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Appendix E
Attachment A

Attachment A

Fermi 2 Clean Water Act Documentation

Attachment A

Fermi 2 Clean Water Act Documentation

- 1977 Section 401 (Water Quality) Certification
- National Pollutant Discharge Elimination System (NPDES) Permit MI0037028

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING, LANSING, MICHIGAN 48926
HOWARD A. TANNER, Director

September 27, 1977

Mr. J. J. Gessner, Director
Environmental Affairs
Detroit Edison Company
2000 Second Avenue
Detroit, Michigan 48226

Dear Mr. Gessner:

A Water Resources Commission policy statement, adopted at the August 19, 1973, meeting, authorizes the Executive Secretary and Assistant Executive Secretary to carry out certain administrative activities as agents of the Commission. One activity specifically listed is the certification to the Environmental Protection Agency that an activity requiring a Federal license for permit will comply with Public Law 92-500.

Your Company's application for certification required under Section 401 of Public Law 92-500 regarding the Enrico Fermi Atomic Power Plant Unit Two, located in Frenchtown Township, Monroe, has been reviewed. Based on the information received from your Company and staff, we hereby certify that the NPDES permit which will be public noticed and issued by the State of Michigan in conformance with Michigan Act No. 245 of the Public Acts of 1929, as amended, and the Federal Water Pollution Control Act, Public Law 92-500, will require compliance with the applicable provisions of Sections 301, 302, 306 and 307 of the Federal Act and will constitute the State's 401 certification.

Very truly yours,

WATER RESOURCES COMMISSION

Robert J. Courchaine
Executive Secretary

RJC/CB/ras

cc: U.S. EPA Region V
J. Bohunsky
R. Schrameck
C. Bek

MICHIGAN
THE GREAT LAKE STATE

R1026-2 6/75

MICHIGAN WATER RESOURCES COMMISSION

RESOLUTION

Detroit Edison Company
Enrico Fermi Atomic Power Plant - Unit 2
PL 92-500 Sec. 401 Certification

WHEREAS, The Detroit Edison Company, On April 14, 1975, filed an application with the Nuclear Regulatory Commission for an operating license for its Enrico Fermi 2 power plant; and

WHEREAS, The Detroit Edison Company, on May 4, 1975, filed an application, numbered MI 0037028, for NPDES permit in accordance with the requirements of Section 402 of PL 92-500 and Act 245, P.A. of 1929, as amended; and

WHEREAS, The Detroit Edison Company, by letter dated May 5, 1975, requested the Water Resources Commission, concurrently with the issuance of the NPDES permit, certify under the provisions of Section 401, PL 92-500 that the discharges from its Enrico Fermi 2 plant will comply with the applicable provision of Sections 301, 302, 306 and 307 of that Act; and

WHEREAS, The Water Resources Commission, at its meeting on August 18, 1977, approved issuance of the NPDES permit No. MI 0037028 following the 30-day public notice of the draft permit in accordance with provisions of Part 21 of the General Rules of the Commission; and

WHEREAS, Said permit will require compliance with the applicable provisions of Sections 301, 302, 306 and 307 of PL 92-500; now therefore be it

RESOLVED, That said permit when issued shall constitute the Water Resources Commission's certification under Section 401 of PL 92-500.

This Resolution unanimously adopted this Twenty-Second day of September, 1977, by the Water Resources Commission.

PRESENT AND VOTING:

Stanley Quackenbush (Chairman), representing the Director of the Department of Agriculture
Helen S. Willis (Vice Chairman), representing Conservation Groups
Wayne H. Tody, representing the Director of the Department of Natural Resources
Max N. Clyde, representing the Director of the Department of State Highways and Transportation
John E. Vogt, representing the Director of the Department of Public Health
Patricia M. Cayemberg, representing Municipal Groups

Robert J. Courchaine
Robert J. Courchaine
Executive Secretary

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING

RICK SNYDER
GOVERNOR

DEQ

DAN WYANT
DIRECTOR

April 30, 2012

RECEIVED BY
MAY 07 2012
LICENSING

J.M. DAVIS
MAY - 3 2012

DTE Energy
One Energy Plaza
Room 655 G.O.
Detroit, Michigan 48226

Dear Sir or Madam:

SUBJECT: National Pollutant Discharge Elimination System (NPDES); Permit No. MI0037028
Designated Name: DECO-Fermi-2 Plt

Your NPDES Permit has been processed in accordance with the appropriate state and federal regulations. It contains the requirements necessary for you to comply with state and federal water pollution control laws.

The issuance of this permit does not authorize the violation of any federal, state, or local laws or regulations, nor does it obviate the necessity of obtaining such permits, including any other Department of Environmental Quality (DEQ) permits, or approvals from other units of government as may be required by law.

REVIEW THE PERMIT EFFLUENT LIMITS AND COMPLIANCE SCHEDULES CAREFULLY. These are subject to the criminal and civil enforcement provisions of both state and federal law. Permit violations are audited by the DEQ and the United States Environmental Protection Agency (USEPA), and may appear in a published quarterly noncompliance report made available to agencies and the public.

Your monitoring and reporting responsibilities must be complied with in accordance with this permit. If required by the permit, self-monitoring data shall be reported via the DEQ Electronic Environmental Discharge Monitoring Reporting (e2-DMR) system. Other reports, notifications, or questions regarding the enclosed permit or the NPDES program should be directed to the following address:

Mr. Jon Russell, District Supervisor
Jackson District Office, Water Resources Division, DEQ
301 East Louis Glick Highway
Jackson, Michigan 49201-1556
Telephone: 517-780-7847, Fax: 517-780-7855

Sincerely,

Philip Argiroff

Philip Argiroff, Chief
Permits Section
Water Resources Division
517-241-1346

pa/sea

Enclosure: Permit No. MI0037028

cc/enc: USEPA-Region 5
208 Agencies – Southeast Michigan Council of Governments; Toledo Metropolitan Area Council of Governments
Mr. Joseph Plona, Site Vice President-Nuclear Power Plant, DTE Energy-Fermi 2 Power Plant
Ms. Mary Hana, Senior Environmental Engineer, DTE Energy Corporate Services LLC
Mr. Jon Russell, Jackson District Supervisor, Water Resources Division, DEQ (electronic)
PCS Unit, Water Resources Division, DEQ
File

PERMIT NO. MI0037028

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENT

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended, (33 U.S.C. 1251 *et seq.*) (the "Federal Act"), Michigan Act 451, Public Acts of 1994, as amended (the "Michigan Act"), Parts 31 and 41, and Michigan Executive Order 2009-45,

DTE Energy
One Energy Plaza
Room 655 G.O.
Detroit, Michigan 48226

is authorized to discharge from the **Fermi-2 Power Plant** located at

6400 North Dixie Highway
Newport, Michigan 48166

designated as **DECO-Fermi-2 Plt**

to the receiving waters named Lake Erie and Swan Creek in accordance with effluent limitations, monitoring requirements, and other conditions set forth in this permit.

This permit is based on a complete application submitted on May 19, 2009.

This permit takes effect August 1, 2010. The provisions of this permit are severable. After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term in accordance with applicable laws and rules. On its effective date this permit shall supersede NPDES Permit No. MI0037028, expiring October 1, 2009.

This permit and the authorization to discharge shall expire at midnight, **October 1, 2014.** In order to receive authorization to discharge beyond the date of expiration, the permittee shall submit an application which contains such information, forms, and fees as are required by the Department of Natural Resources and Environment (Department) by **April 4, 2014.**

Issued June 3, 2010. Based on an application amendment submitted on August 24, 2011, as amended on February 3, 2012, this permit was modified on April 23, 2012.

Phil Argiroff
Philip Argiroff, Chief
Permits Section
Water Resources Division

PERMIT FEE REQUIREMENTS

In accordance with Section 324.3120 of the Michigan Act, the permittee shall make payment of an annual permit fee to the Department for each October 1 the permit is in effect regardless of occurrence of discharge. The permittee shall submit the fee in response to the Department's annual notice. The fee shall be postmarked by January 15 for notices mailed by December 1. The fee is due no later than 45 days after receiving the notice for notices mailed after December 1.

Annual Permit Fee Classification: Industrial-Commercial Major

In accordance with Section 324.3118 of the Michigan Act, the permittee shall make payment of an annual storm water fee to the Department for each January 1 the permit is in effect regardless of occurrence of discharge. The permittee shall submit the fee in response to the Department's annual notice. The fee shall be postmarked by March 15 for notices mailed by February 1. The fee is due no later than 45 days after receiving the notice for notices mailed after February 1.

CONTACT INFORMATION

Unless specified otherwise, all contact with the Department required by this permit shall be made to the Jackson District Supervisor of the Water Bureau. The Jackson District Office is located at 301 East Louis Glick Highway, Jackson, Michigan 49201-1556, Telephone: 517-780-7690, Fax: 517-780-7855.

CONTESTED CASE INFORMATION

Any person who is aggrieved by this permit may file a sworn petition with the Office of Regulatory Reinvention within the Michigan Department of Licensing and Regulatory Affairs, setting forth the conditions of the permit which are being challenged and specifying the grounds for the challenge. The Department of Licensing and Regulatory Affairs may reject any petition filed more than 60 days after issuance as being untimely.

SPECIAL INSTRUCTIONS/NOTIFICATIONS

Note: Pursuant to Executive Order 2011-1, all references to the Department in this permit should now be interpreted as the "Department of Environmental Quality" and all references to the "Water Bureau" should now be interpreted as the "Water Resources Division".

PART I

Section A. Limitations and Monitoring Requirements

1. Final Effluent Limitations, Monitoring Point 001A

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the permittee is authorized to discharge a maximum of 45.1 MGD of cooling tower blowdown, processed radwaste wastewater, residual heat removal system service water, chemical metal cleaning wastes, and nonchemical metal cleaning wastes from Monitoring Point 001A through Outfall 001. Outfall 001 discharges to Lake Erie. Such discharge shall be limited and monitored by the permittee as specified below.

	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration				
Parameter	Monthly	Daily	Units	Monthly	Daily	Units	Monitoring Frequency	Sample Type
Flow	(report)	(report)	MGD	—	—	—	Daily	Report Total Daily Flow
Temperature								
Intake	—	—	—	—	(report)	°F	Daily	Reading
Discharge	—	—	—	—	(report)	°F	Daily	Reading
Total Residual Chlorine (TRC)	—	—	—	—	38	µg/l	5x Weekly	Grab
BetzDearborn Spectrus CT-1300	—	—	—	—	15	µg/l	See f. below	Grab
Outfall Observation	(report)	—	yes/no	—	—	—	Daily	Visual
				Minimum Daily	Maximum Daily			
pH	—	—	—	6.5	9.0	S.U.	Weekly	Grab

a. Narrative Standard
The receiving water shall contain no turbidity, color, oil films, floating solids, foams, settleable solids, suspended solids, or deposits as a result of this discharge in unnatural quantities which are or may become injurious to any designated use.

b. Monitoring Location
Samples, measurements, and observations taken in compliance with the monitoring requirements above shall be taken prior to discharge to Lake Erie.

c. Outfall Observation
Any unusual characteristics of the discharge (i.e., unnatural turbidity, color, oil film, floating solids, foams, settleable solids, suspended solids, or deposits) shall be reported within 24 hours to the Department followed with a written report within five (5) days detailing the findings of the investigation and the steps taken to correct the condition.

d. Water Treatment Additives
This permit does not authorize the discharge of water additives without approval from the Department. Approval of water additives is authorized under separate correspondence. Water additives include any material that is added to water used at the facility or to a wastewater generated by the facility to condition or treat the water. In the event a permittee proposes to discharge water additives, including an increased discharge concentration of a previously approved water additive, the permittee shall submit a request to the Department for approval. See Part I.A.9. for information on requesting water treatment additive use.

PART I

Section A. Limitations and Monitoring Requirements

e. Total Residual Chlorine Requirements
Total Residual Chlorine (TRC) shall be analyzed by Amperometric Titration using either Standard Method 4500-Cl D, Standard Method 4500-Cl E or Orion Electrode Model 97-70 (other analytical methods specified in 40 CFR 136 may be used upon approval of the Department). TRC monitoring is only required during periods of chlorine use and subsequent discharge. For the purposes of TRC effluent limitation compliance a week shall be defined as a calendar week from Monday through Sunday. The permittee shall enter a *G on the Discharge Monitoring Report when no chlorine is discharged.

The permittee may use dechlorination techniques to achieve the applicable TRC limitations, using sodium thiosulfate, sodium sulfite, sodium bisulfite, or other dechlorinating reagents approved by the Department. The quantity of reagent(s) used shall be limited to 1.5 times the stoichiometric amount of applied chlorine.

f. Zebra Mussel Control Requirements
The discharge of any combination of BetzDearborn Spectrus CT-1300 is restricted to no more than 2 times per year. The permittee shall not discharge BetzDearborn Spectrus CT-1300 from Monitoring Points 001A and 001B concurrently. The permittee shall verbally notify the Department at least one (1) normal business hour prior to each discharge. Normal business hours shall be defined as 8:00 A.M. to 5:00 P.M. Monday through Friday excluding National and State Holidays.

The sampling procedures, preservation and handling, and analytical protocol for compliance monitoring shall be in accordance with the Orange II/Methylene Chloride Method. The quantification levels shall not exceed 50 µg/l for BetzDearborn Spectrus CT-1300 unless higher levels are appropriate because of sample matrix interference. Justification for higher quantification levels shall be submitted to the Department within 30 days of such determination. Other methods may be used upon approval of the Department. The highest value measured during the discharge event shall be reported. If the concentration in all samples is less than the quantification level, report zero on the discharge monitoring reports. The permittee shall enter a *G on the Discharge Monitoring Report when no BetzDearborn Spectrus CT-1300 is discharged.

The sampling frequency of analysis shall be every three (3) hours during the first 24 hours of discharge from the Circulating Water System. The sampling frequency of analysis shall be every three (3) hours during the first 24 hours of discharge from the Residual Heat Removal System Service Water, if monitoring is required as defined in Part I.A.2.b.

Any discharge of BetzDearborn Spectrus CT-1300 at or above the indicated quantification levels is a specific violation of this permit. If all the samples in any monthly reporting period are less than the above quantification levels the Department will consider the permittee to be in compliance with the final effluent limitations for this pollutant for that reporting period.

g. Discharge of Radioactive Materials
The Federal Nuclear Regulatory Commission provides the regulation of radioactive materials under the Fermi-2 Nuclear Power Plant's operation license.

h. Power Plants - PCB Prohibition
The permittee shall not discharge any polychlorinated biphenyls to the receiving waters of the State of Michigan as a result of plant operations.

PART I

Section A. Limitations and Monitoring Requirements

2. Final Effluent Limitations, Monitoring Point 001B

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the permittee is authorized to discharge a maximum of 1.44 MGD of residual heat removal system service water excess from Monitoring Point 001B through Outfall 001. Outfall 001 discharges to Lake Erie. Such discharge shall be limited and monitored by the permittee as specified below.

Parameter	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration			Monitoring Frequency	Sample Type
	Monthly	Daily	Units	Monthly	Daily	Units		
Flow	(report)	(report)	MGD	—	—	—	Daily	Report Total Daily Flow
BetzDearborn Spectrus CT-1300	—	—	—	—	(report)	µg/l	See c. below	Grab

a. Monitoring Location
Samples, measurements, and observations taken in compliance with the monitoring requirements above shall be taken prior to mixing with other wastestreams.

b. Monitoring Requirements
The permittee shall monitor each division of the residual heat removal system prior to discharge to the circulating water system.

1) If the concentration of BetzDearborn Spectrus CT-1300 in the residual heat removal system service water is <50 µg/l monitoring for BetzDearborn Spectrus CT-1300 at Monitoring Point 001A will not be required.

2) If the concentration of BetzDearborn Spectrus CT-1300 in the residual heat removal system service water is ≥50 µg/l monitoring for BetzDearborn Spectrus CT-1300 at Monitoring Point 001A is required. See Part I.A.1.

c. Zebra Mussel Control Requirements
The discharge from any combination of treated reservoirs of BetzDearborn Spectrus CT-1300 is restricted to no more than eight (8) times per year. A discharge of BetzDearborn Spectrus CT-1300 shall be defined as a discharge limited to the first discharge occurring after the application of BetzDearborn Spectrus CT-1300, and prior to subsequent applications of BetzDearborn Spectrus CT-1300. The permittee shall not discharge BetzDearborn Spectrus CT-1300 from Monitoring Points 001A and 001B concurrently. The permittee shall verbally notify the Department at least one (1) normal business hour prior to each discharge. Normal business hours shall be defined as 8:00 A.M. to 5:00 P.M. Monday through Friday excluding National and State Holidays.

The sampling procedures, preservation and handling, and analytical protocol for compliance monitoring shall be in accordance with the Orange II/Methylene Chloride Method. The quantification levels shall not exceed 50 µg/l for BetzDearborn Spectrus CT-1300 unless higher levels are appropriate because of sample matrix interference. Justification for higher quantification levels shall be submitted to the Department within 30 days of such determination. Other methods may be used upon approval of the Department. The highest value measured during the discharge event shall be reported. If the concentration in all samples is less than the quantification level, report zero on the discharge monitoring reports. The permittee shall enter a *G on the Discharge Monitoring Report when no BetzDearborn Spectrus CT-1300 is discharged.

