Fermi2LRANPEm Resource

From: Perkins, Leslie
Sent: Wednesday, September 03, 2014 7:58 AM
To: Lynne S Goodman (goodmanl@dteenergy.com); Randall D Westmoreland (westmorelandr@dteenergy.com)
Subject: Draft SAMA audit needs list
Attachments: Draft SAMA Audit needs lists.docx

Importance: High

Lynne,

Attached is the draft SAMA audit needs list. Also below is the proposed schedule for the SAMA audit that the staff provided. Please confirm if you can support this schedule as soon as you can. The SAMA review team is trying to finalize their travel plans.

<u>Monday</u>
9:00 am Greeting, introductions, logistics.
9:30 am Review of Level 1 PRA questions/responses.
11:30 am Lunch Break
12:30 pm Finish Level 1 discussion and Review of Level 2 questions/responses.
5:00 pm Adjourn

<u>Tuesday</u>
8:30 am Finish Level 2 discussion and review of Level 3 questions/responses.
10:30 Review of External Events questions/responses.
11:30 am Lunch Break
12:30 pm Review of SAMA identification and screening questions/responses.
5:00 pm Adjourn

<u>Wednesday</u>
8:30 am Review of SAMA cost-benefit questions/responses.
12:00 am Audit wrap up
12:30 Adjourn

Please let me know if you have any questions

Thanks
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Fermi 2 Nuclear Station

Environmental Site Audit Needs List
Severe Accident Mitigation Alternatives (SAMA)

<u>Provide copies of the following documents for the NRC staff to Review:</u>

1. Documentation of the expert panel review of the human reliability analysis (HRA) dependency analysis cited on page D-74 of the ER.

2. The 2012 Peer Review Report

3. Documentation described in the resolution of Peer Review Item 4-16: "The Quantification Notebook was revised to reference the comparison of the results from a similar plant included in the Uncertainty Analysis Notebook and to explicitly discuss the significant differences."

4. Documentation associated with other reviews of Level 1, 2, and 3 PRAs for Fermi 2.

5. List of Phase I SAMA candidates including the source and disposition of each.

6. Documentation of core damage frequency (CDF) and release category frequency for each Phase II SAMA.

7. Supporting documentation for the core inventory calculation.

8. WinMACCS calculation documentation.

9. ER Reference D.1-31 "Fermi 2 Nuclear Power Station – Preparation of Input for Ex-Plant Consequence Analysis MAAP to MACCS2 Interface Notebook."

<u>SAMA Audit Questions:</u>

1. Level 1 PRA

   a. The ER states that "No other planned major plant modifications, which could adversely impact the SAMA analysis results, have been identified." Confirm that this applies to all planned modifications, major or not, and to changes in operating practices/procedures.

   b. Describe any credit being taken in the FermiV9 PRA for B.5.b mitigating strategies.

   c. Relative to Table D.1-1:

      i. Provide a more detailed listing of the initiating events contribution to the internal events CDF (down to some reasonable contribution such as 1 or 2 percent). Include the breakdown of loss of coolant accidents (LOCAs) by size and/or cause and the various contributors to the general transients and special Initiator groups.

ii. Clarify what is meant by the term, "(without LOSP)" for the general transients descriptions. Are consequential losses of offsite power (LOSPs) modeled and not included in this value?

iii. It is noted that the station blackout (SBO) CDF frequency is relatively large compared to the total and partial loss of offsite power CDF contributions (40 percent of the total LOSP and 27 percent of the combined total and partial LOSP). Discuss briefly the modeling of the LOSP and SBO scenarios including how the combustion turbine generators are incorporated in the model and if common cause loss of alternating current due to weather is considered.

d. The Fermi 2 internal events CDF is considerably lower than those for other BWR 3/4 units. A comparison of CDFs was to have been made in the resolution of the PRA Peer Review (Item 4-16). Provide a discussion of the Fermi 2 CDF in comparison with other similar units and the reasons for any significant differences.

