PrairieIslandNPEm Resource

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Cc: Eckholt, Gene F.; Davis, Marlys E.
Subject: SAMA RAI Response Letter Pages 40-56
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Here's the third part

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RAI SAMA 5.a

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.

NSPM Response to RAI SAMA 5.a

A summary of the operator actions is listed below:

<u>0SLOCAXXCDY</u>: Operator Fails To Perform RCS Cooldown and Depressurization on Small LOCA

This operator action involves failure of the operator to perform an RCS cooldown and depressurization after a small LOCA event with successful secondary cooling and safety injection actuation. If this action fails, the operator must perform high head recirculation to be successful. This event was applied to all small LOCA-like (small LOCA and pressurizer PORV LOCA) sequences.

<u>0HRECIRCC2Y</u>: Operator Fails To Initiate High Head Recirculation Conditional on Failure of RCS Cooldown and Depressurization

This action involves the failure of the operator to initiate high head recirculation following a small LOCA conditional failure of the operator to perform RCS cooldown and depressurization for a small LOCA (operator action 0SLOCAXXCDY), or for a RCP seal LOCA event (0RCPLOCACDY, "Operator Fails to Cooldown and Depressurize RCS for an RCP Seal LOCA"). If the operator fails to perform this action, core damage will occur. This operator action is a conditional operator action based on operator action 0HRECIRCSMY , "Operator Fails to Initiate High Head Recirculation for a Small LOCA."

<u>Part (1):</u>

The Emergency Operating Procedures (EOPs) will be used by Operations to perform the two operator actions listed above. For 0SLOCAXXCDY, the execution procedure covers post-

LOCA cooldown and depressurization. For 0HRECIRCC2Y, the execution procedure covers transfer to recirculation.

For initial license training, simulator scenarios are taught for post-LOCA cooldown and depressurization and transfer to high head recirculation. In addition, a classroom presentation is also given.

Continuing license training includes specific training tasks for both operator actions, including simulator and classroom training. Since both actions are standard EOP actions, they are trained on at least once during the 2 year training cycle in accordance with the 6-year training plan.

Part (2):

Operator action 0SLOCAXXCDY (Operator Fails To Perform RCS Cooldown and Depressurization on Small LOCA) involves failure of the operator to perform an RCS cooldown and depressurization after a small LOCA event with successful secondary cooling and safety injection actuation. If this action fails, the operator must perform high head recirculation to be successful.

Operator action 0HRECIRCC2Y (Operator Fails To Initiate High Head Recirculation Conditional on Failure of RCS Cooldown and Depressurization) involves the failure of the operator to initiate high head recirculation following a small LOCA conditional on failure of the operator to perform RCS cooldown and depressurization for a small LOCA event (0SLOCAXXCDY). Since these two operator actions appear in the same SLOCA initiating cutset, 0HRECIRCC2Y is a conditional operator action based on 0HRECIRCSMY. The EPRI HRA Calculator was used to determine the Human Error Probability (HEP) associated with 0SLOCAXXCDY and 0HRECIRCSMY. The methodology used to determine the cognitive part of the HEP is quantified using Cause Based Decision Tree Methodology (CBDTM). CBDTM methodology is explained in EPRI TR-100259, "An Approach to the Analysis of Operator Actions in Probabilistic Risk Assessment." The execution part of the HEP was quantified using Technique for Human Error Rate Prediction (THERP). THERP methodology is explained in NUREG/CR-1278, "Handbook of Human Reliability Analysis With Emphasis on Nuclear Power Plant Application."

Part (3):

Many factors influence the final Human Error Probability (HEP) value including cues and indications, timing analysis, dependencies (related human interactions), cognitive analysis, cognitive recovery and execution performance shaping factors. Various methods are also available to determine the HEP value such as the EPRI methods (HCR/ORE, Cause Based Decision Tree Method (CBDTM)) and the NRC methods (THERP/ASEP and SPAR-H).

Since credit is already taken for training in calculating the above HEPs, any further improvement in training for the HEP events listed above will have no benefit on improving the success of the operator actions. There is always a degree of uncertainty associated with HEP estimates, but the improvement in training benefits for this particular case would be within the range of uncertainty for these HEPs. In other words, the resolution of HEP methods is not precise enough to capture marginal improvements, such as due to enhanced operator training when operator training is already fully credited.

Part (4):

Both of these operator actions are standard Emergency Operating Procedure (EOP) actions and are trained on at least once during a 2 year training cycle. The CBDTM is applicable to EOP responses in the control room and the training branches are really only to mitigate unusual circumstances such as inaccurate instrumentation, inaccurate cues, unavailability of information required for diagnosis and complex decision logic. Standard operator actions such as these are not subject to these unusual circumstances and are not sensitive to the training mitigating factors in CBDTM. As a result, any additional training will add cost but little benefit in the HEP analysis.