The sampling frequency of analysis shall be every three (3) hours during the first 24 hours of discharge from the Circulating Water System. The sampling frequency of analysis shall be every three (3) hours during the first 24 hours of discharge from the Residual Heat Removal System Service Water, if monitoring is required as defined in Part I.A.2.b.

PART I

Section A. Limitations and Monitoring Requirements

3. Final Effluent Limitations, Monitoring Point 001D

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the permittee is authorized to discharge a maximum of 0.216 MGD of processed radwaste wastewater from Monitoring Point 001D through Outfall 001. Outfall 001 discharges to Lake Erie. Such discharge shall be limited and monitored by the permittee as specified below.

	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration				
Parameter	Monthly	Daily	Units	Monthly	Daily	Units	Monitoring Frequency	Sample Type
Flow	(report)	(report)	MGD	—	—	—	Daily	Report Total Daily Flow
Total Suspended Solids	—	—	—	30	100	mg/l	Weekly	Grab
Oil & Grease	—	—	—	15	20	mg/l	2x Monthly	Grab

a. Monitoring Location
Samples, measurements, and observations taken in compliance with the monitoring requirements above shall be taken prior to mixing with other waste streams.

4. Final Effluent Limitations, Monitoring Point 001E

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the permittee is authorized to discharge a maximum of 0.5 MGD of treated chemical and nonchemical metal cleaning wastes from Monitoring Point 001E through Monitoring Point 001A and Outfall 001. Outfall 001 discharges to Lake Erie. Such discharge shall be limited and monitored by the permittee as specified below.

	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration				
Parameter	Monthly	Daily	Units	Monthly	Daily	Units	Monitoring Frequency	Sample Type
Flow	(report)	(report)	MGD	—	—	—	Daily	Report Total Daily Flow
Total Suspended Solids	—	—	—	30	100	mg/l	Weekly	Grab
Oil & Grease	—	—	—	15	20	mg/l	2x Monthly	Grab
Total Copper	—	—	—	—	1.0	mg/l	Daily	Grab
Total Iron	—	—	—	—	1.0	mg/l	Daily	Grab

a. Monitoring Location
Samples, measurements, and observations taken in compliance with the monitoring requirements above shall be taken prior to mixing with other waste streams.

PART I

Section A. Limitations and Monitoring Requirements

5. Final Effluent Limitations, Monitoring Point 009A

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the permittee is authorized to discharge a maximum of 0.72 MGD of low volume wastes, chemical metal cleaning wastes, and nonchemical metal cleaning wastes and an unspecified amount of storm water runoff from Monitoring Point 009A through Outfall 009. Outfall 009 discharges to Swan Creek via an overflow canal. Such discharge shall be limited and monitored by the permittee as specified below.

	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration				
Parameter	Monthly	Daily	Units	Monthly	Daily	Units	Monitoring Frequency	Sample Type
Flow	(report)	(report)	MGD	---	---	---	Daily	Report Total Daily Flow
Total Suspended Solids	---	---	---	30	100	mg/l	Daily	Grab
Oil & Grease	---	---	---	15	20	mg/l	Daily	Grab
Total Iron	---	---	---	---	1.0	mg/l	Daily (See f. below)	Grab-Composite
Total Residual Chlorine (TRC)	---	---	---	---	38	µg/l	Daily	Grab
Outfall Observation	(report)	---	yes/no	---	---	---	Daily	Visual
				Minimum Daily	Maximum Daily			
pH	---	---	---	6.5	9.0	S.U.	Daily	Grab

a. Narrative Standard
The receiving water shall contain no turbidity, color, oil films, floating solids, foams, settleable solids, or deposits as a result of this discharge in unnatural quantities which are or may become injurious to any designated use.

b. Monitoring Location
Samples, measurements, and observations taken in compliance with the monitoring requirements above shall be taken during discharge of the wastewaters other than storm water and prior to discharge to the overflow canal.

c. Outfall Observation
Any unusual characteristics of the discharge (i.e., unnatural turbidity, color, oil film, floating solids, foams, settleable solids, suspended solids, or deposits) shall be reported within 24 hours to the Department followed with a written report within five (5) days detailing the findings of the investigation and the steps taken to correct the condition.

d. Water Treatment Additives
This permit does not authorize the discharge of water additives without approval from the Department. Approval of water additives is authorized under separate correspondence. Water additives include any material that is added to water used at the facility or to a wastewater generated by the facility to condition or treat the water. In the event a permittee proposes to discharge water additives, including an increased discharge concentration of a previously approved water additive, the permittee shall submit a request to the Department for approval. See Part I.A.9. for information on requesting water treatment additive use.

PART I

Section A. Limitations and Monitoring Requirements

e. Total Residual Chlorine Requirements
Total Residual Chlorine (TRC) shall be analyzed by Amperometric Titration using either Standard Method 4500-Cl D, Standard Method 4500-Cl E or Orion Electrode Model 97-70 (other analytical methods specified in 40 CFR 136 may be used upon approval of the Department). TRC monitoring is only required if a discharge occurs within one week of chlorine application. The permittee shall enter a *G on the Discharge Monitoring Report when no chlorine is discharged.

The permittee may use dechlorination techniques to achieve the applicable TRC limitations, using sodium thiosulfate, sodium sulfite, sodium bisulfite, or other dechlorinating reagents approved by the Department. The quantity of reagent(s) used shall be limited to 1.5 times the stoichiometric amount of applied chlorine.

f. Monitoring Frequency for Total Iron
Total Iron shall be monitored daily during the discharge of chemical metal cleaning wastes. The sampling shall occur prior to mixing with any other wastestreams and/or discharge to the overflow canal. The permittee shall enter *G on the Discharge Monitoring Report when chemical metal cleaning wastes are not discharged.

g. Grab-Composite Samples
A grab-composite sample shall be defined as a composite of grab samples taken every four (4) hours during the discharge event.

6. Final Effluent Limitations, Monitoring Point 011A

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the permittee is authorized to discharge a maximum of 0.216 MGD of treated oily wastewater and an unspecified amount of service water screen backwash and storm water from Monitoring Point 011A through Outfall 011. Outfall 011 discharges to Swan Creek via an overflow canal. Such discharge shall be limited and monitored by the permittee as specified below.

Parameter	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration			Monitoring Frequency	Sample Type
	Monthly	Daily	Units	Monthly	Daily	Units		
Flow	(report)	(report)	MGD	—	—	—	Daily	Report Total Daily Flow
Total Selenium	—	—	—	—	(report)	µg/l	Quarterly	24-Hr Composite
Outfall Observation	(report)	—	yes/no	—	—	—	Daily	Visual
Total Mercury	(report)	—	lbs/day	(report)	—	ng/l	Monthly	Grab
	12-Month Rolling Average			12-Month Rolling Average				
Total Mercury	0.00005	—	lbs/day	27	—	ng/l	Monthly	Calculation
				Minimum Daily	Maximum Daily			
pH	—	—	—	6.5	9.0	S.U.	Daily	Grab

PART I

Section A. Limitations and Monitoring Requirements

a. Narrative Standard
The receiving water shall contain no turbidity, color, oil films, floating solids, foams, settleable solids, suspended solids, or deposits as a result of this discharge in unnatural quantities which are or may become injurious to any designated use.

b. Monitoring Location
Samples, measurements, and observations taken in compliance with the monitoring requirements above shall be taken only during discharge of oily wastewater and prior to discharge to the overflow canal.

c. Outfall Observation
Any unusual characteristics of the discharge (i.e., unnatural turbidity, color, oil film, floating solids, foams, settleable solids, suspended solids, or deposits) shall be reported within 24 hours to the Department followed with a written report within five (5) days detailing the findings of the investigation and the steps taken to correct the condition.

d. Water Treatment Additives
This permit does not authorize the discharge of water additives without approval from the Department. Approval of water additives is authorized under separate correspondence. Water additives include any material that is added to water used at the facility or to a wastewater generated by the facility to condition or treat the water. In the event a permittee proposes to discharge water additives, including an increased discharge concentration of a previously approved water additive, the permittee shall submit a request to the Department for approval. See Part I.A.9. for information on requesting water treatment additive use.

e. Final Effluent Limitation for Total Mercury
The final limit for Total Mercury is the Discharge Specific Level Currently Achievable (LCA) based on a multiple discharger variance from the water quality-based effluent limit of 1.3 ng/l, pursuant to Rule 323.1103(9) of the Water Quality Standards. Compliance with the LCA shall be determined as a 12-month rolling average. The 12-month rolling average shall be determined by adding the present monthly average result to the preceding 11 monthly average results then dividing the sum by 12. For facilities with quarterly monitoring requirements for Total Mercury, quarterly monitoring shall be equivalent to 3 months of monitoring in calculating the 12-month rolling average. Facilities that monitor more frequently than monthly for Total Mercury must determine the monthly average result, which is the sum of the results of all data obtained in a given month divided by the total number of samples taken, in order to calculate the 12-month rolling average. If the 12-month rolling average for any month is less than or equal to the LCA, the permittee will be considered to be in compliance for Total Mercury for that month, provided the permittee is also in full compliance with the Pollutant Minimization Program for Total Mercury, set forth in Part I.A.10.

After a minimum of 12 monthly data points have been collected, the permittee may request a reduction in the monitoring frequency for Total Mercury. This request shall contain an explanation as to why the reduced monitoring is appropriate and shall be submitted to the Department. Upon receipt of written approval and consistent with such approval, the permittee may reduce the monitoring frequency for Total Mercury indicated in Part I.A.6. of this permit. The Department may revoke the approval for reduced monitoring at any time upon notification to the permittee

f. Total Mercury Testing Requirements
The analytical protocol for Total Mercury shall be in accordance with EPA Method 1631, Revision E, "Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry". The quantification level for Total Mercury shall be 0.5 ng/l, unless a higher level is appropriate because of sample matrix interference. Justification for higher quantification levels shall be submitted to the Department within 30 days of such determination.

PART I

Section A. Limitations and Monitoring Requirements

The use of clean technique sampling procedures is required unless the permittee can demonstrate to the Department that an alternative sampling procedure is representative of the discharge. Guidance for clean technique sampling is contained in: EPA Method 1669, *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels (Sampling Guidance)*, EPA-821-R96-001, July 1996. Information and data documenting the permittee's sampling and analytical protocols and data acceptability shall be submitted to the Department upon request.

g. Analytical Method and Quantification Level for Total Selenium
The sampling procedures, preservation and handling, and analytical protocol for compliance monitoring for Total Selenium shall be in accordance with an EPA approved method. The quantification level for Total Selenium shall be 1 µg/l unless a higher level is appropriate because of sample matrix interference. Justification for higher quantification levels shall be submitted to the Department within 30 days of such determination. The quarterly samples shall be collected in the months of January, April, July and October.

h. Monitoring Frequency Reduction for Total Selenium
After the submittal of 12 months (four quarterly samples) of data, the permittee may request, in writing, Department approval of a reduction in monitoring frequency for Total Selenium. This request shall contain an explanation as to why the reduced monitoring is appropriate. Upon receipt of written approval and consistent with such approval, the permittee may reduce or eliminate the monitoring frequency indicated in Part I.A.6. of this permit. The Department may revoke the approval for reduced monitoring at any time upon notification to the permittee.

7. Final Effluent Limitations, Monitoring Point 011C

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the permittee is authorized to discharge a maximum of 0.216 MGD of treated oily wastewater from Monitoring Point 011C through Outfall 011. Outfall 011 discharges to Swan Creek via an overflow canal. Such discharge shall be limited and monitored by the permittee as specified below.

	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration				
Parameter	**Monthly**	**Daily**	**Units**	**Monthly**	**Daily**	**Units**	**Monitoring Frequency**	**Sample Type**
Flow	(report)	(report)	MGD	---	---	---	Daily	Report Total Daily Flow
Total Suspended Solids	---	---	---	30	100	mg/l	Weekly	Grab
Oil & Grease	---	---	---	15	20	mg/l	2x Monthly	Grab

a. Monitoring Location
Samples, measurements, and observations taken in compliance with the monitoring requirements above shall be taken prior to mixing with other wastestreams.

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8. Final Effluent Limitations, Monitoring Point 013A

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the permittee is authorized to discharge a maximum of 450 MGY of dredging dewatering water from Monitoring Point 013A through Outfall 013. Outfall 013 discharges to Lake Erie. Such discharge shall be limited and monitored by the permittee as specified below.

	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration				
Parameter	Monthly	Daily	Units	Monthly	Daily	Units	Monitoring Frequency	Sample Type
Flow	(report)	(report)	MGD	---	---	---	Daily	Report Total Daily Flow
Total Suspended Solids								
Intake	---	---	---	(report)	(report)	mg/l	Daily	Grab
Discharge	---	---	---	(report)	(report)	mg/l	Daily	Grab
Net Discharge	---	---	---	35	70	mg/l	Daily	Grab
Outfall Observation	(report)	---	yes/no	---	---	---	Daily	Visual
				Minimum Daily	**Maximum Daily**			
	---	---	---	6.5	9.0	S.U.	Daily	Grab

a. Narrative Standard
The receiving water shall contain no turbidity, color, oil films, floating solids, foams, settleable solids, or deposits as a result of this discharge in unnatural quantities which are or may become injurious to any designated use.

b. Monitoring Location and Frequency
Samples, measurements, and observations taken in compliance with the monitoring requirements above shall be taken during discharge of wastewaters other than storm water and prior to discharge to Lake Erie.

c. Outfall Observation
Any unusual characteristics of the discharge (i.e., unnatural turbidity, color, oil film, floating solids, foams, settleable solids, suspended solids, or deposits) shall be reported within 24 hours to the Department followed with a written report within five (5) days detailing the findings of the investigation and the steps taken to correct the condition.

d. Water Treatment Additives
This permit does not authorize the discharge of water additives without approval from the Department. Approval of water additives is authorized under separate correspondence. Water additives include any material that is added to water used at the facility or to a wastewater generated by the facility to condition or treat the water. In the event a permittee proposes to discharge water additives, including an increased discharge concentration of a previously approved water additive, the permittee shall submit a request to the Department for approval. See Part I.A.9. for information on requesting water treatment additive use.

e. Net Total Suspended Solids Calculation
The net total suspended solids concentration shall be determined by subtracting the concentration of the intake sample from the concentration of the discharge sample. Negative results shall be reported as "0". Samples shall be taken within the same 24 hour period.

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9. Request for Discharge of Water Treatment Additives

In the event a permittee proposes to discharge water additives, the permittee shall submit a request to discharge water additives to the Department for approval. Such requests shall be sent to the Permits Section, Water Resources Division, Department of Environmental Quality, P.O. Box 30458, Lansing, Michigan 48909, with a copy to the Department contact listed on the cover page of this permit. Instructions to submit a request electronically may be obtained via the Internet (http://www.michigan.gov/deqnpdes; then click on Applicable Rules and Regulations which is under the Information banner and then click on Water Treatment Additive Discharge Application Instructions). Written approval from the Department to discharge such additives at specified levels shall be obtained prior to discharge by the permittee. Additional monitoring and reporting may be required as a condition for the approval to discharge the additive.

A request to discharge water additives shall include all of the following water additive usage and discharge information:

a. Material Safety Data Sheet;
b. the proposed water additive discharge concentration;
c. the discharge frequency (i.e., number of hours per day and number of days per year);
d. the monitoring point from which the product is to be discharged;
e. the type of removal treatment, if any, that the water additive receives prior to discharge;
f. product function (i.e., microbiocide, flocculant, etc.);
g. a 48-hour LC_{50} or EC_{50} for a North American freshwater planktonic crustacean (either *Ceriodaphnia* sp., *Daphnia* sp., or *Simocephalus* sp.); and
h. the results of a toxicity test for one other North American freshwater aquatic species (other than a planktonic crustacean) that meets a minimum requirement of Rule 323.1057(2) of the Water Quality Standards.

Prior to submitting the request, the permittee may contact the Permits Section by telephone at 517-241-1346 or via the Internet at the address given above to determine if the Department has the product toxicity data required by items g. and h. above. If the Department has the data, the permittee will not need to submit product toxicity data.

10. Pollutant Minimization Program for Total Mercury

The goal of the Pollutant Minimization Program is to maintain the effluent concentration of total mercury at or below 1.3 ng/l. The permittee shall continue to implement the Pollutant Minimization Program approved on March 27, 2007, and modifications thereto, to proceed toward the goal. The Pollutant Minimization Program includes the following:

a. an annual review and semi-annual monitoring of potential sources of mercury entering the wastewater collection system;

b. a program for quarterly monitoring of influent; and

c. implementation of reasonable cost-effective control measures when sources of mercury are discovered. Factors to be considered include significance of sources, economic considerations, and technical and treatability considerations.

On or before March 31st of each year, the permittee shall submit a status report for the previous calendar year to the Department that includes 1) the monitoring results for the previous year, 2) an updated list of potential mercury sources, and 3) a summary of all actions taken to reduce or eliminate identified sources of mercury.

Any information generated as a result of the Pollutant Minimization Program set forth in this permit may be used to support a request to modify the approved program or to demonstrate that the Pollutant Minimization Program requirement has been completed satisfactorily.

