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DTE Energy

10 CFR 54

March 5, 2015
NRC-15-0023

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington D C 20555-0001

References:
1) Fermi 2
NRC Docket No. 50-341
NRC License No. NPF-43

2) DTE Electric Company Letter to NRC, "Fermi 2 License Renewal Application," NRC-14-0028, dated April 24, 2014 (ML14121A554)

3) DTE Electric Company Letter to NRC, "Response to NRC Request for Additional Information for the Review of the Fermi 2 License Renewal Application – Severe Accident Mitigation Alternatives," NRC-15-0013, dated January 9, 2015 (ML15009A358)

4) NRC Letter, "Requests for Additional Information for the Environmental Review of the Fermi 2 License Renewal Application – Severe Accident Mitigation Alternatives," dated February 3, 2015 (ML15026A307)

Subject: Response to NRC Request for Additional Information for the Environmental Review of the Fermi 2 License Renewal Application – Severe Accident Mitigation Alternatives Set 2

In Reference 2, DTE Electric Company (DTE) submitted the License Renewal Application (LRA) for Fermi 2. In Reference 3, DTE responded to an NRC staff request for additional information (RAI) regarding the Severe Accident Mitigation Alternatives (SAMA) of the Fermi 2 LRA. The NRC staff issued a follow-up RAI on SAMA in Reference 4. The Enclosure to this letter provides the DTE response to the RAI in Reference 4.

No new commitments are being made in this submittal.

Should you have any questions or require additional information, please contact Lynne Goodman at 734-586-1205.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on March 5, 2015

Vito A. Kaminskas
Site Vice President
Nuclear Generation

Enclosure: DTE Response to NRC Request for Additional Information for the Environmental Review of the Fermi 2 License Renewal Application – Severe Accident Mitigation Alternatives Set 2

cc: NRC Project Manager
NRC License Renewal Project Manager
NRC License Renewal Environmental Project Manager
NRC Resident Office
Reactor Projects Chief, Branch 5, Region III
Regional Administrator, Region III
Michigan Public Service Commission,
Regulated Energy Division (kindschl@michigan.gov)

Enclosure to
NRC-15-0023

Fermi 2 NRC Docket No. 50-341
Operating License No. NPF-43

DTE Response to NRC Request for Additional Information for the Environmental Review of the Fermi 2 License Renewal Application – Severe Accident Mitigation Alternatives Set 2

RAI 1 (relating to response to RAI 1.c.iii)

What is the value for the phenomenological failure probability of the common cause failure of all four combustion turbine generators in the event of a "weather centered" loss of the 345kV (Division 2) Switchyard?

Response:

There is no phenomenological failure of the common cause failure of all four combustion turbine generators in the event of a "weather centered" loss of the 345 kV switchyard. The combustion turbine generators are electrically connected to the 120 kV switchyard. The common cause failure of a weather centered loss of 345 kV switchyard and all four combustion turbine generators without affecting the 120 kV switchyard is not deemed a credible scenario due to the large spatial separation between the 120 kV and 345 kV switchyards. If there were a weather phenomenon large enough to affect both the 345 kV switchyard and the combustion turbine generators, it would also affect the 120 kV switchyard (which is a modeled phenomenon for common cause weather loss of offsite power and combustion turbine generators).

RAI 2 (relating to response to RAI 2.e)

The SAMA analysis release category (RC) frequency is based upon a truncation of 1E-12/yr which results in undercounting the Class II frequency by 3.14E-09/yr compared to the Class II frequency from the Level 1 quantification. This is stated to have been resolved by lowering the truncation to 1E-14/yr. It is stated that this 3.14E-09/yr difference was added to the probabilistic risk assessment (PRA) documentation RC medium/early (M/E) frequency but not that used in the SAMA analysis. Discuss the basis for assigning this undercounting due to truncation to RC M/E and not other RC's such as high/early (H/E) and the impact of not including these truncated out Class II cutsets in the evaluation of the benefit for the SAMAs.

Response:

In order to address this question, it is important to define the context of the "undercounting" of release terms. For Class II sequences (containment failure before core damage) all of the core damage should result in a Level 2 containment release term. However, due to the nature of the quantification process, it is not possible to get "exact" agreement between core damage frequency (CDF) contributions and release terms. This is due to several factors:

a) Truncation: When the same truncation limit is used for CDF and Level 2 quantifications (as dictated by convergence studies), there will be a certain portion of the CDF solution that will fall below the truncation level. If a CDF cutset is near the truncation level and additional multipliers are applied as a result of the application of the Level 2 event trees, this cutset will likely be truncated out of the Level 2 solution.

b) Success Term Handling: Handling of success terms are acknowledged to cause minor losses of precision in Level 2 solutions.