Although additional training would not provide benefit, the important PRA information is transmitted to the Training Department to be incorporated into the Prairie Island Training Center procedure which provides instructions and guidance for using PRA information in operator training programs. Specifically, PRA insights are used in the classroom training and in the development of simulator training and evaluation. The procedure identifies the top two operator actions for both units as 0SLOCAXXCDY and 0HRECIRCC2Y.

RAI SAMA 5.b

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 1.h.

NSPM Response to RAI SAMA 5.b

A copy of ENG-ME-148, Revision 1, is included as Enclosure 2. The objective of this paper is to document the qualifications, design features and periodic inspections in place which provide confidence that the probability of occurrence of a pipe rupture (double-ended guillotine break) is negligible. The break postulation is reviewed from a deterministic standpoint and is based on current Prairie Island licensing basis, plant material condition, and other factors.

The cooling water header piping was completely replaced during the two unit outage in November 1992. The new piping is 33 percent thicker (1/2" compared to the original thickness of 3/8"). The Cooling Water System is a safety related system designed and constructed to Design Class I and QA Type 1 standards. These design and construction standards are much more stringent than are the standards used in industrial and fossil plant design and construction. Also, the internal surface of the new header piping is coated with an epoxy coating to inhibit microbiologically induced corrosion (MIC).

In addition, it is likely that a substantial piping leak (which could lead to a larger piping failure) would be noticed by operators, engineering or maintenance staff, or security personnel who periodically walk through these rooms such that corrective action could be taken well before a break might occur.

As described in the response to RAI SAMA 1.h, the dominant internal flooding sequences for both units involve flooding of the 695' elevation of the Auxiliary Building. The worst case flooding scenario (which is assumed for all flooding events associated with this initiating event) is due to a Cooling Water (CL) header rupture in the Component Cooling Water (CC) heat exchanger area, which is assumed to fail one train of CC pumps on both units as they are located below the associated CL header in that room. This is considered a dual-unit initiating event. The other train of CC pumps will continue to function if operator action to identify and isolate the ruptured CL header prior to submergence of the CC pump electrical connections is successful. Failure of this action will also result in flooding beyond the CC pumps, impacting both trains of Safety Injection (SI) pumps, Residual Heat Removal (RHR) pumps, and Containment Spray (CS) pumps, as well as MCCs supporting the Charging pumps and other safeguards equipment. The core damage sequence involves the occurrence of the flooding initiating event followed by failure of the operators to isolate the break prior to loss of the second train of CC pumps. This results in loss of reactor coolant pump (RCP) seal cooling, which eventually leads to an unrecoverable RCP seal LOCA as the ECCS pumps have been impacted by the flooding event.

The operator action to isolate the Auxiliary Building 695' elevation flooding source (0AB7FLDISLY) was identified in the Level 1 Importance List Review for Unit 1 and Unit 2 (ER Tables F.5-1a and F.5-1b). According to the review for potential SAMAs for this event, several were identified:

- Mitigation of this event can be accomplished via an automatic sump pump system to remove water if the operator fails to isolate Zone 7 of the Auxiliary Bldg. (SAMA 13)
- Consider installing waterproof (EQ) equipment (valves / level sensors) capable of automatically isolating the flooding source. (SAMA 6)
- Consider segregating this zone into 2 compartments to reduce the impact of a flood on both trains of SI and RHR. (SAMA 6a)

As stated in ER Section F.5.1.5, the IPE identified two internal flood enhancements (Items 2 and 3 on page F.5-5). These enhancements are related to flooding in the Auxiliary Feedwater (AFW) Pump Room due to the CL header pipe break. However (as reflected in the response to RAI Question 1.h), AFW Pump Room flooding is no longer a significant contributor to the PRA results. Therefore, potential enhancements would not be warranted.

RAI SAMA 5.c

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.

NSPM Response to RAI SAMA 5.c

Per the PINGP IPEEE one of the recommendations from the seismic margins assessment was to "restrain or remove wall hung ladders and scaffolding that are located near safety related equipment to reduce the impact of seismically induced relay chatter." As noted in IPEEE Section A.2.2.4, "Findings from the Plant Walkdowns," scaffolding was found to be hung on the wall behind the D2 Diesel Generator Control Panel. Although damage to the panel and its anchorage due to the possible impact of the scaffolding was unlikely, it was thought an impact may cause relay chatter. Similarly, a wall-mounted ladder was found to be located behind 4160 VAC Bus 25. Like the D2 control panel, it was thought that if the ladder would fall off its wall-hooks due to earthquake motion, relay chatter may result.

Currently, no scaffolding is stored near safety-related equipment. Scaffolding storage is controlled in accordance with a plant procedure, which states that temporary staging of materials, such as scaffolding, shall be consistent with allowable floor loadings and storage areas shown in plant drawings. Also, a plant procedure provides guidance on scaffolding construction and use, including requirements for clearances to safety-related equipment and seismic restraints to limit horizontal movement during a seismic event. With the guidance given in these procedures, the impact of scaffolding on safety related equipment is negligible.