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A request for modification of the approved program and supporting documentation shall be submitted in writing to the Department for review and approval. The Department may approve modifications to the approved program (approval of a program modification does not require a permit modification), including a reduction in the frequency of the requirements under Items a. & b.

This permit may be modified in accordance with applicable laws and rules to include additional mercury conditions and/or limitations as necessary.

11. Cold Shock Prevention

Cessation of thermal inputs to the receiving water by this facility shall occur gradually so as to avoid fish mortality due to cold shock during the winter months (November through March). The basis for this requirement is to allow fish associated with the discharge-heated mixing zone for Outfall 001 to acclimate to the decreasing temperature.

12. Intake Screen Backwash

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the permittee is authorized to discharge intake screen backwash from Outfalls 000 and 011 to Lake Erie. The permittee shall collect and remove debris accumulated on intake trash bars and dispose of such material on land in an appropriate manner.

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13. Storm Water Pollution Prevention Plan

The permittee is authorized to discharge storm water associated with industrial activities as defined in 40 CFR 122.26(b)(14). These storm water discharges shall be controlled in accordance with the requirements of this special condition. The permittee has developed and implemented a Storm Water Pollution Prevention Plan (plan). The permittee shall continue implementation of the plan for maximum control of significant materials (as defined in Part II.A.) so that storm water discharges will not cause a violation of the Water Quality Standards. The plan shall be routinely reviewed and updated in accordance with the requirements of this section.

a. Source Identification
To identify potential sources of significant materials that can enter storm water and subsequently be discharged from the facility, the plan shall, at a minimum, include the following:

1) A site map identifying the following: buildings and other permanent structures; storage or disposal areas for significant materials; secondary containment structures; storm water discharge outfalls (numbered for reference); location of storm water inlets contributing to each outfall; location of NPDES permitted discharges other than storm water; outlines of the drainage areas contributing to each outfall; structural runoff controls or storm water treatment facilities; areas of vegetation; areas of exposed and/or erodible soils; impervious surfaces (roofs, asphalt, concrete); name and location of receiving water(s); and areas of known or suspected impacts on surface waters as designated under Part 201 (Environmental Response) of the Michigan Act.

2) A list of all significant materials that could enter storm water. For each material listed, the plan shall include the following descriptions:

a) ways in which each type of material has been or has reasonable potential to become exposed to storm water (e.g., spillage during handling; leaks from pipes, pumps, and vessels; contact with storage piles; waste handling and disposal; deposits from dust or overspray, etc.);

b) identification of the outfall or outfalls through which the material may be discharged if released;

c) a listing of spills and leaks of polluting materials in quantities reportable under the Part 5 Rules (Rules 324.2001 through 324.2009 of the Michigan Administrative Code) that occurred at areas that are exposed to precipitation or that otherwise discharge to a point source at the facility. The listing shall include spills and leaks that occurred over the three (3) years prior to the completion of the plan or latest update of the plan; the date, volume and exact location of release; and the action taken to clean up the material and/or prevent exposure to storm water runoff or contamination of surface waters of the state. Any release that occurs after the plan has been developed shall be controlled in accordance with the plan and is cause for the plan to be updated as appropriate within 14 calendar days of obtaining knowledge of the spill or loss; and

d) if there is a Total Maximum Daily Load (TMDL) established by the Department for the receiving waters, which restricts the discharge of any of the identified significant materials or constituents of those materials, then the SWPPP shall identify the level of control for those materials necessary to comply with the TMDL, and an estimate of the current annual load of those materials via storm water discharges to the receiving stream.

3) An evaluation of the reasonable potential for contribution of significant materials to runoff from at least the following areas or activities: loading, unloading, and other material handling operations; outdoor storage, including secondary containment structures; outdoor manufacturing or processing activities; significant dust or particulate generating processes; discharge from vents, stacks and air emission controls; on-site waste disposal practices; maintenance and cleaning of vehicles, machines and equipment; sites of exposed and/or erodible soil; sites of environmental contamination listed under Part 201 (Environmental Response) of the Michigan Act; areas of significant material residue; and other areas where storm water may contact significant materials.

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4) A summary of existing storm water discharge sampling data (if available) describing pollutants in storm water discharges associated with industrial activity at the facility. This summary shall be accompanied by a description of the suspected source(s) of the pollutants detected.

b. Preventive Measures and Source Controls, Non-Structural
To prevent significant materials from contacting storm water at the source, the plan shall, at a minimum, include the following non-structural controls:

1) Description of a program for routine preventive maintenance which includes requirements for inspection and maintenance of storm water management and control devices (e.g., cleaning of oil/water separators and catch basins) as well as inspecting and testing plant equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters. A log of the inspection and corrective actions shall be maintained on file by the permittee, and shall be retained in accordance with Record Keeping, below.

2) A schedule for comprehensive site inspection to include visual inspection of equipment, plant areas, and structural pollution prevention and treatment controls to be performed at least once every six (6) months. A report of the results of the comprehensive site inspection shall be prepared and retained in accordance with Record Keeping, below. The report shall identify any incidents of non-compliance with the plan. If there are no reportable incidents of non-compliance, the report shall contain a certification that the facility is in compliance with this plan.

3) A description of good housekeeping procedures to maintain a clean, orderly facility.

4) A description of material handling procedures and storage requirements for significant materials. Equipment and procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The procedures shall identify measures to prevent the spilled materials or material residues on the outside of containers from being discharged into storm water. The plan may include, by reference, requirements of either a Pollution Incident Prevention Plan (PIPP) prepared in accordance with the Part 5 Rules (Rules 324.2001 through 324.2009 of the Michigan Administrative Code); a Hazardous Waste Contingency Plan prepared in accordance with 40 CFR 264 and 265 Subpart D, as required by Part 111 of the Michigan Act; or a Spill Prevention Control and Countermeasure (SPCC) plan prepared in accordance with 40 CFR 112.

5) Identification of areas that, due to topography, activities, or other factors, have a high potential for significant soil erosion. The plan shall also identify measures used to control soil erosion and sedimentation.

6) A description of employee training programs which will be implemented to inform appropriate personnel at all levels of responsibility of the components and goals of the plan. The plan shall identify periodic dates for such training.

7) Identification of actions to limit the discharge of significant materials in order to comply with TMDL requirements.

8) Identification of significant materials expected to be present in storm water discharges following implementation of non-structural preventative measures and source controls.

c. Structural Controls for Prevention and Treatment
Where implementation of the measures required by Preventive Measures and Source Controls, Non-Structural; above; does not control storm water discharges in accordance with Water Quality Standards, below, the plan shall provide a description of the location, function, and design criteria of structural controls for prevention and treatment. Structural controls may be necessary:

1) To prevent uncontaminated storm water from contacting or being contacted by significant materials, and/or

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2) If preventive measures are not feasible or are inadequate to keep significant materials at the site from contaminating storm water. Structural controls shall be used to treat, divert, isolate, recycle, reuse or otherwise manage storm water in a manner that reduces the level of significant materials in the storm water and provides compliance with the Water Quality Standards, below.

d. Keeping Plans Current

1) The permittee shall review the plan on or before October 1st of each year, and maintain written summaries of the reviews. Based on the review, the permittee shall amend the plan as needed to ensure continued compliance with the terms and conditions of this permit.

2) The plan shall also be updated or amended whenever changes or spills at the facility increase or have the potential to increase the exposure of significant materials to storm water, or when the plan is determined by the permittee or the Department to be ineffective in achieving the general objectives of controlling pollutants in storm water discharges associated with industrial activity. Updates based on increased activity at the facility shall include a description of how the permittee intends to control any new sources of significant materials or respond to and prevent spills in accordance with the requirements of Source Identification; Preventive Measures and Source Controls, Non-Structural; and Structural Controls for Prevention and Treatment; above.

3) The Department or authorized representative may notify the permittee at any time that the plan does not meet minimum requirements. Such notification shall identify why the plan does not meet minimum requirements. The permittee shall make the required changes to the plan within 30 days after such notification from the Department or authorized representative, and shall submit to the Department a written certification that the requested changes have been made.

e. Certified Storm Water Operator Update

If the certified operator has changed or an additional certified storm water operator is added, the permittee shall provide the name and certification number of the new operator to the Department. The new operator shall review and sign the plan.

f. Signature and Plan Review

1) The plan shall be signed by the certified storm water operator and by either the permittee or an authorized representative in accordance with 40 CFR 122.22. The plan shall be retained on site of the facility that generates the storm water discharge.

2) The permittee shall make plans, reports, log books, runoff quality data, and supporting documents available upon request to the Department or authorized representative.

g. Record Keeping

The permittee shall maintain records of all inspection and maintenance activities. Records shall also be kept describing incidents such as spills or other discharges that can affect the quality of storm water runoff. All such records shall be retained for three (3) years.

h. Water Quality Standards

At the time of discharge, there shall be no violation of the Water Quality Standards in the receiving waters as a result of this discharge. This requirement includes, but is not limited to, the following conditions:

1) In accordance with Rule 323.1050 of the Water Quality Standards, the receiving waters shall not have any of the following unnatural physical properties in quantities which are or may become injurious to any designated use: unnatural turbidity, color, oil film, floating solids, foams, settleable solids, suspended solids, or deposits as a result of this discharge.

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2) Any unusual characteristics of the discharge (i.e., unnatural turbidity, color, oil film, floating solids, foams, settleable solids, suspended solids, or deposits) shall be reported within 24 hours to the Department followed with a written report within five (5) days detailing the findings of the investigation and the steps taken to correct the condition.

3) Any pollutant for which a level of control is specified to meet a Total Maximum Daily Load (TMDL) established by the Department shall be controlled at the facility so that its discharge is reduced by the amount specified in the waste load allocation of the TMDL. Any reduction achieved through implementation of the non-structural controls or structural controls in accordance with Preventive Measures and Source Controls, Non-Structural; and Structural Controls for Prevention and Treatment; above; shall count toward compliance with the TMDL.

i. Prohibition of Non-storm Water Discharges
Discharges of material other than storm water shall be in compliance with an NPDES permit issued for the discharge. Storm water shall be defined to include the following non-storm water discharges provided pollution prevention controls for the non-storm water component are identified in the plan: discharges from fire hydrant flushing, potable water sources including water line flushing, fire system test water, irrigation drainage, lawn watering, routine building wash down which does not use detergents or other compounds, pavement wash water where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material have been removed) and where detergents are not used, air conditioning condensate, springs, uncontaminated groundwater, and foundation or footing drains where flows are not contaminated with process materials such as solvents. Discharges from fire fighting activities are authorized by this permit, but do not have to be identified in the plan.

14. Facility Contact

The "Facility Contact" was specified in the application. The permittee may replace the facility contact at any time, and shall notify the Department in writing within 10 days after replacement (including the name, address and telephone number of the new facility contact).

a. The facility contact shall be (or a duly authorized representative of this person):
   - for a corporation, a principal executive officer of at least the level of vice president, or a designated representative, if the representative is responsible for the overall operation of the facility from which the discharge described in the permit application or other NPDES form originates,
   - for a partnership, a general partner,
   - for a sole proprietorship, the proprietor, or
   - for a municipal, state, or other public facility, either a principal executive officer, the mayor, village president, city or village manager or other duly authorized employee.

b. A person is a duly authorized representative only if:
   - the authorization is made in writing to the Department by a person described in paragraph a. of this section; and
   - the authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the facility (a duly authorized representative may thus be either a named individual or any individual occupying a named position).

Nothing in this section obviates the permittee from properly submitting reports and forms as required by law.

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Section A. Definitions

This list of definitions may include terms not applicable to this permit.

Acute toxic unit (TU_A) means $100/LC_{50}$ where the LC_{50} is determined from a whole effluent toxicity (WET) test which produces a result that is statistically or graphically estimated to be lethal to 50% of the test organisms.

Bioaccumulative chemical of concern (BCC) means a chemical which, upon entering the surface waters, by itself or as its toxic transformation product, accumulates in aquatic organisms by a human health bioaccumulation factor of more than 1000 after considering metabolism and other physiochemical properties that might enhance or inhibit bioaccumulation. The human health bioaccumulation factor shall be derived according to R 323.1057(5). Chemicals with half-lives of less than 8 weeks in the water column, sediment, and biota are not BCCs. The minimum bioaccumulation concentration factor (BAF) information needed to define an organic chemical as a BCC is either a field-measured BAF or a BAF derived using the biota-sediment accumulation factor (BSAF) methodology. The minimum BAF information needed to define an inorganic chemical as a BCC, including an organometal, is either a field-measured BAF or a laboratory-measured bioconcentration factor (BCF). The BCCs to which these rules apply are identified in Table 5 of R 323.1057 of the Water Quality Standards.

Biosolids are the solid, semisolid, or liquid residues generated during the treatment of sanitary sewage or domestic sewage in a treatment works. This includes, but is not limited to, scum or solids removed in primary, secondary, or advanced wastewater treatment processes and a derivative of the removed scum or solids.

Bulk biosolids means biosolids that are not sold or given away in a bag or other container for application to a lawn or home garden.

Chronic toxic unit (TU_C) means 100/MATC or $100/IC_{25}$, where the maximum acceptable toxicant concentration (MATC) and IC_{25} are expressed as a percent effluent in the test medium.

Class B Biosolids refers to material that has met the Class B pathogen reduction requirements or equivalent treatment by a Process to Significantly Reduce Pathogens (PSRP) in accordance with the Part 24 Rules. Processes include aerobic digestion, composting, anaerobic digestion, lime stabilization and air drying.

Daily concentration is the sum of the concentrations of the individual samples of a parameter divided by the number of samples taken during any calendar day. If the parameter concentration in any sample is less than the quantification limit, regard that value as zero when calculating the daily concentration. The daily concentration will be used to determine compliance with any maximum and minimum daily concentration limitations (except for pH and dissolved oxygen). When required by the permit, report the maximum calculated daily concentration for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the Discharge Monitoring Reports (DMRs).

For pH, report the maximum value of any individual sample taken during the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs and the minimum value of any individual sample taken during the month in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs. For dissolved oxygen, report the minimum concentration of any individual sample in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs.

Daily loading is the total discharge by weight of a parameter discharged during any calendar day. This value is calculated by multiplying the daily concentration by the total daily flow and by the appropriate conversion factor. The daily loading will be used to determine compliance with any maximum daily loading limitations. When required by the permit, report the maximum calculated daily loading for the month in the "MAXIMUM" column under "QUANTITY OR LOADING" on the DMRs.

Department means the Michigan Department of Natural Resources and Environment.

Detection Level means the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability.

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EC_{50} means a statistically or graphically estimated concentration that is expected to cause 1 or more specified effects in 50% of a group of organisms under specified conditions.

Fecal coliform bacteria monthly is the geometric mean of the samples collected in a calendar month (or 30 consecutive days). The calculated monthly value will be used to determine compliance with the maximum monthly fecal coliform bacteria limitations. When required by the permit, report the calculated monthly value in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMRs.

Fecal coliform bacteria 7-day is the geometric mean of the samples collected in any 7-day period. The calculated 7-day value will be used to determine compliance with the maximum 7-day fecal coliform bacteria limitations. When required by the permit, report the maximum calculated 7-day concentration for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs.

Flow Proportioned sample is a composite sample with the sample volume proportional to the effluent flow.

Grab sample is a single sample taken at neither a set time nor flow.

IC_{25} means the toxicant concentration that would cause a 25% reduction in a nonquantal biological measurement for the test population.

Interference is a discharge which, alone or in conjunction with a discharge or discharges from other sources, both: 1) inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and 2) therefore, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or, of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder (or more stringent state or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA) (including Title II, more commonly referred to as the Resource Conservation and Recovery Act (RCRA), and including state regulations contained in any state sludge management plan prepared pursuant to Subtitle D of the SWDA), the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act. [This definition does not apply to sample matrix interference.]

Land Application means spraying or spreading biosolids or a biosolids derivative onto the land surface, injecting below the land surface, or incorporating into the soil so that the biosolids or biosolids derivative can either condition the soil or fertilize crops or vegetation grown in the soil.

LC_{50} means a statistically or graphically estimated concentration that is expected to be lethal to 50% of a group of organisms under specified conditions.

Maximum acceptable toxicant concentration (MATC) means the concentration obtained by calculating the geometric mean of the lower and upper chronic limits from a chronic test. A lower chronic limit is the highest tested concentration that did not cause the occurrence of a specific adverse effect. An upper chronic limit is the lowest tested concentration which did cause the occurrence of a specific adverse effect and above which all tested concentrations caused such an occurrence.

MGD means million gallons per day.

Monthly frequency of analysis *refers to a calendar month.* When required by this permit, an analytical result, reading, value or observation must be reported for that period if a discharge occurs during that period.

Monthly concentration is the sum of the daily concentrations determined during a reporting month (or 30 consecutive days) divided by the number of daily concentrations determined. The calculated monthly concentration will be used to determine compliance with any maximum monthly concentration limitations. When required by the permit, report the calculated monthly concentration in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMRs.

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For minimum percent removal requirements, the monthly influent concentration and the monthly effluent concentration shall be determined. The calculated monthly percent removal, which is equal to 100 times the quantity [1 minus the quantity (monthly effluent concentration divided by the monthly influent concentration)], shall be reported in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs.