e. Sections D.1.4.3 and D.1.4.4 of the ER list the same model changes from the FermiV2 model for the FermiV3 and FermiV4 models. The CDF for FermiV3 and FermiV4 models are different (3.3E-06 and 5.8E-06, respectively). Clarify the extent to which this difference arises from the FermiV3 model being developed for the EOOS software versus the FermiV4 model being developed for the CAFTA software. Characterize the unavailabilities due to testing and maintenance included in each model.

f. Section D.1.4.8 of the ER indicates that one of the reasons that the FermiV9 CDF is lower than previous revisions is the update of Level 1 and Level 2 dependent human error probabilities. On ER page D-74, an expert panel review of the HRA dependency analysis was discussed. Specify the latest update and its relationship to the HRA dependency analysis reviewed by the expert panel.

g. Page D-73 of the ER states that the Fermi 2 BWROG PRA Peer Review was performed during August 2012. The PRA used for the SAMA analysis is FermiV9 issued in March 2013 (ER page D-8). This version is described as a complete upgrade of the previous model (ER page D-72). While the changes made in the FermiV8 model, to produce the FermiV9 model, may or may not be "upgrades" as defined in the ASME PRA standard, the changes appear to be extensive and cover almost all Level 1 and 2 PRA tasks. Provide further justification for the technical adequacy of the FermiV9 model including the applicability of the peer review to the upgraded model for both Levels 1 and 2. If the peer review was performed on a draft version of the FermiV9 model, provide the results of the draft and identify changes to the draft to produce the model used for the SAMA analysis.

h. Discuss the relevance of the resolution of the peer review findings on internal flooding to the FermiV9 model when the FermiV9 model flooding upgrades are significant such as: "An extensive re-evaluation of the Internal Flooding

Analysis was performed that included initiators, accident sequences, spray effects, HRA, and consequential failures."

i. For the peer review findings discussed in Table D.1-21 of the ER:

   i. The resolution of Item 3-26 is a repeat of the finding. Provide the resolution of this item.

   ii. For Item 4-23, confirm that there are no floor drains from one flood zone to another that have check valves but no sump pump.

2. Level 2 model PRA

   a. The ER states that FermiV9 upgrade included the conversion of the RISKMAN-based CAFTA Level 2 to an upgraded CAFTA Level 2 model (based on first principles). Provide more detail on the extent of use of the RISKMAN individual plant examination (IPE) Level 2 model in the current model and on subsequent changes to the RISKMAN IPE model.

   b. Provide more information on the containment event trees (CETs) utilized in the Level 2 analysis including the number of CETs, the sequences handled by each CET, and how LOSP and SBO sequences are addressed.

   c. Relative to the CET functional nodes and descriptions presented in Table D.1-4:

      i. Discuss the treatment of containment isolation failure sequences and if subsequent early containment failure is modeled.

      ii. Discuss the treatment of, and the nature of, credit taken for containment sprays in the Level 2 model.

   d. Relative to the definition of accident classes provided in Table D.1-8 of the ER, the accident subclasses for Class IV appear to be combined and subsequently modeled as a single class having a frequency that is 13.3 percent of the total CDF. Provide more information supporting this treatment and the meaning of "(not used)" in the class definitions.

   e. Page D-56 of the ER describes a situation in which the release category frequency used in the SAMA analysis is less than that in the Fermi PRA documentation. This is described as due to addressing "an issue with under counting of Class II contribution" in the PRA. It is also noted that the release category frequencies given in the ER are different from those given in the supporting Reference D.1-31 "Fermi 2 Nuclear Power Station – Preparation of Input for Ex-Plant Consequence Analysis MAAP to MACCS2 Interface Notebook." Explain the cause of this "undercounting" and its potential impact on the SAMA analysis and the reasons for the differences between the release category frequencies given in the ER and the cited supporting document.

f. Describe the basis for determining the release category for each of the CET end points without the need for MAAP analysis for each of the CET end points.

g. Provide a discussion of the representative accident scenarios used for the determination of the release characteristics for each of the release categories including:

    i. A description of each scenario

    ii. Bases for the selection of the representative scenarios

    iii. Steps taken to insure that the benefit of a SAMA is not underestimated, particularly for scenarios impacted by the SAMA that may not have the dominant frequency but may have a significantly larger consequence than that for the representative scenario. See for example, the situation that might occur if a SAMA impacted the High Early (H/E) release category scenario represented by MAPP case EF120521 with a CsI release fraction of 0.72 (see ER Reference D.1-31 "Fermi 2 Nuclear Power Station – Preparation of Input for Ex-Plant Consequence Analysis MAAP to MACCS2 Interface Notebook") which is modeled in the ER using MAAP case EF120520 with a CsI release fraction of 0.24.

