for these issues.
PLANT RESPONSE OR RESOLUTION
Limitations will be addressed, as appropriate, in the given application.

2008 Gap Analysis Self-Assessment to ASME/ANS for PRA Standard RA-Sb-2005

This document is a compilation of all of the gaps identified in the 2008 Scientech Review of the Perry PRA Model PRACY11R2. This does not include the gaps applying to the IF or LF requirements, as these requirements were addressed in future model upgrades (see Peer Review F&Os above).

NOTE: The SR numbers listed here are based on the 2005 Revision of the PRA Standard.

Gaps for Initiating Event Analysis

Supporting Rqmt	**Category I**	**Category II**
IE-A4a	When performing the systematic evaluation required in IE-A4, INCLUDE initiating events resulting from multiple failures, if the equipment failures result from a common cause.	When performing the systematic evaluation required in IE-A4, INCLUDE initiating events resulting from multiple failures, if the equipment failures result from a common cause, and from routine system alignments.
NRC Resolution	Issue: Initiating events from common cause or from both routine and non-routine system alignments should be considered. Resolution for Cat II and III (clarification): resulting from multiple failures, if the equipment failures results from a common cause, and from system alignments resulting from preventive and corrective maintenance.	
Status/Gap	FMEA approach used to identify special initiators focused on loss of system function, which includes multiple failures without consideration of cause. However, the initiating event fault trees do not contain common cause failure events during the quantification of the actual initiating event frequency. Suggest using EPRI TR-1013490 as guidance for support system initiator fault trees.	
Action to Close Gap	Modify existing models to consider common cause in the Initiating Event (IE) fault trees. Expand IE fault trees to include support systems using the guidance of EPRI TR-1013490.	
Perry Resolution	Developed initiating event fault trees were updated to include CCF events for applicable components. Refer to the corresponding system notebooks (Section 2.3.3) for the common cause groupings modeled for each given system.	
Significance of Gap	A - Significantly Nonconservative	

Supporting Rqmt	**Category I**	**Category II**
IE-A5	In the identification of the initiating events, INCORPORATE (a) events that have occurred at conditions other than at-power operation (i.e., during low-power or shutdown conditions), and for which it is determined that the event could also occur during at-power operation. (b) events resulting in a controlled shutdown that includes a scram prior to reaching low-power conditions, unless it is determined that an event is not applicable to at-power operation.	In the identification of the initiating events, INCORPORATE (a) events that have occurred at conditions other than at-power operation (i.e., during low-power or shutdown conditions), and for which it is determined that the event could also occur during at-power operation. (b) events resulting in a controlled shutdown that includes a scram prior to reaching low-power conditions, unless it is determined that an event is not applicable to at-power operation.

Supporting Rqmt	Category I	Category II
NRC Resolution		
Status/Gap	The identification of initiating events only considered events that actually caused reactor scram. Events that did not result in scram and events at non-power (OPCOND 1 & 2) were not considered.	
Action to Close Gap	Review plant operating history for events that could be initiators if they had occurred at power.	
Perry Resolution	All Perry events were evaluated for inclusion in the calculation of IE frequencies. One event was found in which a scram would have been caused if the plant was at-power. The initiating event frequency was updated to account for this event. See DB-004 Section 2.3.2.4	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	Category I	Category II
IE-A7	No requirement for precursor review.	REVIEW plant-specific operating experience for initiating event precursors, for the purpose of identifying additional initiating events. For example, plant specific experience with intake structure clogging might indicate that loss of intake structures should be identified as a potential initiating event.
NRC Resolution		
Status/Gap	The identification of initiating events only considered events that actually caused reactor scram. Events that did not result in scram and events at non-power (OPCOND 1 & 2) were not considered.	
Action to Close Gap	Include review of events that did not result in scram, but could under other circumstances.	
Perry Resolution	Certain precursor events have been added as initiators for larger initiating events, such as Intake Structure blockage due to frazile ice or debris. This precursor is included as an initiating event in the Loss of Service Water developed fault tree. Similarly, the failure of a major air header is included in the Loss of Instrument Air fault tree. See DB-004, Section 2.0, and DB-004, Appendix B.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	Category I	Category II
IE-B1	COMBINE initiating events into groups to facilitate definition of accident sequences in the Accident Sequence Analysis element (para. 4.5.2) and to facilitate quantification in the Quantification element (para. 4.5.8).	COMBINE initiating events into groups to facilitate definition of accident sequences in the Accident Sequence Analysis element (para. 4.5.2) and to facilitate quantification in the Quantification element (para. 4.5.8).
NRC Resolution		
Status/Gap	LOCA groups are developed/defined in IE-01 R1. FMEAs used to identify plant-specific initiating events are documented in IE-02 R1. Transient events are identified and categorized into EPRI transient categories in IE-03 R5. IE-05 R0 identifies Interfacing Systems LOCAs. IE-04 R3 presents the grouping and associated rationale for the identified initiators. Some plant-Specific initiators appear to be grouped to multiple initiating event groups (e.g., NCC). FMEA results and grouping should be revisited, specifically to determine if there should be separate initiating event groups for loss of NCC and the loss of specific electrical buses.	

Action to Close Gap	Consider including separate initiating event groups for loss of NCC, loss of specific electrical buses.
Perry Resolution	FMEA was re-performed as part of this model update. It was determined that NCC and the loss of certain electrical busses needed to have separate IE groups, which were added to the PRA model. See DB-004, Section 2.1, DB-004, Section 2.2.1, DB-004, Appendix A, and DB-004, Appendix B
Significance of Gap	B - Small Nonconservative

Supporting Rqmt	**Category I**	**Category II**
IE-C6	Some initiating events are amenable to fault-tree modeling as the appropriate way to quantify them. These initiating events, usually support system failure events, are highly dependent upon plant-specific design features. If the fault-tree approach is used for initiating events, USE the applicable systems-analysis requirements for fault-tree modeling found in the Systems Analysis section (para. 4.5.4).	Some initiating events are amenable to fault-tree modeling as the appropriate way to quantify them. These initiating events, usually support system failure events, are highly dependent upon plant-specific design features. If the fault-tree approach is used for initiating events, USE the applicable systems-analysis requirements for fault-tree modeling found in the Systems Analysis section (para. 4.5.4).
NRC Resolution		
Status/Gap	Some support system initiators that are amenable to IE fault tree modeling are not modeled as a separate initiator, but are grouped under a more generic IE. Example is Loss of non-safety DC grouped under T3B, Loss of NCC grouped under T3A/T3B/T2. This can make later applications such as maintenance risk assessment extremely difficult. Common cause and support systems are not consistently applied in the initiator fault trees. The documentation of the system initiator fault trees does not meet the documentations requirements of the SY supporting requirements.	
Action to Close Gap	Revise the initiating event system model fault trees to address common cause and support systems. Develop documentation consistent with the SY supporting requirements.	
Perry Resolution	Developed initiating event fault trees were updated to include CCF and including support system interactions. See DB-004, Section 2.2.4 as well as section 2.4 of the following system notebooks: SM-016, SM-019, SM-022, SM-023, SM-048, SM-050.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	**Category I**	**Category II**
IE-C7	If fault tree modeling is used for initiating events, QUANTIFY the initiating event frequency (as opposed to the probability of an initiating event over a specific time frame, which is the usual fault tree quantification model described in the Systems Analysis section, para. 4.5.4.). MODIFY as necessary the fault tree computational methods that are used so that the top event quantification produces a failure frequency rather than a top event probability as normally computed. USE the applicable requirements in the Data Analysis section, para. 4.5.6, for the data used in the fault-tree quantification.	If fault tree modeling is used for initiating events, QUANTIFY the initiating event frequency (as opposed to the probability of an initiating event over a specific time frame, which is the usual fault tree quantification model described in the Systems Analysis section, para. 4.5.4.). MODIFY as necessary the fault tree computational methods that are used so that the top event quantification produces a failure frequency rather than a top event probability as normally computed. USE the applicable requirements in the Data Analysis section, para. 4.5.6, for the data used in the fault-tree quantification.

NRC Resolution	
Status/Gap	Common cause is not appropriately included in all of the initiator fault trees.
Action to Close Gap	
Perry Resolution	Initiating Event fault trees were updated to include common cause. Solving the initiating event fault trees gives a frequency result instead of a probability. Initiating event frequencies are dynamically calculated by integration of initiating event fault trees into the single-top model. See DB-004, Section 2.2.4, DB-004, Appendix D and section 2.4 of the following system notebooks: SM-016, SM-019, SM-022, SM-023, SM-048, SM-050.
Significance of Gap	B - Small Nonconservative

Supporting Rqmt	**Category I**	**Category II**
IE-C8	If fault-tree modeling is used for initiating events, CAPTURE within the initiating event fault tree models all relevant combinations of events involving the annual frequency of one component failure combined with the unavailability (or failure during the repair time of the first component) of other components.	If fault-tree modeling is used for initiating events, CAPTURE within the initiating event fault tree models all relevant combinations of events involving the annual frequency of one component failure combined with the unavailability (or failure during the repair time of the first component) of other components.
NRC Resolution		
Status/Gap	Modeled except for some common cause combinations and support system impacts.	
Action to Close Gap		
Perry Resolution	CCF and support system interactions are included in the new developed fault trees. See section 2.4 of the following system notebooks: SM-016, SM-019, SM-022, SM-023, SM-048, SM-050.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	**Category I**	**Category II**
IE-A2	INCLUDE in the spectrum of internal-event challenges considered at least the following general categories: (a) Transients. INCLUDE among the transients both equipment and human-induced events that disrupt the plant and leave the primary system pressure boundary intact. (b) LOCAs. INCLUDE in the LOCA category both equipment and human-induced events that disrupt the plant by causing a breach in the core coolant system with a resulting loss of core coolant inventory. DIFFERENTIATE the LOCA initiators, using a defined rationale for the differentiation. Examples of LOCA types include: (1) Small LOCAs. Examples: reactor coolant pump seal LOCAs, small pipe breaks; (2) Medium LOCAs. Examples: stuck open safety or	INCLUDE in the spectrum of internal-event challenges considered at least the following general categories: (a) Transients. INCLUDE among the transients both equipment and human-induced events that disrupt the plant and leave the primary system pressure boundary intact. (b) LOCAs. INCLUDE in the LOCA category both equipment and human-induced events that disrupt the plant by causing a breach in the core coolant system with a resulting loss of core coolant inventory. DIFFERENTIATE the LOCA initiators, using a defined rationale for the differentiation. Examples of LOCA types include: (1) Small LOCAs. Examples: reactor coolant pump seal LOCAs, small pipe breaks; (2) Medium LOCAs. Examples: stuck open safety or relief valves; (3) Large LOCAs. Examples: inadvertent ADS,

Supporting Rqmt	Category I	Category II
	relief valves; (3) Large LOCAs. Examples: inadvertent ADS, component ruptures; (4) Excessive LOCAs. (LOCAs that cannot be mitigated by any combination of engineered systems). Example: reactor pressure vessel rupture; (5) LOCAs Outside Containment. Example: primary system pipe breaks outside containment (BWRs) (c) SGTRs. INCLUDE spontaneous rupture of a steam generator tube (PWRs) (d) ISLOCAs. INCLUDE postulated events in systems interfacing with the reactor coolant system that could fail or be operated in such a manner as to result in an uncontrolled loss of core coolant outside the containment [e.g., interfacing systems LOCAs (ISLOCAs)]. (e) Special initiators (e.g., support systems failures, instrument line breaks) [Note (1)]. (f) Internal flooding initiators (see IF-D1) [Note (1)].	component ruptures; (4) Excessive LOCAs. (LOCAs that cannot be mitigated by any combination of engineered systems). Example: reactor pressure vessel rupture; (5) LOCAs Outside Containment. Example: primary system pipe breaks outside containment (BWRs) (c) SGTRs. INCLUDE spontaneous rupture of a steam generator tube (PWRs) (d) ISLOCAs. INCLUDE postulated events in systems interfacing with the reactor coolant system that could fail or be operated in such a manner as to result in an uncontrolled loss of core coolant outside the containment [e.g., interfacing systems LOCAs (ISLOCAs)]. (e) Special initiators (e.g., support systems failures, instrument line breaks) [Note (1)]. (f) Internal flooding initiators (see IF-D1) [Note (1)].
NRC Resolution		
Status/Gap	Stated areas of initiators are included. Transients that result in reactor scram are considered as initiators. The various sizes of LOCAs are defined, however no detailed reasons or justification for choosing the size definitions is provided.	
Action to Close Gap	Provide appropriate reasoning and justification for the definition of the LOCA sizes. Provide plant specific justification for these size definitions.	
Perry Resolution	LOCA size definitions provided in Section 2.2.3 of IE Notebook (DB-004). The justification of the LOCA sizes is provided in the Success Criteria Notebook (AS-001). Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	Category I	Category II
IE-A6	No requirement for interviews.	INTERVIEW plant personnel (e.g., operations, maintenance, engineering, safety analysis) to determine if potential initiating events have been overlooked.
NRC Resolution		
Status/Gap	No interviews were conducted	
Action to Close Gap	INTERVIEW plant personnel (e.g., operations, maintenance, engineering, safety analysis) to determine if potential initiating events have been overlooked.	
Perry Resolution	Operator Interviews were performed for FMEA analysis and documented in DB-004, Appendix B. The updated FMEA analysis led to new initiating events that were added to the PRA model.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	Category I	Category II
IE-C10	COMPARE results and EXPLAIN differences in the initiating event analysis with generic data sources to provide a reasonableness check of the results.	COMPARE results and EXPLAIN differences in the initiating event analysis with generic data sources to provide a reasonableness check of the results.
NRC Resolution	Issue: Providing a list of generic data sources would be consistent with other SRs related to data. Resolution: An example of an acceptable generic data source is NUREG/CR-5750.	
Status/Gap	No comparison of the values developed was found in the documentation provided.	
Action to Close Gap	Add Table to compare results obtained with generic data and provide discussions to explain any differences identified.	
Perry Resolution	Comparison of calculated IE frequencies against generic data as well as other plants can be found in section 4.2 of DB-004. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
IE-C12	In the ISLOCA frequency analysis, INCLUDE the following features of plant and procedures that influence the ISLOCA frequency: (a) configuration of potential pathways including numbers and types of valves and their relevant failure modes, existence and positioning of relief valves (b) provision of protective interlocks (c) relevant surveillance test procedures (d) the capability of secondary system piping (e) isolation capabilities given high flow / differential pressure conditions that might exist following breach of the secondary system	In the ISLOCA frequency analysis, INCLUDE the following features of plant and procedures that influence the ISLOCA frequency: (a) configuration of potential pathways including numbers and types of valves and their relevant failure modes, existence and positioning of relief valves (b) provision of protective interlocks (c) relevant surveillance test procedures (d) the capability of secondary system piping (e) isolation capabilities given high flow / differential pressure conditions that might exist following breach of the secondary system
NRC Resolution	Issue: The size of relief valves is an important consideration when evaluating ISLOCAs. Resolution for CC I and II: (a) configuration of potential pathways including numbers and types of valves and their relevant failure modes, and the existence, size and positioning of relief valves	
Status/Gap	There was no documentation found to support the configuration modeled. There is no discussion of interlocks. IE-05 R0 addresses the surveillance procedures. Piping capability and isolation capabilities were reasonably considered.	
Action to Close Gap	Add discussions to document the operating configuration and any related interlocks. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Perry Resolution	See DB-004, Appendix G, Section 1.1.3 for a discussion of operating configurations and interlocks.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
IE-C13	CHARACTERIZE the uncertainty in the initiating event frequencies and PROVIDE mean values for use in the quantification of the PRA results.	CHARACTERIZE the uncertainty in the initiating event frequencies and PROVIDE mean values for use in the quantification of the PRA results.
NRC Resolution		
Status/Gap	DB-04 R3 develops frequencies for most of the initiating events (TCCCW shown in IE-04 R3, Table 3 is missing). The table presented on pages 17 and 18 provides the Mean, Median, and Error Factor for each initiating event.	
Action to Close Gap	Determine if TCCCW has been dropped from the model as it is likely that it should have been removed from IE-04. This TCCCW issue may be related to the HVAC support system dependency issues identified in the system analysis supporting requirements.	
Perry Resolution	Based on the results of the FMEA, the TBCCW system has been removed as an IE – it is subsumed under the loss of feedwater initiating event, Reference DB-004, Appendix B.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
IE-D2	DOCUMENT the processes used to select, group, and screen the initiating events and to model and quantify the initiating event frequencies, including the inputs, methods, and results. For example, this documentation typically includes: (a) the functional categories considered and the specific initiating events included in each (b) the systematic search for plant-unique and plant-specific support system initiators (c) the systematic search for RCS pressure boundary failures and interfacing system LOCAs (d) the approach for assessing completeness and consistency of initiating events with plant-specific experience, industry experience, other comparable PRAs and FSAR initiating events (e) the basis for screening out initiating events (f) the basis for grouping and subsuming initiating events (g) the dismissal of any observed initiating events, including any credit for recovery (h) the derivation of the initiating event frequencies and the recoveries used (i) the approach to quantification of each initiating event frequency (j) the justification for exclusion of any data	DOCUMENT the processes used to select, group, and screen the initiating events and to model and quantify the initiating event frequencies, including the inputs, methods, and results. For example, this documentation typically includes: (a) the functional categories considered and the specific initiating events included in each (b) the systematic search for plant-unique and plant-specific support system initiators (c) the systematic search for RCS pressure boundary failures and interfacing system LOCAs (d) the approach for assessing completeness and consistency of initiating events with plant-specific experience, industry experience, other comparable PRAs and FSAR initiating events (e) the basis for screening out initiating events (f) the basis for grouping and subsuming initiating events (g) the dismissal of any observed initiating events, including any credit for recovery (h) the derivation of the initiating event frequencies and the recoveries used (i) the approach to quantification of each initiating event frequency (j) the justification for exclusion of any data
NRC Resolution		
Status/Gap	The documentation generally satisfies Category II. However, there is no documented systematic approach (d) and there are gaps identified in supporting requirements were noted.	