Monthly loading is the sum of the daily loadings of a parameter divided by the number of daily loadings determined in the reporting month (or 30 consecutive days). The calculated monthly loading will be used to determine compliance with any maximum monthly loading limitations. When required by the permit, report the calculated monthly loading in the "AVERAGE" column under "QUANTITY OR LOADING" on the DMRs.

National Pretreatment Standards are the regulations promulgated by or to be promulgated by the Federal Environmental Protection Agency pursuant to Section 307(b) and (c) of the Federal Act. The standards establish nationwide limits for specific industrial categories for discharge to a POTW.

No observed adverse effect level (NOAEL) means the highest tested dose or concentration of a substance which results in no observed adverse effect in exposed test organisms where higher doses or concentrations result in an adverse effect.

Noncontact Cooling Water is water used for cooling which does not come into direct contact with any raw material, intermediate product, by-product, waste product or finished product.

Nondomestic user is any discharger to a POTW that discharges wastes other than or in addition to water-carried wastes from toilet, kitchen, laundry, bathing or other facilities used for household purposes.

Partially treated sewage is any sewage, sewage and storm water, or sewage and wastewater, from domestic or industrial sources that is treated to a level less than that required by the permittee's National Pollutant Discharge Elimination System permit, or that is not treated to national secondary treatment standards for wastewater, including discharges to surface waters from retention treatment facilities.

Pretreatment is reducing the amount of pollutants, eliminating pollutants, or altering the nature of pollutant properties to a less harmful state prior to discharge into a public sewer. The reduction or alteration can be by physical, chemical, or biological processes, process changes, or by other means. Dilution is not considered pretreatment unless expressly authorized by an applicable National Pretreatment Standard for a particular industrial category.

POTW is a publicly owned treatment works.

Quantification level means the measurement of the concentration of a contaminant obtained by using a specified laboratory procedure calculated at a specified concentration above the detection level. It is considered the lowest concentration at which a particular contaminant can be quantitatively measured using a specified laboratory procedure for monitoring of the contaminant.

Quarterly frequency of analysis refers to a three month period, defined as January through March, April through June, July through September, and October through December. When required by this permit, an analytical result, reading, value or observation must be reported for that period if a discharge occurs during that period.

Regional Administrator is the Region 5 Administrator, U.S. EPA, located at R-19J, 77 W. Jackson Blvd., Chicago, Illinois 60604.

Significant industrial user is a nondomestic user that: 1) is subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N; or 2) discharges an average of 25,000 gallons per day or more of process wastewater to a POTW (excluding sanitary, noncontact cooling and boiler blowdown wastewater); contributes a process wastestream which makes up five (5) percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the permittee as defined in 40 CFR 403.12(a) on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's treatment plant operation or violating any pretreatment standard or requirement (in accordance with 40 CFR 403.8(f)(6)).

PART II

Section A. Definitions

Significant Materials Significant Materials means any material which could degrade or impair water quality, including but not limited to: raw materials; fuels; solvents, detergents, and plastic pellets; finished materials such as metallic products; hazardous substances designated under Section 101(14) of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (see 40 CFR 372.65); any chemical the facility is required to report pursuant to Section 313 of Emergency Planning and Community Right-to-Know Act (EPCRA); polluting materials as identified under the Part 5 Rules (Rules 324.2001 through 324.2009 of the Michigan Administrative Code); Hazardous Wastes as defined in Part 111 of the Michigan Act; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharges.

Tier I value means a value for aquatic life, human health or wildlife calculated under R 323.1057 of the Water Quality Standards using a tier I toxicity database.

Tier II value means a value for aquatic life, human health or wildlife calculated under R 323.1057 of the Water Quality Standards using a tier II toxicity database.

Total Maximum Daily Loads (TMDLs) are required by the Federal Act for waterbodies that do not meet Water Quality Standards. TMDLs represent the maximum daily load of a pollutant that a waterbody can assimilate and meet Water Quality Standards and an allocation of that load among point sources, nonpoint sources, and a margin of safety.

Toxicity Reduction Evaluation (TRE) means a site-specific study conducted in a stepwise process designed to identify the causative agents of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity.

Water Quality Standards means the Part 4 Water Quality Standards promulgated pursuant to Part 31 of Act No. 451 of the Public Acts of 1994, as amended, being Rules 323.1041 through 323.1117 of the Michigan Administrative Code.

Weekly frequency of analysis refers to a calendar week which begins on Sunday and ends on Saturday. When required by this permit, an analytical result, reading, value or observation must be reported for that period if a discharge occurs during that period.

Yearly frequency of analysis refers to a calendar year beginning on January 1 and ending on December 31. When required by this permit, an analytical result, reading, value or observation must be reported for that period if a discharge occurs during that period.

24-Hour Composite sample is a flow proportioned composite sample consisting of hourly or more frequent portions that are taken over a 24-hour period.

3-Portion Composite sample is a sample consisting of three equal volume grab samples collected at equal intervals over an 8-hour period.

7-day concentration is the sum of the daily concentrations determined during any 7 consecutive days in a reporting month divided by the number of daily concentrations determined. The calculated 7-day concentration will be used to determine compliance with any maximum 7-day concentration limitations. When required by the permit, report the maximum calculated 7-day concentration for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs.

7-day loading is the sum of the daily loadings of a parameter divided by the number of daily loadings determined during any 7 consecutive days in a reporting month. The calculated 7-day loading will be used to determine compliance with any maximum 7-day loading limitations. When required by the permit, report the maximum calculated 7-day loading for the month in the "MAXIMUM" column under "QUANTITY OR LOADING" on the DMRs.

PART II

Section B. Monitoring Procedures

1. Representative Samples

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Test Procedures

Test procedures for the analysis of pollutants shall conform to regulations promulgated pursuant to Section 304(h) of the Federal Act (40 CFR Part 136 - Guidelines Establishing Test Procedures for the Analysis of Pollutants), unless specified otherwise in this permit. Requests to use test procedures not promulgated under 40 CFR Part 136 for pollutant monitoring required by this permit shall be made in accordance with the Alternate Test Procedures regulations specified in 40 CFR 136.4. These requests shall be submitted to the Chief of the Permits Section, Water Bureau, Michigan Department of Natural Resources and Environment, P.O. Box 30273, Lansing, Michigan, 48909-7773. The permittee may use such procedures upon approval.

The permittee shall periodically calibrate and perform maintenance procedures on all analytical instrumentation at intervals to ensure accuracy of measurements. The calibration and maintenance shall be performed as part of the permittee's laboratory Quality Control/Quality Assurance program.

3. Instrumentation

The permittee shall periodically calibrate and perform maintenance procedures on all monitoring instrumentation at intervals to ensure accuracy of measurements.

4. Recording Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information: 1) the exact place, date, and time of measurement or sampling; 2) the person(s) who performed the measurement or sample collection; 3) the dates the analyses were performed; 4) the person(s) who performed the analyses; 5) the analytical techniques or methods used; 6) the date of and person responsible for equipment calibration; and 7) the results of all required analyses.

5. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained for a minimum of three (3) years or longer if requested by the Regional Administrator or the Department.

PART II

Section C. Reporting Requirements

1. Start-up Notification

If the permittee will not discharge during the first 60 days following the effective date of this permit, the permittee shall notify the Department within 14 days following the effective date of this permit, and then 60 days prior to the commencement of the discharge.

2. Submittal Requirements for Self-Monitoring Data

Part 31 of Act 451 of 1994, as amended, specifically Section 324.3110(3) and Rule 323.2155(2) of Part 21 allows the Department to specify the forms to be utilized for reporting the required self-monitoring data. Unless instructed on the effluent limitations page to conduct "Retained Self Monitoring" the permittee shall submit self-monitoring data via the Michigan DEQ Electronic Environmental Discharge Monitoring Reporting (e2-DMR) system.

The permittee shall utilize the information provided on the e2-Reporting website @ **https://secure1.state.mi.us/e2rs/** to access and submit the electronic forms. . Both monthly summary and daily data shall be submitted to the Department no later than the **20th day of the month** following each month of the authorized discharge period(s).

3. Retained Self-Monitoring Requirements

If instructed on the effluent limits page to conduct retained self-monitoring, the permittee shall maintain a year-to-date log of retained self-monitoring results and, upon request, provide such log for inspection to the staff of the Water Bureau, Michigan Department of Natural Resources and Environment. Retained self-monitoring results are public information and shall be promptly provided to the public upon request.

The permittee shall certify, in writing, to the Department, on or before January 10th of each year, that: 1) all retained self-monitoring requirements have been complied with and a year-to-date log has been maintained; and 2) the application on which this permit is based still accurately describes the discharge. With this annual certification, the permittee shall submit a summary of the previous years monitoring data. The summary shall include maximum values for samples to be reported as daily maximums and/or monthly maximums and minimum values for any daily minimum samples.

4. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report. Such increased frequency shall also be indicated.

Monitoring required pursuant to Part 41 of the Michigan Act or Rule 35 of the Mobile Home Park Commission Act (Act 96 of the Public Acts of 1987) for assurance of proper facility operation shall be submitted as required by the Department.

5. Compliance Dates Notification

Within 14 days of every compliance date specified in this permit, the permittee shall submit a written notification to the Department indicating whether or not the particular requirement was accomplished. If the requirement was not accomplished, the notification shall include an explanation of the failure to accomplish the requirement, actions taken or planned by the permittee to correct the situation, and an estimate of when the requirement will be accomplished. If a written report is required to be submitted by a specified date and the permittee accomplishes this, a separate written notification is not required.

PART II

Section C. Reporting Requirements

6. Noncompliance Notification

Compliance with all applicable requirements set forth in the Federal Act, Parts 31 and 41 of the Michigan Act, and related regulations and rules is required. All instances of noncompliance shall be reported as follows:

a. 24-hour reporting - Any noncompliance which may endanger health or the environment (including maximum daily concentration discharge limitation exceedances) shall be reported, verbally, within 24 hours from the time the permittee becomes aware of the noncompliance. A written submission shall also be provided within five (5) days.

b. other reporting - The permittee shall report, in writing, all other instances of noncompliance not described in a. above at the time monitoring reports are submitted; or, in the case of retained self-monitoring, within five (5) days from the time the permittee becomes aware of the noncompliance.

Written reporting shall include: 1) a description of the discharge and cause of noncompliance; and 2) the period of noncompliance, including exact dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and the steps taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

7. Spill Notification

The permittee shall immediately report any release of any polluting material which occurs to the surface waters or groundwaters of the state, unless the permittee has determined that the release is not in excess of the threshold reporting quantities specified in the Part 5 Rules (Rules 324.2001 through 324.2009 of the Michigan Administrative Code), by calling the Department at the number indicated on the second page of this permit, or if the notice is provided after regular working hours call the Department's 24-hour Pollution Emergency Alerting System telephone number, 1-800-292-4706 (calls from out-of-state dial 1-517-373-7660).

Within ten (10) days of the release, the permittee shall submit to the Department a full written explanation as to the cause of the release, the discovery of the release, response (clean-up and/or recovery) measures taken, and preventative measures taken or a schedule for completion of measures to be taken to prevent reoccurrence of similar releases.

8. Upset Noncompliance Notification

If a process "upset" (defined as an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee) has occurred, the permittee who wishes to establish the affirmative defense of upset, shall notify the Department by telephone within 24-hours of becoming aware of such conditions; and within five (5) days, provide in writing, the following information:

a. that an upset occurred and that the permittee can identify the specific cause(s) of the upset;

b. that the permitted wastewater treatment facility was, at the time, being properly operated; and

c. that the permittee has specified and taken action on all responsible steps to minimize or correct any adverse impact in the environment resulting from noncompliance with this permit.

In any enforcement proceedings, the permittee, seeking to establish the occurrence of an upset, has the burden of proof.

PART II

Section C. Reporting Requirements

9. Bypass Prohibition and Notification

a. Bypass Prohibition - Bypass is prohibited unless:

1) bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

2) there were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass; and

3) the permittee submitted notices as required under 9.b. or 9.c. below.

b. Notice of Anticipated Bypass - If the permittee knows in advance of the need for a bypass, it shall submit prior notice to the Department, if possible at least ten (10) days before the date of the bypass, and provide information about the anticipated bypass as required by the Department. The Department may approve an anticipated bypass, after considering its adverse effects, if it will meet the three (3) conditions listed in 9.a. above.

c. Notice of Unanticipated Bypass - The permittee shall submit notice to the Department of an unanticipated bypass by calling the Department at the number indicated on the second page of this permit (if the notice is provided after regular working hours, use the following number: 1-800-292-4706) as soon as possible, but no later than 24 hours from the time the permittee becomes aware of the circumstances.

d. Written Report of Bypass - A written submission shall be provided within five (5) working days of commencing any bypass to the Department, and at additional times as directed by the Department. The written submission shall contain a description of the bypass and its cause; the period of bypass, including exact dates and times, and if the bypass has not been corrected, the anticipated time it is expected to continue; steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass; and other information as required by the Department.

e. Bypass Not Exceeding Limitations - The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of 9.a., 9.b., 9.c., and 9.d., above. This provision does not relieve the permittee of any notification responsibilities under Part II.C.10. of this permit.

f. Definitions

1) Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

2) Severe property damage means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

PART II

Section C. Reporting Requirements

10. Notification of Changes in Discharge

The permittee shall notify the Department, in writing, within 10 days of knowing, or having reason to believe, that any activity or change has occurred or will occur which would result in the discharge of: 1) detectable levels of chemicals on the current Michigan Critical Materials Register, priority pollutants or hazardous substances set forth in 40 CFR 122.21, Appendix D, or the Pollutants of Initial Focus in the Great Lakes Water Quality Initiative specified in 40 CFR 132.6, Table 6, which were not acknowledged in the application or listed in the application at less than detectable levels; 2) detectable levels of any other chemical not listed in the application or listed at less than detection, for which the application specifically requested information; or 3) any chemical at levels greater than five times the average level reported in the complete application (see the first page of this permit for the date(s) the complete application was submitted). Any other monitoring results obtained as a requirement of this permit shall be reported in accordance with the compliance schedules.

11. Changes in Facility Operations

Any anticipated action or activity, including but not limited to facility expansion, production increases, or process modification, which will result in new or increased loadings of pollutants to the receiving waters must be reported to the Department by a) submission of an increased use request (application) and all information required under Rule 323.1098 (Antidegradation) of the Water Quality Standards or b) by notice if the following conditions are met: 1) the action or activity will not result in a change in the types of wastewater discharged or result in a greater quantity of wastewater than currently authorized by this permit; 2) the action or activity will not result in violations of the effluent limitations specified in this permit; 3) the action or activity is not prohibited by the requirements of Part II.C.12.; and 4) the action or activity will not require notification pursuant to Part II.C.10. Following such notice, the permit may be modified according to applicable laws and rules to specify and limit any pollutant not previously limited.

12. Bioaccumulative Chemicals of Concern (BCC)

Consistent with the requirements of Rules 323.1098 and 323.1215 of the Michigan Administrative Code, the permittee is prohibited from undertaking any action that would result in a lowering of water quality from an increased loading of a BCC unless an increased use request and antidegradation demonstration have been submitted and approved by the Department.

13. Transfer of Ownership or Control

In the event of any change in control or ownership of facilities from which the authorized discharge emanates, the permittee shall submit to the Department 30 days prior to the actual transfer of ownership or control a written agreement between the current permittee and the new permittee containing: 1) the legal name and address of the new owner; 2) a specific date for the effective transfer of permit responsibility, coverage and liability; and 3) a certification of the continuity of or any changes in operations, wastewater discharge, or wastewater treatment.

If the new permittee is proposing changes in operations, wastewater discharge, or wastewater treatment, the Department may propose modification of this permit in accordance with applicable laws and rules.

PART II

Section D. Management Responsibilities

1. Duty to Comply

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit.

It is the duty of the permittee to comply with all the terms and conditions of this permit. Any noncompliance with the Effluent Limitations, Special Conditions, or terms of this permit constitutes a violation of the Michigan Act and/or the Federal Act and constitutes grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of an application for permit renewal.

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

2. Operator Certification

The permittee shall have the waste treatment facilities under direct supervision of an operator certified at the appropriate level for the facility certification by the Department, as required by Sections 3110 and 4104 of the Michigan Act. Permittees authorized to discharge storm water shall have the storm water treatment and/or control measures under direct supervision of a storm water operator certified by the Department, as required by Section 3110 of the Michigan Act.

3. Facilities Operation

The permittee shall, at all times, properly operate and maintain all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance includes adequate laboratory controls and appropriate quality assurance procedures.

4. Power Failures

In order to maintain compliance with the effluent limitations of this permit and prevent unauthorized discharges, the permittee shall either:

a. provide an alternative power source sufficient to operate facilities utilized by the permittee to maintain compliance with the effluent limitations and conditions of this permit; or

b. upon the reduction, loss, or failure of one or more of the primary sources of power to facilities utilized by the permittee to maintain compliance with the effluent limitations and conditions of this permit, the permittee shall halt, reduce or otherwise control production and/or all discharge in order to maintain compliance with the effluent limitations and conditions of this permit.

5. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to the surface waters or groundwaters of the state resulting from noncompliance with any effluent limitation specified in this permit including, but not limited to, such accelerated or additional monitoring as necessary to determine the nature and impact of the discharge in noncompliance.

