**REQUEST FOR ADDITIONAL INFORMATION
REGARDING THE ANALYSIS OF SEVERE ACCIDENT MITIGATION ALTERNATIVES
FOR PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2**

1. Provide the following information regarding the Probabilistic Risk Assessment (PRA) models used for the Severe Accident Mitigation Alternative (SAMA) analysis (for both units unless otherwise specified):

   a. Provide the core damage frequency (CDF) for each of the initiating event categories shown in Figures F.2-1 and F.2-2. (The percent contribution to CDF reported in these figures does not provide sufficient resolution).

   b. Provide the CDF for anticipated transient without scram (ATWS) and station blackout events.

   c. The Environmental Report (ER) notes several differences between Unit 1 and 2, including auxiliary feedwater (AFW) pump breaker control power, Unit 1 replacement steam generators (SGs), and improved Unit 1 sump design. Provide a complete summary of differences between the units with a discussion of the estimated impact of these differences on CDF and the release frequencies. Include the reasons for the difference in the emergency diesel generator common cause failure that was stated in Section F.2.1.2.4.

   d. In Section F.2.1.2.4 of the ER, the description of the changes made in PRA Revision 2.0 does not distinguish between changes made to the Unit 1 model to produce Unit 1, Revision 2.0, and changes to the Unit 1 model to develop the initial Unit 2 model (i.e., Unit 2, Revision 2.0). Provide a separate listing of each set of changes.

   e. The peer review of the PRA was performed in September 2000, several years prior to the development of the Unit 2 PRA. In this regard, provide a description of the quality controls, including any internal and external peer reviews, applied to the development of the Unit 2 PRA.

   f. The model changes identified in Section F.2.1.2 of the ER do not include changes to the reactor coolant pump seal loss-of-coolant accident (LOCA) model. Describe the current seal LOCA model, including the conditional seal LOCA probabilities used in the model.

   g. The discussion in Section F.2.2.2 of the ER notes that the Level 1 model used for the SAMA evaluation included one additional correction that had a slight impact on CDF, but does not describe this correction. Provide a description of this change and its impact on CDF.

   h. Provide the CDF and containment release characteristics for internal flood events, and a breakdown and summary of the top flood scenarios.

2. Provide the following information relative to the Level 2 PRA analysis:

    a. Describe the modeled risk benefit achieved from the removal of procedural guidance to operator initiation of containment spray recirculation as discussed in Section F.2.1.3.1.

    b. It appears that treatment of induced-steam generator tube rupture (SGTR) events was eliminated in Revision 1.0 of the Level 2 PRA (per ER Section F.2.1.3.1) but re-introduced in Revision 2.2 SAMA of the Level 2 PRA (per ER Sections F.2.3.1 and F.2.3.2). Clarify the evolution of the treatment of induced-SGTR events. Describe the approach to modeling pressure-induced and thermally-induced SGTRs in the version of the PRA used for the SAMA analyses, including the conditional tube rupture probability and the likelihood of a stuck open SG safety valve.

    c. State the version of the modular accident analysis program (MAAP) code used for the SAMA analysis, and the PRA version in which the MAAP cases were last updated.

3. Provide the following information regarding the treatment of external events in the SAMA analysis:

    a. Provide a summary of the dominant fire scenarios for the individual plant examination of external events (IPEEE) fire model in terms of overall fire frequency, plant initiator, and structures, systems, and components (SSCs) impacted. Demonstrate for each fire scenario that no viable SAMA candidates exist to reduce fire risk.

    b. ER Section F.5.1.8 indicates that the maximum averted cost-risk (MACR) for internal events was doubled to account for external events contributions. However, ER Section F.5.1.7.2 indicates that the IPEEE fire CDF is about 5E-5 per year, which is approximately five times the internal event CDF. (This value is stated as being conservative in part due to not crediting automatic and manual fire suppression.) Furthermore, in a July 21, 2006, request for additional information (RAI) response related to an extension of the containment integrated leakage rate test (ML062060033), Nuclear Management Company, LLC estimated the seismic CDF for Prairie Island Nuclear Generating Plant (PINGP) to be 7.82E-6 per year. Provide additional justification for use of a multiplier of 2 given that the fire CDF is approximately five times the current internal events CDF, that credit for automatic and manual fire suppression has been included for many of the dominant fire sequences, and that seismic and other external events also contribute to the total CDF.