Supporting Rqmt	Category I	Category II
	REVISIT - PROCEDURE	
Action to Close Gap	Document the approach used. Address gaps identified in the supporting requirements.	
Perry Resolution	IE notebook has been re-written as part of PRA Update. Documentation of processes used for performing the IE analysis are described in the notebook (DB-004). Previously identified gaps have been addressed and documented in the revision history section. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
IE-D3	DOCUMENT the key assumptions and key sources uncertainty with the initiating event analysis.	DOCUMENT the key assumptions and key sources uncertainty with the initiating event analysis.
NRC Resolution	Issue: All the sources of uncertainty and assumptions that can impact the risk profile of the base PRA need to be documented; see definition of key source of uncertainty for definition of source of uncertainty. Resolution: DOCUMENT the assumptions and sources uncertainty associated with the initiating event analysis.	
Status/Gap	See discussion in SR-SC-C3 (NUREG/CR-1855).	
Action to Close Gap	See discussion in SR-SC-C3.	
Perry Resolution	Assumptions and sources of uncertainty are contained in each notebook. The Quantification Notebook (QU-001) documents sources of uncertainty in the model as a whole in Sections 1.2, 3.2.6 and 4.0. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
IE-A4	PERFORM a systematic evaluation of each system, including support systems, to assess the possibility of an initiating event occurring due to a failure of the system. PERFORM a qualitative review of system impacts to identify potential system initiating events.	PERFORM a systematic evaluation of each system, including support systems, to assess the possibility of an initiating event occurring due to a failure of the system. USE a structured approach (such as a system-by-system review of initiating event potential, or an FMEA [failure modes and effects analysis] or other systematic process) to assess and document the possibility of an initiating event resulting from individual systems or train failures.
NRC Resolution	Issue: The search for initiators should go down to the subsystem/train level. Resolutions for Cat I and II (clarification): PERFORM a systematic evaluation of each system where necessary (e.g., down to the subsystem or train level), including support systems.	
Status/Gap	FMEA approach used to identify support system initiators.	

Supporting Rqmt	Category I	Category II
Action to Close Gap	Modify existing models to consider common cause in the Initiating Event (IE) fault trees. Expand IE fault trees to include support systems using the guidance of EPRI TR-1013490..	
Perry Resolution	Developed initiating event fault trees were updated to include CCF and including support system interactions. See DB-004, Section 2.2.4 as well as section 2.4 of the following system notebooks: SM-016, SM-019, SM-022, SM-023, SM-048, SM-050.	
Significance of Gap		

Gaps for Accident Sequence Analysis

Supporting Rqmt	Category I	Category II
AS-A7	DELINEATE the possible accident sequences for each modeled initiating event, unless the sequences can be shown to be a non-contribution using qualitative arguments.	DELINEATE the possible accident sequences for each modeled initiating event, unless the sequences can be shown to be a non-contribution using qualitative arguments.
NRC Resolution		
Status/Gap	Accident sequences were developed for each modeled initiating event. No sequences were eliminated as being non-contributing sequences. It was noted that the Large LOCA event tree also models R, Excessive LOCA. The reference for the value (1.00E-8) is CA 03-04634-002. This is an internal calculation and is not contained in any of the PRA documentation. The Intermediate LOCA event tree also models V, Interfacing Systems LOCA. The discussion in Section 4.2 indicates that the model for V is 2 basic events but there are specific analysis files for Interfacing Systems LOCA (IE-05 R0 "Interfacing System LOCA & LOCAs Bypassing Containment" and IE-06 R0 "Frequency of LOCAs Bypassing Containment").	
Action to Close Gap	Suggest separate event trees for R and Interfacing Systems LOCA. Include the development of the frequency of R (vessel rupture) in DB-04 (Initiating Event Frequency). If this is not done it will skew the importance of the Large LOCA and Intermediate LOCA.	
Perry Resolution	As part of the PRA model update, the Vessel Rupture event (R) and the ISLOCA event were separated into separate event trees.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	Category I	Category II
AS-C3	DOCUMENT the key assumptions and key sources of uncertainty associated with the accident sequence analysis.	DOCUMENT the key assumptions and key sources of uncertainty associated with the accident sequence analysis.
NRC Resolution	Issue: "All the sources of uncertainty and assumptions that can impact the risk profile of the base PRA need to be documented; see definition of key source of uncertainty for definition of source of uncertainty." Position: Clarification. Resolution: DOCUMENT the {key text deleted} assumptions and {key text deleted} sources of uncertainty associated ...."	
Status/Gap	While each analysis has a section titled "Assumptions", these sections describe the required safety functions and how each may be met for the given initiating event. Specific causes of uncertainty are not identified. See SC-C3.	
Action to Close Gap	See SC-C3.	

Supporting Rqmt	Category I	Category II
Perry Resolution	General Assumptions for AS analysis are contained in AS-000. Specific assumptions are discussed where appropriate within the applicable AS notebook. The Quantification Notebook (QU-001) documents sources of uncertainty in the model as a whole in Sections 1.2, 3.2.6 and 4.0. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	Category I	Category II
AS-A4	For each modeled initiating event, using the success criteria defined for each key safety function (in accordance with SR SC-A4), IDENTIFY the necessary operator actions to achieve the defined success criteria.	For each modeled initiating event, using the success criteria defined for each key safety function (in accordance with SR SC-A4), IDENTIFY the necessary operator actions to achieve the defined success criteria.
NRC Resolution		
Status/Gap	While the discussions in Section 4, Function Definitions, describe specific actions to be performed and state the time available, no specific operator actions are explicitly presented.	
Action to Close Gap	Add a Human Actions section to each of the event tree analyses. Include the basic event names and a description of each event.	
Perry Resolution	Applicable Human Actions are identified in System Modeling notebooks and in Accident Sequence notebooks. Basic Event names and descriptions are supplied for each operator action. All of the human actions are listed in the HRA Notebook, HI-001, Table 4-1 and Table 4-2. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
AS-A8	DEFINE the end state of the accident progression as occurring when either a core damage state or a steady-state condition has been reached.	DEFINE the end state of the accident progression as occurring when either a core damage state or a steady-state condition has been reached.
NRC Resolution		
Status/Gap	Core damage is defined in AS-01 R2. Event tree endstates are defined in Section 6.0 in some event tree analysis file. The end states assigned are shown on the event tree figures. For some event trees endstates are not defined (e.g. AS-03 R2, AS-04 R1, etc.) Event tree endstates should be defined in the calculation files as specified in PSAI-02 "Task IE/AS - Initiating Events and Accident Sequence Delineation", Section 5.4.6.	
Action to Close Gap	Review all event tree calculation files to be sure that they contain all of the elements specified in PSAI-02.	
Perry Resolution	End states are shown for each sequence on the event trees and each End State is defined in AS-000. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
AS-B5a	If plant configurations and maintenance practices create dependencies among various system alignments, DEFINE and MODEL these configurations and alignments in a manner that reflects these dependencies, either in the accident sequence models or in the system models.	If plant configurations and maintenance practices create dependencies among various system alignments, DEFINE and MODEL these configurations and alignments in a manner that reflects these dependencies, either in the accident sequence models or in the system models.
NRC Resolution		
Status/Gap	Little discussion found on system alignments, however modeling appears to correctly account for any dependencies.	
Action to Close Gap	Revise documentation to include discussion of how system alignments were determined.	
Perry Resolution	System alignments and operational considerations were discussed in Section 1.4 and 2.1.2 of each System Modeling notebook. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
AS-C1	DOCUMENT the accident sequence analysis in a manner that facilitates PRA applications, upgrades, and peer review.	DOCUMENT the accident sequence analysis in a manner that facilitates PRA applications, upgrades, and peer review.
NRC Resolution		
Status/Gap	The documentation for the accident sequences was found to be consistent and complete. Each analysis presents the relevant safety functions, and the specific systems considered (or not considered) to satisfy each function. Each event tree heading, event tree function, and plant damage state is clearly defined. A graphic depiction of the event tree and the functional fault trees are presented.	
Action to Close Gap	Functional fault trees were missing from AS-03, AS-06, AS-07, AS-09, AS-11. These should be added for consistency. AS-021, Revision 3 needs to be revised to reflect latest revision of AS-011.	
Perry Resolution	Functional Fault Tree descriptions and graphics are provided in notebook AS-021. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
AS-B2	IDENTIFY the dependence of modeled mitigating systems on the success or failure of preceding systems, functions, and human actions. INCLUDE the impact on accident progression, either in the accident sequence models or in the system models. For example: (a) turbine driven system dependency on SORV, depressurization, and containment heat removal (suppression pool cooling); (b) low pressure system injection success dependent on need for RPV depressurization.	IDENTIFY the dependence of modeled mitigating systems on the success or failure of preceding systems, functions, and human actions. INCLUDE the impact on accident progression, either in the accident sequence models or in the system models. For example: (a) turbine driven system dependency on SORV, depressurization, and containment heat removal (suppression pool cooling); (b) low pressure system injection success dependent on need for RPV depressurization.

NRC Resolution	
Status/Gap	Dependencies correctly captured in the AS calculations. RPV depressurization dependency is correctly captured in most cases as well as dependencies of mitigating systems on possible containment failure (event tree heading C). RPV depressurization was moved in the Intermediate LOCA event tree such that it is not questioned for event heading V. However, smaller size Intermediate LOCAs were not analyzed with MAAP to determine whether this is results in success.
Action to Close Gap	
Perry Resolution	LOCA size breakpoints were determined based on the mitigating systems required to get the plant into a safe condition. See the "LOCA Sizes" section of AS-001 for more information, including MAAP analysis. Closing this gap did not affect the PRA model; this was completeness of documentation only.
Significance of Gap	

Gaps for Success Criteria Analysis

Supporting Rqmt	**Category I**	**Category II**
SC-A4	SPECIFY success criteria for each of the key safety functions identified per SR AS-A2 for each modeled initiating event [Note (2)].	SPECIFY success criteria for each of the key safety functions identified per SR AS-A2 for each modeled initiating event [Note (2)].
NRC Resolution		
Status/Gap	Documentation of MAAP runs is insufficient to determine whether this SR is met. Listed HEP timing is not readily obtainable from AS-001. Range of LOCA sizes should be run for MAAP analyses. (Ex.: Interim. LOCA size is .01 to 0.5 ft2 (liquid) while MAAP run used 0.19 ft2 (2 SRVs). MAAP analyses summaries indicates CRD flow credited, however no CRD system modeling was found. Note: Minimum pump flow requirements are actually just MAAP input assumptions.	
Action to Close Gap	Perform new MAAP analyses for a range of LOCA sizes. Review and determine use of CRD flow in MAAP analyses, and document bases. Perform a review of AS calculations and provide a road map for the success criteria. NOTE: The new MAAP analyses may require additional changes, depending on the results. This adds considerable uncertainty to the estimated effort.	
Perry Resolution	New MAAP runs have been generated for different LOCA sizes and the use of CRD and SLC injection sources have been evaluated and included where applicable. Documentation on LOCA sizes is in AS-001 and documentation on CRD and SLC injection is in AS-005 and AS-006. The PRA model was updated to include CRD and SLC injection as an alternate high pressure injection source.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	**Category I**	**Category II**
SC-A2	SPECIFY the plant parameters (e.g., highest node temperature, core collapsed liquid level) and associated acceptance criteria (e.g., temperature limit) to be used in determining core damage. Examples	SPECIFY the plant parameters (e.g., highest node temperature, core collapsed liquid level) and associated acceptance criteria (e.g., temperature limit) to be used in determining core damage. SELECT

Supporting Rqmt	Category I	Category II
	of measures for core damage suitable for Capability Category I are as defined in NUREG/CR-4550 [Note (1)].	these parameters such that the determination of core damage is as realistic as practical, consistent with current best practice. DEFINE computer code-predicted acceptance criteria with sufficient margin on the code-calculated values to allow for limitations of the code, sophistication of the models, and uncertainties in the results, consistent with requirements specified under HLR-SC-B. Examples of measures for core damage suitable for Capability Category II / III, which have been used in PRAs, include: (a) collapsed liquid level less than 1/3 core height or code predicted peak core temperature >2,500°F (BWR) (b) collapsed liquid level below top of active fuel for a prolonged period; or code-predicted core peak node temperature >2,200°F using a code with detailed core modeling; or code-predicted core peak node temperature >1,800°F using a code with simplified (e.g., single-node core model, lumped parameter) core modeling; or code-predicted core exit temperature >1,200°F for 30 min using a code with simplified core modeling (PWR)
NRC Resolution		
Status/Gap	Page 2 of AS-001 states that core damage is defined to occur when max nodal average fuel temperature exceeds 2200F or upon the onset of RPV steam cooling when MZIRWL is 42.5 inches below TAF. These parameters meet this SR. Page 2 of AS-001 states that manual initiation of alternate injection must occur prior to a max. core temperature of 1100F for S1 events. No basis could be found for the 1100F parameter.	
Action to Close Gap	Research and document the basis for this success criteria.	
Perry Resolution	AS-001 describes the basis behind 1100F as the point at which the alternate injection must be initiated to prevent exceeding an average fuel temperature of 2200F. As shown in AS-001, Case #9 (MAAP run 03-07-51) shows that initiation of the Condensate Transfer Alternate Injection at 1100F will prevent maximum core temperature from reaching 2200F. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
SC-B4	USE analysis models and computer codes that have sufficient capability to model the conditions of interest in the determination of success criteria for CDF, and that provide results representative of the plant. A qualitative evaluation of a relevant application of codes, models, or analyses that has been used for a similar class of plant	USE analysis models and computer codes that have sufficient capability to model the conditions of interest in the determination of success criteria for CDF, and that provide results representative of the plant. A qualitative evaluation of a relevant application of codes, models, or analyses that has been used for a similar class of plant

	(e.g., Owner's Group generic studies) may be used. USE computer codes and models only within known limits of applicability.	(e.g., Owner's Group generic studies) may be used. USE computer codes and models only within known limits of applicability.
NRC Resolution		
Status/Gap	MAAP 4.04 is used. There is no discussion of limitations of MAAP. It is recommended that a limitations be documented to assure that the code is used appropriately.	
Action to Close Gap	The MAAP Users Group is in the process of documenting this information. PNPP should have a process in place to incorporate this into the PRA documentation. It is recognized that updating MAAP calcs due to changes in the code is a great deal of effort, but PNPP should also evaluate changes to MAAP to determine whether to update the version of MAAP in use to the current version.	
Perry Resolution	Limitations associated with MAAP are discussed in AS-001. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	**Category I**	**Category II**
SC-B5	CHECK the reasonableness and acceptability of the results of the thermal/hydraulic, structural, or other supporting engineering bases used to support the success criteria. Examples of methods to achieve this include: (a) comparison with results of the same analyses performed for similar plants, accounting for differences in unique plant features (b) comparison with results of similar analyses performed with other plant-specific codes (c) check by other means appropriate to the particular analysis	CHECK the reasonableness and acceptability of the results of the thermal/hydraulic, structural, or other supporting engineering bases used to support the success criteria. Examples of methods to achieve this include: (a) comparison with results of the same analyses performed for similar plants, accounting for differences in unique plant features (b) comparison with results of similar analyses performed with other plant-specific codes (c) check by other means appropriate to the particular analysis
NRC Resolution		
Status/Gap	There is no evidence of checks of reasonableness of the SC analysis results.	
Action to Close Gap	Perform comparison of results of SC with other similar plants.	
Perry Resolution	A check of the reasonableness was performed and is documented in AS-001. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	**Category I**	**Category II**
SC-C1	DOCUMENT the success criteria in a manner that facilitates PRA applications, upgrades, and peer review.	DOCUMENT the success criteria in a manner that facilitates PRA applications, upgrades, and peer review.
NRC Resolution		
Status/Gap	The documentation should identify the need for SC determination, define the need for the determination and identify how the need was satisfied.	
Action to Close Gap	Define the question being addressed by a SC analysis, the means of addressing the question and the results.	