PART II

Section D. Management Responsibilities

6. Containment Facilities

The permittee shall provide facilities for containment of any accidental losses of polluting materials in accordance with the requirements of the Part 5 Rules (Rules 324.2001 through 324.2009 of the Michigan Administrative Code). For a Publicly Owned Treatment Work (POTW), these facilities shall be approved under Part 41 of the Michigan Act.

7. Waste Treatment Residues

Residuals (i.e. solids, sludges, biosolids, filter backwash, scrubber water, ash, grit, or other pollutants or wastes) removed from or resulting from treatment or control of wastewaters, including those that are generated during treatment or left over after treatment or control has ceased, shall be disposed of in an environmentally compatible manner and according to applicable laws and rules. These laws may include, but are not limited to, the Michigan Act, Part 31 for protection of water resources, Part 55 for air pollution control, Part 111 for hazardous waste management, Part 115 for solid waste management, Part 121 for liquid industrial wastes, Part 301 for protection of inland lakes and streams, and Part 303 for wetlands protection. Such disposal shall not result in any unlawful pollution of the air, surface waters or groundwaters of the state.

8. Right of Entry

The permittee shall allow the Department, any agent appointed by the Department or the Regional Administrator, upon the presentation of credentials:

a. to enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit; and

b. at reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect process facilities, treatment works, monitoring methods and equipment regulated or required under this permit; and to sample any discharge of pollutants.

9. Availability of Reports

Except for data determined to be confidential under Section 308 of the Federal Act and Rule 2128 (Rule 323.2128 of the Michigan Administrative Code), all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department and the Regional Administrator. As required by the Federal Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Federal Act and Sections 3112, 3115, 4106 and 4110 of the Michigan Act.

PART II

Section E. Activities Not Authorized by This Permit

1. Discharge to the Groundwaters

This permit does not authorize any discharge to the groundwaters. Such discharge may be authorized by a groundwater discharge permit issued pursuant to the Michigan Act.

2. POTW Construction

This permit does not authorize or approve the construction or modification of any physical structures or facilities. Approval for such construction for a POTW must be by permit issued under Part 41 of the Michigan Act. Approval for such construction for a mobile home park, campground or marina shall be from the Water Bureau, Michigan Department of Natural Resources and Environment. Approval for such construction for a hospital, nursing home or extended care facility shall be from the Division of Health Facilities and Services, Michigan Department of Consumer and Industry Services upon request.

3. Civil and Criminal Liability

Except as provided in permit conditions on "Bypass" (Part II.C.9. pursuant to 40 CFR 122.41(m)), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance, whether or not such noncompliance is due to factors beyond the permittee's control, such as accidents, equipment breakdowns, or labor disputes.

4. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee may be subject under Section 311 of the Federal Act except as are exempted by federal regulations.

5. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by Section 510 of the Federal Act.

6. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize violation of any federal, state or local laws or regulations, nor does it obviate the necessity of obtaining such permits, including any other Department of Natural Resources and Environment permits, or approvals from other units of government as may be required by law.

Attachment B

Threatened and Endangered Species Consultation

Attachment B

Threatened and Endangered Species Consultation

- Zachary W. Rad, DTE Electric Company, to Keith Creagh, Michigan Department of Natural Resources. July 1, 2013.
- Zachary W. Rad, DTE Electric Company, to Scott Hicks, U.S. Fish and Wildlife Service. July 1, 2013.
- Lynne Goodman, DTE Electric Company, to Michigan Natural Features Inventory. July 8, 2013.
- Russ Mason, Michigan Department of Natural Resources, to Lynne Goodman, DTE Electric Company. July 11, 2013.
- Lynne Goodman, DTE Electric Company, to Michigan Natural Features Inventory. July 16, 2013.
- Scott Hicks, U.S. Fish and Wildlife Service, to Lynne Goodman, DTE Electric Company. August 9, 2013.
- Michael Sanders, Michigan Natural Features Inventory, to Lynne Goodman, DTE Electric Company. September 17, 2013.

Fermi 2
6400 North Dixie Hwy
Newport, MI 48166

DTE Energy

July 1, 2013
NANL-13-0039

Keith Creagh
Director, Executive Division
Michigan Department of Natural Resources (DNR)
PO Box 30028
Lansing, MI 48909

SUBJECT: Request for DNR Feedback Regarding the Fermi 2 Nuclear Power Plant Operating License Renewal Application

Dear Mr. Creagh:

In 2014, DTE Electric Company (DTE) [formerly, The Detroit Edison Company] intends to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for Fermi 2. The Fermi 2 site is located in Monroe County, Michigan on the west shoreline of Lake Erie, approximately 30 miles southwest of Detroit, Michigan. The existing operating license for Fermi 2 was issued for a 40-year term that expires in 2025. A renewed license would give DTE the option to continue operating Fermi 2 until 2045.

The NRC requires that the license renewal application for Fermi 2 include an environmental report assessing potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on threatened or endangered species or designated critical habitats located on the Fermi 2 site and its immediate environs (6-mile radius). Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51.53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act (NEPA), the NRC may request information from your office.

DTE is contacting you now in order to obtain input regarding issues that may need to be addressed in the Fermi 2 license renewal environmental report, to assist DTE in identifying any information your staff believes would be helpful to expedite NRC's consultation, and to make you aware of the potential for an NRC request.

The Fermi 2 site consists primarily of developed areas, woodlands, water, and swamp or wetland areas. The land in the vicinity is mostly rural (see Figure 1). A portion of Lake Erie is also within the six-mile vicinity. The Detroit River International Wildlife Refuge encompasses 646 acres of the 1260 acre Fermi 2 site. The only transmission lines associated with Fermi 2 that are within the scope of this evaluation are located in the developed industrialized area of the Fermi 2 site and within the property boundary.

DTE does not expect Fermi 2 operations during the license renewal term to adversely affect any threatened or endangered species or designated critical habitats because the renewed license, itself, will not add or demolish any existing facilities on the 1,260-acre property. No ground outside the currently developed area of the Fermi 2 site is expected to be disturbed, view sheds altered, or operational noise levels increased as a result of license renewal. Maintenance activities necessary to support continued operation of Fermi 2 are expected to be limited to currently developed areas of the site. Administrative procedural controls will ensure compliance with applicable state and federal laws to preserve biological resources during potential land disturbance activities that may be initiated throughout the 20 year license extension period.

After your review of the information provided in this letter, please send a reply by July 30, 2013. Please indicate any concerns you may have about potential impacts to threatened or endangered species or designated critical habitat on the Fermi 2 site and in the immediate environs (6-mile radius). Alternatively, please confirm our conclusion that these species or habitats will not be adversely affected as a result of renewing the Fermi 2 operating license for an additional 20 years. In addition, please send us a copy of the latest list of endangered or threatened species in the vicinity (e.g. onsite or within 6 miles) of the Fermi 2 site.

DTE will include copies of this letter and your response in the environmental report submitted to the NRC as part of the Fermi 2 license renewal application.

An inquiry will also be filed via the Michigan Natural Features Inventory website.

Thank you in advance for your assistance. Please address all correspondence or inquiries to:

Lynne Goodman
6400 N. Dixie Hwy, 110NOC
Newport, MI 48166
goodmanl@dteenergy.com
734-586-1205

Sincerely,

for Zackary W. Rad
Manager, Nuclear Licensing

Attachment:

Figure 1: 6-Mile Radius of Fermi 2

bcc: G. D Cerrullo
L.S. Goodman
K. Hlavaty
A. Lim
M. Luempert-Coy
Z.W. Rad
M. Shackelford
R. Westmoreland
Information Management (140 NOC)

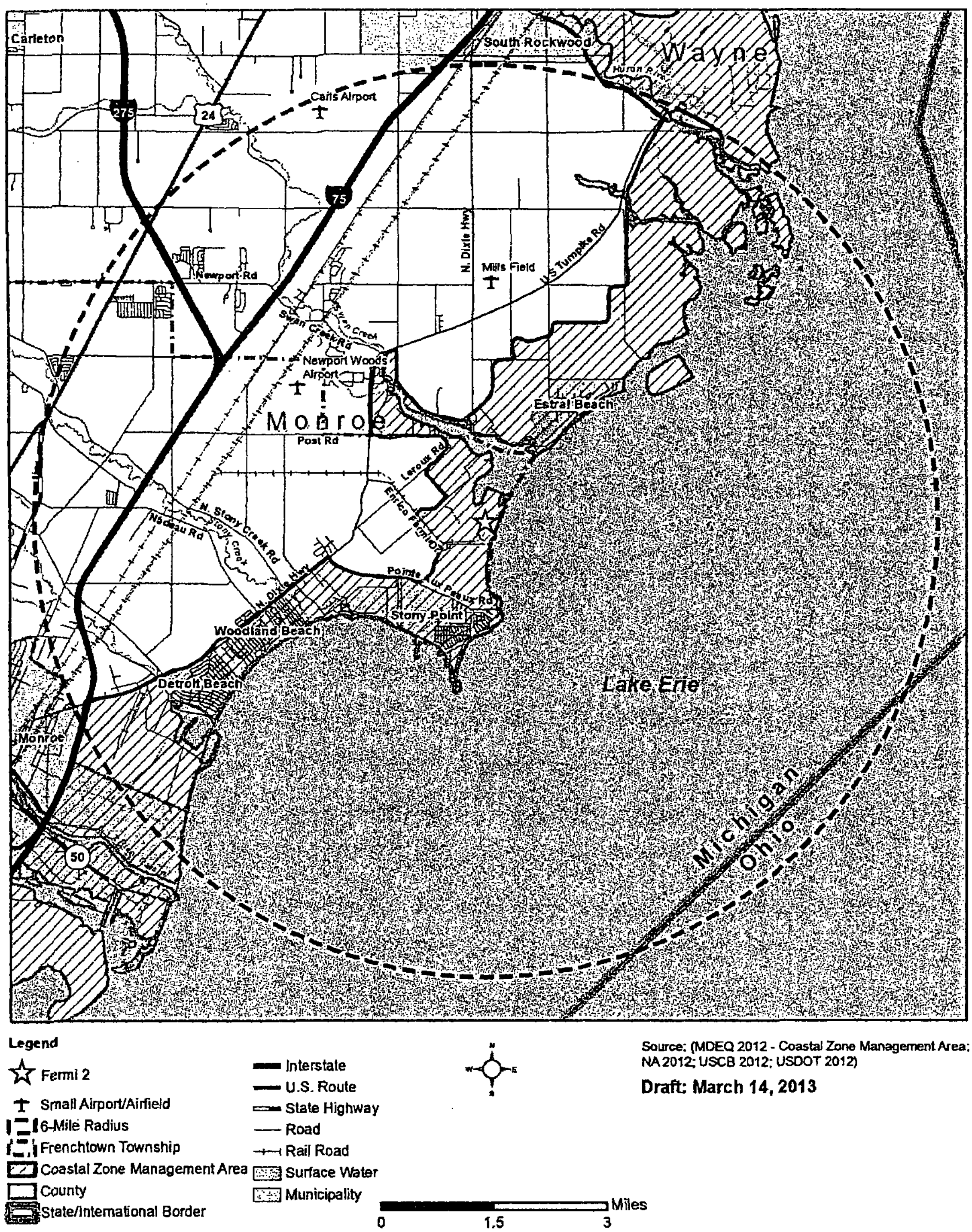


Figure 1
6-Mile Radius of Fermi 2

Fermi 2
6400 North Dixie Hwy
Newport, MI 48166

DTE Energy

July 1, 2013
NANL-13-0040

Mr. Scott Hicks, Field Office Supervisor
U.S. Fish and Wildlife Service (USFWS)
East Lansing Michigan Field Office
2651 Coolidge Road
East Lansing, MI 48823-6316

SUBJECT: Request for USFWS Feedback Regarding the Fermi 2 Nuclear Power Plant Operating License Renewal Application

Dear Mr. Hicks:

In 2014, DTE Electric Company (DTE) [formerly, The Detroit Edison Company] intends to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for Fermi 2. The Fermi 2 site is located in Monroe County, Michigan on the west shoreline of Lake Erie, approximately 30 miles southwest of Detroit, Michigan. The existing operating license for Fermi 2 was issued for a 40-year term that expires in 2025. A renewed license would give DTE the option to continue operating Fermi 2 until 2045.

The NRC requires that the license renewal application for Fermi 2 include an environmental report assessing potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on threatened or endangered species or designated critical habitats located on the Fermi 2 site and its immediate environs (6-mile radius). Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51.53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act (NEPA), the NRC may request information from your office.

DTE is contacting you now in order to obtain input regarding issues that may need to be addressed in the Fermi 2 license renewal environmental report, and to assist DTE in identifying any information your staff believes would be helpful to expedite NRC's consultation.

The Fermi 2 site consists primarily of developed areas, woodlands, water, and swamp or wetland areas. The land in the vicinity is mostly rural (see Figure 1). A portion of Lake Erie is also within the six-mile vicinity. The Detroit River International Wildlife Refuge encompasses 646 acres of the 1260 acre Fermi 2 site. The only transmission lines associated with Fermi 2 that are within the scope of this evaluation are located in the developed industrialized area of the Fermi 2 site and within the property boundary.

DTE does not expect Fermi 2 operations during the license renewal term to adversely affect any threatened or endangered species or designated critical habitats because the renewed license, itself, will not add or demolish any existing facilities on the 1,260-acre property. No ground outside the currently developed area of the Fermi 2 site is expected to be disturbed, view sheds altered, or operational noise levels increased as a result of license renewal. Maintenance activities necessary to support continued operation of Fermi 2 are expected to be limited to currently developed areas of the site. Administrative procedural controls will ensure compliance with applicable state and federal laws to preserve biological resources during potential land disturbance activities that may be initiated throughout the 20 year license extension period.

After your review of the information provided in this letter, please send a reply by July 30, 2013. Please indicate any concerns you may have about potential impacts to threatened or endangered species or designated critical habitat on the Fermi 2 site and in the immediate environs (6-mile radius). Alternatively, please confirm our conclusion that these species or habitats will not be adversely affected as a result of renewing the Fermi 2 operating license for an additional 20 years. In addition, please send us a copy of the latest list of endangered or threatened species in the vicinity (e.g. onsite or within 6 miles) of the Fermi 2 site.

DTE will include copies of this letter and your response in the environmental report submitted to the NRC as part of the Fermi 2 license renewal application.

Thank you in advance for your assistance. Please address all correspondence or inquiries to:

Lynne Goodman
6400 N. Dixie Hwy, 110NOC
Newport, MI 48166
goodmanl@dteenergy.com
734-586-1205

Sincerely,

Zackary W. Rad
Manager, Nuclear Licensing

Attachment:

Figure 1: 6-Mile Radius of Fermi 2

bcc: G. D Cerrullo
L.S. Goodman
K. Hlavaty
A. Lim
M. Luempert-Coy
Z.W. Rad
M. Shackelford
R. Westmoreland
Information Management (140 NOC)

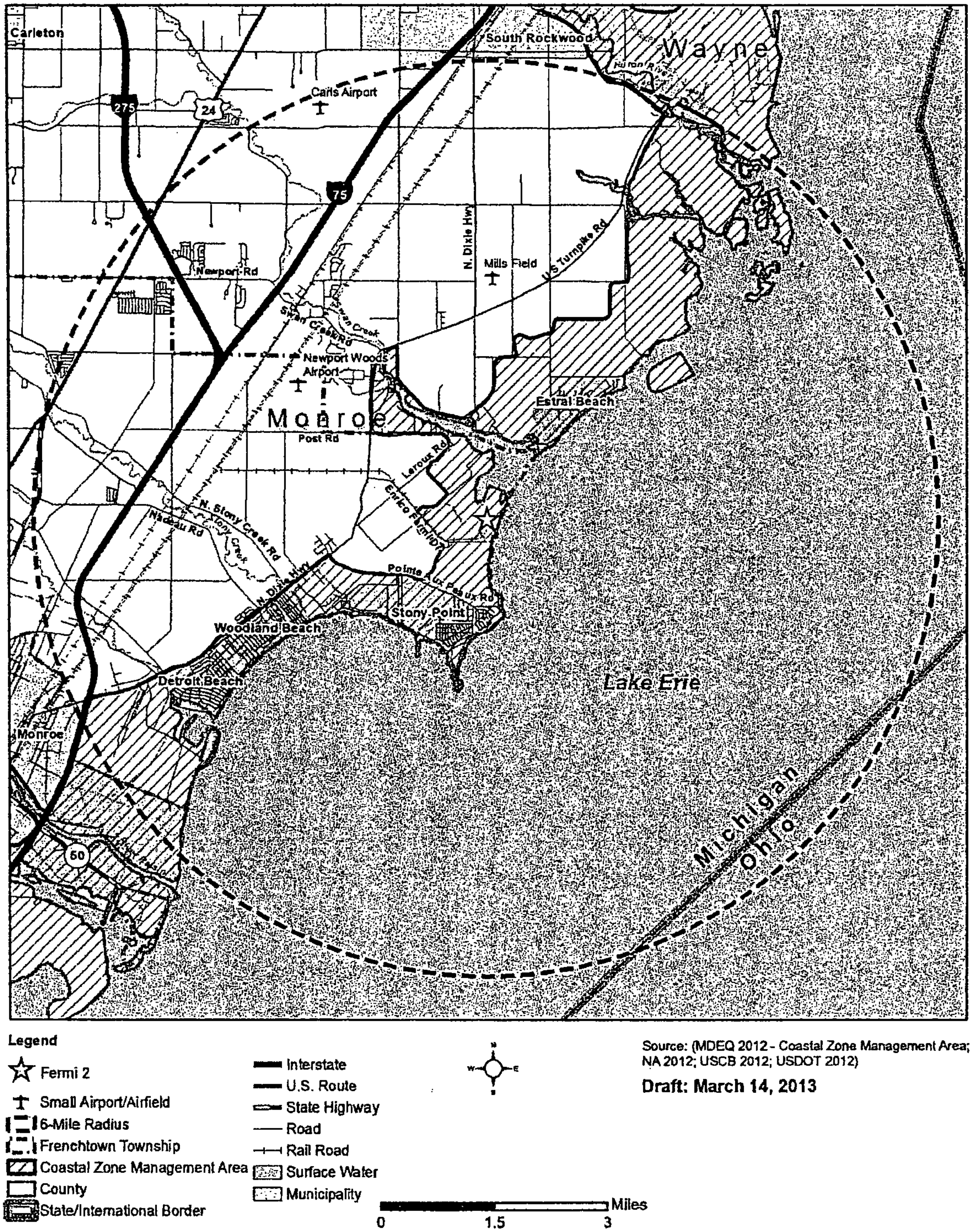


Figure 1
6-Mile Radius of Fermi 2

From: Lynne S Goodman/Employees/dteenergy
To: mnfi@msu.edu

Date: Monday, July 08, 2013 03:45PM
Subject: Request for Rare Species and Natural Features Enhanced Review

---

To: MNFI

From: Lynne Goodman, Manager Licensing, Major Enterprise Projects, DTE Electric

Subject: Request for Rare Species and Natural Features Enhanced Review

Please perform an enhanced review for rare species and natural features for the Fermi 1 license renewal project. Here is the requested information:

- Name and address of the company, organization or individual making the request

  Lynne Goodman, DTE Electric

  Fermi 2 Nuclear Station, 110NOC

  6400 N. Dixie Highway

  Newport, MI 48166

- Brief description of the proposed project

In 2014, DTE Electric Company (DTE) [formerly, The Detroit Edison Company] intends to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for Fermi 2. The Fermi 2 site is located in Monroe County, Michigan on the west shoreline of Lake Erie, approximately 30 miles southwest of Detroit, Michigan. The existing operating license for Fermi 2 was issued for a 40-year term that expires in 2025. A renewed license would give DTE the option to continue operating Fermi 2 until 2045.