h. Provide the duration of the MAAP analysis for each release category and provide an assessment of the adequacy of the time to characterize the releases over the full accident duration.

i. Clarify whether plant-specific fission product masses of the relevant fission product elements were used in the MAAP 4.0.7 analyses instead of the isotopic activity of those elements recommended by the MAAP Users Group.

j. Specify the design basis leakage for containment and compare that leakage rate to the release fractions for the containment intact release category.

3. External Events

    a. The Fermi 2 license renewal application (LRA) utilizes a seismic CDF from the Generic Issue (GI) 199 assessment in developing the external events multiplier used in the SAMA analysis. In response to NRC requests following the accident at the Fukushima Daiichi Nuclear Power Plant, new seismic hazard curves have been developed for each nuclear power plant site. Based on this information, EPRI has produced updates to the GI-199 seismic CDFs. Discuss the impact of using the updated Fermi 2 seismic CDF on the Fermi 2 SAMA analysis.

    b. As noted in the NRC staff's evaluation report on the individual plant examination of external events (IPEEE), and as can be seen in the IPEEE (Tables 4-6 and 4-13), there is a 1.5E-05/year CDF from the remaining areas screened (with CDFs less than 1E-06/year) that was subjected to the same

detailed analysis as the unscreened areas. Because this 1.5E-05/year CDF was not included in the 2.15E-05/year CDF from the unscreened fire areas, provide justification for not including it in the SAMA analysis and/or assess the impact on the SAMA cost-benefit evaluation.

4. Level 3 Consequence Analysis

   a. Section D.1.5.2.3 of the ER indicates that a watershed index of 1 (drained by rivers) was used for all spatial elements for conservatism. Explain why drainage by rivers is conservative compared to drainage by large water bodies.

   b. The offsite economic cost risk calculation includes an assumption that all crops exposed to radiation are destroyed.

      i. Specify the distances from the point of release that apply to this assumption.

      ii. Clarify if the assumption includes destroying crops grown in contaminated soil in the years following the radioactive release and/or crops not grown in contaminated soils.

   c. Specify the dollar-to-hectare values and data sources used for farm and nonfarm land in the analysis.

   d. For each assessed year, indicate the percentage of missing meteorological data replaced with data substitution.

   e. Explain how precipitation events were modeled in the analysis.

   f. Estimate the sensitivity of the Level 3 results to the plume heat of 10 MW.

   g. Explain how the network wide evacuation speed was computed and how it factored into the total time estimated for evacuation. Indicate if this evacuation speed or time reflects radial distance traveled and if population weighting was included.

   h. Specify software codes and the versions used for calculating the core inventory.

   i. Provide rationale for the selection of radionuclides listed in the core inventory. For example, radioisotopes for cobalt are not included in Table D.1-23.

   j. Confirm if any changes in future fuel management practices or fuel design are planned or being considered that would influence the core inventory.

   k. Specify the thermal power level for the core inventory shown in Table D.1-23. Indicate if changes to this thermal power are anticipated.

5. Selection and Screening of Phase I SAMAs

   a. Relative to Table D.1-2 of the ER:

      i. For basic event %TX (p. D-10), "Turbine trip with bypass initiating event," SAMA 018 regarding the upgrade to the UPS system to make the 120V I&C system more reliable is identified to reduce the likelihood of the event. The probability (frequency) is given as 0.87 per year indicating that Fermi 2 has had some of these events in its 26 years of operation. Does this experience indicate other mitigating actions?

      ii. SAMA 034, regarding the upgrade to the automatic depressurization system (ADS) to improve reliability, is identified for basic event HE1FRXPCHWML (p. D-11) "Operator fails to depr (Medium Water LOCA)." As shown in Table D.2-1, this SAMA does not impact this basic event because the ADS function is bypassed by the emergency procedure guidelines. Provide justification for the appropriateness of this SAMA or identify mitigation alternatives that address this basic event.