The undercounting of Level 2 accident sequences is characterized as being very small based upon the following considerations:

1) It represents approximately 0.5% of total release.
2) It represents approximately 1% of the high/early (H/E) release.
3) It represents approximately 5% of the medium/early (M/E) release.

It can reasonably stated, therefore, that the magnitude of the undercounting is well within accepted uncertainty bounds associated with probabilistic risk assessment (PRA) calculations (as evidenced by the error factors present in CDF and large early release frequency (LERF) parametric uncertainty analysis). Nonetheless, sensitivity studies are presented below to further characterize the impact of this issue on the severe accident mitigation alternative (SAMA).

A subjective judgment was made to assign the undercounted Level 2 accident frequency to the M/E release category when developing the model of record. New quantifications performed at the 1E-14/yr level resulted in a relatively even distribution of the additional release contribution between H/E and M/E. Based on these quantifications, it would have been more appropriate to have split the frequency between release categories H/E and M/E or assign all of it to H/E. Since the population dose and economic cost for release category H/E is significantly higher than that for M/E (> a factor of 15), the sensitivity evaluations presented below conservatively assumed that all of the undercounted contribution would result in an H/E release.

The maximum averted cost risk (MACR) that results from adding the additional Class II release contribution of 3.14E-09/yr to the H/E release category was determined to be $3,386,054 for both internal and external events. This is an increase of $16,222 over the MACR used in the SAMA analysis. Therefore it is the maximum possible additional benefit that could be obtained if a SAMA eliminated all the additional frequency. A realistic estimate is obtained by assuming the reduction in additional Class II release frequency due to a SAMA is proportional to the reduction in H/E frequency from the original SAMA evaluation. When this is applied to all SAMA evaluations, the maximum increase in benefit is $2093 for the base internal and external events evaluation and $5033 for the uncertainty sensitivity case. With these increases, none of the existing SAMAs will change from "not cost-beneficial" to "potentially cost-beneficial." Based on these evaluations, the impact of not including the truncated-out Class II cutsets in the SAMA evaluation does not change any conclusions with regard to the cost-benefit of the SAMAs.

RAI 3 (relating to response to RAI 2.g.iii)

The RAI response provided a wealth of information supporting the selection of representative sequences in terms of the determination of the base case risk, however, the impact of representative selection on the calculation of delta risk for a SAMA is not specifically addressed. Furthermore, the information provided indicates that the specific example in the RAI will not adversely impact the selection of cost-beneficial SAMAs; however, it does raise concern about the impact of combining Class IIA sequences with Class IV sequences. As indicated in the RAI response, separating the Class IIA sequences from the Class IV sequences in the H/E release category results in a 15% increase in dose risk and a 0.6% increase in offsite economic cost risk (OECR) in the total risk. Table 2.g-4 indicates the revised Class II contribution is 2.69 times the person-rem/yr and 1.08 times the OECR contributions when they are included in the H/E base case release category. Thus, the staff believes, the benefit of any SAMA that significantly reduces the risk of Class IIA (loss of containment heat removal) sequences will be underestimated. Please address the impact of combining Class IIA sequences with Class IV sequences and clarify the impact of representative selection on the calculation of delta risk for a SAMA.

Response:

In the initial response to RAI 2.g, the potential impact of separating Class IIA sequences from the Class IV sequences was conservatively evaluated using surrogate MACCS2 results since such results were not available for Class IIA sequences. Class IIA release impacts (i.e., MACCS2 conditional population dose and offsite economic costs) were conservatively assumed to be the same as those for a high early release due to a break outside containment (i.e., H/E-BOC served as the surrogate). Therefore the increases identified in the initial response to RAI 2.g were not for Class IIA sequences directly, but rather based on the conservative surrogate release impacts using the Class IIA sequence frequency.

The conservatisms associated with grouping Class IIA sequences into the H/E release category with Class IV sequences are noted based on the metrics of population dose and offsite economic cost. Experience has shown that population dose in the early time frame is primarily driven by CsI releases, and offsite economic costs are primarily driven by CsOH releases through the release period. Table 3-1 in this response provides a release summary of representative MAAP scenarios for the representative H/E-BOC sequence (V-003), the representative H/E sequence (Class IV sequence IVA-037), and the dominant Class IIA sequences (IIA-063, IIA-024, and IIA-037). The identification of the dominant Class IIA sequences was provided in the response for RAI 2.g.