The NRC requires that the license renewal application for Fermi 2 include an environmental report assessing potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on threatened or endangered species or designated critical habitats located on the Fermi 2 site and its immediate environs (6-mile radius). Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR *51.53).* Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act (NEPA), the NRC may request information from the state DNR.

DTE does not expect Fermi 2 operations during the license renewal term to adversely affect any threatened or endangered species or designated critical habitats because the renewed license, itself, will not add or demolish any existing facilities on the 1,260-acre property. No ground outside the currently developed area of the Fermi 2 site is expected to be disturbed, view sheds altered, or operational noise levels increased as a result of license renewal. Maintenance activities necessary to support continued operation of Fermi 2 are expected to be limited to currently developed areas of the site. Administrative procedural controls will ensure compliance with applicable state and federal laws to preserve biological resources during potential land disturbance activities that may be initiated throughout the 20 year license extension period.

- Description of what is there now (building, type of vegetation, recent disturbance)

The Fermi 2 site consists primarily of developed areas, woodlands, water, and swamp or wetland areas. The land in the vicinity is mostly rural (see Figure 1). A portion of Lake Erie is also within the six-mile vicinity. The Detroit River International Wildlife Refuge encompasses 646 acres of the 1260 acre Fermi 2 site. The only transmission lines associated with Fermi 2 that are within the scope of this evaluation are located in the developed industrialized area of the Fermi 2 site and within the property boundary.

- Location of the area to be searched listed by PLSS town, range and section

The Fermi 2 site includes portions of Sections 16, 17, 19, 20, 21, 28 and 29, Township 6S, Range 10E.

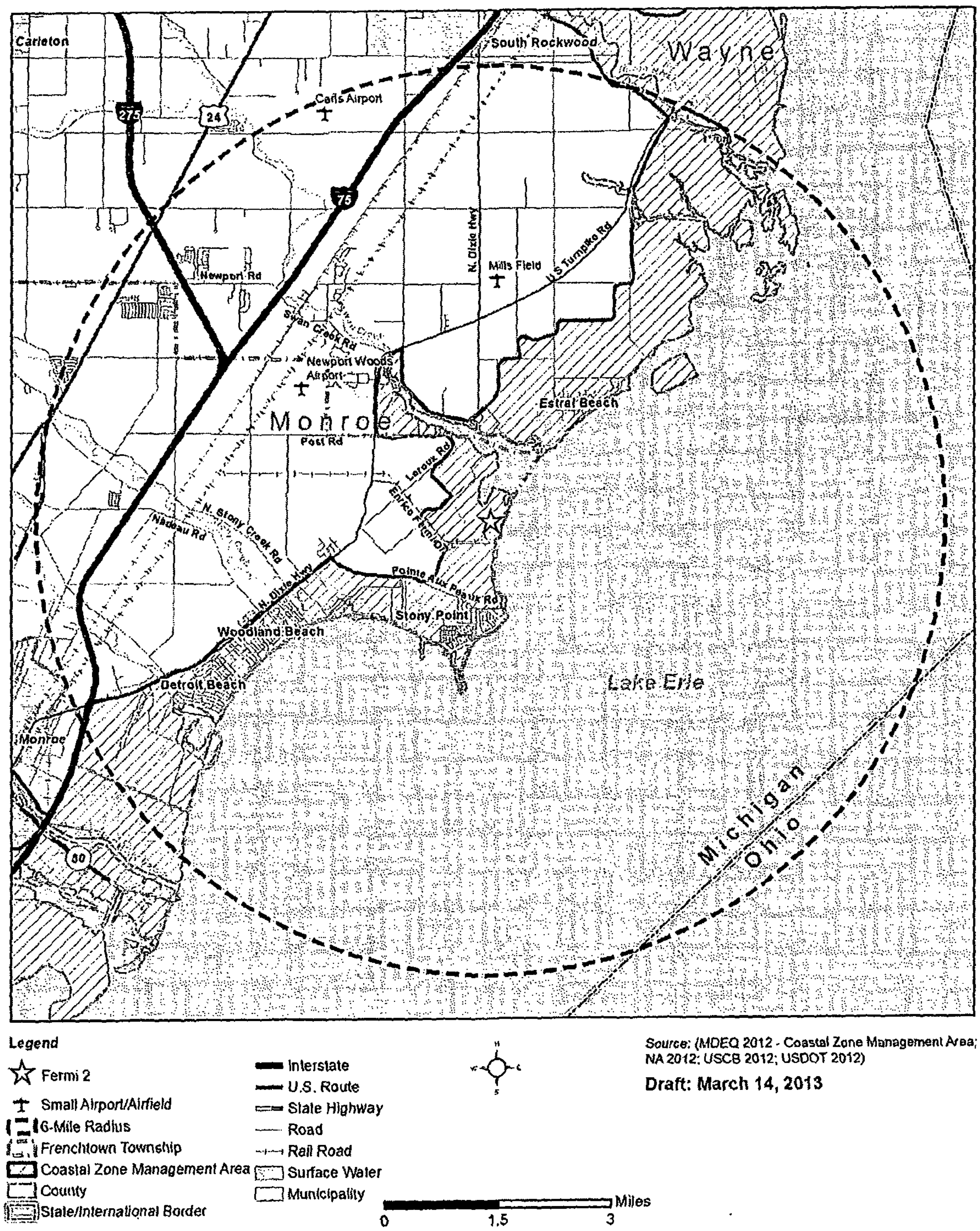
- Indication if a rush order is desired for an additional $100

No, the 20 day turnaround will work. Response is needed by July 30, 2013.

Attachments:
Figure 1.docx

Figure 1

6-Mile Radius of Fermi 2



STATE OF MICHIGAN

DEPARTMENT OF NATURAL RESOURCES

LANSING

RICK SNYDER
GOVERNOR

KEITH CREAGH
DIRECTOR

July 11, 2013

Ms. Lynne Goodman
DTE Energy
6400 North Dixie Highway, 110NOC
Newport, Michigan 48166

Dear Ms. Goodman:

The Michigan Department of Natural Resources (DNR) is, unfortunately, no longer able to conduct Environmental Reviews (ER) and ceased acceptance of review requests September 16, 2011. Funding for the program was not included in the state budget for the fiscal year that began October 1, 2012, and issuance of clearance letters will no longer be done. Project review requests can be sent to Michigan Natural Features Inventory (MNFI), a program of Michigan State University Extension.

Michigan Natural Features Inventory will review projects for potential impacts to endangered species, but there will now be a cost to the requestor for MNFI's services. For information on environmental reviews, please contact Mr. Ed Schools, Senior Conservation Scientist, at 517-373-0798, or at schools@msu.edu. Requests will no longer be accepted through the DNR Endangered Species Assessment website.

Endangered species and wetland laws remain in place. Under Part 365 of Public Act 451, people are not allowed to take or harm any endangered or threatened fish, plants, or wildlife. The DNR will still be responsible for issuing permits and enforcement relative to the take of endangered and threatened species.

Thank you for contacting the DNR. Should you have any questions, please contact Ms. Lori Sargent, Wildlife Biologist at sargentl@michigan.gov.

Sincerely,

Russ Mason, Ph.D., Chief
Wildlife Division
517-373-1263

cc: Mr. Keith Creagh, Director, DNR
Dr. William E. Moritz, Natural Resources Deputy, DNR
Ms. Lori Sargent, DNR

MICHIGAN STATE UNIVERSITY | Extension

Information Agreement

The Michigan Natural Features Inventory (MNFI) is a member of the Natural Heritage Program Network and is part of Michigan State University Extension Service and the Michigan Department of Natural Resources. MNFI is an organization of professionals dedicated to the conservation of Michigan's special natural features. MNFI has the responsibility for inventorying and collecting information about the state's "elements of biological diversity". These data are used to guide conservation and land management activities throughout the state.

The MNFI database is an ongoing and continuously updated information base. The database is the only comprehensive single source of existing information on Michigan's endangered, threatened, or otherwise significant plant and animal species, natural plant communities, and other natural features. This database cannot provide a definitive statement on the presence, absence, or condition of the natural features in any given locality, since most sites have not been specifically or thoroughly surveyed. Furthermore, plant and animal populations and natural communities change with time. Therefore, the information services provided should not be regarded as a complete statement on the occurrence of special natural features of the area in question. In many cases the information may require the interpretation of a trained scientist.

The recipient(s) of the information understand that state endangered and threatened species are protected under state law (Act 451 of 1994, the Natural Resources and Environmental Protection Act, Part 365, Endangered Species Protection). Any questions, observations, new findings, violations or permitting of project activities should be conducted with the Michigan Department of Natural Resources, Wildlife Division. Contact the Endangered Species Coordinator at (517) 373-1263. The recipient(s) of the information understand that federally endangered and threatened species are protected under federal law (Endangered Species Act of 1973). Any questions, observations, new findings, violations or permitting of project activities should be conducted with the U.S. Fish and Wildlife Service in East Lansing. Their phone number is (517) 351-2555. Recipients of the information are responsible for ensuring the protection of protected species before project activities begin.

MNFI is not a for-profit entity and fees for the data are turned back into database maintenance and program support. The costs for information can be obtained on our website MNFI.ANR.MSU.EDU under the services heading.

By acceptance of the information services made available through MNFI, the recipient understands that access to the information is provided for primary use only. MNFI requests that the user respect the confidential and sensitive nature of the information and restrict access to only those individuals requiring the information for the primary use. There should be no redistribution of the information. Indiscriminate distribution of information regarding locations of many rare species represents a threat to their protection. Additionally, since the information is constantly being updated MNFI requests that any information service provided by MNFI is destroyed upon completion of the primary use. This information should be considered valid for one year only.

The user should identify MNFI as information contributors on any map or publication using MNFI information, as follows: **Michigan Natural Features Inventory. 2013. Biotics 4 - Michigan's Natural Heritage Database. Lansing, Michigan. (Accessed: Month Day, 2013).** Abbreviations are acceptable on maps if referenced in full on accompanying documents.

MSU EXTENSION

Michigan Natural Features Inventory

P.O. Box 13036
Lansing, MI 48901

(517) 373-1552
fax: (517) 373-9566

mnfi.anr.msu.edu

Enhanced Rare Species Review #1271 - DTE Electric Fermi 2 License Renewal Project.

☒ Standard turn around

☐ Rush order

Project or primary use of information: data for legally protected species and other rare natural features.

Description of information: T6S, R10E, Sections 16, 17, 19, 20, 21, 28 & 29

Lynne S Goodman
Recipient (Please Print)

[signature]
Signature

DTE Energy
Organization/Association

7/16/13
Date

United States Department of the Interior

FISH AND WILDLIFE SERVICE
East Lansing Field Office (ES)
2651 Coolidge Road, Suite 101
East Lansing, Michigan 48823-6316

IN REPLY REFER TO:

August 9, 2013

Lynne Goodman
DTE Energy
6400 North Dixie Highway
Newport, Michigan 48166

Dear Ms. Goodman:

We are responding to the 22 July 2013 letter from Zachery W. Rad, Manager, Nuclear Licensing, regarding the proposed 20 year extension for the Fermi 2 Nuclear Power Plant License. The current license will expire in 2025 and a renewed license would allow DTE Electric Company (DTE) to operate Fermi 2 until 2045. The Fermi site currently has one operating boiling water reactor, Fermi 2; Unit 1 has been defueled and is in the process of being decommissioned. The proposed construction of Fermi 3 is adjacent to the existing facilities in an area that has been previously disturbed. Fermi 2 is located on approximately 1,260 acres along Lake Erie at the existing Enrico Fermi Nuclear Power in Monroe County, Michigan.

Mr. Rad's letter requests our concurrence on the effects of the proposed project on federally-listed species. DTE has concluded that the relicensing of Fermi 2 will not adversely affect any federally-listed species during the license renewal term. They have reached this conclusion because there will be no addition or demolition of any existing facilities and no ground is to be disturbed outside the currently disturbed area of the Fermi 2 site. Operational noise levels will not increase and maintenance activities are expected to be limited to the currently developed areas. Also, the applicant will follow administrative procedural controls to ensure compliance with applicable State and federal laws to preserve biological resources during any land disturbance activities.

We concur with your determination that the proposed action will not likely to adversely affect federally-listed species. This precludes the need for further action on this project as required by the Endangered Species Act of 1973, as amended. However, if the project is modified or new information about the project becomes available that indicates listed or proposed species may be present and/or affected, consultation with this Service office should be reinitiated. At your request, we have attached a list of currently known threatened and endangered species within six miles of the project site.

We further advise that should any species occurring in the project area become federally-listed or proposed, the federal action agency for the work would also be required to reevaluate its responsibilities under the Act. Since threatened and endangered species data is continually updated, we suggest the lead federal agency annually request an updated federal list of the species occurring in the project area. Please forward any forthcoming NEPA documents regarding the relicensing of Fermi 2 to this office.

We appreciate this opportunity to provide comments and look forward to continued coordination in the future if necessary. Questions should be directed to Mr. Burr Fisher at 517/351-8282 or burr_fisher@fws.gov.