For ladder use and storage, current practices are defined in a plant procedure, which states that ladders shall be returned to storage racks or other designated storage locations, when not in use. In addition, a housekeeping and material condition procedure states that all portable ladders in an area (not in use) are to be secured at the proper ladder storage location and visually checked for safety concerns.

During a recent field walkdown, it was noted that ladders are still located near safety-related equipment such as 4160 VAC Bus 25 and D2. The ladders are stored on plant storage racks per procedure; however, it was questioned whether additional restraints were warranted to secure the ladders. Investigation determined that there was no clear guidance for the location and construction of ladder storage. The condition has been entered into the corrective action program to further investigate the issue and determine whether current ladder storage standards are adequate.

RAI SAMA 5.d

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.

NSPM Response to RAI SAMA 5.d

Although the screening criteria listed may appear to be different between the two documents, they are meant to be equivalent with similar intent. Also, even though a particular screening criterion was listed, it does not imply that it was necessarily utilized, since it may not have been necessary or applicable. The following table attempts to resolve the apparent discrepancy between the two sections by showing their similarity.

ER Section F.5.2	ER Section 4.17.1
Applicability to the Plant: If a proposed SAMA does not apply to the Prairie Island design, it is not retained.	(1) Candidates not applicable to the PINGP design
Engineering Judgment: Using extensive plant knowledge and sound engineering judgment, potential SAMAs are evaluated based on their expected maximum cost and dose benefits; those that are deemed not beneficial are screened from further analysis.	(2) Candidates with no significant benefit in pressurized water reactors such as PINGP (5) Candidates whose estimated implementation costs exceed the maximum averted cost-risk
It was not deemed necessary to list a potential SAMA candidate if the option has already been, or is planned to be, implemented, e.g., planned replacement of steam generators on Unit 2.	(3) Candidates that have already been implemented at PINGP
Table F.5-3 discusses the various SAMA options, and as applicable, recommends the use of other SAMAs that could prove more effective, e.g., SAMA 18 was dispositioned by recommending the use of SAMA 15.	(4) Candidates with benefits that have been achieved using other means

RAI SAMA 5.e

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.

NSPM Response to RAI SAMA 5.e

ER Table F.5-3 provides a description of how each SAMA was dispositioned in Phase I. Those SAMAs that required a more detailed cost-benefit analysis were evaluated in Section F.6. Also see the response for RAI 5.f below.

RAI SAMA 5.f

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.

NSPM Response to RAI SAMA 5.f

This response addresses both RAIs 5.e and 5.f:

Four of the five Phase 1 SAMAs (1, 10, 17, and 19a) were originally carried forward into the Phase 2 evaluation based on preliminary implementation costs, but later refined estimates clearly made them not cost beneficial when compared with other Phase 1 SAMAs that were dispositioned as being too costly. Nonetheless, it was decided to retain their analysis by including them as a sensitivity calculation rather than delete the earlier Phase 2 work. SAMA 21, although not seen as cost-beneficial, was retained as a sensitivity calculation only as an exercise to see what possible averted cost benefits might be realized since the SAMA option was viewed to have a large impact on LERF. The other 11 screened out Phase 1 SAMAs were screened based on the implementation cost being high and the perceived risk benefit as being low. The following table was developed to help clarify where in the ER each of the identified SAMAs was dispositioned.

SAMA Identifier	License Renewal Section / Comments
1	Section F.7.2.1.1
6	Section F.5.2.1
6a	Section F.5.2.2
7	Table F.5-3
8	Section F.5.2.3
10	Section F.7.2.1.2
11	Table F.5-3; SAMA 10 viewed as alternative to this SAMA
13	Section F.5.2.4
14	Table F.5-3
16	Table F.5-3
17	Section F.7.2.1.3
18	Table F.5-3; SAMA 15 viewed as alternative
19a	Section F.7.2.1.4
21	Section F.7.2.1.5
23	Table F.5-3; SAMAs 5 and 19a viewed as alternatives
24	Table F.5-3; SAMAs 16, 17, 21, and 22 viewed as alternatives

RAI SAMA 5.g

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.

NSPM Response to RAI SAMA 5.g

As shown in USAR Figure 1.1-5, the critical equipment in the scope of SAMA 6a is all located on the same floor elevation of the Auxiliary Building. The equipment involved includes (for each unit) two SI pumps, two CC pumps, several motor control centers, three charging pumps, and two RHR pumps located in pits below the floor level. The equipment is not separated by flood-proof barriers, and, for the CC pumps, all pumps from both units are located in the same large area. Therefore, any modification to achieve the benefits of SAMA 6a would have to consist of a series of enclosures that surround individual pieces of equipment. Some enclosures may only consist of walls to protect from rising water, but others may need to be full covered enclosures to protect from spray. At least 22 (11 per unit) individual, custom-designed enclosures would be required. Additional enclosures may also be required to protect specific instrumentation, MOVs, or other electrical devices.