When the timing of CsI releases are compared between the Class IV representative case and the Class IIA cases, it is evident that the Class IV sequence has a significantly higher CsI release fraction in the first initial hours (e.g., five hours) after declaration of a general emergency (GE) during which time evacuation would occur. Per the Fermi 2 Level 2 PRA, evacuation should be completed by 4 hours following GE declaration. When the CsI releases of the Class IIA cases are compared against the H/E-BOC case which was used as a surrogate for the Class IIA release category (i.e., by substituting the H/E-BOC MACCS2 population dose and economic cost values for the H/E values based on the Class IV IVA-037 sequence) in the initial RAI response (see Table 2g-4 from the RAI 2.g response), it is clear that the BOC case is very conservative, with the CsI release being approximately three orders of magnitude higher by 5 hours after the GE. With regard to timing, the following additional factors are noted:

- Class IIA radionuclide releases as modeled by representative MAAP scenarios indicate that significant radionuclide releases (i.e., > 1% CsI or CsOH release fractions) would not occur for more than 30 hours after accident initiation, providing significant time for onsite and offsite actions.
- The Class IIA sequence frequency from the Level 2 PRA provides no credit for the site Emergency Director to declare a GE early, although the director has that discretion.

These additional factors represent conservatisms in the assumed "early" timing of Class IIA sequences.

With respect to offsite cost impacts, Table 3-1 in this response shows that the CsOH release fractions of the Class IV case (IVA-037) at 48 hours following accident initiation matches or significantly exceeds that of the Class IIA sequences (IIA-063, IIA-024, and IIA-037). While the CsOH release of the BOC surrogate case (V-003) was less than that of the Class IIA sequences, the MACCS2 results for the BOC case did show a slightly higher offsite cost impact than the Class IV sequence MACCS2 results. This higher BOC offsite cost impact is attributed to the more concentrated release typical of a BOC scenario.

Table 3-2 in this response duplicates Table 2g-4 of the initial RAI response and provides an estimate of the total cost risk and dose risk from all release categories if the Class IIA H/E sequences are considered as a separate H/E category consisting of 17% of the total H/E frequency and the H/E-BOC scenario MACCS2 results are conservatively used as a surrogate. As described in previous paragraphs, these MACCS2 dose and cost results from the H/E-BOC release category would conservatively represent a release from a Class IIA sequence. As noted in this RAI, using the surrogate results, the Class IIA contribution is 2.69 times the dose and 1.08 times the cost relative to the H/E base case release category. The 2.69 factor for dose and 1.08 factor for cost may be applied to evaluate the potential impacts on Class IIA sequence contributions for individual SAMA candidates.

Table 3-3 in this response lists select SAMA candidates from Appendix D Table D.2-1 of the Fermi 2 Environmental Report (ER) for evaluation of the impacts of including Class IIA sequences with Class IV sequences. These SAMA candidates in Table 3-3 were selected on the following basis:

- The candidate was not already considered potentially cost-beneficial in the base case analysis or in the sensitivity analysis

- The candidate was not specifically oriented towards other types of sequences (e.g., LOCA, ATWS, early loss of RPV injection)
- The candidate has a non-marginal impact on Class IIA sequences relative to non-Class IIA sequences

The first five columns of Table 3-3 are taken from Table D.2-1 of the Fermi 2 ER. The last two columns of Table 3-3 identify the estimated SAMA candidate cost benefit from offsite versus onsite costs based on the methodology of Section D.1.5.4 of the ER. Only that portion of the cost benefit from offsite is relevant for the adjustment evaluation for Class IIA sequences and MACCS2 results because other SAMA cost categories related to onsite costs (i.e., Onsite Exposure Cost, Onsite Cleanup Cost, Replacement Power Cost) are independent of accident class as calculated using the SAMA methodology. The offsite benefit portion is calculated by multiplying the respective Table D.1-35 Offsite Exposure (Dose) Cost (i.e., $105,676) or Offsite Economic Cost (i.e., $167,403) times the External Event Multiplier (i.e., 11), times the population dose reduction or offsite economic cost reduction portion for each given SAMA candidate. The offsite dose cost and offsite economic costs are then added together to obtain the total offsite benefit cost.

The Offsite Dose Cost and Offsite Economic Cost multiplied by only the External Events multiplier is identified in Table 3-4 in this response. These costs may be adjusted to evaluate the potential impact of Class IIA sequences. Table 3-4 identifies the portion of the base cost for dose and economic cost that are associated with Class IIA sequences. The increase factor for dose and cost noted above (2.69 for offsite dose risk and 1.08 for offsite cost risk) are applied to this Class IIA portion, multiplied by the base offsite dose and economic costs (column 2), and then added to the base costs (column 2) to calculate adjusted costs (column 5).