Perry Resolution	Success Criteria is documented in AS-001 and was written using up-to-date methods to facilitate documentation reviews. Closing this gap did not affect the PRA model; this was completeness of documentation only.
Significance of Gap	D - Documentation Only

Supporting Rqmt	**Category I**	**Category II**
SC-C2	DOCUMENT the processes used to develop overall PRA success criteria and the supporting engineering bases, including the inputs, methods, and results. For example, this documentation typically includes: (a) the definition of core damage used in the PRA including the bases for any selected parameter value used in the definition (e.g., peak cladding temperature or reactor vessel level) (b) calculations (generic and plant-specific) or other references used to establish success criteria, and identification of cases for which they are used (c) identification of computer codes or other methods used to establish plant-specific success criteria (d) a description of the limitations (e.g., potential conservatisms or limitations that could challenge the applicability of computer models in certain cases) of the calculations or codes (e) the uses of expert judgment within the PRA, and rationale for such uses (f) a summary of success criteria for the available mitigating systems and human actions for each accident initiating group modeled in the PRA (g) the basis for establishing the time available for human actions (h) descriptions of processes used to define success criteria for grouped initiating events or accident sequences	DOCUMENT the processes used to develop overall PRA success criteria and the supporting engineering bases, including the inputs, methods, and results. For example, this documentation typically includes: (a) the definition of core damage used in the PRA including the bases for any selected parameter value used in the definition (e.g., peak cladding temperature or reactor vessel level) (b) calculations (generic and plant-specific) or other references used to establish success criteria, and identification of cases for which they are used (c) identification of computer codes or other methods used to establish plant-specific success criteria (d) a description of the limitations (e.g., potential conservatisms or limitations that could challenge the applicability of computer models in certain cases) of the calculations or codes (e) the uses of expert judgment within the PRA, and rationale for such uses (f) a summary of success criteria for the available mitigating systems and human actions for each accident initiating group modeled in the PRA (g) the basis for establishing the time available for human actions (h) descriptions of processes used to define success criteria for grouped initiating events or accident sequences
NRC Resolution		
Status/Gap	Process for identification of need for SC determination and resolution of need is not provided.	
Action to Close Gap	Develop a Success Criteria analysis guideline	

Supporting Rqmt	Category I	Category II
Perry Resolution	Documentation that may be considered the Success Criteria analysis guideline is in AS-001. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
SC-C3	DOCUMENT the key assumptions and key sources of uncertainty associated with the development of success criteria.	DOCUMENT the key assumptions and key sources of uncertainty associated with the development of success criteria.
NRC Resolution	DOCUMENT the assumptions and sources of uncertainty associated . (i.e., delete the words "key")	
Status/Gap	Assumptions/sources of uncertainty have not been documented.	
Action to Close Gap	Perform analysis per Draft NUREG 1855.	
Perry Resolution	The Quantification Notebook (QU-001) Sections 1.2, 3.2.6 and 4.0 document the sources of uncertainty in the model as a whole, including the Success Criteria. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Gaps for System Modeling Analysis

Supporting Rqmt	Category I	Category II
SY-A12	INCLUDE in the system model those failures of the equipment and components that would affect system operability (as identified in the system success criteria), except when excluded using the criteria in SYA14. This equipment includes both active components (e.g., pumps, valves, and air compressors) and passive components (e.g., piping, heat exchangers, and tanks) required for system operation.	INCLUDE in the system model those failures of the equipment and components that would affect system operability (as identified in the system success criteria), except when excluded using the criteria in SYA14. This equipment includes both active components (e.g., pumps, valves, and air compressors) and passive components (e.g., piping, heat exchangers, and tanks) required for system operation.
NRC Resolution		
Status/Gap	The Service/Instrument air system model has assumption 4 that states that failures of the air dryers and filters are considered negligible when compared to the failure rate of the compressors. Based on the experience of the reviewers, this may not be the case.	
Action to Close Gap	Verify that the generic failure data supports this assumption or add the air dryers/filters to the fault tree model. If the failure data supports the assumption, document the justification in the system notebook.	
Perry Resolution	As part of the PRA update, instrument air filters were conservatively added to the model. Air dryers are not included in the model as a failure to the dryers will not immediately impact the instrument air system. It is assumed that the instrument air system may be degraded due to the presence of moisture, but this will not be a concern over the 24-hour period considered by the PRA. Dryers and filters are not included in the development of the support system initiating event, due to the redundant trains, and the dominance of the air compressors on the failure frequency of the system. See SM-016.	

Supporting Rqmt	Category I	Category II
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	Category I	Category II
SY-B3	ESTABLISH common cause failure groups by using a logical, systematic process that considers similarity in (a) service conditions (b) environment (c) design or manufacturer (d) maintenance JUSTIFY the basis for selecting common cause component groups. Candidates for common cause failures include, for example: (a) motor-operated valves (b) pumps (c) safety-relief valves (d) air-operated valves (e) solenoid-operated valves (f) check valves (g) diesel generators (h) batteries (i) inverters and battery charger (j) circuit breakers	ESTABLISH common cause failure groups by using a logical, systematic process that considers similarity in (a) service conditions (b) environment (c) design or manufacturer (d) maintenance JUSTIFY the basis for selecting common cause component groups. Candidates for common cause failures include, for example: (a) motor-operated valves (b) pumps (c) safety-relief valves (d) air-operated valves (e) solenoid-operated valves (f) check valves (g) diesel generators (h) batteries (i) inverters and battery charger (j) circuit breakers
NRC Resolution		
Status/Gap	No discussion of process for establishing CCCGs. The task plan for dependent failures (dated 1997) briefly mentions CCCGs but does not address a process. DF-001R2 presupposes the existence of CCCGs. - DGs common caused together although different mfg/size - Batteries NOT common caused together because different mfg/size.	
Action to Close Gap	Develop CCCG process. Review systems to make sure that the CCCGs are consistently identified and documented in the system notebooks. The documentation should include a justification for the selection of the groups. See EPRI guidance.	
Perry Resolution	As part of the PRA update process, new Common Cause Groups were added to the model. Discussion of general guidance for selection of CCG provided in SM-000 – General Assumptions. Specific justification for selection of CCG provided in each system notebook in section 2.3.3.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	Category I	Category II
SY-B4	INCORPORATE common cause failures into the system model consistent with the common cause model used for data analysis. (See DA-D6.)	INCORPORATE common cause failures into the system model consistent with the common cause model used for data analysis. (See DA-D6.)

Supporting Rqmt	Category I	Category II
NRC Resolution		
Status/Gap	Several issues have been identified in the CCF modeling. - Found Common Cause data problems (DVMCC: 4.059E-3 in BED but 1.11E-5 in calc; DCBTLC: type 3 in BED [demand] but value in BED is 1.24e-9 which hrly number) - IACMCC (ccf of IA and SA compressors) in fault tree/BED at 8.43E-3 but not in DF-001 R2 - ECCS Initiation fault tree missing hardware CCF (PTs, relays, etc.) - DG CCF: values in calc do not match BED - Many CCF events are modeled as single events and not expanded to capture multiple failure combinations.	
Action to Close Gap	Update CCF analysis to assure that it is consistent (see CCCG discussion in SY-B3) across systems and to assure that it is correct (see Basis). During benchmark quantification after conversion to CAFTA, compare the results after quantification with the CCF terms set to ZERO.	
Perry Resolution	CCF analysis updated using CAFTA software to calculate the CCF parameters using the Multiple Greek Letter methodology. Groupings and methodology are consistent between systems. See SM-000 for general discussion of CC modeling and section 2.3.3 in each system notebook for specific information.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	Category I	Category II
SY-B6	PERFORM engineering analyses to determine the need for support systems that are plant-specific and reflect the variability in the conditions present during the postulated accidents for which the system is required to function.	PERFORM engineering analyses to determine the need for support systems that are plant-specific and reflect the variability in the conditions present during the postulated accidents for which the system is required to function.
NRC Resolution		
Status/Gap	There are numerous outstanding evaluation requests for determining the actual dependency of equipment on HVAC and room cooling. At present, the dependence of many SSCs on room cooling is evaluated by assumption, with no specific engineering bases for the assumption.	
Action to Close Gap	Perform the necessary HVAC/room heatup calculations to support determination of the room cooling conditions for mitigating equipment.	
Perry Resolution	As part of PRA model update, added a dependency of Class 1E divisional switchgear rooms on HVAC to maintain availability throughout the 24 hour mission time based on thermo-hydraulic calculations performed with GOTHIC. Additionally, ECCS pump rooms are dependent on room cooling as well. See system notebooks, Section 1.5 for support system dependencies and ECA-072 through ECA-076 for room heatup calculations.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	Category I	Category II
SY-B7	BASE support system modeling on the use of conservative success criteria and timing.	BASE support system modeling on realistic success criteria and timing, unless a conservative approach can be justified, i.e., if their use does not impact risk significant contributors.

NRC Resolution	
Status/Gap	Support system modeling of HVAC/room cooling dependencies is based on assumptions that have no basis or verification.
Action to Close Gap	
Perry Resolution	GOTHIC thermo-hydraulic calculations performed as part of the model update to assess the need for room cooling, and to address the bases behind assumptions in the calculations. See ECA-072 through ECA-076.
Significance of Gap	B - Small Nonconservative

Supporting Rqmt	**Category I**	**Category II**
SY-B10	When modeling a system, INCLUDE appropriate interfaces with the support systems required for successful operation of the system for a required mission time. (See also AS-A6.) Examples include: (a) actuation logic (b) support systems required for control of components (c) component motive power (d) cooling of components (e) any other identified support function (e.g., heat tracing) necessary to meet the success criteria and associated systems	When modeling a system, INCLUDE appropriate interfaces with the support systems required for successful operation of the system for a required mission time. (See also AS-A6.) Examples include: (a) actuation logic (b) support systems required for control of components (c) component motive power (d) cooling of components (e) any other identified support function (e.g., heat tracing) necessary to meet the success criteria and associated systems
NRC Resolution	…required mission time (see also ASY-A6). Examples of support systems include:	
Status/Gap	Some actuation logic/permissives are not included for LPCI/LPCS. The LPCS and RHR pumps do not have an explicitly modeled dependence on DC power for pump start. DC power is required to close the motor circuit breaker. This may not be an issue for the overall logic since the DC power dependency does exist under the ECCS initiation logic portion of the fault tree logic. However, other equipment started by the ECCS initiation logic does include an explicit dependency on DC power to start the equipment.	
Action to Close Gap	Add logic for the LPCI/LPCS low RPV permissive signal. Add the DC power dependency under the LPCS and RHR pump start logic. During CAFTA conversion look at dependencies to make sure they appear complete.	
Perry Resolution	As part of the PRA update, logic has been added for RHR and LPCS dependency on DC power for the pump start permissive and the Low RPV Pressure Permissive for the opening of the injection valve. See section 1.4 and 1.5 of SM-005 and SM-006.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	**Category I**	**Category II**
SY-B11	IDENTIFY those systems that are required for initiation and actuation of a system. MODEL them unless a justification is provided (e.g., the initiation and actuation system can be argued to be highly reliable	MODEL those systems that are required for initiation and actuation of a system. In the model quantification, INCLUDE the presence of the conditions needed for automatic actuation (e.g., low vessel water

	and is only used for that system, so that there are no intersystem dependencies arising from failure of the system). In the model quantification, INCLUDE the presence of the conditions needed for automatic actuation (e.g., low vessel water level). INCLUDE permissive and lockout signals that are required to complete actuation logic.	level). INCLUDE permissive and lockout signals that are required to complete actuation logic.
NRC Resolution		
Status/Gap	Low pressure ECCS (LPCI/LPCS) systems do not include the reactor low pressure permissive circuitry for opening of the injection valves.	
Action to Close Gap	Add the required modeling for the permissive signals in LPCS and LPCI. Review all other systems for any missing permissive logic.	
Perry Resolution	As part of the PRA update, the permissive logic has been added to the model for LPCI and LPCS. Permissive logic is modeled in all other systems when appropriate. See system notebooks, Section 1.4 and 1.5.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	**Category I**	**Category II**
SY-B15	IDENTIFY SSCs that may be required to operate in conditions beyond their environmental qualifications. INCLUDE dependent failures of multiple SSCs that result from operation in these adverse conditions. Examples of degraded environments include: (a) LOCA inside containment with failure of containment heat removal (b) safety relief valve operability (small LOCA, drywell spray, severe accident) (for BWRs) (c) steam line breaks outside containment (d) debris that could plug screens/filters (both internal and external to the plant) (e) heating of the water supply (e.g., BWR suppression pool, PWR containment sump) that could affect pump operability (f) loss of NPSH for pumps (g) steam binding of pumps	IDENTIFY SSCs that may be required to operate in conditions beyond their environmental qualifications. INCLUDE dependent failures of multiple SSCs that result from operation in these adverse conditions. Examples of degraded environments include: (a) LOCA inside containment with failure of containment heat removal (b) safety relief valve operability (small LOCA, drywell spray, severe accident) (for BWRs) (c) steam line breaks outside containment (d) debris that could plug screens/filters (both internal and external to the plant) (e) heating of the water supply (e.g., BWR suppression pool, PWR containment sump) that could affect pump operability (f) loss of NPSH for pumps (g) steam binding of pumps
NRC Resolution	Examples of degraded environments include: (h) harsh environments induced by containment venting or failure that may occur prior to the onset of core damage	
Status/Gap	Although some information appears in AS documentation on EQ issues, the system documentation does not consistently address the SR. There is a potential for nonconservatism here, if components are credited under conditions that would result in component failure.	