Because the area of concern is congested and limited in size, and the equipment separation distance tends to be small, permanent barriers are generally not practical. Open access will continue to be needed for each component during periodic disassembly or replacement; permanent barriers that provide room for maintenance are either not possible or would unreasonably restrict access to other equipment. Therefore, each individual equipment enclosure would have to be able to be constructed in relatively small sections that can be moved and assembled in restricted areas, and they would have to be disassembled easily to provide access for equipment operation, maintenance or replacement. Simply pouring concrete walls around equipment is not an option. The enclosures would also have to be seismically designed and capable of being sealed to the floors. Provisions would also be needed to remove water that may leak from the component inside each enclosure to prevent flooding from even small leaks rendering inoperable the equipment that the enclosure is intended to protect. Floor drains located within proposed enclosures may have to be relocated or modified to provide backflow protection.

For the RHR pump pits, it may be possible to increase the heights of the existing curbs or build new higher curbs outside the existing curbs. However, higher curbs would still have to permit easy access to remove and install the pit covers, and to move personnel, materials and equipment into and out of the pits during maintenance and inspections. The power operators used to remove and reinstall pit covers may have to be redesigned. The RHR pit curb design, therefore, is not necessarily straightforward.

The construction work to erect these enclosures would be difficult. Assembly would be labor-intensive. Special precautions would be required during construction to avoid contacting and damaging the safety-related equipment each enclosure is intended to protect, as well as to protect other safety-related equipment in the vicinity.

In view of these considerations, it is reasonable to conclude that the cost of design, fabrication and construction of each enclosure, costs associated with future removal and replacement of each enclosure for equipment maintenance, and costs of maintaining the sealed joints in each enclosure water tight, could easily reach $200,000 each, or more than $2,000,000 per unit.

RAI SAMA 6.a

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.

NSPM Response to RAI SAMA 6.a

Cost estimates for potential plant modifications identified in the SAMA analysis have been developed as order-of-magnitude cost estimates. Contingency cost or inflation adjustments were not included in these estimates. Each cost estimate is broken down into relevant work activities across the following major project phases: Study, Analysis, Design, Implementation, and Life Cycle.

Work activities associated with the various project phases as described below are considered with respect to the expanded SAMA project descriptions.

The 'Study' phase estimates account for the identification of physical design change alternatives, identification of stakeholders, pre-conceptual design, assessment of impact on plant procedures, processes and programs, and a draft safety evaluation or licensing / permitting assessment.

Estimates for the 'Analysis' phase of each project account for evaluations, calculations and analyses required to support the basis for the project such as revisions to the plant heat balance or accident analyses.

The "Engineering and Design' phase estimates account for conceptual design, preliminary design and final design. This involves preparation, review and approval of drawings, specifications, data sheets, design change packages, as well as various discipline engineering elements and engineering program elements. Also included are evaluations, calculations and analyses required to support the implementation of the design change such as piping analysis, pipe support calculations, structural load analyses, electrical circuit analyses and loading, cable tray loading, etc.

The 'Implementation' phase estimates account for procurement, materials management, work planning, installation, testing, return to operations and closeout. This involves maintenance services, construction services, craft labor, design engineering support, program engineering support and procurement services.

Estimates in the 'Life Cycle' phase accounts for labor and materials required for maintaining plant equipment in operable condition for 20 years. Life cycle costs do not include any contingency or inflation adjustments. Life cycle costs are costs related to ensuring the operability of the equipment.

RAI SAMA 6.b

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.

NSPM Response to RAI SAMA 6.b

The $300k estimate for each unit credited the B.5.B portable fire pump being connected to the cooling water system. The estimate also credited existing connections with operator actions to open valves, and nominal costs associated with procedure changes. However, additional analysis indicated that the B.5.B Fire Protection System pump capacity would be limited, and additional capacity would be needed. To meet the additional pumping capacity, a diesel driven pump could be installed for an estimated $2.4 million between both units. The cost estimate is comparable to the cost of a similar installation at Palisades. This higher cost would screen this SAMA from being cost beneficial.

RAI SAMA 6.c

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.

NSPM Response to RAI SAMA 6.c

A description of SAMA 20 and a breakdown of the cost factors are provided below:

Title: Close Low Head Injection MOVs to Prevent RCS Backflow to SI System

Description: Change the safety-related motor-operated low head reactor vessel injection valves (one valve in each Emergency Core Cooling System train) from normally open to normally closed. Valves would need modifying by drilling a hole in the upstream disk in order to eliminate any pressure locking concern.