Table 3-5 in this response evaluates the potential impact on each selected SAMA candidate from Table 3-3. It is conservatively assumed that for each of the selected SAMA candidates, the SAMA benefit is all associated with Class IIA sequences calculated using offsite dose reduction and offsite cost reduction increase factors of 2.69 and 1.08, respectively. Using the Table 3-4 Adjusted Cost Including External Hazards and the Table 3-5 adjusted dose and cost reductions, a new Adjusted Benefit Portion from Offsite is calculated. This new Adjusted Benefit Portion from Offsite is added to the baseline Benefit Portion from Onsite (which is not impacted by the Class IIA MACCS2 results) to achieve a new Adjusted Cost Benefit for comparison against the Estimated Implementation Cost. As the table shows, each SAMA candidate remains non-cost beneficial by a significant margin. The evaluation noted in Table 3-5 contains several conservatisms:

- The assessment conservatively assumes that all of the cost benefit comes from Class IIA sequences. In general the benefit would be expected to address some accident classes other than Class IIA such that the Adjusted Cost Benefit specified in Table 3-5 is conservatively high.
- The assessment conservatively assumes that the BOC MACCS2 results apply to the Class IIA sequences. As discussed previously, use of the BOC results for Class IIA sequences

is judged very conservative, especially in regard to offsite dose (upon which the 2.69 factor is based).

The Fermi 2 ER also evaluates two separate sensitivity cases for pertinent SAMA candidates (i.e., 3% Discount Rate and 95th percentile uncertainty). The 95th percentile uncertainty sensitivity increases the estimated benefit by a factor of 2.5 and presents the bounding case of the two sensitivity cases. A review of Table 3-5 indicates that three (3) SAMA candidates (i.e., SAMAs 50, 145, and 194) would potentially be cost-beneficial if the 95% uncertainty sensitivity increase factor of 2.5 is applied to the Adjusted Cost Benefit value in the table. Additionally, SAMA candidate 177 is also close to the threshold. These four SAMA candidates were therefore further reviewed. Specifically, the cutset results associated with these SAMA candidates were reviewed to determine the proportion of benefit due to H/E Class IIA sequences.

Table 3-6 in this response provides a summary of the reduction of the total H/E Class IIA frequency for each of these four SAMA candidates. This table estimates the additional dose and economic cost benefit over the base results provided in Table D.1-24 in Appendix D of the Fermi 2 ER. The "Other" H/E release category identified in Table 3-2 represents this baseline benefit estimate for non-BOC H/E sequences, represented by the Class IV sequence IVA-037 (the "H/E" category in Table D.1-24). The difference between the MACCS2 population dose and offsite economic cost results in Table 3-2 for H/E Class IIA and H/E "Other" represents the potential additional benefit over the base case for SAMA candidates that mainly mitigate Class IIA sequences. By subtracting the dose and economic cost results of the "Other" (i.e., baseline) H/E category from the Class IIA H/E category, the additional dose and economic costs benefit relative to the baseline values by using a separate Class IIA H/E category are determined. This difference can then be used to calculate the additional cost benefit associated with a separate Class IIA H/E release category.

Table 3-6 provides the additional Offsite Dose Cost Benefit calculated from these SAMAs if it is assumed that the difference between the H/E Class IIA release category population dose (2.18E+07 person-rem, using the BOC MACCS2 results) and the "Other" H/E release category population dose (8.10E+06 person-rem) provides the additional benefit (1.37E+07 person-rem) to the offsite dose, and also applying a dose benefit of $2000 /person-rem and the reduction in Class IIA frequency from the SAMA candidate. These values are also multiplied by the external events factor (11) and 7% discount rate factor (10.76). Similarly, this table also provides the additional offsite economic cost benefit calculated from these SAMAs assuming that the difference between the H/E Class IIA release category economic cost ($3.03E+10) and the "Other" H/E release category economic cost ($2.80E+10) provides additional benefit ($2.30E+09) to the offsite economic cost, and also applying the reduction in Class IIA frequency from the SAMA candidate. These values are also multiplied by the external events factor (11) and 7% discount rate factor (10.76). The Additional Offsite Dose Benefit and Additional Offsite Economic Cost Benefit are summed with the base case offsite and base case onsite costs to calculate the Adjusted Cost Benefit.

Review of Table 3-6 indicates that these SAMA candidates have significant margin to being potentially cost beneficial and are not potentially cost beneficial even if the 95% uncertainty sensitivity factor (2.5) were to be included in the cost benefit calculation.