Action to Close Gap	Review all accident scenarios specifically to identify conditions that challenge EQ limits of components, identify the equipment that is challenged, determine the EQ limits for the challenged equipment, and evaluate the survivability of the equipment under the conditions/demands.
Perry Resolution	Systems reviewed for functionality based in different EQ requirements. See Section 1.4.5 of each system notebook for spatial dependency requirements as well as section 2.1 for modeling assumptions. Also, general AS modeling assumptions are contained in Section 4.0 of AS-000.
Significance of Gap	B - Small Nonconservative

Supporting Rqmt	**Category I**	**Category II**
SY-A8	ESTABLISH the boundaries of the components required for system operation. MATCH the definitions used to establish the component failure data. For example, a control circuit for a pump does not need to be included as a separate basic event (or events) in the system model if the pump failure data used in quantifying the system model include control circuit failures. MODEL as separate basic events of the model, those subcomponents (e.g., a valve limit switch that is associated with a permissive signal for another component) that are shared by another component or affect another component, in order to account for the dependent failure mechanism.	ESTABLISH the boundaries of the components required for system operation. MATCH the definitions used to establish the component failure data. For example, a control circuit for a pump does not need to be included as a separate basic event (or events) in the system model if the pump failure data used in quantifying the system model include control circuit failures. MODEL as separate basic events of the model, those subcomponents (e.g., a valve limit switch that is associated with a permissive signal for another component) that are shared by another component or affect another component, in order to account for the dependent failure mechanism.
NRC Resolution		
Status/Gap	Component boundaries are not identified.	
Action to Close Gap	Identify the component boundaries for all components. Assure that the definitions are consistent across modeling and data analysis.	
Perry Resolution	General Component Boundaries are discussed in the General Assumptions Notebook (SM-000). Specific boundaries that deviate from the general assumptions are discussed in the individual system notebooks.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	**Category I**	**Category II**
SY-A14	In meeting SY-A12 and SY-A13, contributors to system unavailability and unreliability (i.e., components and specific failure modes) may be excluded from the model if one of the following screening criteria is met: (a) A component may be excluded from the system model if the total failure probability of the component failure modes resulting in the same effect on system operation is at least two orders of magnitude	In meeting SY-A12 and SY-A13, contributors to system unavailability and unreliability (i.e., components and specific failure modes) may be excluded from the model if one of the following screening criteria is met: (a) A component may be excluded from the system model if the total failure probability of the component failure modes resulting in the same effect on system operation is at least two orders of magnitude

	lower than the highest failure probability of the other components in the same system train that results in the same effect on system operation. (b) One or more failure modes for a component may be excluded from the systems model if the contribution of them to the total failure rate or probability is less than 1% of the total failure rate or probability for that component, when their effects on system operation are the same.	lower than the highest failure probability of the other components in the same system train that results in the same effect on system operation. (b) One or more failure modes for a component may be excluded from the systems model if the contribution of them to the total failure rate or probability is less than 1% of the total failure rate or probability for that component, when their effects on system operation are the same.
NRC Resolution		
Status/Gap	SR not met. See SR SY-A12	
Action to Close Gap	Included in AS-A12.	
Perry Resolution	As part of the PRA update, Instrument air filters were added to the model. Air dryers are not included in the model as a failure to the dryers will not immediately impact the instrument air system. It is assumed that the instrument air system may be degraded due to the presence of moisture, but this will not be a concern over the 24-hour period considered by the PRA. Dryers and filters and not included in the development of the support system initiating event, due to the redundant trains, and the dominance of the air compressors on the failure frequency of the system. See SM-016.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	**Category I**	**Category II**
SY-A19	IDENTIFY system conditions that cause a loss of desired system function, e.g., excessive heat loads, excessive electrical loads, excessive humidity, etc.	IDENTIFY system conditions that cause a loss of desired system function, e.g., excessive heat loads, excessive electrical loads, excessive humidity, etc.
NRC Resolution		
Status/Gap	In SM-08 R3 (RCIC), Sections 3 and 4 outline the conditions that impact the operability of the RCIC system. SM-22 R2 (AC Electric Power) notes room cooling but assumes it is not needed. There is no indication of the acceptable temperature range for equipment.	
Action to Close Gap	Add discussion on expected system conditions and environment. Include discussion of the operability range of SSCs.	
Perry Resolution	As part of the PRA update, room cooling dependencies were added for switchgear components based on GOTHIC room heatup calculations. Expected system conditions and operability considerations for SSCs are discussed in Section 1.4.5, 1.5, and 2.1 of each system notebook. See ECA-072 through ECA-076 for room heatup calculations.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	Category I	Category II
SY-A20	DO NOT TAKE CREDIT for system or component operability when the potential exists for rated or design capabilities to be exceeded.	TAKE CREDIT for system or component operability only if an analysis exists to demonstrate that rated or design capabilities are not exceeded.
NRC Resolution		
Status/Gap	Credit is taken for electrical systems without supporting documentation. In SM-22 R2, page 17, assumptions g and h state that HVAC systems M42 (cools the non-Class 1E buses) and M23 (cools bus EH13) are not modeled. There is no analysis that supports the operation of these electrical systems without HVAC. The requirement is to demonstrate that rated design capability is not exceeded. See also SY-B6 and SY-B7.	
Action to Close Gap	Review all systems documents to determine if there are other places where credit it taken for a system. Develop analyses to support the operation of these systems in the expected environment.	
Perry Resolution	New room heatup calculations performed as part of the model update, including addressing the bases behind assumptions in the calculations. Class 1E divisional switchgear rooms are dependent on HVAC to maintain availability throughout the 24 hour mission time. Additionally, ECCS pump rooms are dependent on room cooling as well. See system notebooks, Section 1.5 for support system dependencies and ECA-072 through ECA-076 for room heatup calculations.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	Category I	Category II
SY-A4	CONFIRM that the system analysis correctly reflects the as-built, as-operated plant through discussions with system engineers and plant operations staff.	PERFORM plant walkdowns and interviews with system engineers and plant operators to confirm that the systems analysis correctly reflects the as-built, as-operated plant.
NRC Resolution		
Status/Gap	Interviews with system engineers and plant operators are not documented. Walkdowns are discussed in the system notebooks, however.	
Action to Close Gap	Conduct interviews with system engineers and plant operators to assure that the models reflect the plant as-built/as-operated.	
Perry Resolution	System Engineer Interviews are documented in Section C of each system notebook. Updates to the PRA model were made based on the results of the interviews (e.g. inclusion of Service Water pump dependency on the Clearwell system).	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
SY-A6	In defining the system model boundary (see SY-A3), INCLUDE within the boundary the components required for system operation,	In defining the system model boundary (see SY-A3), INCLUDE within the boundary the components required for system operation,

Supporting Rqmt	Category I	Category II
	and the components providing the interfaces with support systems required for actuation and operation of the system components.	and the components providing the interfaces with support systems required for actuation and operation of the system components.
NRC Resolution		
Status/Gap	System model boundaries are not consistently documented as required by SR	
Action to Close Gap	Update system notebooks to assure that the system model boundary is defined consistently with SR. Clearly indicate in the SY Guideline the approach to documenting interface components and incorporate into all notebooks.	
Perry Resolution	The System Model Boundary is addressed in section 1.3 of each system notebook. Interfacing systems/components are addressed in section 1.5. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
SY-A7	DEVELOP detailed systems models, unless (a) sufficient system-level data are available to quantify the system failure probability, or (b) system failure is dominated by operator actions, and omitting the model does not mask contributions to the results of support systems or other dependent-failure modes. For case (a), USE a single data value only for systems with no equipment or human-action dependencies, and if data exist that sufficiently represent the unreliability or unavailability of the system and account for plant-specific factors that could influence unreliability and unavailability. Examples of systems that have sometimes not been modeled in detail include the scram system, the power-conversion system, instrument air, and the keep-fill systems. JUSTIFY the use of limited (i.e., reduced or single data value) modeling.	DEVELOP detailed systems models, unless (a) sufficient system-level data are available to quantify the system failure probability, or (b) system failure is dominated by operator actions, and omitting the model does not mask contributions to the results of support systems or other dependent-failure modes. For case (a), USE a single data value only for systems with no equipment or human-action dependencies, and if data exist that sufficiently represent the unreliability or unavailability of the system and account for plant-specific factors that could influence unreliability and unavailability. Examples of systems that have sometimes not been modeled in detail include the scram system, the power-conversion system, instrument air, and the keep-fill systems. JUSTIFY the use of limited (i.e., reduced or single data value) modeling.
NRC Resolution		
Status/Gap	In general detailed modeling is used. The only example of a limited-detail model identified is failure to scram. There is one term for mechanical failure to scram and one term for electrical failure to scram. A justification is needed for use of limited modeling.	
Action to Close Gap	Include the sources for the use of these single-value model representations in the documentation	
Perry Resolution	The basis for single-value model representations is in DB-016, Table 5. Specifically, the basis for the failure to scram is from NUREG/CR -5550. Additionally, further discussion is contained in Section 3.0 of AS-011. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
SY-C1	DOCUMENT the systems analysis in a manner that facilitates PRA applications, upgrades, and peer review.	DOCUMENT the systems analysis in a manner that facilitates PRA applications, upgrades, and peer review.
NRC Resolution		
Status/Gap	There are a number of inconsistencies in data and information from one system to another. There are a number of editorial/typographical errors in the system notebooks. The system modeling guidance provides a format with section numbers and topics. None of the system notebooks followed this format. There were a large number of format and content differences between the various notebooks. This is probably due to the number of changes made to the requirements of the engineer calculation control procedure.	
Action to Close Gap	Correct the errors and inconsistencies in the system analysis documentation.	
Perry Resolution	System notebooks were re-written in their entirety, using a standard template for guidance. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
SY-C2	DOCUMENT the system functions and boundary, the associated success criteria, the modeled components and failure modes including human actions, and a description of modeled dependencies including support system and common cause failures, including the inputs, methods, and results. For example, this documentation typically includes: (a) system function and operation under normal and emergency operations (b) system model boundary (c) system schematic illustrating all equipment and components necessary for system operation (d) information and calculations to support equipment operability considerations and assumptions (e) actual operational history indicating any past problems in the system operation (f) system success criteria and relationship to accident sequence models (g) human actions necessary for operation of system (h) reference to system-related test and maintenance procedures (i) system dependencies and shared component interface (j) component spatial information (k) assumptions or simplifications made in development of the system models (l) the components and failure modes included in the model and justification for any exclusion of components and failure modes (m) a description of the modularization process (if used) (n) records of resolution of logic loops developed during fault tree linking (if used) (o) results of the system model evaluations (p) results of sensitivity studies (if used) (q) the sources of the above information (e.g., completed checklist from walkdowns, notes from discussions with plant personnel) (r) basic events in the system fault trees so that they are traceable to modules and to cutsets. (s) the nomenclature used in the system models.	DOCUMENT the system functions and boundary, the associated success criteria, the modeled components and failure modes including human actions, and a description of modeled dependencies including support system and common cause failures, including the inputs, methods, and results. For example, this documentation typically includes: (a) system function and operation under normal and emergency operations (b) system model boundary (c) system schematic illustrating all equipment and components necessary for system operation (d) information and calculations to support equipment operability considerations and assumptions (e) actual operational history indicating any past problems in the system operation (f) system success criteria and relationship to accident sequence models (g) human actions necessary for operation of system (h) reference to system-related test and maintenance procedures (i) system dependencies and shared component interface (j) component spatial information (k) assumptions or simplifications made in development of the system models (l) the components and failure modes included in the model and justification for any exclusion of components and failure modes (m) a description of the modularization process (if used) (n) records of resolution of logic loops developed during fault tree linking (if used) (o) results of the system model evaluations (p) results of sensitivity studies (if used) (q) the sources of the above information (e.g., completed checklist from walkdowns, notes from discussions with plant personnel) (r) basic events in the system fault trees so that they are traceable to modules and to cutsets. (s) the nomenclature used in the system models.
NRC Resolution		
Status/Gap	There are a number of inconsistencies in data and information from one system to another. There are a number of editorial/typographical errors in the system notebooks. The system modeling guidance provides a format with section numbers and topics. None of the system notebooks followed this format. There were a large number of format and content differences between the various notebooks. This is probably due to the number of changes made to the requirements of the engineer calculation control procedure.	

Supporting Rqmt	Category I	Category II
Action to Close Gap	Correct the errors and inconsistencies in the system analysis documentation.	
Perry Resolution	System notebooks were re-written in their entirety, using a standard template for guidance. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
SY-C3	DOCUMENT the key assumptions and key sources uncertainty associated with the systems analysis.	DOCUMENT the key assumptions and key sources uncertainty associated with the systems analysis.
NRC Resolution	DOCUMENT the assumptions and sources of uncertainty associated.	
Status/Gap	SR not met. See SR SC-C3.	
Action to Close Gap	Included in SC-C3	
Perry Resolution	General Assumptions for all System Modeling is provided in SM-000. Specific Assumptions for each system are provided in Section 2.1 of each system notebook. Specific uncertainties in each system are addressed in Section 2.5.2 each system notebook and the Quantification Notebook (QU-001) documents sources of uncertainty in the model as a whole in Sections 1.2, 3.2.6 and 4.0. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Gaps for Human Reliability Analysis

Supporting Rqmt	Category I	Category II
HR-G7	For multiple human actions in the same accident sequence or cut set, identified in accordance with supporting requirement QU-C1, ASSESS the degree of dependence, and calculate a joint human error probability that reflects the dependence. ACCOUNT for the influence of success or failure in preceding human actions and system performance on the human event under consideration including (a) the time required to complete all actions in relation to the time available to perform the actions (b) factors that could lead to dependence (e.g., common instrumentation, common procedures, increased stress, etc.) (c) availability of resources (e.g., personnel) [Note (1)]	For multiple human actions in the same accident sequence or cut set, identified in accordance with supporting requirement QU-C1, ASSESS the degree of dependence, and calculate a joint human error probability that reflects the dependence. ACCOUNT for the influence of success or failure in preceding human actions and system performance on the human event under consideration including (a) the time required to complete all actions in relation to the time available to perform the actions (b) factors that could lead to dependence (e.g., common instrumentation, common procedures, increased stress, etc.) (c) availability of resources (e.g., personnel) [Note (1)]

Supporting Rqmt	Category I	Category II
NRC Resolution	"....common procedures, increases stress, etc.) (c) availability of resources (e.g., personnel accounting for time of day)" Addenda A	
Status/Gap	Although some dependencies are identified during the identification and definition process, all possible HFE combinations and dependencies are not addressed.	
Action to Close Gap	Perform dependency analysis and document.	
Perry Resolution	HRA analysis for post-initiators, including HEP dependencies, has been completely redone. HRA dependency analysis has been performed using HRA Calculator including both Level 1 and Level 2 HFEs to capture all HFE combinations. The identified combinations are accounted for in the model using Recovery Rules. Reference Sections 1.1 and 3.3.5 and Appendix E of QU-001 and the HRA Notebook HI-001.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	Category I	Category II
HR-H2	CREDIT operator recovery actions only if, on a plant-specific basis: (a) a procedure is available and operator training has included the action as part of crew's training, or justification for the omission for one or both is provided (b) "cues" (e.g., alarms) that alert the operator to the recovery action provided procedure, training, or skill of the craft exist (c) attention is given to the relevant performance shaping factors provided in HR-G3 (d) there is sufficient manpower to perform the action	CREDIT operator recovery actions only if, on a plant-specific basis: (a) a procedure is available and operator training has included the action as part of crew's training, or justification for the omission for one or both is provided (b) "cues" (e.g., alarms) that alert the operator to the recovery action provided procedure, training, or skill of the craft exist (c) attention is given to the relevant performance shaping factors provided in HR-G3 (d) there is sufficient manpower to perform the action
NRC Resolution		
Status/Gap	Not all these factors are addressed for every recovery action credited.	
Action to Close Gap	Review recovery actions with reference to these factors.	
Perry Resolution	Operator recovery actions are the verification that a system has initiated when required (e.g. the HPCS initiates on RPV Level 2). These actions are all proceduralized as part of a Hardcard or as part of the procedure, and they are all covered extensively in training. The HFEs are developed in HRA Calculator which assesses procedures, cues, performance shaping factors, and manpower requirements. Discussion of the basis for operator recovery actions is provided in Section 2.1.2 of HI-001.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	Category I	Category II
HR-H3	ACCOUNT for any dependency between the HFE for recovery and any other HFEs in the sequence, scenario, or cutset to which the recovery is applied.	ACCOUNT for any dependency between the HFE for recovery and any other HFEs in the sequence, scenario, or cutset to which the recovery is applied.
NRC Resolution	"or cutset to which the recovery is applied. These dependencies include: (a) the time required to complete all actions in relation to the time available to perform the actions (b) factors that could lead to dependence (e.g., common instrumentation, common procedures, increases stress, etc.) (c) availability of resources (e.g., personnel accounting for time of day) - Addenda A	

Status/Gap	May be implicit in 0.1 HEP used for recovery actions
Action to Close Gap	Do dependency analysis. Included in HR-G7.
Perry Resolution	HRA analysis for post-initiators, including HEP dependencies, has been completely redone. HRA dependency analysis has been performed using HRA Calculator including both Level 1 and Level 2 HFEs to capture all HFE combinations. The identified combinations are accounted for in the model using Recovery Rules. A 0.1 screening value for HEPs is not used. Reference Sections 1.1 and 3.3.5 and Appendix E of QU-001 and the HRA Notebook HI-001.
Significance of Gap	B - Small Nonconservative