    c. As stated in the IPEEE seismic analysis, several potential seismic outliers were dispositioned through an analysis process which determined that the impacted function was not required or could be recovered, or that an alternate means for performing the associated function was available. For those outliers identified in IPEEE Section A.2.4.1.2, where recovery or an alternate means is credited, demonstrate that enhancing the ruggedness of the associated components is not cost-beneficial. The outliers include: turbine-driven AFW pump trip and throttle valves (recovered), diesel generator fuel oil storage tanks 122 and 124 (alternative tanks available), the boric acid transfer pumps (alternate supply available), charging pumps 12 and 23 (alternative charging pumps available), panel 117 (alternate power normally available), cooling water pump 121 (alternate pumps available), condensate storage tanks 11, 12 and 13 (recovered through the use of alternate sources (e.g., cooling water)), component cooling water pressure switches (alternate start signal available), and diesel-driven cooling water pump pressure switches (alternative start signal available). For those outliers stated as being resolved through the closure of USI A-46 (IPEEE Section A.2.4.1.1), confirm that all corrective actions have been completed, and that their use is supported by procedures and training, as appropriate.

d. Discuss the results of the seismic IPEEE from the standpoint of potential SAMAs for the SSCs with the lowest seismic margins, and provide an assessment of whether any SAMAs to increase the seismic capacity of these limiting components would be cost beneficial (i.e., improvements to the component cool water heat exchanger anchorage).

4. ER Section F.3.5 indicates that the core radionuclide inventory used in the MACCS2 analysis is based on results of a plant-specific calculation assuming a core average exposure of 50,000 MWD/MTU, combined with core inventory information from MACCS2 Sample Problem A adjusted to account for the PINGP power level. Describe the plant specific calculation (which appears to be in addition to the calculation described in the updated safety analysis report (USAR)). Describe the purpose and development of the additional adjustment factor of 1.39 (based on differences between the PINGP USAR calculation and MACCS2 Sample Problem A values). Confirm that the resulting core inventory reflects the PINGP-specific fuel burnup/management as the plant is expected to be operated during the renewal period, including any planned fuel management changes (power uprates, extended burnup fuel, etc.).

5. Provide the following information with regard to the selection and screening of Phase I SAMA candidates:

   a. The top two events in the Level 1 importance listing (ER Table F.5-1a) involve failure of operator actions (Events OSLOCAXXCDY and OHRECIRCC2Y, with failure probabilities 1.9E-02 and 5.3E-02, respectively). Potential improvements to operator training are mentioned in the table, but dismissed on the basis that there is a great deal of uncertainty regarding the operator failure probability estimates. Despite the uncertainties, improvement to operator training would appear to be a potentially cost-beneficial SAMA given the high importance of these operator actions for both CDF and large early release frequency. In this regard provide the following: (1) a description of the current procedural guidance and training scope and frequency, (2) the bases for the human error probability values, including the role that timing, experience/training, and procedures play in determining these values, (3) a characterization of the uncertainty associated with these actions and discussion of why their uncertainty may be greater than other events in the PRA, and (4) an evaluation of the costs and benefits of improving the training and/or procedures for these actions.

   b. ER Section F.5.1.5 indicates that two internal flood related enhancements identified in the individual plant examination (Items 2 and 3 on page F.5-5) were implemented through piping modifications, design features, and periodic inspections, as described in Calculation ENG-ME-148, Rev. 1. The thrust of the argument appears to be that this has rendered the probability of cooling water system header rupture negligible. Provide a copy of this calculation/white paper. Justify that the potential enhancements would not be warranted given the dominant contributors to internal flooding CDF, as described in response to RAI 1h.

c. ER Section F.5.1.7.1 states that a recommendation from the seismic margins analysis was to restrain or remove wall hung ladders and scaffolding. Describe the actions taken in response to this recommendation.

d. ER Section 4.17.1 identifies five criteria for screening out Phase I SAMA candidates, whereas ER Section F.5.2 identifies two such criteria, one of which involves the use of engineering judgment and expected maximum cost and dose benefits. Clarify which criteria were actually used in the SAMA screening process.

e. For each screened Phase I SAMA candidate (i.e., SAMAs 1, 6, 6a, 7, 8, 10, 11, 13, 14, 16, 17, 18, 19a, 21, 23, 24) identify the criteria used to screen the SAMA. If engineering judgment was used as the criteria (as opposed to the criteria provided in ER Section 4.17.1), provide the estimated cost and dose benefit values used in the screening decision for each SAMA, as well as the basis for the engineering judgment decision.

f. ER Section F.7.2.1 identifies five Phase 1 SAMAs that were originally screened out but subsequently screened in and further evaluated as a result of an uncertainty assessment (i.e., SAMAs 1, 10, 17, 19a, and 21). Describe the process and criteria used to identify these five SAMAs. Explain why an uncertainty evaluation for the remaining 11 screened out SAMAs is not appropriate.

g. Provide additional description of the SAMA 6a barriers described in Section F.5.2.2 in order to better justify the cost estimate of $2M per unit.