Assumptions: Each valve will be placed in the closed position (or verified closed) by the control room operator prior to entering the appropriate Tech Spec MODE and each valve will receive, as it does presently, an "S" (safety injection) signal; therefore, in order to implement this alternative, procedure and drawing changes are required. Assumptions include:

- The design requirements for the valve and its motor operator which were in effect at the time the valve was a normally open valve are still valid.

- The current valve design will support the modification to eliminate any pressure locking concern.
- The valve MEDP (maximum expected differential pressure) and actuator will not be changed by this modification. Minor changes in the wedge friction factor may occur, but will not change the valve actuator or its settings

PHASE	ITEM	RESOURCE	FUNCTIONAL AREA	ESTIMATE
Study/Analyses	1	Contract Labor	Engineering Design Studies	$40,000
	2	PINGP Support	Engr / Ops / Lic	$12,000
Design	3	Contract Labor	Engr Design – Mech / Civil	$60,000
	4	Contract Labor	Engr Design – Elec / I&C	$60,000
	5	PINGP Support	Engr / Ops / Maint	$40,000
Implement	6	Labor	Maintenance / Construction	$50,000
	7	Contract Labor	Engineering	$2,000
	8	Materials	Material & Material Mgmt	$1,000
	9	PINGP Support	Engr / Ops / Lic	$3,000
Life Cycle	10	Labor	Ops / Maint for 20 years	$100,000
GRAND TOTAL				$368,000

Note: This estimate is for one unit only. The cost estimate for the second unit would save approximately 30% on the Design Phase. Therefore, the total cost for the second unit is $258,000. The sum of the two costs is $626K, or an average of $313K per unit.

RAI SAMA 6.d

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.

NSPM Response to RAI SAMA 6.d

Basic events are included in the PRA to model the failure probability of the air accumulators for the pressurizer PORV to be able to open the valves for bleed and feed with the instrument air supply to the valves failed. The current failure probability is 0.1.

RAI SAMA 6.e

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.

NSPM Response to RAI SAMA 6.e

The correct values are $1,114,000 and $2,980,000 for Unit 1 and 2, respectively. The values listed in Section F.7.1 are the result of typographical errors. The MMACR values had been modified based on updated information, but the older values within Section F.7.1 were inadvertently not corrected. This section dealt with adjusting the Real Discount Rate (RDR) value from 3% to 7%. The end result is that this typographical error does not change any of the results or conclusions for any of the SAMA analyses or sensitivity cases.

Accordingly, the third paragraph in Section F.7.1 is hereby corrected to state the following, with changes shown in boldface:

The Phase II analysis was re-performed using the 7 percent RDR. Implementation of the 7 percent RDR reduced the MMACR by 28.4 percent compared with the case where a 3 percent RDR was used. This corresponds to a decrease in the MMACR from ***$1,114,000*** *to* ***$798,000*** *for Unit 1 and from* ***$2,980,000*** *to* ***$2,134,000*** *for Unit 2.*

Additionally, the values in the tables of Section F.7.1 are hereby updated as follows, with changes shown in **boldface**:

Unit 1 Summary of the Impact of the RDR Value on the Detailed SAMA Analyses

SAMA ID	Cost of Implementation	Averted Cost Risk (3 percent RDR)	Net Value (3 percent RDR)	Averted Cost Risk (7 percent RDR)	Net Value (7 percent RDR)	Change in Cost Effective-ness?
1	$4,250,000	$268,252	($3,981,748)	**$192,168**	**($4,057,832)**	No
2	**$1,200,000**[1]	$123,376	**($1,076,624)**	**$88,388**	**($1,111,612)**	No
3	$250,000	$74,956	($175,044)	**$53,700**	**($196,300)**	No
5	$1,500,000	$75,942	($1,424,058)	**$54,346**	**($1,445,654)**	No
9	$62,500	$62,746	$246	**$44,950**	**($17,550)**	Yes
10	$2,866,000	$46,870	($2,819,130)	**$33,580**	**($2,832,420)**	No
12	$900,000	$186,188	($713,812)	**$133,376**	**($766,624)**	No
15	$130,000	$0	($130,000)	**$0**	**($130,000)**	No
17	$2,362,000	$88,030	($2,273,970)	**$63,004**	**($2,298,996)**	No
19	$700,000	$60,330	($639,670)	**$43,178**	**($656,822)**	No
19a	$1,935,000	$329,802	($1,605,198)	**$236,168**	**($1,698,832)**	No
20	$313,000	$53,910	($259,090)	**$38,582**	**($274,418)**	No
21	$3,000,000	$11,286	($2,988,714)	**$8,082**	**($2,991,918)**	No
22	$39,000	$15,350	($23,650)	**$10,990**	**($28,010)**	No

[1]Cost of implementation is revised as discussed in NSPM response to RAI SAMA 6.b.