Supporting Rqmt	**Category I**	**Category II**
HR-D4	When taking into account self-recovery or recovery from other crew members in estimating HEPs for specific HFEs, USE pre-initiator recovery factors consistent with selected methodology. If recovery of pre-initiator errors is credited (a) ESTABLISH the maximum credit that can be given for multiple recovery opportunities (b) USE the following information to assess the potential for recovery of pre-initiator: (1) post-maintenance or post-calibration tests required and performed by procedure (2) independent verification, using a written check-off list, which verify component status following maintenance/testing (3) original performer, using a written check-off list, makes a separate check of component status at a later time (4) work shift or daily checks of component status, using a written check-off list	When taking into account self-recovery or recovery from other crew members in estimating HEPs for specific HFEs, USE pre-initiator recovery factors consistent with selected methodology. If recovery of pre-initiator errors is credited (a) ESTABLISH the maximum credit that can be given for multiple recovery opportunities (b) USE the following information to assess the potential for recovery of pre-initiator: (1) post-maintenance or post-calibration tests required and performed by procedure (2) independent verification, using a written check-off list, which verify component status following maintenance/testing (3) original performer, using a written check-off list, makes a separate check of component status at a later time (4) work shift or daily checks of component status, using a written check-off list
NRC Resolution		
Status/Gap	A minimum HEP = 1E-04 is applied, so maximum credit for multiple recoveries is implicitly ensured. The recovery factors related to surveillance testing that are calculated on pages 4 and 5 are divided by a factor of 4, which is not explained.	
Action to Close Gap	Explain the factor of 4, or eliminate and recalculate recovery factors. Also, avoid the use of a question mark "?" as a variable in equations.	
Perry Resolution	This gap refers to miscalibration events. As stated in other gap resolutions, miscalibration events are included within the failure rates of the applicable sensors. If a miscalibration event occurred, it was counted as a failure of that sensor (pressure element, temperature element, etc). See Section 4.1 of HI-001.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	Category I	Category II
HR-F2	COMPLETE THE DEFINITION of the HFEs by specifying (a) accident sequence specific timing of cues, and time window for successful completion (b) accident sequence specific procedural guidance (e.g., AOPs, and EOPs) (c) the availability of cues and other indications for detection and evaluation errors (d) the complexity of the response. (Task analysis is not required.)	COMPLETE THE DEFINITION of the HFEs by specifying (a) accident sequence specific timing of cues, and time window for successful completion (b) accident sequence specific procedural guidance (e.g., AOPs, and EOPs) (c) the availability of cues and other indications for detection and evaluation errors (d) the specific high level tasks (e.g., train level) required to achieve the goal of the response
NRC Resolution		
Status/Gap	This information generally seems to be implicit in the event tree based discussions in HI-001 The documentation of the individual HFEs are not included in HI 001 and have not been provided. The provided HRA Calculator database does not correspond with the HI-001 documentation and is probably an earlier version.	
Action to Close Gap	Include the documentation of the individual HFEs. The estimated effort allows for some fixing and formatting of the documentation. However, without the current relevant HRA Calculator data file to review, it is not known whether more time would be required	
Perry Resolution	The HRA has been redone as part of the PRA model update. Documentation of HRA from the HRA Calculator program is provided in the HRA Notebook, HI-001.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	Category I	Category II
HR-G2	USE an approach to estimation of HEPs that addresses failure in cognition as well as failure to execute.	USE an approach to estimation of HEPs that addresses failure in cognition as well as failure to execute.
NRC Resolution	Document if both cognitive and execution errors are included in the evaluation of HEPs.	
Status/Gap	The statements on page 7 "...For time-critical human interactions the CBDTM approach [DIN #2] was used to estimate the probability of failure in the DDD phase. The HCWORE approach PIN #2] was used to evaluate the HEPs for those HIS that are not time critical or are dependent on the time..." are the wrong way around.	
Action to Close Gap	Correct the above to reflect that HCR/ORE is used for time critical actions, while CBDTM is used for non time-critical actions. .	
Perry Resolution	Cognitive and Execution failures are accounted for in each HEP. Discussion of the development of each HEP and the methodology used is contained in sections 3.2 and 4.2.1 of HI-001.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	Category I	Category II
HR-A2	IDENTIFY, through a review of procedures and practices, those calibration activities that if performed incorrectly can have an adverse impact on the automatic initiation of standby safety equipment.	IDENTIFY, through a review of procedures and practices, those calibration activities that if performed incorrectly can have an adverse impact on the automatic initiation of standby safety equipment.
NRC Resolution		
Status/Gap	(1) The write-up on page 2 states that "Generally miscalibration events of events affecting more than one redundant train have not been found to be significant contributors to core damage, unless they are common cause failures". This sentence seems contradictory as miscalibration of redundant trains will be a common cause failure by definition". (2) The write-up on page 2 states "...In this study, the common cause error was not considered credible due to the independence of the crew and time separating calibration activities on various channels...". Yet, these type of events are modeled e.g. miscalibration of RPV level channels.	
Action to Close Gap	Clarify documentation	
Perry Resolution	Miscalibration events are included within the failure rates of the applicable sensors. If a miscalibration event occurred, it was counted as a failure of that sensors (pressure element, temperature element, etc). See Section 4.1 of HI-001.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
HR-B1	If screening is performed, ESTABLISH rules for screening classes of activities from further consideration. Example: Screen maintenance and test activities from further consideration only if the plant practices are generally structured to include independent checking of restoration of equipment to standby or operational status on completion of the activity.	If screening is performed, ESTABLISH rules for screening individual activities from further consideration. Example: Screen maintenance and test activities from further consideration only if (a) equipment is automatically re-aligned on system demand, or ((b) following maintenance activities, a post-maintenance functional test is performed that reveals misalignment, or (c) equipment position is indicated in the control room, status is routinely checked, and realignment can be affected from the control room, or (d) equipment status is required to be checked frequently (i.e., at least once a shift)

NRC Resolution	
Status/Gap	The example screening criteria in HR B1 are adopted for use. The write-up, last paragraph on p.2 states "..For safety related systems, there is a functional test required before declaring the system operable. The safety related manual valves inside Containment and Drywell have indication in the Control Room. Applying the screening criteria would leave only the non-safety systems as potential candidates for restoration errors". This seems to suggest that all safety related systems are screened out, but this is not done as misalignment HFEs are modeled for most systems.
Action to Close Gap	Clarify documentation
Perry Resolution	If the screening criteria are rigidly applied, there would be no "restoration errors" for the safety-related systems. To conservatively account for the possibility of these events, HRA calculator was used to determine a value for each HEP to account for the possibility of a future error. See Section 4.1 of HI-001. Closing this gap did not affect the PRA model; this was completeness of documentation only.
Significance of Gap	D - Documentation Only

Supporting Rqmt	**Category I**	**Category II**
HR-B2	DO NOT screen activities that could simultaneously have an impact on multiple trains of a redundant system or diverse systems (HR-A3).	DO NOT screen activities that could simultaneously have an impact on multiple trains of a redundant system or diverse systems (HR-A3).
NRC Resolution		
Status/Gap	(1) Common cause miscalibrations were not considered credible "due to the independence of the crew and time separating calibration activities on". (2) in the RHR system notebook page 7 "...Human Error Reliabilities (HER) incorporated into the fault tree model include common cause miscalibration of actuation sensors (NBLXCCL2 and NBPXCCDW)..."	
Action to Close Gap	Clarify the position on miscalibration. Support the apparent general screening of common cause miscalibration with a calculation.	
Perry Resolution	Miscalibration events are included within the failure rates of the applicable sensors. If a miscalibration event occurred, it was counted as a failure of that sensors (pressure element, temperature element, etc). See Section 4.1 of HI-001.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	**Category I**	**Category II**
HR-D3	No requirement for evaluating the quality of written procedures, administrative controls, or human-machine interfaces.	For each detailed human error probability assessment, INCLUDE in the evaluation process the following plant-specific relevant information: (a) the quality of written procedures (for performing tasks) and administrative controls (for independent review) (b) the quality of the human-machine interface, including both the equipment configuration, and instrumentation and control layout
NRC Resolution	Issue: Add examples for what is meant by quality in items (a) and (b) of Cat II, III	

Supporting Rqmt	Category I	Category II
	Resolution: (a) the quality (including format, logical structure, case of use, clarity, and comprehensiveness) of written procedures and the quality (e.g., configuration control process, technical review process, training process, and management emphasis on adherence to procedures) of administrative controls (for independent review); (b) the quality (e.g., adherence to human factors guidelines [NUREG-0700, Rev. 2, Human-System Interface Design Review Guidelines, O'hara, et al, May 2002] and results of any quantitative evaluations of performance per functional requirements) of the human-machine interface, including both the equipment configuration, and instrumentation and control layout	
Status/Gap	This is partly addressed in THERP (procedure format, structure instrumentation and control layout, manual valve configuration).	
Action to Close Gap	Make a global statement regarding quality of administrative controls.	
Perry Resolution	General discussion of plant procedures is provided in Section 2.2 of HI-001. The quality of each procedure was verified when documenting and determining the basis for each HEP calculation. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
HR-E3	REVIEW the interpretation of the procedures with plant operations or training personnel to confirm that interpretation is consistent with plant operational and training practices.	TALK THROUGH (i.e., review in detail) with plant operations and training personnel the procedures and sequence of events to confirm that interpretation of the procedures is consistent with plant observations and training procedures.
NRC Resolution		
Status/Gap	No references are made to operator interviews or talk throughs with the operators.	
Action to Close Gap	Document simulator observations or operator talk throughs, if they had been done. If not, conduct operator interviews and/or simulator observations.	
Perry Resolution	Interviews with plant operators and training personnel along with simulator runs were completed where applicable. This is discussed in Section 1.2 of HI-001.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
HR-E4	No requirement for using simulator observations or talk- throughs with operators to confirm response models.	USE simulator observations or talk-throughs with operators to confirm the response models for scenarios modeled.
NRC Resolution		
Status/Gap	Only one reference in the document to simulator observations for the median response time for inhibiting ADS.	
Action to Close Gap	Document simulator observations or operator talk throughs, if they had been done. If not, conduct operator interviews and/or simulator observations.	

Supporting Rqmt	Category I	Category II
Perry Resolution	Interviews with plant operators and training personnel along with simulator runs were completed where applicable. This is discussed in Section 1.2 of HI-001. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
HR-G1	USE conservative estimates (e.g., screening values) for the HEPs of the HFEs in accident sequences that survive initial quantification.	PERFORM detailed analyses for the estimation of HEPs for significant HFEs. USE screening values for HEPs for non-significant human failure basic events.
NRC Resolution		
Status/Gap	Detailed calculations have been performed using the HRA Calculator, but only the final HEPs are provided in the HI-001 calculation note.	
Action to Close Gap	Include individual HFE analyses in the documentation.	
Perry Resolution	The details used by HRA Calculator to determine the HEP are contained in the appendices of the HRA Notebook, HI-001. Additionally, the actual values determined by HRA calculator are contained in a field called “HEP” in the CAFTA database.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
HR-G3	USE an approach that takes the following into account: (a) the complexity of the response (b) the time available and time required to complete the response (c) some measure of scenario-induced stress The ASEP Approach is an acceptable approach.	When estimating HEPs EVALUATE the impact of the following plant-specific and scenario-specific performance shaping factors: (a) quality [type (classroom or simulator) and frequency] of the operator training or experience (b) quality of the written procedures and administrative controls (c) availability of instrumentation needed to take corrective actions (d) degree of clarity of the cues/indications (e) human-machine interface (f) time available and time required to complete the response (g) complexity of the required response (h) environment (e.g., lighting, heat, radiation) under which the operator is working (i) accessibility of the equipment requiring manipulation (j) necessity, adequacy, and availability of special tools, parts, clothing, etc.

Supporting Rqmt	Category I	Category II
NRC Resolution	Issue: In item (d) of CC II, III, clarify that 'clarity' refers to the meaning of the cues, etc. In item (g) of CC II, III, clarify that complexity refers to both determining the need for and executing the required response. Resolution: Cat I, II, and III: (d) degree of clarity of the meaning of cues / indications (g) complexity of detection , diagnosis and decision-making, and executing the required response.	
Status/Gap	Detailed calculations have been performed using the HRA Calculator, but only the final HEPs are provided in the HI-001 calculation note.	
Action to Close Gap	Include individual HFE analyses in the documentation. The estimated effort associated with HRA assumes that the most recent HRA Calculator data file is available.	
Perry Resolution	The details used by HRA Calculator to determine the HEP are contained in the appendices of the HRA Notebook, HI-001. Additionally, the actual values determined by HRA calculator are contained in a field called “HEP” in the CAFTA database.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
HR-G5	When needed, ESTIMATE the time required to complete actions. The approach described in ASEP is an acceptable approach.	When needed, BASE the required time to complete actions for significant HFEs on action time measurements in either walkthroughs or talk-throughs of the procedures or simulator observations.
NRC Resolution		
Status/Gap	Required time to complete actions is generally only evaluated for internal flooding HEPs in HI-001.	
Action to Close Gap	Document the time required in addition to the time available and the timing of the cues. .	
Perry Resolution	The timing information for each HEP is discussed in the “Time Window” tab of HRA Calculator and can be found in the “Timing” section of the HRA Calculator report. This report is exported from HRA Calculator and is included as an appendix in the HRA Notebook, HI-001.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
HR-G6	CHECK the consistency of the post-initiator HEP quantifications. REVIEW the HFEs and their final HEPs relative to each other to check their reasonableness given the scenario context, plant history, procedures, operational practices, and experience.	CHECK the consistency of the post-initiator HEP quantifications. REVIEW the HFEs and their final HEPs relative to each other to check their reasonableness given the scenario context, plant history, procedures, operational practices, and experience.
NRC Resolution		
Status/Gap	No consistency check.	
Action to Close Gap	Perform and document consistency check.	
Perry Resolution	Consistency check performed and documented in HI-001, Section 7.0. Closing this gap did not affect the PRA model; this was completeness of documentation only.	

Significance of Gap	D - Documentation Only

Supporting Rqmt	Category I	Category II
HR-I1	DOCUMENT the human reliability analysis in a manner that facilitates PRA applications, upgrades, and peer review.	DOCUMENT the human reliability analysis in a manner that facilitates PRA applications, upgrades, and peer review.
NRC Resolution	(b)(2) their impact on the CDF and LERF results - (Addenda A)	
Status/Gap	See HR-I2	
Action to Close Gap	See HR-I2	
Perry Resolution	The HRA has been updated since the previous revision and has been documented in accordance with industry practices to facilitate review. HI-001 documents all information related to the HRA. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
HR-I2	DOCUMENT the process used to identify, characterize and quantify the pre-initiator, post-initiator and recovery actions considered in the PRA, including the inputs, methods, and results. For example, this documentation typically includes: (a) HRA methodology and process used to identify pre- and post-initiator HEPs (b) qualitative screening rules and results of screening (c) factors used in the quantification of the human action, how they were derived (their bases), and how they were incorporated into the quantification process (d) quantification of HEPs, including: (1) screening values and their bases (2) detailed HEP analyses with uncertainties and their bases (3) the method and treatment of dependencies for post-initiator actions (4) tables of pre- and post-initiator human actions evaluated by model, system, initiating event, and function (5) HEPs for recovery actions and their dependency with other HEPs	DOCUMENT the process used to identify, characterize and quantify the pre-initiator, post-initiator and recovery actions considered in the PRA, including the inputs, methods, and results. For example, this documentation typically includes: (a) HRA methodology and process used to identify pre- and post-initiator HEPs (b) qualitative screening rules and results of screening (c) factors used in the quantification of the human action, how they were derived (their bases), and how they were incorporated into the quantification process (d) quantification of HEPs, including: (1) screening values and their bases (2) detailed HEP analyses with uncertainties and their bases (3) the method and treatment of dependencies for post-initiator actions (4) tables of pre- and post-initiator human actions evaluated by model, system, initiating event, and function (5) HEPs for recovery actions and their dependency with other HEPs
NRC Resolution	(b)(2) their impact on the CDF and LERF results - (Addenda A)	
Status/Gap	See: HR-A2, HR-B1, HR-B2, HR-D3, HR-F2, HR-G1, HR-G2, HR-G3, HR-G5, HR-G6, HR-G7	

Action to Close Gap	
Perry Resolution	The HRA has been updated since the previous revision and has been documented in accordance with industry practices to facilitate review. HI-001 documents all information related to the HRA. Closing this gap did not affect the PRA model; this was completeness of documentation only.
Significance of Gap	D - Documentation Only

Supporting Rqmt	**Category I**	**Category II**
HR-I3	DOCUMENT the key assumptions and key sources uncertainty associated with the human reliability analysis.	DOCUMENT the key assumptions and key sources uncertainty associated with the human reliability analysis.
NRC Resolution	Issue: All the sources of uncertainty and assumptions that can impact the risk profile of the base PRA need to be documented; see definition of key source of uncertainty for definition of source of uncertainty. Resolution: DOCUMENT the assumptions and sources of uncertainty associated. . .	
Status/Gap	Assumptions/uncertainties not documented.	
Action to Close Gap	Perform assumption/uncertainty assessment similar to Draft NUREG-1855. See SC-C3.	
Perry Resolution	Assumptions and uncertainties for the HRA are documented in HI-001. The Quantification Notebook (QU-001) documents sources of uncertainty in the model as a whole in Sections 1.2, 3.2.6 and 4.0. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Gaps for Data Analysis

Supporting Rqmt	**Category I**	**Category II**
DA-A1a	ESTABLISH definitions of SSC boundaries, failure modes, and success criteria consistent with corresponding basic event definitions in Systems Analysis (SY-A5, SY-A7, SY-A8, SY-A10 through SY-A13 and SY-B4) for failure rates and common cause failure parameters, and ESTABLISH boundaries of unavailability events consistent with corresponding definitions in Systems Analysis (SY-A18).	ESTABLISH definitions of SSC boundaries, failure modes, and success criteria consistent with corresponding basic event definitions in Systems Analysis (SY-A5, SY-A7, SY-A8, SY-A10 through SY-A13 and SY-B4) for failure rates and common cause failure parameters, and ESTABLISH boundaries of unavailability events consistent with corresponding definitions in Systems Analysis (SY-A18).
NRC Resolution		
Status/Gap	There is no documentation defining SSC boundaries.	