6. Provide the following information with regard to the Phase II cost-benefit evaluations:

a. ER Section F.6 states that the PINGP-specific implementation cost estimates do not account for replacement power costs that may be incurred due to consequential shutdown time. Clarify whether contingency costs or inflation adjustments are included in the cost estimates. Describe the types of costs that are included within the estimated "life cycle" costs.

b. For SAMA 2, ER Section F.6.1 indicates a $300K implementation cost for each unit but provides no basis for this value. It appears that this SAMA would involve the upgrade of one site diesel-driven fire pump and the addition of the associated piping connections and starting circuitry. As such, the cost would be shared by each unit. Provide additional information regarding the basis for the cost estimates for this SAMA. Identify any other SAMAs that serve both units and whose costs are shared.

c. For SAMA 20, ER Table F.5-3 indicates a $313K implementation cost for each unit to change normally-open motor-operated valve to normally-closed, including a $100K "life cycle" cost. Describe the physical changes that are included in this cost estimate. Elaborate on the each of the cost factors that contribute to this implementation cost.

d. For SAMA 22, it is stated that the PRA model does not take full credit for the ability of the power-operated relief valve (PORV) accumulators, because their ability to supply sufficient air to support bleed and feed operation over the full range of reactor coolant system break sizes has not been verified (through testing or through engineering calculations). Describe the credit that is taken for the accumulators in the current model.

e. In ER Sections 4.17 and F.4.6, the modified MACR (MMACR) is indicated to be $1,114,000 and $2,980,000 for Unit 1 and 2, respectively. In ER Section F.7.1 it is indicated to be $1,048,000 and $2,706,000. Address this discrepancy.

f. ER Table F.3-7 contains a number of entries that are inconsistent with values reported elsewhere in the ER. Specifically, the Unit 1 CDF is indicated to 9.85E-6 per year, whereas a value of 9.79E-6 per year is reported elsewhere. The Unit 2 dose-risk is indicated to be 8.37 person-rem per year, whereas a value of 8.43 is reported elsewhere. The offsite economic cost risk for Unit 1 and 2, is indicated to be 1.36E4 and 5.44E4, whereas values of 1.59E4 and 6.33E4 are reported elsewhere. Address these discrepancies.

g. ER Section F.7.2 presents the approach used to address the impact of uncertainty on SAMA results. For PINGP, this approach involves quantifying the Level 1 model uncertainty (and uncertainty multiplier) separately for each SAMA evaluation case. (In previous licensee renewal uncertainty analyses, licensees determined and applied a single uncertainty multiplier based on the uncertainty distribution in the baseline risk model.) The ER indicates that for those SAMAs whose modeling required the addition of new basic events, no new uncertainty distributions were assigned since the design and implementation of the SAMA was defined by the analysis. It appears that this approach may have had the unintended consequences of narrowing the uncertainty for those SAMAs that provide a significant risk reduction (because the added basic events are point estimates, the more they show up in the cutsets the tighter the distribution becomes.) In addition, the actual uncertainty is associated with the difference between the base model and the model with the improvement. The approach used in the ER assigns that uncertainty distribution to the model with the improvement even though two different distributions are being subtracted. As a result, the actual uncertainty distribution may be broader than indicated in the ER. Demonstrate that the approach used to estimate uncertainty is appropriate. Describe the impact on SAMA results if a single uncertainty multiplier (based on the uncertainty in the baseline model) were used in lieu of the SAMA-specific uncertainty multipliers.

8. For certain SAMAs considered in the ER, there may be lower-cost alternatives that could achieve much of the risk reduction at a lower cost. In this regard, discuss whether any lower-cost alternatives to those Phase II SAMAs considered in the ER would be viable and potentially cost-beneficial. Evaluate the following SAMAs or indicate if the particular SAMA has already been considered. If the latter, indicate whether the SAMA has been implemented or has been determined to not be cost-beneficial at PINGP.

   a. Procedure for manually controlling the degree of SG depressurization and reclosing the SG PORVs in the event core damage is imminent, in order to prevent or reduce the challenge to SG tube integrity.

b. Procedure for enhancing manual operation of turbine-driven AFW pumps including alternate water sources, and operator aids for using local flow indication to maintain SG level.

c. Procedure and equipment for using a portable pump to provide feedwater to the SGs with suction from either the external fire ring header or intake canal.

d. Procedure for recovering emergency diesel generators D-1 and D-2 by supplying alternate cooling from well water or fire water through a spool piece on the inlet to the emergency diesel generator heat exchangers.

e. As an alternative to SAMA 15 (Portable DC Power Source), reconfiguring the non-safety main feedwater loads to be powered from DC Bus B rather than the addition of a portable DC power source for 21 AFW pump breaker control as proposed for SAMA 15.

f. Modifying the charging pump(s) electrical connections to enable re-powering from alternate 480VAC power supply (e.g., opposite unit) using pre-staged cables.

g. Installing a connection flange and valve on safety injection (SI) pump flow test return line to the refueling water storage tank to enable cross-connection of SI pumps to AFW piping via a temporary connection/hose.

h. Modifying the charging and volume control system to allow cross-tie of the charging pumps from opposite unit using temporary connections.

i. Purchase or manufacture of a gagging device that could be used to close a stuck-open SG safety value on the ruptured steam generator prior to core damage in SGTR events.