Unit 2 Summary of the Impact of the RDR Value on the Detailed SAMA Analyses

SAMA ID	Cost of Implementation	Averted Cost Risk (3 percent RDR)	Net Value (3 percent RDR)	Averted Cost Risk (7 percent RDR)	Net Value (7 percent RDR)	Change in Cost Effective-ness?
1	$4,250,000	$270,474	($3,979,526)	**$193,762**	**($4,056,238)**	No
2	**$1,200,000**[1]	$123,092	**($1,076,908)**	**$88,180**	**($1,111,820)**	No
3	$250,000	$76,654	($173,346)	**$54,910**	**($195,090)**	No
5	$1,500,000	$222,610	($1,277,390)	**$159,310**	**($1,340,690)**	No
9	$62,500	$62,918	$418	**$45,070**	**($17,430)**	Yes
10	$2,866,000	$48,630	($2,817,370)	**$34,838**	**($2,831,162)**	No
12	$900,000	$302,132	($597,868)	**$216,350**	**($683,650)**	No
15	$130,000	$19,324	($110,676)	**$13,842**	**($116,158)**	No
17	$2,362,000	$488,118	($1,873,882)	**$349,330**	**($2,012,670)**	No
19	$700,000	$60,514	($639,486)	**$43,308**	**($656,692)**	No
19a	$1,935,000	$929,586	($1,005,414)	**$665,408**	**($1,269,592)**	No
20	$313,000	$54,646	($258,354)	**$39,106**	**($273,894)**	No
21	$3,000,000	$12,518	($2,987,482)	**$8,958**	**($2,991,042)**	No
22	$39,000	$67,650	$28,650	**$48,420**	**$9,420**	No

[1]Cost of implementation is revised as discussed in NSPM response to RAI SAMA 6.b.

RAI SAMA 6.f

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.

NSPM Response to RAI SAMA 6.f

The Containment Event Tree (CET) sequence frequencies were determined through quantification of the Boolean logic models and included delete-term operations to remove success-branch cutsets from the output at the sequence level. The CET sequences are mapped to release categories; to produce the release category frequencies presented in Table F.3-7, a simple summation of the appropriate sequence frequencies was used. This introduces a small amount of over-prediction in the release category frequencies, as another delete-term operation on the combined sequence cutsets for mutually-exclusive sequences was not performed. Some of the release category frequency values shown on Table F.3-7 are, therefore, slightly higher than their actual values. The Unit 1 and Unit 2 CDF values presented in the table are also simple summations of the release category frequencies. As shown in the CDF for Unit 1, the sum of the release category frequencies produces a CDF metric for Unit 1 that is approximately 6E-8 (less than 1%) higher than the Boolean-logic quantified CDF value of 9.79E-6. The difference in the Unit 2 CDF value is not noticeable to 3 significant digits, but is also less than 1% higher. The slightly higher CDF values presented in Table F.3-7 were not used in the SAMA quantification. The slightly higher release category frequencies were used, but as the differences are small, and it is the delta between release category values that is used as the basis for the SAMA evaluations, these differences are considered insignificant to the overall results of the evaluation.

Note that the release categories making up the LERF risk metric are more important to the SAMA results, as these categories are more likely to impact onsite and offsite doses and cleanup costs. The over prediction of the LERF metric produced by summing these release categories is less than 3/1000 of 1% for both units, which indicates that the actual frequencies for these release categories are very close to the approximations used in the analysis.

During performance of the Prairie Island analysis, three SECPOP2000 code errors were publicized, specifically: 1) incorrect column formatting of the output file, 2) incorrect 1997 economic database file end character resulting in the selection of data from wrong counties, and 3) gaps in the 1997 economic database numbering scheme resulting in the selection of data from wrong counties. All three errors were addressed and new MACCS2 results were generated. It was verified that these new results for MACCS2 served as the basis for all SAMA quantifications. However, the numbers that were presented in Table F.3-7 had not been updated to reflect the latest values from MACCS2.

Accordingly, ER Table F.3-7 is hereby corrected as presented below, with changes shown in **boldface**. Coincidentally, the Unit 1 Dose Risk (2.94 p-rem/yr), at least to three significant figures, did not change when using the updated MACCS2 results, which is the reason why it is not shown in boldface.