Action to Close Gap	A document should be developed that describes the SSC boundaries. Once defined, a review should be performed to ensure that any generic data used is consistent with the defined SSC boundaries.
Perry Resolution	SSC boundaries are described in SM-000 General Assumptions. Specific conditions or differences from the general assumptions are described in the applicable system notebooks. Closing this gap did not affect the PRA model; this was completeness of documentation only.
Significance of Gap	B - Small Nonconservative

Supporting Rqmt	**Category I**	**Category II**
DA-C15	Data on recovery from loss of offsite power, loss of service water, etc. are rare on a plant-specific basis. If available, for each recovery, COLLECT the associated recovery time with the recovery time being the period from identification of the system or function failure until the system or function is returned to service.	Data on recovery from loss of offsite power, loss of service water, etc. are rare on a plant-specific basis. If available, for each recovery, COLLECT the associated recovery time with the recovery time being the period from identification of the system or function failure until the system or function is returned to service.
NRC Resolution		
Status/Gap	Data analysis did not collect and document the recovery time from the 2003 loss of offsite power event.	
Action to Close Gap	Collect and document the actual recovery time from the 2003 loss of offsite power event. Use the information to revise DB-005 if warranted.	
Perry Resolution	A convolution method was used to determine recovery parameters for LOOP transients and is documented in QU-001 Appendix E. The data from the 2003 LOOP recovery was included in the generic data used in the convolution.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	**Category I**	**Category II**
DA-C3	COLLECT plant-specific data, consistent with uniformity in design, operational practices, and experience. JUSTIFY the rationale for screening or disregarding plant-specific data (e.g., plant design modifications, changes in operating practices).	COLLECT plant-specific data, consistent with uniformity in design, operational practices, and experience. JUSTIFY the rationale for screening or disregarding plant-specific data (e.g., plant design modifications, changes in operating practices).
NRC Resolution		
Status/Gap	Component data is grouped at a high level but no discussion is provided of screening, etc.	
Action to Close Gap	Need process for screening, grouping, and demonstrate the application of the process. Assumes that no new data is needed.	
Perry Resolution	Grouping guidance was addressed in the Data Notebook (DB-016) in Section 3.2. with additional descriptions provided in 2.2, 2.3.2, and 2.4.1.1. The rationale for screening or disregarding plant specific events is provided in Section 2.3.1 and 2.4.1. Closing this gap did not affect the PRA model; this was completeness of documentation only.	

Supporting Rqmt	Category I	Category II
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	Category I	Category II
DA-D1	USE plant-specific parameter estimates for events modeling the unique design or operational features if available, or use generic information modified as discussed in DA-D2; USE generic information for the remaining events.	CALCULATE realistic parameter estimates for significant basic events based on relevant generic and plant-specific evidence unless it is justified that there are adequate plant-specific data to characterize the parameter value and its uncertainty. When it is necessary to combine evidence from generic and plant-specific data, USE a Bayes update process or equivalent statistical process that assigns appropriate weight to the statistical significance of the generic and plant-specific evidence and provides an appropriate characterization of uncertainty. CHOOSE prior distributions as either noninformative, or representative of variability in industry data. CALCULATE parameter estimates for the remaining events by using generic industry data.
NRC Resolution	CC II and III: ...USE a Bayes update process. CHOOSE...	
Status/Gap	Generic and plant-specific data is used, using a Bayes update process. The latest revision of DB-016 used a new generic database and updated some data using plant-specific data from Cycles 8, 9, and 10. However, not all basic events had their probabilities updated. Per RC-003, Revision 3, there are significant (i.e., RAW >= 2 and/or F-V >= 0.005) basic events which were not updated (e.g., Attachment 3, Item 48, EPFAFS1M39B0003 and Item 84, ECMPFS1P42C0001B). Thus, Cat II cannot be considered met.	
Action to Close Gap	Identify significant events. Update as appropriate. Consider this in conjunction with a data update.	
Perry Resolution	As part of the PRA model update, data was updated for all components in the model using either generic data or a Bayesian Update process. See Section 3.0 of the Data Notebook for a discussion of component codes.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	Category I	Category II
DA-D5	USE the Beta-factor approach (i.e., the screening approach in NUREG/CR-5485) or an equivalent for the estimation of CCF parameters.	USE one of the following models for estimating CCF parameters for significant CCF basic events: (a) Alpha Factor Model (b) Basic Parameter Model

Supporting Rqmt	Category I	Category II
		(c) Multiple Greek Letter Model (d) Binomial Failure Rate Model JUSTIFY the use of alternative methods (i.e., provide evidence of peer review or verification of the method that demonstrates its acceptability).
NRC Resolution		
Status/Gap	The Alpha Factor method is used to conduct the CCF analysis. There is at least one exception to this, the IA/SA compressor common cause is a single event at the top of the fault tree (IACMCC). This appears to be a simplified ("beta") but there is not documentation on this event. (see SY-B4).	
Action to Close Gap	This SR is essentially Cat II except for the simplified item on IA/SA.	
Perry Resolution	In the PRA model update, the Multiple Greek Letter method was used to perform the Common Cause analysis for the model. See Section 3.1.4 of the Data Notebook for a discussion of the methodology used in Common Cause development.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	Category I	Category II
DA-A1	IDENTIFY from the systems analysis the basic events for which probabilities are required. Examples of basic events include: (a) independent or common cause failure of a component or system to start or change state on demand (b) independent or common cause failure of a component or system to continue operating or provide a required function for a defined time period (c) equipment unavailable to perform its required function due to being out of service for maintenance (d) equipment unavailable to perform its required function due to being in test mode (e) failure to recover a function or system (e.g., failure to recover offsite-power) (f) failure to repair a component, system, or function in a defined time period	IDENTIFY from the systems analysis the basic events for which probabilities are required. Examples of basic events include: (a) independent or common cause failure of a component or system to start or change state on demand (b) independent or common cause failure of a component or system to continue operating or provide a required function for a defined time period (c) equipment unavailable to perform its required function due to being out of service for maintenance (d) equipment unavailable to perform its required function due to being in test mode (e) failure to recover a function or system (e.g., failure to recover offsite-power) (f) failure to repair a component, system, or function in a defined time period
NRC Resolution		
Status/Gap	The data required to solve the model has been developed/updated. However, there appears to be no documentation linking the systems analysis to the data developed. The systems analyses do not present a list of components or basic events from which this could be obtained. The data analyses do not refer back to the systems analyses.	
Action to Close Gap	Each systems analysis should include a table of the data required for the fault tree mode. Additionally, specific sections should be added (as per PSAI-01) if not currently present to identify testing, maintenance, human actions, define common cause groups, etc.	

Perry Resolution	There is a Basic Event Description Report provided in each system notebook (Section 2.3.4) which provides the probability and description for each event which appears in that system's fault tree. Closing this gap did not affect the PRA model; this was completeness of documentation only.
Significance of Gap	D - Documentation Only

Supporting Rqmt	**Category I**	**Category II**
DA-B1	For parameter estimation, GROUP components according to type (e.g., motor-operated pump, air-operated valve).	For parameter estimation, GROUP components according to type (e.g., motor-operated pump, air-operated valve) and according to the characteristics of their usage to the extent supported by data: (a) mission type (e.g., standby, operating) (b) service condition (e.g., clean vs. untreated water, air)
NRC Resolution		
Status/Gap	Seventeen component groupings were used in the most recent data update documented in DB-16, Revision 3. However, no description of the basis for the groupings was provided. It does not appear that mission type or service condition was considered.	
Action to Close Gap	Develop grouping guidance and verify that the existing grouping is consistent.	
Perry Resolution	Grouping guidance was addressed in the Data Notebook (DB-016) in Section 3.2. with additional descriptions provided in 2.2, 2.3.2, and 2.4.1.1. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	**Category I**	**Category II**
DA-B2	DO NOT INCLUDE outliers in the definition of a group (e.g., do not group valves that are never tested and unlikely to be operated with those that are tested or otherwise manipulated frequently)	DO NOT INCLUDE outliers in the definition of a group (e.g., do not group valves that are never tested and unlikely to be operated with those that are tested or otherwise manipulated frequently)
NRC Resolution		
Status/Gap	No discussion was provided for differences in component operation. Therefore there was no information on outliers.	
Action to Close Gap	Search for outliers, document search and results.	
Perry Resolution	Search for outliers discussed in Section 3.2 of DB-016. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	**Category I**	**Category II**
DA-C1	OBTAIN generic parameter estimates from recognized sources. ENSURE that the parameter definitions and boundary conditions are consistent with those established in response to DA-A1 to DA-A3. [Example: some sources include the breaker within the pump	OBTAIN generic parameter estimates from recognized sources. ENSURE that the parameter definitions and boundary conditions are consistent with those established in response to DA-A1 to DA-A3. [Example: some sources include the breaker within the pump

Supporting Rqmt	Category I	Category II
	boundary, whereas others do not.] DO NOT INCLUDE generic data for unavailability due to test, maintenance, and repair unless it can be established that the data is consistent with the test and maintenance philosophies for the subject plant. Examples of parameter estimates and associated sources include: (a) component failure rates and probabilities: NUREG/CR-4639, NUREG/CR-4550 (b) common cause failures: NUREG/CR-5497, NUREG/CR-6268 (c) AC off-site power recovery: NUREG/CR-5496, NUREG/CR-5032 (d) component recovery	boundary, whereas others do not.] DO NOT INCLUDE generic data for unavailability due to test, maintenance, and repair unless it can be established that the data is consistent with the test and maintenance philosophies for the subject plant. Examples of parameter estimates and associated sources include: (a) component failure rates and probabilities: NUREG/CR-4639, NUREG/CR-4550 (b) common cause failures: NUREG/CR-5497, NUREG/CR-6268 (c) AC off-site power recovery: NUREG/CR-5496, NUREG/CR-5032 (d) component recovery
NRC Resolution	Examples of parameter estimates and associated sources include: (a) component failure rates and probabilities: NUREG/CR-4639 [Note (1)], NUREG/CR-4550 [Note (2)], NUREG-1715 [Note 7] ... See NUREG/CR-6823 [Note 8] for lists of additional data sources.	
Status/Gap	Common cause information source is good; the reference is to the CCF database (NUREG-6268). Generic data documentation does not lend itself to review of the sources. The PRM files contain references but the capability to verify that the generic data is all referenced is not feasible. The PRM files contain some overlap (some events are in more than one PRM file).	
Action to Close Gap	Document the sources of all events in the BED file. Use most recent generic data.	
Perry Resolution	BED file is no longer used following PRA model update to CAFTA software. Basic event data is discussed in Section 4.0 of the Data Notebook, DB-016. See Tables 1 through 6 of the Data Notebook. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
DA-C5	COUNT repeated plant-specific component failures occurring within a short time interval as a single failure if there is a single, repetitive problem that causes the failures. In addition, COUNT only one demand.	COUNT repeated plant-specific component failures occurring within a short time interval as a single failure if there is a single, repetitive problem that causes the failures. In addition, COUNT only one demand.
NRC Resolution		
Status/Gap	There is no mention of this condition in the documentation. There does not appear to be a case of not meeting this SR, but there is also no evidence that it is met.	
Action to Close Gap	Add a discussion of this process to DB-003 and PSAI-01.	
Perry Resolution	A discussion of the development of component failures is provided in section 2.4.1.2 of the Data Notebook, DB-016. Closing this gap did not affect the PRA model; this was completeness of documentation only.	

Significance of Gap	D - Documentation Only

Supporting Rqmt	Category I	Category II
DA-C8	When required, ESTIMATE the time that components were configured in their standby status.	When required, USE plant-specific operational records to determine the time that components were configured in their standby status.
NRC Resolution		
Status/Gap	DB-016 contains detailed plant specific run times and demands from plant records.	
Action to Close Gap	Add a discussion of this process to DB-003 and PSAI-01.	
Perry Resolution	Following PRA model update, the DB-003 and PSAI-01 documents are no longer used. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
DA-C9	ESTIMATE operational time from surveillance test practices for standby components, and from actual operational data.	ESTIMATE operational time from surveillance test practices for standby components, and from actual operational data.
NRC Resolution		
Status/Gap	SR Met. DB-016 contains detailed information on demands and run hours for plant equipment.	
Action to Close Gap	Add a discussion of this process to DB-003 and PSAI-01.	
Perry Resolution	See Section 2.4.1.2 of the Data Notebook for a discussion of operational exposure calculations. Following PRA model update, the DB-003 and PSAI-01 documents are no longer used. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
DA-C11	When using data on maintenance and testing durations to estimate unavailabilities at the component, train, or system level, as required by the system model, only INCLUDE those maintenance or test activities that could leave the component, train, or system unable to perform its function when demanded.	When using data on maintenance and testing durations to estimate unavailabilities at the component, train, or system level, as required by the system model, only INCLUDE those maintenance or test activities that could leave the component, train, or system unable to perform its function when demanded.
NRC Resolution		
Status/Gap	This SR is met. T&M durations are not estimated, but are based on collected maintenance rule unavailability data.	
Action to Close Gap	Add a discussion of this process to DB-003 and PSAI-01.	
Perry Resolution	See Section 2.4.2 of the Data Notebook for a discussion of the methodology for determination of unavailability time. Following PRA model update, the DB-003 and PSAI-01 documents are no longer used. Closing this gap did not affect the PRA model; this was completeness of documentation only.	

Supporting Rqmt	Category I	Category II
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
DA-C11a	When an unavailability of a front line system component is caused by an unavailability of a support system, COUNT the unavailability towards that of the support system and not the front line system, in order to avoid double counting and to capture the support system dependency properly.	When an unavailability of a front line system component is caused by an unavailability of a support system, COUNT the unavailability towards that of the support system and not the front line system, in order to avoid double counting and to capture the support system dependency properly.
NRC Resolution		
Status/Gap	SR Met, but the documentation does not discuss that this was done or how.	
Action to Close Gap	Add a discussion of this process to DB-003 and PSAI-01.	
Perry Resolution	See Section 2.4.2.2 of the Data Notebook for a discussion of the methodology used when calculating unavailability time. Following PRA model update, the DB-003 and PSAI-01 documents are no longer used. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
DA-D4	No requirement for use of Bayesian approach.	When the Bayesian approach is used to derive a distribution and mean value of a parameter, CHECK that the posterior distribution is reasonable given the relative weight of evidence provided by the prior and the plant-specific data. Examples of tests to ensure that the updating is accomplished correctly and that the generic parameter estimates are consistent with the plant-specific application include the following: (a) confirmation that the Bayesian updating does not produce a posterior distribution with a single bin histogram (b) examination of the cause of any unusual (e.g., multimodal) posterior distribution shapes (c) examination of inconsistencies between the prior distribution and the plant-specific evidence to confirm that they are appropriate (d) confirmation that the Bayesian updating algorithm provides meaningful results over the range of values being considered (e) confirmation of the reasonableness of the posterior distribution mean value

Supporting Rqmt	Category I	Category II
NRC Resolution		
Status/Gap	No reasonableness check was performed of the Bayesian update.	
Action to Close Gap	Perform the indicated reasonableness checks.	
Perry Resolution	See Section 3.1 of the Data Notebook for a discussion of reasonableness checks and consistency checks. Also, Section 5 discusses the comparison of the data to the previous revision of the model. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
DA-E1	DOCUMENT the data analysis in a manner that facilitates PRA applications, upgrades, and peer review.	DOCUMENT the data analysis in a manner that facilitates PRA applications, upgrades, and peer review.
NRC Resolution		
Status/Gap	The data calculations are not structured to facilitate review. Information is spread through multiple documents and some of the calculations do not agree with each other. The information in the model database does not match the information in the calculations.	
Action to Close Gap	Revise documents to remove inconsistencies. Consider revising documentation process to consolidate the documents.	
Perry Resolution	The Data Notebook (DB-016) contains all of the data information/values used in the PRA model. Additionally, documents NOBP-CC-6001 and NOPM-CC-6000 direct the configuration control for the PRA model to ensure inconsistencies are not induced in the PRA model documentation. The new Data Notebook consolidates the information which had previously been contained in 9 separate documents/calculations. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
DA-E2	DOCUMENT the processes used for data parameter definition, grouping, and collection including parameter selection and estimation, including the inputs, methods, and results. For example, this documentation typically includes: (a) system and component boundaries used to establish component failure probabilities (b) the model used to evaluate each basic event probability (c) sources for generic parameter estimates (d) the plant-specific sources of data (e) the time periods for which plant-specific data were gathered (f) justification for exclusion of any data	DOCUMENT the processes used for data parameter definition, grouping, and collection including parameter selection and estimation, including the inputs, methods, and results. For example, this documentation typically includes: (a) system and component boundaries used to establish component failure probabilities (b) the model used to evaluate each basic event probability (c) sources for generic parameter estimates (d) the plant-specific sources of data (e) the time periods for which plant-specific data were gathered (f) justification for exclusion of any data