Sincerely,

Acting for Scott Hicks
Field Supervisor

cc: MDNR, Wildlife Division, Lansing, MI (Attn: Lori Sargent)
Detroit River International Wildlife Refuge, Grosse Ile, MI (Attn: John Hartig)

Michigan
County Distribution of Federally-listed Threatened, Endangered, Proposed, and Candidate Species
Revised March 2013

SPECIES	STATUS	COUNTIES	HABITAT
MAMMALS			
Canada lynx *(Lynx canadensis)*	Threatened	**Current distribution:** A Canada lynx was recently documented in the Upper Peninsula. The counties listed here have the highest potential for Lynx presence: Alger, Baraga, Chippewa, Delta, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Luce, Mackinac, Marquette, Menominee, Ontonagon, Schoolcraft.	Northern forests
Indiana bat *(Myotis sodalis)*	Endangered	Allegan, Barry, Bay, Benzie, Berrien, Branch, Calhoun, Cass, Clinton, Eaton, Genesee, Gratiot, Hillsdale, Huron, Ingham, Ionia, Jackson, Kalamazoo, Kent, Lapeer, Leelanau, Lenawee, Livingston, Macomb, Manistee, Mason, Monroe, Montcalm, Muskegon, Oakland, Oceana, Ottawa, Saginaw, St. Joseph, Sanilac, Shiawassee, St. Clair, Tuscola, Van Buren, Washtenaw, and Wayne	Summer habitat includes small to medium river and stream corridors with well developed riparian woods; woodlots within 1 to 3 miles of small to medium rivers and streams; and upland forests. Caves and mines as hibernacula.
BIRDS			
Kirtland's warbler *(Dendroica kirtlandii)*	Endangered	Alcona, Alger, Antrim, Baraga, Chippewa, Clare, Crawford, Delta, Grand Traverse, Iosco, Kalkaska, Luce, Marquette, Montmorency, Ogemaw, Oscoda, Otsego, Presque Isle, Roscommon, Schoolcraft	Breeding in jack pine
Piping plover *(Chradrius melodus)*	Endangered	Alger, Alpena, Benzie, Berrien, Charlevoix, Cheboygan, Chippewa, Delta, Emmet, Leelanau, Luce, Mackinac, Manistee, Mason, Muskegon, Presque Isle, Schoolcraft	Beaches along shorelines of the Great Lakes
Piping plover *(Chradrius melodus)*	Critical Habitat Designated	Alger, Benzie, Charlevoix, Cheboygan, Chippewa, Emmet, Iosco, Leelanau, Luce, Mackinac, Mason, Muskegon, Presque Isle, Schoolcraft	Beaches along shorelines of the Great Lakes
REPTILES			
Copperbelly water snake *(Nerodia erythrogaster neglecta)*	Threatened	Branch, Calhoun, Cass, Eaton, Hillsdale, St. Joseph	Wooded and permanently wet areas such as oxbows, sloughs, brushy ditches and floodplain woods

SPECIES	STATUS	COUNTIES	HABITAT
Eastern massasauga (*Sistrurus catenatus*)	Candidate	Alcona, Allegan, Alpena, Antrim, Arenac, Barry, Berrien, Branch, Calhoun, Cass, Cheboygan, Clare, Clinton, Crawford, Eaton, Emmett, Genesee, Grand Traverse, Hillsdale, Huron, Ingham, Ionia, Iosco, Jackson, Kalamazoo, Kalkaska, Kent, Lake, Lapeer, Lenawee, Livingston, Mackinac, Macomb, Manistee, Mason, Missaukee, Montcalm, Montmorency, Muskegon, Newaygo, Oakland, Oscoda, Presque Isle, Saginaw, St. Joseph, Shiawassee, Van Buren, Washtenaw, Wayne	
INSECTS			
Hine's emerald dragonfly *(Somatochlora hineana)*	Endangered	Alcona, Alpena, Mackinac, Menominee, Presque Isle	Spring fed wetlands, wet meadows and marshes; calcareous streams & associated wetlands overlying dolomite bedrock
Hungerford's crawling water beetle *(Brychius hungerfordi)*	Endangered	Emmet, Montmorency, Oscoda, Presque Isle	Cool riffles of clean, slightly alkaline streams; known to occur in five streams in northern Michigan.
Karner blue butterfly *(Lycaeides melissa samuelis)*	Endangered	Allegan, Ionia, Kent, Lake, Mason, Mecosta, Monroe, Montcalm, Muskegon, Newaygo, Oceana	Pine barrens and oak savannas on sandy soils and containing wild lupines *(Lupinus perennis)*, the only known food plant of larvae.
Mitchell's satyr *(Neonympha mitchellii mitchellii)*	Endangered	Barry, Berrien, Branch, Cass, Jackson, Kalamazoo, St. Joseph, Van Buren, Washtenaw	Fens; wetlands characterized by calcareous soils which are fed by carbonate-rich water from seeps and springs
Poweshiek skipperling (*Oarisma poweshiek*)	Candidate	Jackson, Lenawee, Livingston, Oakland, Washtenaw	Wet prairie and fens
MUSSELS			
Clubshell *(Pleurobema clava)*	Endangered	Hillsdale	Found in coarse sand and gravel areas of runs and riffles within streams and small rivers
Northern riffleshell *(Dysnomia torulosa rangiana)*	Endangered	Monroe, Sanilac, Wayne	Large streams and small rivers in firm sand of riffle areas; also occurs in Lake Erie

SPECIES	STATUS	COUNTIES	HABITAT
Rayed Bean (*Villosa fabalis*)	Endangered	Hillsdale, Lenawee, Macomb, Monroe, Oakland, St. Clair, and Wayne	Belle, Black, Clinton, and Pine Rivers
Snuffbox (*Epioblasma triquetra*)	Endangered	Gratiot, Ionia, Kent, Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw	Small to medium-sized creeks in areas with a swift current and some larger rivers
PLANTS			
American hart's tongue fern *(Asplenium scolopendrium* var. *americanun = Phyllitis japonica ssp. a.)*	Threatened	Chippewa, Mackinac	Cool limestone sinkholes in mature hardwood forest
Dwarf lake iris *(Iris lacustris)*	Threatened	Alpena, Charlevoix, Cheboygan, Chippewa, Delta, Emmet, Mackinac, Menominee, Presque Isle, Schoolcraft	Partially shaded sandy-gravelly soils on lakeshores
Eastern prairie fringed orchid *(Plantathera leucophaea)*	Threatened	Bay, Cheboygan, Clinton, Eaton, Genesee, Gratiot, Huron, Livingston, Monroe, Saginaw, St. Clair, St. Joseph, Tuscola, Washtenaw, Wayne	Mesic to wet prairies and meadows
Houghton's goldenrod *(Solidago houghtonii)*	Threatened	Charlevoix, Cheboygan, Chippewa, Crawford, Emmet, Kalkaska, Mackinac, Presque Isle, Schoolcraft	Sandy flats along Great Lakes shores
Lakeside daisy *(Hymenoxy acaulis var. glabra)*	Threatened	Mackinac	Dry, rocky prairie grassland underlain by limestone
Michigan monkey-flower *(Mimulus michiganesis)*	Endangered	Benzie, Charlevoix, Cheboygan, Emmet, Leelanau, Mackinac	Soils saturated with cold flowing spring water; found along seepages, streams and lakeshores
Pitcher's thistle *(Cirsium pitcheri)*	Threatened	Alcona, Alger, Allegan, Alpena, Antrim, Arenac, Benzie, Berrien, Charlevoix, Cheboygan, Chippewa, Delta, Emmet, Grand Traverse, Huron, Iosco, Leelanau, Mackinac, Manistee, Mason, Muskegon, Oceana, Ottawa, Presque Isle, Schoolcraft, Van Buren	Stabilized dunes and blowout areas
Small whorled pogonia *(Isotria medeoloides)*	Threatened	Berrien	Dry woodland; upland sites in mixed forests (second or third growth stage)

MICHIGAN STATE UNIVERSITY | Extension

Lynne Goodman
DTE Electric
Fermi 2 Nuclear Station, 110NOC
6400 N. Dixie Highway
Newport, MI 49546

September 17, 2013

Re: Enhanced Rare Species Review #1271– DTE Electric Fermi 2 Nuclear Station License Renewal, Monroe County, MI T6S, R10E Sections 16, 17, 19, 20, 21, 28 & 29.

Ms. Goodman:

The location for the proposed project was checked against known localities for rare species and unique natural features, which are recorded in the Michigan Natural Features Inventory (MNFI) natural heritage database. This continuously updated database is a comprehensive source of existing data on Michigan's endangered, threatened, or otherwise significant plant and animal species, natural plant communities, and other natural features. Records in the database indicate that a qualified observer has documented the presence of special natural features. The absence of records in the database for a particular site may mean that the site has not been surveyed. The only way to obtain a definitive statement on the status of natural features is to have a competent biologist perform a complete field survey.

Under Act 451 of 1994, the Natural Resources and Environmental Protection Act, Part 365, Endangered Species Protection, "a person shall not take, possess, transport, ...fish, plants, and wildlife indigenous to the state and determined to be endangered or threatened," unless first receiving an Endangered Species Permit from the Michigan Department of Natural Resources (MDNR), Wildlife Division. Responsibility to protect endangered and threatened species is not limited to the lists below. Other species may be present that have not been recorded in the database.

According to the natural heritage database, it is **highly likely** that listed species will be impacted in the event of a major nuclear accident at the site, or during on-site construction (e.g., new building) or as infrastructure develops, such as a new road, that significantly impacts relevant habitat. Mitigation efforts could greatly reduce any construction related impacts. Keep in mind that MNFI cannot fully assess potential impacts without an on-site survey.

Sincerely,

Michael Sanders
Environmental Review Specialist/Zoologist
Michigan Natural Features Inventory

SU EXTENSION

Michigan Natural Features Inventory

PO Box 13036
Lansing MI 48901

(517) 373-1552
Fax (517) 373-9566

mnfi.anr.msu.edu

Table 1: Legally protected species within 1.5 miles of 1271

SNAME	SCOMNAME	FIRSTOBS	LASTOBS	USESA	SPROT	GRANK	SRANK	ELCAT
Tyto alba	Barn owl	1974	1980-06-20		E	G5	S1	Animal
Sagittaria montevidensis	Arrowhead		1980?		T	G4G5	S1S2	Plant
Sterna hirundo	Common tern		1985		T	G5	S2	Animal
Pantherophis gloydi	Eastern fox snake	1960'S	1986		T	G3	S2	Animal
Nelumbo lutea	American lotus		1982-07-20		T	G4	S2	Plant
Sagittaria montevidensis	Arrowhead	1964	2001-08-15		T	G4G5	S1S2	Plant
Nelumbo lutea	American lotus	2007-09-19	2007-09-19		T	G4	S2	Plant
Ligumia nasuta	Eastern pondmussel				E	G4	SNR	Animal
Cyclonaias tuberculata	Purple wartyback				T	G5	S2S3	Animal
Obovaria subrotunda	Round hickorynut	18??	1977-03-01		E	G4	S1	Animal
Ligumia recta	Black sandshell	1911	1980-12-18		E	G5	SNR	Animal

Table 2: Special concern species and rare natural features within 1.5 miles of #1271

SNAME	SCOMNAME	FIRSTOBS	LASTOBS	USESA	SPROT	GRANK	SRANK	ELCAT
Strophostyles helvula	Trailing wild Bean	1964	1964-09-01		SC	G5	S3	Plant
Strophostyles helvula	Trailing wild Bean	1982-08-04	1982-08-04		SC	G5	S3	Plant
Haliaeetus leucocephalus	Bald eagle	1930	2005-03-28		SC	G5	S4	Animal
Utterbackia imbecillis	Paper pondshell	1935	1935		SC	G5	SNR	Animal
Pleurobema sintoxia	Round pigtoe				SC	G4G5	S2S3	Animal
Ptychobranchus fasciolaris	Kidney shell	1910	1954-pre		SC	G4G5	SNR	Animal

Comments for Enhanced Rare Species Review #1271: Several legally protect species have been known to occur within 1.5 miles of the Fermi 2 Nuclear Station. Some listed species have been observed on the Fermi 2 property. It is important to note that it is the applicant's responsibility to comply with both state and federal Threatened and Endangered species legislation. Therefore, if a State listed species occurs at a project site, and you think you need an endangered species permit please contact: Lori Sargent, Nongame Wildlife Biologist, Wildlife Division, Michigan Department of Natural Resources, P.O. Box 30444, Lansing, MI 48909, 517-373-9418, or SargentL@michigan.gov. If a federally listed species is involved and, you think a permit is needed, please contact Barb Hosler, Endangered Species Program, U.S. Fish and Wildlife Service, East Lansing office, 517-351-6326, or Barbara_Hosler@fws.gov.

The state **endangered barn owl** (*Tyto alba*) has been known to nest along Post Road to the north of the Nuclear Station. Barn owls may utilize a wide array of natural community types and agricultural lands. They may utilize large hollow trees, buildings, or nest boxes for nesting or roosting. Barn owls are less common where intensive agriculture dominates the landscape. Nesting occurs from the first week of April to fourth week of July.

The state endangered **black sandshell mussel** (*Ligumia recta*) has been known to occur in the area off Pointe aux Peaux. It is a spectacular mussel that occurs in the medium to large rivers of the eastern U.S. and Canada in riffles or raceways in gravel or firm sand. The mantle lure is very large and active, and the marsupial gill is stark white. The fish hosts include walleye, sauger, black and largemouth bass, white crappie and bluegill. These predators attack the lure, rupturing the marsupia that lie between the mantle flaps and releasing the glochidia.

The state endangered **round hickorynut** (*Obovaria subrotunda*) has been observed in Lake Erie off of Pointe aux Peaux. This mussel inhabits medium-sized streams in sand and gravel in areas with moderate flow. The round hickorynut is a historically wide-ranging species that has disappeared from many areas due to alterations in streamflow, habitat destruction and fragmentation, and degradation in water quality.

The state threatened **Eastern fox snake** (*Pantherophis gloydi*) has been known to occur in the Frenchtown wetlands. This species entire range is within the Great Lakes basin. It inhabits coastal marshes and other near-shore habitats (i.e. vegetated dunes and beaches), although it sometimes wanders into nearby farm fields, pastures, and woodlots. This snake will bask or forage on raised dikes, muskrat houses, and road embankments but only rarely climbs into trees or shrubbery. Although not strictly aquatic, they are good swimmers capable of moving considerable distances over open offshore waters and between islands. Small mammals, particularly meadow voles *(Microtus)* and deer mice *(Peromyscus)*, make up the largest part of this snake's diet. The Eastern fox snake is harmless to humans, and its rodent-eating habits make it an economically useful species in agricultural areas. Human-related threats (harassment and killing) and continued habitat loss of Great Lakes marshes are the main threats pressuring Michigan's Eastern fox snake population.

The state threatened **common tern** (*Sterna hirundo*) has been observed nesting near the Fermi 2 Nuclear Station. Common terns nest mainly on bare sandy, gravelly parts of islands or peninsulas where they are safe from mammalian predation. Nesting usually begins the second week of May in southern counties, with later starts farther north, and concludes by early August. Significant disturbance around nesting colonies can disrupt nesting behavior and result in nest abandonment or egg and chick mortality.

The state threatened **arrowhead** (*Sagittaria montevidensis*) has been known to occur on the grounds of the Fermi 2 Nuclear Station. Along western Lake Erie, arrowhead grows on wet to shallowly-inundated mud flats, exposed by the cycles of fluctuating lake levels. It has been seen inside dikes when the water levels drop. Arrowhead flowers during late August and early September, producing fruits by late September.

The state threatened **American lotus** (*Nelumbo lutea*) has been known to occur on the grounds of the Fermi 2 Nuclear Station. This water lily inhabits lakes, ponds, backwater areas and marshes. The leaves are large and shield-shaped and float on the water surface. The yellow flower blooms in July and August.

Please consult MNFI's Rare Species Explorer for additional information related to the above mentioned species.

Special concern species and natural communities are not protected under endangered species legislation but efforts should be taken to minimize any or all impacts. Species classified as special concern are species whose numbers are getting smaller in the state. If these species continue to decline they would be recommended for reclassification to threatened or endangered status. However, the special concern **bald eagle** (*Haliaeetus leucocephalus*) is protected under the Bald and Golden Eagle Protection Act which prohibits anyone from "taking" bald eagles, including their parts, eggs or nests.

Codes to accompany Tables 1 and 2:

State Protection Status Code Definitions (SPROT)
E: Endangered
T: Threatened
SC: Special concern
Global Heritage Status Rank Definitions (GRANK)
The priority assigned by NatureServe's national office for data collection and protection based upon the element's status throughout its entire world-wide range. Criteria not based only on number of occurrences; other critical factors also apply. Note that ranks are frequently combined.
G1 = critically imperiled globally because of extreme rarity (5 or fewer occurrences range-wide or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.
G2 = imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.
G3: Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g. a single western state, a physiographic region in the East) or because of other factor(s) making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.
G4: Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
G5: Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
Q: Taxonomy uncertain

State Heritage Status Rank Definitions (SRANK)
The priority assigned by the Michigan Natural Features Inventory for data collection and protection based upon the element's status within the state. Criteria not based only on number of occurrences; other critical factors also apply. Note that ranks are frequently combined.
S1: Critically imperiled in the state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation in the state.
S2: Imperiled in state because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.
S3: Rare or uncommon in state (on the order of 21 to 100 occurrences).
S4 = apparently secure in state, with many occurrences.
S5 = demonstrably secure in state and essentially ineradicable under present conditions.
SX = apparently extirpated from state.

Attachment C

Cultural Resources Consultation

Attachment C

Cultural Resources Consultation

- Zachary W. Rad, DTE Electric Company, to Brian D. Conway, Michigan State Historic Preservation Officer. June 27, 2013.
- Zachary W. Rad, DTE Electric Company, to Warren C. Swartz, Jr., Keweenaw Bay Indian Community; Kurt Perron, Bay Mills Indian Community; Alvin Pedwaydon, Grand Traverse Band of Ottawa and Chippewa Indians; James Williams Jr., Lac Vieux Desert Band of Lake Superior Chippewa Indians; Dexter McNamara, Little Traverse Bay Bands of Odawa Indians; Matt Wesaw, Pokagon Band of Potawatomi Indians; Aaron Payment, Sault Ste. Marie Tribe of Chippewa Indians of Michigan; Kenneth Meshiguad, Hannahville Indian Community; Homer A. Mandoka, Huron Potawatomi, Inc (Nottawaseppi Huron Band of the Potawatomi); Dennis V. Kequom, Saginaw Chippewa Indian Tribe of Michigan; David K. Sprague, Match-e-be-nash-she-wish Band of Pottawatomi Indians of Michigan; Larry Romanelli, Little River Band of Ottawa Indians; Harold G. Frank, Forest County Potawatomi; Ron Sparkman, Shawnee Tribe; CJ Watkins, Delaware Nation; Billy Friend, Wyandotte Nation; Ethel E. Cook, Ottawa Tribe of Oklahoma; Joseph Gilber, Walpole Island (Bkejwanong First Nation); Monroe County Historical Museum; Monroe County Labor History Museum; Michigan Archaeological Society, River Raisin Chapter; Friends of the River Raisin Battlefield; James McDevitt, Frenchtown Charter Township; Daniel Harrison, Henry Ford Community College Eshleman Library; Bill Reiser and Louis Komorowski, Ellis Library & Reference System (Monroe County Library System). June 27, 2013.
- Giiwegiizhigookway Martin, Ketegitigaaning Ojibwe Nation, Lac Vieux Desert Band of Lake Superior Chippewa, to Lynne Goodman, DTE Electric Company. July 22, 2013.
- Zachary Rad, DTE Electric Company, to Giiwegiizhigookway Martin, Ketegitigaaning Ojibwe Nation, Lac Vieux Desert Band of Lake Superior Chippewa. October 29, 2013.
- Brian Grennell (for Brian Conway) Michigan State Historic Preservation Officer, to Randall Westmoreland, Detroit Edison Company. January 24, 2014.