Based on the above evaluation, combining Class IIA sequences with Class IV sequences is judged reasonable and does not impact the conclusions of the SAMA analysis. The independent consideration of Class IIA H/E sequences separate from Class IV sequences does not result in any SAMAs becoming potentially cost-beneficial.

Table 3-1
REPRESENTATIVE MAAP SCENARIOS FOR THE DOMINANT CLASS IIA SEQUENCES OF THE H/E RELEASE CATEGORY

Sequence	Represent. MAAP Case	Release Start Time (Hrs)	GE Time (Hrs)	Release Fraction 5 Hours After GE		Time Release Fractions > 1% (Hrs)		Release Fraction at 48 Hrs		Release Fraction at 72 Hrs	
				CsI	CsOH	CsI	CsOH	CsI	CsOH	CsI	CsOH
V-003 (100% of H/E-BOC frequency)	EF120524	< 1 hr	0.5	0.32	0.21	0.75	0.75	0.35	0.25	N/A – Run is 48 hr	N/A – Run is 48 hr
IVA-037 (27% of H/E frequency)	EF120520 (H/E Case)	2	0.5	0.001	0.001	7.5	8.5	0.25	0.32	N/A – Run is 48 hr	N/A – Run is 48 hr
IIA-063 (7% of H/E frequency)	EF120516	33.6	31.6	0.0003	0.0003	38.5	38.9	0.58	0.32	0.60	0.35
IIA-024 (6% of H/E frequency)	EF120514	33.6	31.6	0.0002	0.0002	38.5	39.2	0.42	0.10	0.49	0.12
IIA-037 (4% of H/E frequency)	EF120509	29.5	23.9	0	0	31	32	0.28	0.16	0.33	0.17

Table 3-2
FERMI 2 SAMA DOSE RISK AND COST RISK WITH SEPARATE CLASS IIA H/E RELEASE CATEGORY

Characteristics of Release Mode			Population Dose	Offsite Economic Cost	Population Dose Risk	Offsite Economic Cost Risk
Release Category		yr^{-1}	person-rem	$	person-rem/yr	$/yr
H/E-BOC		5.93E-08	2.18E+07	3.03E+10	1.29E+00	1.80E+03
H/E	Class IIA	5.32E-08	2.18E+07	3.03E+10	1.16E+00	1.61E+03
H/E	Other	2.60E-07	8.10E+06	2.80E+10	2.11E+00	7.28E+03
H/I		7.20E-08	9.52E+06	5.26E+10	6.86E-01	3.79E+03
H/L		2.46E-10	8.98E+06	1.67E+10	2.21E-03	4.11E+00
M/E		6.17E-08	2.48E+06	8.39E+09	1.53E-01	5.18E+02
M/I		3.71E-08	2.76E+06	6.10E+09	1.03E-01	2.27E+02
L/E		4.36E-08	2.26E+05	2.26E+07	9.85E-03	9.85E-01
L/I		5.46E-08	2.14E+06	8.25E+09	1.17E-01	4.51E+02
LL/E		5.02E-10	1.31E+04	3.81E+05	6.57E-06	1.91E-04
LL/I		7.75E-08	1.29E+05	4.05E+06	1.00E-02	3.14E-01
CI		7.83E-07	6.46E+01	1.96E+00	5.06E-05	1.54E-06
Totals					5.64E+00	1.57E+04

Table 3-3
FERMI 2 SAMA CANIDATES WITH POTENTIAL IMPACTS ON CLASS IIA SEQUENCES

SAMA #	Description	Population Dose Reduction (%)	Offsite Economic Cost Reduction (%)	Base Case Internal & External Benefit ($)	Base Case Benefit Portion from Offsite	Base Case Benefit Portion from Onsite
21	Use firewater system as a backup source for diesel cooling	5.79%	9.47%	256,946	241,689	15,257
24	Training for offsite power recovery after SBO	0.07%	0.11%	6,268	2,839	3,429
50	Change procedures to allow cross connect of motor cooling for RHRSW pumps	0.38%	0.41%	13,154	11,967	1,187
54	Enhance procedural guidance for use of cross-tied component cooling or service water pumps	0.05%	0.09%	3,237	2,239	998
67	Enhance procedure to trip unneeded RHR or CS pumps on loss of room ventilation	0.03%	0.02%	1,185	717	468
78	Enable flooding of drywell head seal	0.28%	0.31%	8,896	8,896	~0(1)
123	Filtered containment vent	34.84%	37.89%	1,102,769	1,102,769	~0(1)
145	Increase training and operating experience feedback to improve operator response	8.21%	9.76%	309,765	275,160	34,605
152	Proceduralize all potential 4-kV AC bus cross-tie actions	0.74%	0.79%	25,338	23,149	2,189
177	Provide an alternate means of supplying the instrument air header	2.95%	3.10%	99,460	91,376	8,084
194	Provide ability to maintain suppression pool temperature lower	0.81%	0.82%	28,874	24,515	4,359

Note 1: These SAMA candidates do not result in a CDF reduction. Therefore, by the SAMA benefit calculation methodology, the onsite benefit is zero.