Supporting Rqmt	Category I	Category II
	(g) the basis for the estimates of common cause failure probabilities, including justification for screening or mapping of generic and plant-specific data (h) the rationale for any distributions used as priors for Bayesian updates, where applicable (i) parameter estimate including the characterization of uncertainty, as appropriate	(g) the basis for the estimates of common cause failure probabilities, including justification for screening or mapping of generic and plant-specific data (h) the rationale for any distributions used as priors for Bayesian updates, where applicable (i) parameter estimate including the characterization of uncertainty, as appropriate
NRC Resolution		
Status/Gap	Not all suggested information is provided in sufficient detail. Some information does not agree between different documents.	
Action to Close Gap	Revise documents to remove inconsistencies. Consider revising documentation process to consolidate the documents.	
Perry Resolution	The Data Notebook (DB-016) contains all of the data information/values used in the PRA model. Additionally, documents NOBP-CC-6001 and NOPM-CC-6000 direct the configuration control for the PRA model to ensure inconsistencies are not induced in the PRA model documentation. The new Data Notebook consolidates the information which had previously been contained in 9 separate documents/calculations. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
DA-E3	DOCUMENT the key assumptions and key sources of uncertainty associated with the data analysis.	DOCUMENT the key assumptions and key sources of uncertainty associated with the data analysis.
NRC Resolution	DOCUMENT the assumptions and sources of uncertainty associated.... (i.e., delete the words "key")	
Status/Gap	See SR SC-C3	
Action to Close Gap		
Perry Resolution	Assumptions and uncertainties for the Data Analysis task are documented in Section 2.4, 3.1 and 5.0 of DB-016. The Quantification Notebook (QU-001) documents sources of uncertainty in the model as a whole in Sections 1.2, 3.2.6 and 4.0. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Gaps for Quantification Analysis

Supporting Rqmt	Category I	Category II
QU-C1	IDENTIFY cutsets with multiple HFEs that potentially impact significant accident sequences/cutsets by requantifying the PRA model with HEP values set to values that are sufficiently high that the cutsets are not truncated. The final quantification of these post-initiator HFEs may be done at the cutset level or saved sequence level.	IDENTIFY cutsets with multiple HFEs that potentially impact significant accident sequences/cutsets by requantifying the PRA model with HEP values set to values that are sufficiently high that the cutsets are not truncated. The final quantification of these post-initiator HFEs may be done at the cutset level or saved sequence level.
NRC Resolution		
Status/Gap	No evidence that this was done. No mention in either quantification or HRA calculations.	
Action to Close Gap	Identify cutsets with multiple HFE events and ensure that HEP values are sufficiently high that the cutsets are not truncated without consideration of the dependency between multiple HFE events.	
Perry Resolution	HRA dependency analysis was performed using EPRI's HRA Calculator and is documented in HI-001, Section 4.2.2. Cutsets with multiple HFEs were identified and the HEP values were set with a screening value to ensure that important cutsets were not truncated.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	Category I	Category II
QU-C2	ASSESS the degree of dependency between the HFEs in the cutset or sequence in accordance with HR-D5 and HR-G7.	ASSESS the degree of dependency between the HFEs in the cutset or sequence in accordance with HR-D5 and HR-G7.
NRC Resolution		
Status/Gap	No evidence that this was done. No mention in either quantification or HRA calculations.	
Action to Close Gap	Analyze the dependency between multiple HFE in the same cutset and determine the correct dependent HFE value to use.	
Perry Resolution	As part of the PRA model update, the HRA dependency analysis has been performed using HRA Calculator and is accounted for in the model using Recovery Rules. Reference Sections 1.1 and 3.3.5 and Appendix E of QU-001 and the HRA Notebook HI-001.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	Category I	Category II
QU-D4	REVIEW a sampling of nonsignificant accident cutsets or sequences to determine they are reasonable and have physical meaning.	REVIEW a sampling of nonsignificant accident cutsets or sequences to determine they are reasonable and have physical meaning.
NRC Resolution		
Status/Gap	No review was performed	

Action to Close Gap	Perform a review of a sample of nonsignificant cutset/sequences to determine reasonability.
Perry Resolution	Non-significant cutsets have been reviewed and are accurate, as discussed in Section 3.3.2. Non-significant sequences have been reviewed and are presented in Appendix B.
Significance of Gap	C - Conservative/Very Small

Supporting Rqmt	**Category I**	**Category II**
QU-D5b	REVIEW the importance of components and basic events to determine that they make logical sense.	REVIEW the importance of components and basic events to determine that they make logical sense.
NRC Resolution		
Status/Gap	No review was performed	
Action to Close Gap	Review the importance of SSCs and basic events to ensure they make logical sense.	
Perry Resolution	Significant cutsets have been reviewed and are accurate, as discussed in Section 3.3.1. Non-significant cutsets have been reviewed and are accurate, as discussed in Section 3.3.2. Importance data, have been reviewed and are logically sound, as discussed in Section 3.3.3.	
Significance of Gap	C - Conservative/Very Small	

Supporting Rqmt	**Category I**	**Category II**
QU-A2b	ESTIMATE the point estimate CDF from internal events.	ESTIMATE the mean CDF from internal events, accounting for the "state-of- knowledge" correlation between event probabilities when significant [Note (1)].
NRC Resolution	Cat II: ESTIMATE the mean CDF from internal events, accounting for the "state-of knowledge" correlation between event probabilities [phrase "when significant" deleted] (see NOTE 1). (RG 1.200 Rev 1)	
Status/Gap	An uncertainty analysis was performed and the results are included in RC-001, Attachment 1. The Mean CDF is provided on Page A1-1 It must be noted that RC-001 refers to SQ-001 R5 and is thus out of date. It represents the uncertainty analysis of the previous version of the Sequence Quantification documentation.	
Action to Close Gap	Update RC-001 to current PRA model.	
Perry Resolution	RC-001 was a Risk Contribution Notebook that discussed Uncertainty and Importance Analysis. Those analyses have been as part of the PRA model update, and RC-001 has been superseded by QU-001. Reference QU-001 Section 3.2.6 for Uncertainty Analysis and Sections 3.2.3 and 3.3.3 for Importance Analysis.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	**Category I**	**Category II**
QU-B1	PERFORM quantification using computer codes that have been demonstrated to generate appropriate results when compared to	PERFORM quantification using computer codes that have been demonstrated to generate appropriate results when compared to

	those from accepted algorithms. IDENTIFY method-specific limitations and features that could impact the results.	those from accepted algorithms. IDENTIFY method-specific limitations and features that could impact the results.
NRC Resolution		
Status/Gap	The quantification of the PNPP PRA was originally done using the WinNUPRA code which is developed to Appendix B standards. It is tested by the developer and compared with the output of other codes producing acceptable results. However, the method-specific limitations and features that could impact results are not specified. This is a documentation issue. The limitations of use of WinNUPRA need to be documented and understood by the user.	
Action to Close Gap	Document the limitations of the method used for quantification and the code features that could impact the results of the analysis.	
Perry Resolution	WinNUPRA method no longer used for linked fault tree quantification, the Perry PRA model is now a linked fault tree CAFTA model with no change in methodology. Both models were benchmarked before the CAFTA update to ensure consistent results. Code limitations are discussed in QU-001, Section 1.4. A notable limitation is the conservatism introduced during sequence quantification when the failure probability is on the order of 0.1 or larger. Truncation sensitivity discussed in QU-001, Section 3.3.4. The CAFTA model has been shown to converge.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	**Category I**	**Category II**
QU-B3	ESTABLISH truncation limits by an iterative process of demonstrating that the overall model results converge and that no significant accident sequences are inadvertently eliminated. For example, convergence can be considered sufficient when successive reductions in truncation value of one decade result in decreasing changes in CDF or LERF, and the final change is less than 5%.	ESTABLISH truncation limits by an iterative process of demonstrating that the overall model results converge and that no significant accident sequences are inadvertently eliminated. For example, convergence can be considered sufficient when successive reductions in truncation value of one decade result in decreasing changes in CDF or LERF, and the final change is less than 5%.
NRC Resolution		
Status/Gap	Convergence is demonstrated in SQ-001 R6. The process for performing convergence is not discussed so the documentation of the convergence does not include the quantification files used to perform the truncation limit-specific analyses.	
Action to Close Gap		
Perry Resolution	Convergence has been demonstrated and a truncation value has been found to be acceptable for applications. Truncation sensitivity discussed in QU-001, Section 3.3.4. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
QU-B7a	IDENTIFY cutsets (or sequences) containing mutually exclusive events in the results.	IDENTIFY cutsets (or sequences) containing mutually exclusive events in the results.
NRC Resolution		
Status/Gap	The quantification processing include the use of mutually exclusive combination event file for eliminating illogical cutsets No documentation of DAM file contents. Confusing discussion of DAM/DDAM files in SQ-001.	
Action to Close Gap		
Perry Resolution	As part of the PRA model update, the mutually exclusive (MEX) and disallowed maintenance (DAM) logic has been updated. MEX and DAM logic pertinent to individual systems are discussed in Section 2.3 of that system's notebook. The overall MEX and DAM logic is discussed in Appendix B of the quantification notebook, QU-001.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
QU-B7b	CORRECT cutsets containing mutually exclusive events by either: (a) developing logic to eliminate mutually exclusive situations; or (b) deleting cutsets containing mutually exclusive events.	CORRECT cutsets containing mutually exclusive events by either: (a) developing logic to eliminate mutually exclusive situations; or (b) deleting cutsets containing mutually exclusive events.
NRC Resolution		
Status/Gap	The MEX approach using the disallowed maintenance fault tree approach in WinNUPRA is to eliminate the cutsets containing the cutsets in the disallowed maintenance fault tree results. The DAM.lgc file must be documented. Currently, the disallowed maintenance combinations are not discussed in the documentation	
Action to Close Gap		
Perry Resolution	As part of the PRA model update, the mutually exclusive (MEX) and disallowed maintenance (DAM) logic has been updated. MEX and DAM logic pertinent to individual systems are discussed in Section 2.3 of that system's notebook. The overall MEX and DAM logic is discussed in Appendix B of the quantification notebook, QU-001.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
QU-B8	When using logic flags, SET logic flag events to either TRUE or FALSE (instead of setting the event probabilities to 1.0 or 0.0), as appropriate for each accident sequence, prior to the generation of cutsets.	When using logic flags, SET logic flag events to either TRUE or FALSE (instead of setting the event probabilities to 1.0 or 0.0), as appropriate for each accident sequence, prior to the generation of cutsets.

Supporting Rqmt	Category I	Category II
NRC Resolution		
Status/Gap	The house events that have value 1.0 are logical events but the house events having value 0.0 are not set to LOGICAL event type codes. This should not affect the results of the quantification but it prevents meeting this SR. Document the logic data files.	
Action to Close Gap	Change the bed files such that the ZEROs are also logical events.	
Perry Resolution	CAFTA requires flag events to be set to 1.0 to remain in the cutsets during quantification. During the application of the recovery rules, the flag events are set to TRUE and the cutsets are minimized to eliminate any non-minimal cutsets to generate the final set of cutsets. Reference Appendix E of QU-001 for discussion on Recovery Rules.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
QU-D1a	REVIEW a sample of the significant accident sequences/cutsets sufficient to determine that the logic of the cutset or sequence is correct.	REVIEW a sample of the significant accident sequences/cutsets sufficient to determine that the logic of the cutset or sequence is correct.
NRC Resolution		
Status/Gap	The top sequences/cutsets were identified, but there is no document review for appropriateness or validity.	
Action to Close Gap	Perform/document the review of the significant sequences/cutsets.	
Perry Resolution	Significant cutsets have been reviewed. This review is documented in the quantification notebook, QU-001, Section 3.3.1.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
QU-D1b	REVIEW the results of the PRA for modeling consistency (e.g., event sequence models consistency with systems models and success criteria) and operational consistency (e.g., plant configuration, procedures, and plant-specific and industry experience).	REVIEW the results of the PRA for modeling consistency (e.g., event sequence models consistency with systems models and success criteria) and operational consistency (e.g., plant configuration, procedures, and plant-specific and industry experience).
NRC Resolution		
Status/Gap	The quantification documents mention no review of this type.	
Action to Close Gap	Perform and document a review of the PRA results for modeling consistency.	
Perry Resolution	PRA results have been reviewed to verify model consistency. This review is documented in the quantification notebook, QU-001, Section 3.3. Closing this gap did not affect the PRA model; this was completeness of documentation only.	

Significance of Gap	D - Documentation Only

Supporting Rqmt	**Category I**	**Category II**
QU-D1c	REVIEW results to determine that the flag event settings, mutually exclusive event rules, and recovery rules yield logical results.	REVIEW results to determine that the flag event settings, mutually exclusive event rules, and recovery rules yield logical results.
NRC Resolution		
Status/Gap	The quantification documents mention no review of this type.	
Action to Close Gap	Perform and document a review of the PRA results for modeling consistency.	
Perry Resolution	PRA results have been reviewed to verify model consistency. This review is documented in the quantification notebook, QU-001, Section 3.3. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	**Category I**	**Category II**
QU-D3	No requirement to compare results to those from similar plants.	COMPARE results to those from similar plants and IDENTIFY causes for significant differences. For example: Why is LOCA a large contributor for one plant and not another?
NRC Resolution		
Status/Gap	No review to similar plants was performed.	
Action to Close Gap	Perform a review comparing the results to similar plants.	
Perry Resolution	A comparison of the results between the Perry PRA model and similar plants (Clinton, Grand Gulf) has been performed. This comparison, including causes of significant differences, is documented in the quantification notebook, QU-001, Section 3.3.6. Closing this gap did not affect the PRA model; this was completeness of documentation only.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	**Category I**	**Category II**
QU-E1	IDENTIFY key sources of model uncertainty.	IDENTIFY key sources of model uncertainty.
NRC Resolution	IDENTIFY [delete word "key"] sources of uncertainty. (RG 1.200 Rev 1)	
Status/Gap	Not identified. See SC-C3	
Action to Close Gap	Performing the assumption/uncertainty assessment described in Draft NUREG-1855 would accomplish this.	
Perry Resolution	Uncertainty is discussed in Sections 1.2 and 3.2.6, and discussed in detail in Section 4.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
QU-E2	IDENTIFY key assumptions made in the development of the PRA model.	IDENTIFY key assumptions made in the development of the PRA model.
NRC Resolution	IDENTIFY [delete word "key"] assumptions made in the development of the PRA model. (RG 1.200 Rev 1)	
Status/Gap	Not identified. See SC-C3	
Action to Close Gap	Performing the assumption/uncertainty assessment described in Draft NUREG-1855 would accomplish this.	
Perry Resolution	Uncertainty is discussed in Sections 1.2 and 3.2.6, and discussed in detail in Section 4.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
QU-E3	ESTIMATE the uncertainty interval of the overall CDF results. Provide a basis for the estimate consistent with the characterization of parameter uncertainties (DA-D3, HR-D6, HR-G9, IE-C13).	ESTIMATE the uncertainty interval of the overall CDF results. ESTIMATE the uncertainty intervals associated with parameter uncertainties (DA-D3, HR-D6, HR-G9, IE-C13), taking into account the "state-of-knowledge" correlation
NRC Resolution		
Status/Gap	An uncertainty analysis was performed using the PSACY10r0 model. This model is out of date, however, and the uncertainty analysis needs to be updated.	
Action to Close Gap	Update the uncertainty analysis to be consistent with the current model.	
Perry Resolution	Following the model update, an Uncertainty Analysis was performed, as documented in QU-001 Section 3.2.6.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
QU-E4	PROVIDE an assessment of the impact of the key model uncertainties on the results of the PRA.	EVALUATE the sensitivity of the results to key model uncertainties and key assumptions using sensitivity analyses [Note (1)].
NRC Resolution	Cat I: PROVIDE an assessment of the impact of the [delete word "key"] model uncertainties and assumptions on the results of the PRA. Cat II: EVALUATE the sensitivity of the results to [delete word "key"] model uncertainties.... Cat III: EVALUATE the sensitivity of the results to uncertain model boundary conditions and other [delete word "key"] assumptions using . . . (RG 1.200 Rev 1)	
Status/Gap	The uncertainties and assumptions are not identified and therefore not evaluated. Some sensitivities are documented in RC-002 but these need to be related to the modeling uncertainties and assumptions documented for the other PRA elements.	