Table F.3-7
MACCS2 Base Case Mean Results

Source Term	Release Category	Dose (p-sv)(1)	Offsite Economic Cost ($)	Unit 1 Freq. (/yr)	Unit 1 Dose-Risk (p-rem/yr)(1)	Unit 1 OECR ($/yr)	Unit 2 Freq. (/yr)	Unit 2 Dose-Risk (p-rem/ yr)(1)	Unit 2 OECR ($/yr)
1	H-XX-X	**1.64E+01**	**3.39E+02**	7.28E-06	**1.19E-02**	**2.47E-03**	8.52E-06	**1.40E-02**	**2.89E-03**
2	H-H2-E	**2.11E+04**	**1.20E+10**	2.32E-11	**4.89E-05**	**2.78E-01**	2.32E-11	**4.89E-05**	**2.78E-01**
3	L-H2-E	**2.14E+04**	**1.32E+10**	5.61E-08	**1.20E-01**	**7.41E+02**	6.52E-08	**1.40E-01**	**8.60E+02**
4	L-CL-E	**3.40E+04**	**2.10E+10**	8.40E-10	**2.86E-03**	**1.76E+01**	9.17E-10	**3.12E-03**	**1.93E+01**
5	H-OT-L	**2.48E+03**	**5.70E+07**	4.89E-09	**1.21E-03**	**2.79E-01**	5.87E-09	**1.46E-03**	**3.35E-01**
6	L-CC-L	**2.23E+04**	**3.41E+09**	2.82E-07	**6.28E-01**	**9.61E+02**	3.39E-07	**7.56E-01**	**1.16E+03**
7	H-DH-L	**1.95E+02**	**1.22E+06**	3.09E-08	**6.03E-04**	**3.77E-02**	3.14E-08	**6.13E-04**	**3.83E-02**
8	L-DH-L	**6.22E+02**	**9.60E+06**	1.92E-06	**1.20E-01**	**1.85E+01**	1.97E-06	**1.22E-01**	**1.89E+01**
9	SGTR	**5.69E+04**	**5.03E+10**	2.33E-07	**1.32E+00**	**1.17E+04**	1.17E-06	**6.66E+00**	**5.89E+04**
10	ISLOCA	**2.28E+05**	**7.47E+10**	3.22E-08	**7.35E-01**	**2.41E+03**	3.22E-08	**7.35E-01**	**2.41E+03**
FREQUENCY WEIGHTED TOTALS				9.85E-06	2.94E+00	**1.59E+04**	1.21E-05	**8.43E+00**	**6.33E+04**

(1) MAACS2 provides dose results in Sieverts (sv). The MAACS2 result is converted to rem (1 sv = 100 rem) for the Dose-Risk results to be used in Section F.4.

RAI SAMA 6.g

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.

NSPM Response to RAI SAMA 6.g

The approach used that accounted for the uncertainty associated with each specific SAMA option on a case-by-case basis was deemed to be more precise in capturing the specific uncertainty associated with those particular generated cutsets. Although the practice of using a single multiplier has been used for other License Renewal applications, the use of a single multiplier for the 95th percentile utilizing baseline model CDF cutsets tends to provide a multiplier that may not necessarily represent the individual uncertainty associated with each particular SAMA. That is, in using a single multiplier, some SAMAs could be perceived as not being cost beneficial if the overall multiplier was too low. Likewise, an individual SAMA may be mistakenly perceived as being cost beneficial if the single multiplier is too high. Therefore, it was deemed more appropriate to evaluate the 95th percentile estimates using those cutsets that pertain to the actual SAMA of interest to provide for better resolution and a more refined estimate of the 95th percentile cost benefits for each individual SAMA. Therefore, the use of individual multipliers based on each SAMA option's 95th percentile results was considered technically sound.

However, in reviewing the PINGP application of the above process, where it was intended to isolate the uncertainty effects to each individual SAMA, it was found that the 95th percentile result for each SAMA had been actually divided by the baseline CDF value. To provide a more accurate ratio of the 95th to the mean estimate, the denominator should have been each SAMA's point estimate for CDF, not the baseline CDF. The revised results using each SAMA's CDF point estimate are provided in the following tables. The tables also reflect the cost correction for SAMA 2 discussed in the response to SAMA 6.b above. The resulting impact from these changes is that Unit 2 now shows SAMA 19a as potentially cost beneficial when using this corrected method.

Unit 1 95th Percentile Results Using Individual SAMA Uncertainty Multipliers

SAMA ID	Cost of Implementation	Ratio of 95th to SAMA CDF	Unit 1 Averted Cost-Risk	Net Value
SAMA 1	$4,250,000	2.89	$775,079	-$3,474,921
SAMA 2	**$1,200,000**[1]	2.69	**$332,481**	**-$867,519**
SAMA 3	$250,000	2.75	$205,793	-$44,207
SAMA 5	$1,500,000	2.86	$216,922	-$1,283,078
SAMA 9	$62,500	2.87	$180,002	**$117,502**
SAMA 10	$2,866,000	2.84	$132,985	-$2,733,015
SAMA 12	$900,000	2.79	$519,433	-$380,567
SAMA 15	$130,000	2.90	$0	-$130,000
SAMA 17	$2,362,000	2.89	$254,417	-$2,107,583
SAMA 19	$700,000	2.86	$172,754	-$527,246
SAMA 19a	$1,935,000	2.77	$914,173	-$1,020,827
SAMA 20	$313,000	2.85	$153,784	-$159,216
SAMA 21	$3,000,000	2.91	$32,882	-$2,967,118
SAMA 22	$39,000	2.89	$44,386	**$5,386**