Table 3-4
BASELINE OFFSITE DOSE AND ECONOMC COST CALCULATION WITH SEPARATE CLASS IIA H/E RELEASE CATEGORY

Cost Category	Base Cost Including External Hazards ($)	Portion From Class IIA Sequences	Increase Factor	Adjusted Cost Including External Hazards ($)
Offsite Dose Cost	1,162,436	8.76E-02	2.69	1,436,357
Offsite Economic Cost	1,841,433	9.57E-02	1.08	2,031,756

Table 3-5
FERMI 2 SAMA CANIDATES WITH POTENTIAL IMPACTS ON CLASS IIA SEQUENCES

SAMA #	Description	Adjusted Dose Reduction (2.69)	Adjusted Cost Reduction (1.08)	Adjusted Benefit Portion from Offsite	Base Case Benefit Portion from Onsite	Adjusted Cost Benefit ($)	Est Implementation Cost ($)
21	Use firewater system as a backup source for diesel cooling	15.58%	10.23%	431,514	15,257	446,771	2,000,000
24	Training for offsite power recovery after SBO	0.19%	0.12%	5,118	3,429	8,547	50,000
50	Change procedures to allow cross connect of motor cooling for RHRSW pumps	1.02%	0.44%	23,679	1,187	24,866	50,000
54	Enhance procedural guidance for use of cross-tied component cooling or service water pumps	0.13%	0.10%	3,907	998	4,905	50,000
67	Enhance procedure to trip unneeded RHR or CS pumps on loss of room ventilation	0.08%	0.02%	1,598	468	2,066	50,000
78	Enable flooding of drywell head seal	0.75%	0.33%	17,621	~0	17,621	100,000
123	Filtered containment vent	93.72%	40.92%	2,177,567	~0	2,177,567	40,000,000

Table 3-5
FERMI 2 SAMA CANIDATES WITH POTENTIAL IMPACTS ON CLASS IIA SEQUENCES

SAMA #	Description	Adjusted Dose Reduction (2.69)	Adjusted Cost Reduction (1.08)	Adjusted Benefit Portion from Offsite	Base Case Benefit Portion from Onsite	Adjusted Cost Benefit ($)	Est Implementation Cost ($)
145	Increase training and operating experience feedback to improve operator response	22.08%	10.54%	531,381	34,605	565,987	1,000,000
152	Proceduralize all potential 4-kV AC bus cross-tie actions	1.99%	0.85%	45,927	2,189	48,116	1,000,000
177	Provide an alternate means of supplying the instrument air header	7.94%	3.35%	182,005	8,084	190,089	489,300
194	Provide ability to maintain suppression pool temperature lower	2.18%	0.89%	49,290	4,359	53,649	100,000

Table 3-6
FERMI 2 CLASS IIA SAMA CANDIDATE DETAILED CALCULATIONS

SAMA #	Description	Class IIA Frequency Reduction	Additional Offsite Cost Dose Benefit ($)(1)	Additional Offsite Economic Cost Benefit ($)(2)	Base Case Benefit Portion from Offsite(3)	Base Case Benefit Portion from Onsite(3)	Adjusted Benefit Portion from Offsite(4)	Adjusted Cost Benefit ($)(5)	Implementation Cost(6)
50	Change procedures to allow cross connect of motor cooling for RHRSW pumps	1.49E-09	4,817	404	11,967	1,187	17,189	18,376	50,000
145	Increase training and operating experience feedback to improve operator response	6.16E-09	19,997	1,679	275,160	34,605	296,835	331,440	1,000,000
177	Provide an alternate means of supplying the instrument air header	8.18E-09	26,521	2,226	91,376	8,084	120,123	128,207	489,300