      iii. SAMA 001, regarding the addition of direct current power supplies, is identified to mitigate event BTTSEDCSCC33_1 (p. D-11) "CC GROUP DC BATTERY FAILS DURING OPERATION 2A, 2B, 2C" and others. This is not a Phase II SAMA, as it was screened out on the basis of being already implemented per DTE addressing NRC Order 12-049 requirements with a FLEX portable, direct current generator. Confirm that the generator is large enough to carry direct current loads without relying on batteries. Consider other potential cost-beneficial SAMAs, such as increasing the size of the FLEX generator to carry direct current loads or the use of fuel cells.

      iv. Event HE1FRXPCHEOD11 (p. D-12) "Operator fails to depressurize for LP injection (ATWS)" is said to be addressed by SAMA 115 on a revision of the procedures to control vessel injection to prevent boron loss or dilution following standby liquid control system injection. This SAMA does not appear to address the basic event. Provide justification for the appropriateness of this SAMA or identify mitigation alternatives that address the basic event. If SAMA 115 procedure revision will impact the depressurization event, consider its inclusion in the benefit evaluation.

v. For event HE1FUHS1AC001 (p. D-13) “Operators manually start MDCT fan,” consider a SAMA to automate the starting of the mechanical draft cooling tower (MDCT) fan, unless the design already includes automatic starting. Since the human error probability for failure to start the fan is a low value of 1.5E-04, explain if the fan itself should be in the importance list.

vi. For event HE1FSLCSHEBI2E (p. D-13) “Operator fails to initiate SLCS early,” consider a SAMA to automate the injection of boron from the SLCS.

vii. SAMA 129 is cited in the disposition of event %FL-TB-MCWS-TBXX-M (p. D-14) “Major rupture in Circulating Water pipe or expansion joints in Turbine Building” and others. This SAMA is apparently addressed through the External Surfaces Monitoring Program for external degradation and the Internal Surfaces Miscellaneous Piping and Ducting Components Program for internal degradation. Clarify if this is an existing program and if the benefit of this program is incorporated in the current Fermi 2 PRA. Identify other actions that might be taken to mitigate this flood event.

viii. SAMA 009 to reduce the DC dependence between high pressure injection and ADS is cited to mitigate event TPFSHPCIC001A for “failure of the turbine-driven high pressure coolant injection pump to start” (p. D-18). Explain how this SAMA mitigates the event because common cause failure of direct current would not be included in this event. Include other potential SAMAs that might be applicable in the discussion.

ix. SAMA 101 for “improving leak detection procedures” is cited for a number of events (e.g., %FL-AB-FPRO-RELAY-N) in Tables D.1-2 and D.1-5. This SAMA is not included as a Phase II SAMA in the cost benefit evaluation in Section D.2.3. Clarify if this treatment is because of the currently in progress implementation of a risk informed in-service inspection program based on ASME Code Case N-716, which explicitly addresses internal flooding initiators for inclusion in the in-service inspection program. Because internal flooding is a significant contributor to the CDF, discuss the impact of the risk-informed in-service inspection program on this contribution and the potential that other mitigating actions might be cost beneficial.

x. Discuss the potential for a flood barrier to prevent flood propagation to adjacent flood areas through openings and/or failed flood doors for flood events such as %FL-AB-FPRO-RELAY-N “Nominal rupture in FPS line in AB propagating to Relay Room,” %FL-TB-MCWS-TBXX-M “Major rupture in Circulating Water pipe or expansion joints in Turbine Building,” and %FL-AB-ECW2-B20XX-N, “Nominal rupture in RBCCW/EECW Div 2 line in DC Switchgear Room.”

xi. The DTE response to EA-12-050, which is stated to include measures that would increase the likelihood of successful containment venting to prevent containment overpressure, is cited in the disposition of event CPFFRBLDFAILDUCTL1 “COND. PROB. THAT ADVERSE ENVIRONMENT FAILS EQUIPMENT IN RB BASEMENT (LEVEL 1)” (p. D-28). Describe the specifics of this response that would impact this basic event.