1. Results reflect cost correction discussed in the response to RAI SAMA 6.b

Unit 2 95th Percentile Results Using Individual SAMA Uncertainty Multipliers

SAMA ID	Cost of Implementation	Ratio of 95th to SAMA CDF	Unit 2 Averted Cost-Risk	Net Value
SAMA 1	$4,250,000	2.82	$763,219	-$3,486,781
SAMA 2	**$1,200,000**[1]	2.79	**$343,506**	**-$856,494**
SAMA 3	$250,000	2.71	$207,943	-$42,057
SAMA 5	$1,500,000	2.89	$642,520	-$857,480
SAMA 9	$62,500	2.75	$173,012	**$110,512**
SAMA 10	$2,866,000	2.86	$138,918	-$2,727,082
SAMA 12	$900,000	2.92	$881,438	-$18,562
SAMA 15	$130,000	2.84	$54,901	-$75,099
SAMA 17	$2,362,000	2.86	$1,397,133	-$964,867
SAMA 19	$700,000	2.87	$173,931	-$526,069
SAMA 19a	$1,935,000	2.74	$2,542,917	**$607,917**
SAMA 20	$313,000	2.85	$155,678	-$157,322
SAMA 21	$3,000,000	2.76	$34,610	-$2,965,390
SAMA 22	$39,000	2.84	$192,028	**$153,028**

1. Results reflect cost correction discussed in the response to RAI SAMA 6.b

In response to the question involving the impact of using a single multiplier, the tables below show that when the baseline 95th percentile estimate is divided by the respective unit's baseline CDF, the results show the same outcome with respect to those SAMAs that are cost beneficial at this level of uncertainty. The tables also reflect the cost correction for SAMA 2 discussed in the response to RAI SAMA 6.b above. Therefore, this exercise has shown for this particular SAMA evaluation that the two methods, when appropriately applied, produced similar results with regard to determining those SAMAs that are cost beneficial at the 95th percentile.

Unit 1 95th Percentile Results Using Global Uncertainty Multiplier

SAMA ID	Cost of Implementation	Ratio of 95th to Base CDF	Unit 1 Averted Cost-Risk	Net Value
SAMA 1	$4,250,000	2.95	$791,490	-$3,458,510
SAMA 2	**$1,200,000**[1]	2.95	**$364,026**	**-$835,974**
SAMA 3	$250,000	2.95	$221,161	-$28,839
SAMA 5	$1,500,000	2.95	$224,070	-$1,275,930
SAMA 9	$62,500	2.95	$185,135	**$122,635**
SAMA 10	$2,866,000	2.95	$138,292	-$2,727,708
SAMA 12	$900,000	2.95	$549,356	-$350,644
SAMA 15	$130,000	2.95	$0	-$130,000
SAMA 17	$2,362,000	2.95	$259,736	-$2,102,264
SAMA 19	$700,000	2.95	$178,006	-$521,994
SAMA 19a	$1,935,000	2.95	$973,096	-$961,904
SAMA 20	$313,000	2.95	$159,064	-$153,936
SAMA 21	$3,000,000	2.95	$33,300	-$2,966,700
SAMA 22	$39,000	2.95	$45,291	**$6,291**

1. Results reflect cost correction discussed in the response to RAI SAMA 6.b

Unit 2 95th Percentile Results Using Global Uncertainty Multiplier

SAMA ID	Cost of Implementation	Ratio of 95th to Base CDF	Unit 2 Averted Cost-Risk	Net Value
SAMA 1	$4,250,000	2.78	$751,691	-$3,498,309
SAMA 2	**$1,200,000**[1]	2.78	**$342,092**	**-$857,908**
SAMA 3	$250,000	2.78	$213,034	-$36,966
SAMA 5	$1,500,000	2.78	$618,669	-$881,331
SAMA 9	$62,500	2.78	$174,859	**$112,359**
SAMA 10	$2,866,000	2.78	$135,151	-$2,730,849
SAMA 12	$900,000	2.78	$839,673	-$60,327
SAMA 15	$130,000	2.78	$53,704	-$76,296
SAMA 17	$2,362,000	2.78	$1,356,558	-$1,005,442
SAMA 19	$700,000	2.78	$168,178	-$531,822
SAMA 19a	$1,935,000	2.78	$2,583,469	**$648,469**
SAMA 20	$313,000	2.78	$151,870	-$161,130
SAMA 21	$3,000,000	2.78	$34,790	-$2,965,210
SAMA 22	$39,000	2.78	$188,010	**$149,010**

1. Results reflect cost correction discussed in the response to RAI SAMA 6.b