Table 3-6
FERMI 2 CLASS IIA SAMA CANDIDATE DETAILED CALCULATIONS

SAMA #	Description	Class IIA Frequency Reduction	Additional Offsite Cost Dose Benefit ($)(1)	Additional Offsite Economic Cost Benefit ($)(2)	Base Case Benefit Portion from Offsite(3)	Base Case Benefit Portion from Onsite(3)	Adjusted Benefit Portion from Offsite(4)	Adjusted Cost Benefit ($)(5)	Implementation Cost(6)
194	Provide ability to maintain suppression pool temperature lower	2.45E-09	7,934	666	24,515	4,359	33,115	37,474	100,000

Notes to Table 3-6:

1. These values are derived by taking the difference between the H/E Class IIA release category population dose (2.18E+07 rem, using the BOC MACCS2 results) and the "Other" H/E release category population dose (8.10E+06 rem) to calculate the additional benefit (1.37E+07 rem) to the population dose reduction and applying a dose benefit of $2000 /person-rem and the Class IIA frequency reduction listed in Column 3. These values are multiplied by the external hazards factor (11) and the 7% discount rate factor (10.76).
2. These values are derived by taking the difference between the H/E Class IIA release category economic cost ($3.03E+10) and the "Other" H/E release category offsite economic cost ($2.80E+10) to calculate the additional benefit ($2.30E+09) to the offsite economic costs assuming the Class IIA frequency reduction listed in Column 3. These values are multiplied by the external hazards factor (11) and the 7% discount rate factor (10.76).
3. Values from Table 3-3.
4. Values from summation of Columns 4, 5, and 6.
5. Values from summation of Columns 7 and 8.
6. Values from Table 3-5.

RAI 4 (relating to response to RAI 4.c)

The economic multiplier stated in the RAI response is 2.1384, which is different from the value of 1.2964 stated on page D-96 of the environmental report (ER). The RAI response does not mention any reason for different values. Please clarify which is the correct value for the economic multiplier value used in the assessment of cost beneficial SAMAs.

Response:

The economic multiplier stated in the previous RAI response was incorrect. The economic multiplier that was used in the assessment of SAMAs was 1.2964 as stated on page D-96 of the Environmental Report (ER).

The response to RAI 4.c. should be revised to state, as follows:

> The dollar-to-hectare values for farm land range from \$5610/ha to \$17,934/ha with an average of \$9,335/ha. The dollar-to-person values for non-farm land range from \$198,181/person to \$322,884/person with an average of \$223,430/person. It should be noted that WinMACCS does not require dollar-to-hectare values for non-farm land, rather it uses dollar-to-person values. Therefore, dollar-to-hectare values for non-farmland was not utilized in the SAMA analysis.
>
> Farmland and non-farmland data is taken from SECPOP2000 v3.13.1 county level data from 2002. This data is then multiplied by a factor of 1.2964 to account for inflation from 2002 to 2013. The factor was calculated by extrapolating the consumer price index (i.e. inflation) from current data through 2013 assuming linear growth.

RAI 5 (relating to response to RAI 5.a.ii, 5.a.vi, 5.a.vii, 6.h and 7.a)

The response to these RAIs provides the result of new cost benefit analyses. Was this based on doing the complete analysis similar to that for the ER evaluation involving determining the new RC frequencies and resulting cost risks, or were some other assumptions made? Some of the results do not appear to be consistent with those given in Table D.2-1 for similar SAMAs.

Response:

Item 5.a.ii – The additional cost benefit evaluation performed for basic event HE1FUHS1AC001 "Operators fail to manually start MDCT fans" was performed using the same methodology as described in the ER. The failure probability was reduced to zero in the PRA model, the release categories were recalculated, and the averted cost risk based on these release categories was determined. The same external event multiplier used in the ER was applied to this evaluation.

Item 5.a.vi – The new cost benefit evaluation performed for SAMA 101 was performed using the same methodology as described in the ER. The initiating event frequencies for the risk significant internal flooding initiators in ER Appendix D Table D.1-2 were reduced by 25% in the PRA model, the release categories were recalculated, and the averted cost risk based on these release categories was determined. The same external event multiplier used in the ER was applied to this evaluation.

Item 5.a.vii – The additional cost benefit evaluations performed for the internal flooding initiators listed in the response to RAI 5.a.vii were performed using the same methodology as listed in the ER. No unique assumptions that would impact the averted cost risk were made other than those associated with the averted risk associated with implementing the SAMA, specifically installing flood barriers to prevent propagation, installing leak detection, etc. The release categories were recalculated, and the averted cost risk based on these release categories was determined. The same external event multiplier used in the ER was applied to this evaluation.