b. ER Section D.2.1 indicates that documentation for eleven previous industry SAMA analyses was reviewed to identify potential SAMA candidates. Discuss how SAMAs from these sources were selected for incorporation into the Fermi 2 Phase I SAMA identification.

c. Relative to the Phase I screening of candidate SAMAs as documented in Table 1 of DTE011-CALC-003:

i. Phase I SAMA 042 to revise procedures to align emergency diesel generators and allow use of the essential control rod drive (CRD) system for vessel injection was screened out as already implemented. The basis is given that “SAG-1 provides guidance to use the CRD (23.106) as one of the Group 1 sources of RPV injection.” Is the CRD normally powered from an emergency bus and if not is guidance available to align it to an emergency diesel generator?

ii. Phase I SAMA 066 to create the ability to switch high pressure coolant injection (HPCI) and reactor core isolation cooling (RCIC) room fan power supply to direct current in an SBO event, was screened out as already implemented. The basis is indicated to be that procedures exist for defeating the HPCI and RCIC high area temperature isolations. While this may allow the HPCI or RCIC to run longer in an SBO, provide further justification that the intent of this SAMA is met.

iii. Phase I SAMA 069 to add a switchgear room high temperature alarm was screened out as already implemented. The basis is given that the “Rooms are equipped with Room Ambient Temperature Controllers.” If high room temperature is not alarmed in the control room, consider such an alarm.

iv. Phase I SAMA 086 to install a filtered containment vent to remove decay heat was combined with SAMA 123 for an anticipated transient without scram (ATWS) sized filtered containment vent. Because a filtered vent to remove decay heat is considerably smaller than that required for an ATWS event, the evaluation of SAMA 123 does not appear to be valid for SAMA 086. Provide an evaluation of SAMA 086.

v. Phase I SAMA 105 to install additional pressure or leak monitoring instruments for detection of interfacing systems loss of coolant accidents (ISLOCAs) was screened out as already implemented, by citing the existing Reactor Coolant Pressure Boundary Leak Detection

System. It is not clear that this system is effective in detecting ISLOCAs. Provide further justification to support screening out this SAMA or consider additional instrumentation that would be effective in detecting potential ISLOCA situations.

vi. Phase I SAMA 109 to install self-actuating containment isolation valves was screened out as already implemented. The disposition describes the containment isolation system in general. Discuss the applicability of the SAMA to the drywell floor drain and equipment sumps.

vii. Several Phase I SAMAs (SAMAs 138, 139 and 140) address fire risk, and Phase I SAMA182 addresses the internal flooding risk by enhancing or improving procedures or awareness. These SAMAs were screened out as already implemented based on existing Fermi procedures, training, or capability. Provide support for not considering improvements to the existing procedures and/or training to mitigate these risks for these SAMAs.

viii. Phase I SAMA 220 to add a seismic event to operator simulator training was screened out as already implemented based on the results of the seismic walkdown required by the 50.54f letter. Confirm that a seismic event has been incorporated in simulator training or provide further justification that the intent of this SAMA has been met.

6. Cost-benefit analysis and site-specific cost estimates

   a. Identify what is included and what is not included in the Fermi 2 specific cost estimates including such things as contingency, replacement power, lifetime maintenance, etc.

   b. For SAMA 012 to improve the 4.16-kV cross-tie ability, describe the existing Fermi 2 cross-tie capability, what the SAMA involves, and how it compares to the cited source for the cost estimate.

   c. For SAMA 023 on developing procedures to repair or replace failed 4 kV breakers, the benefit is estimated by eliminating failure of the operator to cross tie non-emergency buses, failure to recover AC power from plant and switchyard-centered events, as well as failure during operation of non-emergency 4.16-kV buses. Are there other 4-kV breaker failures that can be mitigated by this SAMA?

   d. For SAMA 024 on emphasis of steps for recovery of off-site power following a station blackout through training, explain what “Level 1 events” refers to in “... Level 1 events (i.e., 30 minute, 4 hour and 12 hour recovery)” and what “common failure” refers to in “The common failure to respond to SBO was also eliminated.”