Action to Close Gap	Identify the sensitivity analyses that are to be performed from the assumptions/areas of uncertainty assessment done in SC-C3. Develop sensitivity analyses and perform these analyses.
Perry Resolution	Sensitivity Analyses have been identified and are documented in QU-001 Section 4.
Significance of Gap	D - Documentation Only

Supporting Rqmt	**Category I**	**Category II**
QU-F1	DOCUMENT the model quantification in a manner that facilitates PRA applications, upgrades, and peer review.	DOCUMENT the model quantification in a manner that facilitates PRA applications, upgrades, and peer review.
NRC Resolution		
Status/Gap	The quantification is not documented in a manner that facilitates reviews. It is extremely difficult to find the latest complete quantification package. Calcs documenting an apparent complete quantification does not identify all the files needed for the quantification (e.g., fault tree files are named but the timestamp is not capture to indicate the specific files that are used, similarly OCL files, etc.). The calc process allows changes to be implemented without updating all related documentation (e.g., SQ-001R6 Addendum -01 corrects parameter file and recalculates CDF. This addendum states the documents that are impacted and indicates that a PRA model update is in progress and will be documented in the next rev of SQ-001. The addendum is dated Oct 2006 but the update has not been completed so the applications using the PRA are out of date.)	
Action to Close Gap	Update the documentation to completely document the model/files. Assure that the documentation is all consistent and that when changes are made they are propagated to the impacted documents and those documents are updated.	
Perry Resolution	As part of the PRA model update, the quantification SQ-001 and risk contribution notebooks RC-001 and RC-002 have been superseded by the new quantification notebook, QU-001. All documentation has been reviewed to verify accuracy, completeness, and consistency.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	**Category I**	**Category II**
QU-F3	DOCUMENT the significant contributors (such as initiating events, accident sequences, basic events) to CDF in the PRA results summary	DOCUMENT the significant contributors (such as initiating events, accident sequences, basic events) to CDF in the PRA results summary. PROVIDE a detailed description of significant accident sequences or functional failure groups.
NRC Resolution		
Status/Gap	There is no description of significant accident sequences (there is a listing, however). There are lists of several different sets of results but there is no assessment of those results to look for conclusions, etc. that may be available in this information. PDSs are defined in AS-002; the results are broken down by CM classes in SQ-001R6. However, there does not seem to be a use of this information in the level 2/LERF assessment.	
Action to Close Gap		

Perry Resolution	Initiating Event contribution to CDF is has been identified and is discussed in the Quantification Notebook. Section 3.2.1. Dominant accident sequences have been identified and are discussed in Section 3.2.2. Significant cutsets have been identified and are discussed in Section 3.2.3. Importance data, including equipment failures, common cause failures, and operator actions, have been identified and are discussed in Section 3.2.4. RC-001 has been superseded by QU-001.
Significance of Gap	D - Documentation Only

Supporting Rqmt	**Category I**	**Category II**
QU-D5a	IDENTIFY significant contributors to CDF, such as initiating events, accident sequences, equipment failures, common cause failures, and operator errors.	IDENTIFY significant contributors to CDF, such as initiating events, accident sequences, equipment failures, common cause failures, and operator errors. INCLUDE SSCs and operator actions that contribute to initiating event frequencies and event mitigation.
NRC Resolution		
Status/Gap	RC-001 identifies the top contributors. Since the operator actions and initiating events are included in the quantification, these are included in the importance assessment. However, calculations RC-001 and RC-002 were not updated for the latest version of the PRA model and quantification.	
Action to Close Gap		
Perry Resolution	Initiating Event contribution to CDF is has been identified and is discussed in the Quantification Notebook. Section 3.2.1. Dominant accident sequences have been identified and are discussed in Section 3.2.2. Significant cutsets have been identified and are discussed in Section 3.2.3. Importance data, including equipment failures, common cause failures, and operator actions, have been identified and are discussed in Section 3.2.4. RC-001 has been superseded by QU-001.	
Significance of Gap		

Supporting Rqmt	**Category I**	**Category II**
QU-F4	DOCUMENT key assumptions and key sources of uncertainty, such as: possible optimistic or conservative success criteria, suitability of the reliability data, possible modeling uncertainties (modeling limitations due to the method selected), degree of completeness in the selection of initiating events, possible spatial dependencies, etc.	DOCUMENT key assumptions and key sources of uncertainty, such as: possible optimistic or conservative success criteria, suitability of the reliability data, possible modeling uncertainties (modeling limitations due to the method selected), degree of completeness in the selection of initiating events, possible spatial dependencies, etc.
NRC Resolution	DOCUMENT the [delete word "key"] assumptions and [delete word "key"] sources of uncertainty associated with the quantification analysis. [delete phrase ", such as: possible optimistic or conservative success criteria, suitability of the reliability data, possible modeling uncertainties (modeling limitations due to the method selected), degree of completeness in the selection of initiating events, possible spatial dependencies, etc."] (RG 1.200 Rev 1)	
Status/Gap	Not done. See SC-C3	
Action to Close Gap	Performing the assumption/uncertainty assessment described in Draft NUREG-1855 would accomplish this.	

Perry Resolution	Uncertainty is discussed in Sections 1.2 and 3.2.6, and discussed in detail in Section 4.
Significance of Gap	D - Documentation Only

Supporting Rqmt	**Category I**	**Category II**
QU-F5	DOCUMENT limitations in the quantification process that would impact applications.	DOCUMENT limitations in the quantification process that would impact applications.
NRC Resolution		
Status/Gap	Not done.	
Action to Close Gap	Identify and document quantification process limitations. This is to assure that such limitations are understood, which will better demonstrate that use of the code is proper.	
Perry Resolution	Process and software limitations have been evaluated. A notable limitation is the conservatism introduced during sequence quantification when the failure probability is on the order of 0.1 or larger. Code limitations are discussed in QU-001, Section 1.4.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	**Category I**	**Category II**
QU-F2	DOCUMENT the model integration process, including any recovery analysis, and the results of the quantification including uncertainty and sensitivity analyses. For example, documentation typically includes (a) records of the process/results when adding non-recovery terms as part of the final quantification (b) records of the cutset review process (c) a general description of the quantification process including accounting for systems successes, the truncation values used, how recovery and post-initiator HFEs are applied (d) the process and results for establishing the truncation screening values for final quantification demonstrating that convergence towards a stable result was achieved (e) the total plant CDF and contributions from the different initiating events and accident classes (f) the accident sequences and their contributing cutsets (g) equipment or human actions that are the key factors in causing the accidents to be non-dominant (h) the results of all sensitivity studies (i) the uncertainty distribution for the total CDF (j) importance measure results	DOCUMENT the model integration process, including any recovery analysis, and the results of the quantification including uncertainty and sensitivity analyses. For example, documentation typically includes (a) records of the process/results when adding non-recovery terms as part of the final quantification (b) records of the cutset review process (c) a general description of the quantification process including accounting for systems successes, the truncation values used, how recovery and post-initiator HFEs are applied (d) the process and results for establishing the truncation screening values for final quantification demonstrating that convergence towards a stable result was achieved (e) the total plant CDF and contributions from the different initiating events and accident classes (f) the accident sequences and their contributing cutsets (g) equipment or human actions that are the key factors in causing the accidents to be non-dominant (h) the results of all sensitivity studies (i) the uncertainty distribution for the total CDF (j) importance measure results (k) a list of mutually exclusive events eliminated from the resulting cutsets and their bases for Elimination

Supporting Rqmt	Category I	Category II
	(k) a list of mutually exclusive events eliminated from the resulting cutsets and their bases for Elimination (l) asymmetries in quantitative modeling to provide application users the necessary understanding regarding why such asymmetries are present in the model (m) the process used to illustrate the computer code(s) used to perform the quantification will yield correct results process	(l) asymmetries in quantitative modeling to provide application users the necessary understanding regarding why such asymmetries are present in the model (m) the process used to illustrate the computer code(s) used to perform the quantification will yield correct results process
NRC Resolution	(g) equipment or human actions that are the key factors in causing the accidents sequences to be [delete term "non-dominant"] nonsignificant. (RG 1.200 Rev 1)	
Status/Gap	The quantification calc provides many of the exemplified documentation items. This calc discusses the quantification approach briefly and provides some assessment of the results. However, there are recommended items that are not included that would indicate better understanding of the model and results, such as discussion of cutset reviews, convergence, etc.	
Action to Close Gap		
Perry Resolution	The documentation of all of the individual pieces of the Quantification Analysis is contained in QU-001. This Quantification Notebook supersedes previous notebooks SQ-001, RC-001, and RC-002. QU-001 contains discussions/documentation of the recommended items required by the current PRA Standard.	
Significance of Gap		

Gaps for Maintenance and Update

Supporting Rqmt	Category I	Category II
MU-B3	PRA changes shall be performed consistent with the previously defined Supporting Requirements.	PRA changes shall be performed consistent with the previously defined Supporting Requirements.
NRC Resolution		
Status/Gap	Current process meets requirements. However, this is only implied and not stated specifically. The only guidance documents that exist are the PSAI series of documents. Until recently not all PRA staff were aware of their existence. The PSAI documents are in need of revision to fully meet the standard. The guidance of the existing PSAIs is not being followed. The requirements of NOP-CC-3002, Calculations, appears to not be followed. When a calculation is revised that provides input to another calculation, the referenced calculation is not being revised. The result of this is that a number of calculations are outdated and a number of calculations are in conflict.	
Action to Close Gap	Revise PYBP-DES-0003 to include a specific statement that the ASME Standard is to be used as guidance when modifying the PRA model. Revise the PSAI series documents to reflect implementation of SRs.	
Perry Resolution	NOPM-CC-6000 (PRA Program Manual) states that the PRA program shall be conducted in accordance with NRC Regulatory Guides and Consensus PRA Standards. Business Practice NOBP-CC-6001, requires the plant to maintain an Effective Reference Model, while all model updates and changes are incorporated into a “working model”, from which model updates will be made.	

Supporting Rqmt	Category I	Category II
Significance of Gap	A - Significantly Nonconservative	

Supporting Rqmt	Category I	Category II
MU-B1	Changes in PRA inputs or new information (as obtained per MU-A1 and MU-A2) shall be assessed and incorporated as appropriate in PRA maintenance activities (i.e., PRA update) or a PRA Upgrade.	Changes in PRA inputs or new information (as obtained per MU-A1 and MU-A2) shall be assessed and incorporated as appropriate in PRA maintenance activities (i.e., PRA update) or a PRA Upgrade.
NRC Resolution		
Status/Gap	Current process meets requirements. However the process does not appear to be being followed. Some parts of the PRA model are modified, but the other impacted calculations are not being updated. As an example, calculations RC-001 and RC-002 were not updated to incorporate the quantification of the latest model.	
Action to Close Gap	Incorporate changes in PRA-related information into the PRA model/documentation per SRs.	
Perry Resolution	A new fleet business practice, NOBP-CC-6001, has been approved which requires the plant to maintain an Effective Reference Model, while all model updates and changes are incorporated into a “working model”, from which model updates will be made.	
Significance of Gap	B - Small Nonconservative	

Supporting Rqmt	Category I	Category II
MU-B4	PRA Upgrades shall receive a peer review (in accordance with the requirements specified in Section 6 of the ASME PRA Standard) for those aspects of the PRA that have been upgraded. Refer to Section 2 of the ASME PRA Standard for the distinction of a PRA Upgrade versus PRA maintenance and update.	PRA Upgrades shall receive a peer review (in accordance with the requirements specified in Section 6 of the ASME PRA Standard) for those aspects of the PRA that have been upgraded. Refer to Section 2 of the ASME PRA Standard for the distinction of a PRA Upgrade versus PRA maintenance and update.
NRC Resolution		
Status/Gap	The current PRA configuration control documentation contains no information concerning peer review.	
Action to Close Gap	Incorporate guidance on when to seek peer review.	
Perry Resolution	PRA Program Manuals and Business Practices (NOPM-CC-6000, NOBP-CC-6001 and 6002) provide references to the PRA Standard and NRC Regulatory Guide 1.200 regarding the requirements to complete Peer Reviews.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	Category I	Category II
MU-C1	The PRA configuration control process shall consider the cumulative impact of pending changes in the performance of risk applications.	The PRA configuration control process shall consider the cumulative impact of pending changes in the performance of risk applications.

NRC Resolution	
Status/Gap	Current process meets requirements. However, some direction on how this is to be accomplished should be added to PYBP-DES-0003.
Action to Close Gap	Add some specific direction on how to assess the impact of pending changes to the PRA.
Perry Resolution	The PRA model and PRA applications are controlled in accordance with NOBP-CC-6001 and NOBP-CC-6002. These Business Practices direct the requirement to assess changes to PRA applications based on updates to the PRA model and that the applications be based on the current "Effective Reference Model". Additionally, the NOBPs direct that the PRA applications be updated based on the specific interval required by that application.
Significance of Gap	D - Documentation Only

Supporting Rqmt	**Category I**	**Category II**
MU-D1	The PRA configuration control process shall include evaluation of the impact of changes on previously implemented risk-informed decisions that have used the PRA AND that affect the safe operation of the plant.	The PRA configuration control process shall include evaluation of the impact of changes on previously implemented risk-informed decisions that have used the PRA AND that affect the safe operation of the plant.
NRC Resolution		
Status/Gap	Current process meets requirements. However, some direction on how this is to be accomplished should be added to PYBP-DES-0003.	
Action to Close Gap	Add some specific direction on how to assess the changes to the PRA on previous applications.	
	The PRA model and PRA applications are controlled in accordance with NOBP-CC-6001 and NOBP-CC-6002. These Business Practices direct the requirement to assess changes to PRA applications based on updates to the PRA model and that the applications be based on the current "Effective Reference Model". Additionally, the NOBPs direct that the PRA applications be updated based on the specific interval required by that application.	
Significance of Gap	D - Documentation Only	

Supporting Rqmt	**Category I**	**Category II**
MU-E1	The PRA configuration control process shall include a process for maintaining control of computer codes used to support PRA quantification.	The PRA configuration control process shall include a process for maintaining control of computer codes used to support PRA quantification.
NRC Resolution		
Status/Gap	Current process meets requirements.	
Action to Close Gap	Add reference to the FENOC Usable Software List.	
Perry Resolution	NOPM-CC-6000 states that all PRA software and computers used in the PRA program shall be controlled in accordance with the company's program for computer related activities (NOP-SS-1001).	

Significance of Gap	D - Documentation Only

Supporting Rqmt	Category I	Category II
MU-F1	The PRA configuration control process shall be documented. Documentation typically includes: (a) Description of the process used to monitor PRA inputs and collect new information (b) Evidence that the aforementioned process is active (c) Descriptions of proposed changes (d) Descriptions of changes in PRA due to each Update or Upgrade (e) Record of the performance and result of the appropriate PRA reviews (f) Record of the process and results used to address the cumulative impact of pending changes (g) Record of the process and results used to evaluate changes on previously implemented risk-informed decisions (pursuant to MU-D1) (h) Description of the process used to maintain software configuration control.	The PRA configuration control process shall be documented. Documentation typically includes: (a) Description of the process used to monitor PRA inputs and collect new information (b) Evidence that the aforementioned process is active (c) Descriptions of proposed changes (d) Descriptions of changes in PRA due to each Update or Upgrade (e) Record of the performance and result of the appropriate PRA reviews (f) Record of the process and results used to address the cumulative impact of pending changes (g) Record of the process and results used to evaluate changes on previously implemented risk-informed decisions (pursuant to MU-D1) (h) Description of the process used to maintain software configuration control.
NRC Resolution	ISSUE: It is unclear what is to be documented from the peer review. RESOLUTION: (e) record of the performance and results of the appropriate PRA reviews (consistent with the requirements of Section 6.6).	
Status/Gap	Current process meets requirements. However, improvements in detail are warranted.	
Action to Close Gap	Add more detail to areas identified in previous SRs.	
Perry Resolution	NOPM-CC-6000 (PRA Program Manual provides direction on how to manage the PRA Program and maintain proper documentation. This Program Manual also references Business Practices NOBP-CC-6001 and 6002 which provide further detail into PRA model and application management.	
Significance of Gap	D - Documentation Only	