Item 6.h – The additional cost benefit evaluations performed for the basic events included in the response to RAI 6.h were performed using the same methodology as listed in the ER. The failure probability of events HE1FRBCW-FLISOL-AB3 "Fail to Term. Flood from EECW in an AB3 SWGR Room;" PHPHL2CZMELT "Control Rods Melt Prior To Fuel Rods;" and PHPHDWVTPCISOL "Operator Fails To Isolate Path Given Isolation Signal Fails" were reduced, the release categories were recalculated, and the averted cost risk based on these release categories was determined. It was not necessary to perform a new SAMA evaluation for event PHPHGVFAIL "Failure of Combustible Gas Venting" based on the planned implementation of NRC Order 13-109. A new SAMA evaluation was not required for event PHPHCNTM-BURN "Hydrogen Deflagration Occurs Globally" because this event is addressed by SAMAs 93 and 103.

Item 7.a – The additional cost benefit evaluations performed for basic event HE1FRSP-CNTRL "Operators fail to shutdown from outside the main control room" was performed using the same methodology as listed in the ER. The failure probability of the basis event was reduced by half, the release categories were recalculated, and the averted cost risk based on these release categories was determined. The same external event multiplier used in the ER was applied to this evaluation.

RAI 6 (relating to response to RAI 6.c)

While Fermi 2 may not have the same vulnerability that prompted SAMA 023 to develop procedures to repair or replace failed 4 kV breakers, this SAMA was cited to mitigate a number of important Fermi events in Table D.1-2 and screening it out is not considered appropriate. Evaluate the benefit of a procedure to develop or replace failed 4 kV breakers where ever it may be of a benefit at Fermi 2.

Response:

In ER Table D.1-2, SAMA 023 was included as a source for the Phase 1 screening of SAMA candidates based on risk significant terms. All risk terms that used SAMA 023 were again reviewed for applicability. To ensure SAMA 023 adequately addresses the risk terms as listed in ER Table D.1-2, a new evaluation was performed. The new cost benefit evaluation decreased the failure probability of breakers greater than 600 V (which includes 4 kV, 120 kV, and 345 kV). This evaluation was performed by changing the Type Code Data failure rate for circuit breakers higher than 600 V for fails to close, fails to open, transfers closed, and transfers open. The failure rate for each of these type codes was decreased by 20%. With these changes, the model was quantified and release category frequencies were re-calculated resulting in an averted cost risk of $14,258 ($35,646 when including the 95th percentile sensitivity). Therefore, implementation of this SAMA remains "not cost-beneficial" even when including breakers greater than 4 kV. This new evaluation for SAMA 023 is applicable to all the terms in ER Table D.1-2 for which SAMA 023 was originally listed.

RAI 7 (relating to response to RAI 6.e)

The response indicates that assuming a 15% reduction in main steam isolation valves (MSIVs) failure to close and safety relief valves (SRVs) failure to open has essentially no impact (~<0.01) on risk. On the other hand, operator failures to depressurize have risk reduction worths of 1.10, 1.05, and 1.03. These are equivalent to SRVs failure to open and would indicate that the above reduction in SRV failure to open would lead to a 2% reduction in CDF. Please discuss the MSIV and SRV hardware failure modeling characteristics included in the Fermi 2 PRA that lead to this very small risk impact.

Response:

The success criteria for safety relief valve (SRV) depressurization depends on the accident scenario. For transient events, 1 of 15 SRVs opening is success and for anticipated transient without scram (ATWS) events, 11 of 15 SRVs opening is success. For manual depressurization, 3 of 15 SRVs opening is success. Therefore, failure to depressurize occurs when 15 SRVs fail to open for transient events, 5 SRVs fail to open for ATWS events and 13 SRVs fail to open for manual depressurization. Since multiple SRVs (each with a fail to open probability of 3E-03) must fail at the same time, the hardware failure probability is significantly lower than the probabilities (ranging from 1E-03 to 6.7E-03) of the operator actions to depressurize the reactor pressure vessel (RPV). This results in a significantly lower risk reduction worth for the SRV hardware failures compared to the risk reduction worth of the operator failure events.

The modeling of main steam isolation valves (MSIVs) failing to close is somewhat similar in that two inline MSIVs must fail to close for failure to isolate each main steam line. With a failure to close probability of 1E-03 for each valve, the failure to isolate a main steam line would be 1E-06. Consideration of the common cause failure of the two valves increases the failure probability by 2.6E-05. The failure to isolate the MSIVs is only relevant for failure to isolate the containment in the Level 2 model. Since core damage must first occur, failure of MSIVs resulting in failure to isolate the containment is relatively low in risk importance. The Fussell-Vesely of the common cause of two MSIVs to close event is 5.7E-05 for the LERF quantification results.