   e. The title of SAMA 031, revise procedures to allow intermittent operations of HPCI and RCIC, is not consistent with the intent of the SAMA. SAMA 031 indicated to be the elimination of intermittent operation of high pressure

coolant injection (HPCI)/reactor core isolation cooling (RCIC) by allowing flow to be throttled thus preventing intermittent starts and stops. Clarify the SAMA description and intent.

f. For SAMA 074 to improve pneumatic components of safety relief valves (SRVs) and main steam isolation valves (MSIVs), explain how eliminating the air dependency of these valves models improvement of the reliability of SRVs and MSIVs.

g. Provide further information and justification for the modeling of the benefit of SAMA 078 to enable flooding of the drywell head seal including the expected containment failure location(s) and why only Class II and IV large rupture sequences were considered. Explain why the benefit is so small considering that Class IV (anticipated transients without scram sequences) would be expected to make up a significant part of release category H/E, which is the major contributor to risk.

h. For SAMA 154 to modify procedures to allow switching of the combustion turbines to buses while running, explain how eliminating all failures during operation of the combustion turbine generators (CTGs), including the startup diesel generator and failures of the CTG transformers during operation, relates to the impact of the SAMA.

i. SAMAs 165 and 166 both address mitigating the failure of emergency core cooling system low pressure permissiveswith a stated order-of-magnitude improvement by operator action to bypass the low pressure permissives (p. D-121). With an associated CDF reduction of 3 percent, explain why the human error probability for this operator action does not appear in the Level 1 importance list.

j. The cost for SAMA 176 to develop a procedure to open the door to the emergency diesel generator buildings upon the high temperature alarm is given as $200,000 based on a Sequoyah estimate. Because this cost exceeds other typical procedure implementation costs, identify the specific source of this estimate in the Sequoyah documentation and provide additional justification on its relevance to Fermi 2.

k. SAMAs 183 and 187 both involve improvements to the alternate shutdown panel. DTE assumed that this reduced the conditional core damage probability (CCDP) of operation from the alternate shutdown panel by a factor of 10. Table D.1-2 includes basic event HE1FRSP-CNTRL “Operators fail to shutdown from outside the main control room” (p. D-10), which is described as included in an internal flood scenario. Provide more information on how the benefit of these SAMAs was determined including the potential for impacting both fire risk and internal event risk.

l. Provide more information on how the benefit was determined for SAMAs mitigating internal fires (e.g., SAMAs 183, 187, and 206 through 211) including the determination of the change in fire CDF and how this was used to determine the cost risk benefit. The information should include:

i. The differing assumptions in the SAMAs concerning the reduction in CCDP due to the modifications ("... reduced to that for non-severe fires" versus "... being reduced by an order of magnitude").

ii. The specific source, values, and calculations used to determine the reduced fire CDF for at least one example SAMA.

iii. Exactly of how the cost risk benefit was obtained from the reduction in fire CDF.

m. The SAMA costs for fire-related SAMAs 207 through 211 are from two sources, "Fermi Estimate" and "Implementation Cost from Cooper." Explain the reasons that the costs differ significantly between the two sources.

n. SAMAs 213 and 214 both involve providing leak detection and automatic isolation valves for emergency equipment cooling water (EECW) piping in the direct current switchgear room or the Division 2 switchgear room, respectively. The benefit for each was indicated to be based on the assumption that a flood from the piping failure would not result in the failure of any electrical equipment in the switchgear room in which the flood occurred. These SAMAs were identified to mitigate important flooding events whose disposition in ER Table D.1-2 indicated that the flood would or could cause failures in adjacent electrical rooms. Confirm that the benefit assessment included the elimination of failures in the adjacent rooms.

7. Consider the following potentially lower cost or more effective alternative SAMAs:

a. For basic event HE1FRSP-CNTRL "Operators fail to shutdown from outside the main control room" (p. D-10), consider improvements to training for this specific event as opposed to SAMA 145, which is much broader in scope.

b. Discuss the potential for cost-beneficial SAMAs that include only leak detection as alternatives to SAMAs 213 and 214, both of which involve providing leak detection and automatic isolation valves for EECW piping. Leak detection might provide sufficient time for manual actions to isolate the flood source thereby limiting the failures due to flooding, particularly in adjacent rooms.