Fermi 2
6400 North Dixie Hwy
Newport, MI 48166

DTE Energy

June 27, 2013
NANL-13-0036

Mr. Brian D. Conway
Michigan State Historic Preservation Officer
State Historic Preservation Office (SHPO)
Michigan State Housing Development Authority
702 W. Kalamazoo St., 5th floor
P.O. Box 30740
Lansing, MI 48909

Subject: Request for SHPO Feedback Regarding the Fermi 2 Nuclear Power Plant Operating License Renewal Application

Dear Mr. Conway:

In 2014, DTE Electric Company (DTE) [formerly, The Detroit Edison Company] intends to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for Fermi 2. The Fermi 2 site is located in Monroe County, Michigan on the west shoreline of Lake Erie, approximately 30 miles southwest of Detroit, Michigan. The existing operating license for Fermi 2 was issued for a 40-year term that expires in 2025. A renewed license would give DTE the option to continue operating Fermi 2 until 2045.

The NRC requires that the license renewal application for Fermi 2 include an environmental report assessing potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the potential effect of license renewal on cultural resources including above-ground properties, archaeological sites, and traditional cultural properties that may be located on the 1,260-acre Fermi 2 site and within a 10-mile band around the Fermi 2 site property boundaries as shown in Figure 1. Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51.53). Later, during its review of the proposed license renewal environmental report pursuant to the National Environmental Policy Act (NEPA), the NRC may request information from your office to assess compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800).

DTE is contacting you now to obtain any early input you may have regarding issues to be addressed in the Fermi 2 license renewal environmental report (ER) and to assist DTE in the identification of any information your staff believes would be helpful during ER preparation and ultimately, the NRC's review. For that request we provide the following information that may facilitate your review.

The 1,260 acre Fermi 2 site primarily consists of developed areas, woodlands, and swamp or wetland areas. The land in a 10-mile band around the Fermi 2 site is mostly rural (see enclosed Figure 1). A portion of Lake Erie is also within the 10-mile band. The only transmission lines associated with Fermi 2 that are within scope of this evaluation are located in the developed industrialized area of the Fermi 2 site and within the property boundary. Based on previous consultations and other available information, DTE is providing a brief summary of the results of archaeological/cultural resource surveys and file reviews that have been completed for the Fermi 2 site and for the 10-mile band around the Fermi 2 site, including an onsite survey and file review update conducted as recently as August, 2012 for the current Fermi 2 license renewal.

Historic properties on and within 10 miles of the Fermi 2 site, and archaeological sites located on and within 1.5 miles of the Fermi 2 site (Figure 1), identified during these investigations are listed in Tables 1 and 2.

DTE does not expect Fermi 2 operations during the license renewal term (an additional 20 years) to adversely affect above-ground or archaeological resources because a renewed license itself will not add or demolish any existing facilities on the 1,260-acre Fermi 2 site. No ground outside the currently developed area of the Fermi 2 site is expected to be disturbed, view sheds altered, or operational noise levels increased as a result of license renewal, and maintenance activities necessary to support continued operation of Fermi 2 are expected to be limited to currently developed areas of the Fermi 2 site. Administrative procedural controls will be in place for management of cultural resources ahead of any future ground-disturbing activities at the plant.

After your review of the information provided in this letter, your office is invited to send a letter to DTE by July 30, 2013. Please indicate any concerns you may have regarding cultural resources addressed in this letter or otherwise known to your office that are not addressed, especially any traditional cultural properties that may be recognized by Native American organizations. A similar letter of early consultation is also being sent by DTE to other potentially interested parties (see Attachment A for recipients), including Native American organizations and persons/organizations with local historical interests. Alternatively, you may concur with our conclusion that operation of Fermi 2 during the license renewal term would have no adverse effects on properties listed in or eligible for the NRHP. DTE will include copies of this letter and of any response(s) from your office within the environmental report that will be submitted to the NRC as part of the Fermi 2 license renewal application.

Please address all correspondence or inquiries to:
Lynne Goodman
6400 N. Dixie Hwy, 110NOC
Newport, MI 48166
goodmanl@dteenergy.com
734-586-1205

Sincerely,

Zackary W. Rad
Manager, Nuclear Licensing

Enclosures:

Table 1	NRHP-Listed, NRHP-Eligible, or Recommended Eligible Properties on or within a 10-Mile Band of the Fermi 2 Site
Table 2	Known Archaeological Sites on or within 1.5 miles of the Fermi 2 Site
Figure 1	Fermi 2 Site / Archaeological APE, 1.5-Mile Band, and 10-Mile Band/Aboveground APE
Attachment A	Cultural Resources Consultation Contact List

cc: Dean Anderson, PH.D., State Archaeologist, State Historic Preservation Office

bcc: G. D Cerrullo
L.S. Goodman
K. Hlavaty
A. Lim
M. Lumpert-Coy
Z.W. Rad
R. Westmoreland
Information Management (140 NOC)

Table 1
NRHP-Listed, NRHP-Eligible, or Recommended Eligible Properties on or within a 10-Mile Band of the Fermi 2 Site

Name	Address	Resource Description	City or Township/County	NRHP Status
Enrico Fermi Power Plant Unit 1[(a)]	6400 N. Dixie Hwy.	Early nuclear reactor; the nation's only commercial-sized liquid-metal-cooled fast breeder reactor, and the world's largest at the time of construction. Construction began 1956; the reactor reached criticality 1963 and was decommissioned in 1975.	Frenchtown Township/Monroe	Eligible[(a)]
River Raisin Battlefield Site[(b)(c)] (20MR227)	E. Elm Ave	Site of the 1813 battles of Frenchtown (War of 1812).	Monroe/Monroe	Listed[(b)]
Hull's Trace North Huron River Corduroy Segment Historic Trail/Road[(c)]	36000 W. Jefferson Avenue	Only known extant segment of military road between Urbana, Ohio, and Detroit; segment dates to 1812.	Brownstown Township/Wayne	Listed[(c)]
Jefferson Avenue Bridge[(d)]	Jefferson Avenue over the Huron River	Three main spans; steel I-beam construction; representative example of new mill technology; erected in 1930.	Brownstown Township/Wayne	Listed[(d)]
Gibraltar Road Bridge[(d)]	Gibraltar Road over Waterway Canal	Reinforced concrete cantilevered-arch bridge; constructed in 1931.	Gibraltar/Wayne	Listed[(d)]
East River Road-North Hickory Canal Bridge[(d)]	East River Road over Hickory Canal	Three-span bridge; illustrates evolution of Wayne County road commission's bridge design; constructed in 1945.	Grosse Ile/Wayne	Listed[(d)]
South Pointe Drive Bridge[(d)]	Pointe Drive over Swan Island Canal	Concrete T-beam span; WPA construction project; bridge plate dated 1939.	Grosse Ile/Wayne	Listed[(d)]
Edward Loranger House[(d)]	7211 S. Stony Creek Road	Brick residence; example of early 19th-century French-Canadian architecture; constructed in 1925.	Monroe Vicinity/Monroe	Listed[(d)]

Name	Address	Resource Description	City or Township/County	NRHP Status
George Armstrong Custer Equestrian Monument[d]	SW corner Elm and North Monroe (M-125) streets	Monument depicting General Custer "sighting the enemy;" commemorates Custer's Michigan Cavalry Brigade on Rummel fields at Gettysburg (July 3, 1863); dedicated in 1910.	Monroe/Monroe	Listed[d]
East Elm-North Macomb Street Historic District[d]	Roughly bounded by the River Raisin, Lorain, Monroe, and Macomb streets	Historic district of high-style homes and working-class dwellings; represents all periods from 1820 to 1930.	Monroe/Monroe	Listed[d]
Governor Robert McClelland House[d]	47 E Elm Street	Greek Revival-style home of Michigan Governor Robert McClelland; constructed ca. 1841.	Monroe/Monroe	Listed[d]
Navarre-Anderson Trading Post[d]	West of Monroe at N. Custer (M-130) and Raisinville roads	Log structure; *pièce sur pièce* construction technique; restored to 1799 appearance.	Monroe/Monroe	Listed[d]
Rudolph Nims House[d]	206 W. Noble Avenue	Greek Revival-style dwelling; constructed ca. 1836–1846.	Monroe/Monroe	Listed[d]
Old Village Historic District[d]	Along the River Raisin, Navarre, Wadsworth, LaPlaisance, Seventh, Washington, Monroe, and Third streets	District containing 19th- and early 20th-century residential, commercial, ecclesiastical, and institutional architecture; represents the period spanning 1825 to 1925.	Monroe/Monroe	Listed[d]
Saint Mary's Church Complex[d]	Elm Avenue and M-125 (N. Monroe Avenue)	Gothic Revival-influenced stone and brick church (1836–1839), school (1903), rectory (ca. 1920s), and Brothers of Holy Cross Hall (Italianate-style former residence, 1870).	Monroe/Monroe	Listed[d]

Table 1 (cont.)
NRHP-Listed, NRHP-Eligible, or Recommended Eligible Properties on or within a 10-Mile Band of the Fermi 2 Site

Name	Address	Resource Description	City or Township/County	NRHP Status
Sawyer House[d]	320 E. Front Street	Red brick Italianate cube dwelling; constructed in 1873.	Monroe/Monroe	Listed[d]
Weis Manufacturing Company Building[d]	Union and Seventh streets	Former home of local employers Weis Manufacturing Company, Floral City Furniture Company, and La-Z-Boy Chair Company; constructed 1905–1912.	Monroe/Monroe	Listed[d]
Detroit River Light Station[d]	Lake Erie, 3.75 miles SE of Millerville Beach	Light tower and fog signal building; aka Bar Point Light Station; first established in 1885.	Rockwood vicinity/Monroe	Listed[d]
5046 Williams Road House[d]	5046 Williams Road	Two-story gable-front residence; constructed ca. 1940.	Frenchtown Township/Monroe	Eligible[d]
2187 Hurd Road House[d]	2187 E. Hurd Road	Red brick; gabled-ell residence; constructed ca. 1860s.	Frenchtown Township/Monroe	Eligible[d]
I-75 Bridge[d]	I-75 Bridge over Conrail and Raisin River	Three main spans; steel girder and floor beam spans; constructed in 1955.	Monroe/Monroe	Eligible[d]
Monroe Armory[d]	15483 S. Dixie Hwy.	Classic armory form head-house and drill hall; constructed 1926–1928.	Monroe/Monroe	Eligible[d]
St. Mary's Academy Historic District[d]	610 W. Elm Avenue	Catholic girls' school; founded in 1846.	Monroe/Monroe	Eligible[d]
Horse Island Drive Bridge[d]	Horse Island Drive Bridge over Horse Island Bayou	Concrete closed spandrel deck arch bridge; constructed in 1925.	Gibraltar/Wayne	Eligible[d]
Horse Island Drive Bridge[d]	Horse Island Drive Bridge over Adams Bayou	Concrete closed spandrel deck arch bridge; constructed in 1925.	Gibraltar/Wayne	Eligible[d]

Table 1 (cont.)
NRHP-Listed, NRHP-Eligible, or Recommended Eligible Properties on or within a 10-Mile Band of the Fermi 2 Site

Name	Address	Resource Description	City or Township/County	NRHP Status
St. Charles (Borromeo) Church and Complex[e]	8109 Swan Creek Road	Gothic revival Catholic church; polychrome brick masonry construction; constructed 1882–1886; rectory (built 1886); convent, auditorium, garages (all built in the 1930s).	Berlin Township/Monroe	Eligible[e]
2381 Hurd Road Farmhouse[e]	2381 Hurd Road	Red brick farmhouse; former home of early settler James Fix; constructed ca. 1850.	Frenchtown Township/Monroe	Eligible[e]
2122 N. Dixie Hwy. House[e]	2122 N. Dixie Hwy.	Brick residence; home of Columbus, Henry, and Oliver Fix (sons of early settler Joseph Fix); constructed ca. 1875.	Frenchtown Township/Monroe	Eligible[e]
6511 Leroux Road Farmstead[e]	6511 Leroux Road	Joseph Fix (son of early settler Joseph Fix) farmstead; brick gabled-ell residence and brick three-bay threshing barn; house constructed 1878.	Frenchtown Township/Monroe	Eligible[e]
Dixie Skateland Building[e]	5179 N. Dixie Hwy.	Barrel-vaulted recreational structure; yellow brick exterior cladding; constructed in 1958.	Frenchtown Township/Monroe	Eligible[e]
St. Anne's Catholic Church Grotto[e]	2430 N. Dixie Hwy.	Stone grotto housing statues of St. Anne and the Virgin Mary; constructed in 1958.	Frenchtown Township/Monroe	Eligible[e]
2983 Third Street House[e]	2983 Third Street	Storybook Tudor residence; constructed ca. 1930.	Frenchtown	Recommended eligible[e]
3360 Elmwood Street House[e]	3360 Elmwood Street	Mediterranean-style residence; yellow brick; constructed ca. 1940.	Frenchtown	Recommended eligible[e]
3390 Lawndale Street House[e]	3390 Lawndale Street	Modest Queen Anne-style residence; constructed ca. 1910.	Frenchtown	Recommended eligible[e]
3518 Nippising Street Building[e]	3518 Nippising Street	Concrete "log" resort clubhouse; constructed ca. 1930–1940s.	Frenchtown	Recommended eligible[e]

Table 1 (cont.)
NRHP-Listed, NRHP-Eligible, or Recommended Eligible Properties on or within a 10-Mile Band of the Fermi 2 Site

Name	Address	Resource Description	City or Township/County	NRHP Status
3677 Lakeview Drive House[(e)]	3677 Lakeview Drive	Possible Mershon & Morley "portable" (panelized) residence; constructed ca. 1945.	Frenchtown	Recommended eligible[(e)]
3535, 3555, 3575, and 3595 Pearl Drive houses [(e)]	Pearl Drive Historic District	Two-/two and one-half-story stucco-finished residences; constructed ca. 1927.	Frenchtown	Recommended eligible[(e)]
Frenchtown Township District No. 13 School[(e)]	3684 Brest Road	One-story brick schoolhouse; constructed 1926–1927.	Frenchtown	Recommended eligible[(e)]
3738 Brest Road house[(e)]	3738 Brest Road	Greek revival-style residence; possible home of prominent 19th-century fishing and business Dewey family; constructed ca. 1840.	Frenchtown	Recommended eligible[(e)]
6068 N. Dixie Hwy. farmstead [(e)]	6068 N. Dixie Hwy.	Side-gabled residence and three-bay threshing barn farmstead complex; constructed ca. 1885.	Frenchtown	Recommended eligible[(e)]
South of 4973 N. Dixie Hwy. building[(e)]	No visible address	Former Redemptorist Mission; constructed ca. 1850s.	Frenchtown	Recommended eligible[(e)]
3606 Lakeshore Drive house[(e)]	3606 Lakeshore Drive	Mediterranean-style residence; constructed ca. 1940.	Frenchtown	Recommended eligible[(e)]
Old St. Charles Cemetery[(e)]	N. Dixie Hwy. (no visible address)	Third burial ground associated with St. Charles (Borromeo) Catholic Church; aka White Cemetery, LaDuc Cemetery; established 1851.	Berlin	Recommended eligible[(e)]
St. Charles Cemetery[(e)]	N. Dixie Hwy. (no visible address)	Fourth burial ground associated with St. Charles (Borromeo) Catholic Church; established 1882.	Berlin	Recommended eligible[(e)]

Table 1 (cont.)
NRHP-Listed, NRHP-Eligible, or Recommended Eligible Properties on or within a 10-Mile Band of the Fermi 2 Site

Name	Address	Resource Description	City or Township/County	NRHP Status
6344 Trombley Road farmstead[e]	6344 Trombley Road	Farmstead complex held by early settler Jacob Masserant; contains building of possible notched log construction; farmstead established ca. 1853.	Berlin	Recommended eligible[e]
Motor Cities National Heritage Area[c][f]	Includes over 1,200 contributing sites in 13 Michigan counties[f]	Cohesive, nationally important landscape in the development of the automotive industry and the relationship between labor and industry. [f]	Overlaps within 10-mile vicinity but does not "have specific or identified locations within" the 2007–2008 aboveground survey area (NRC 2013).	Designated National Heritage Area, 1998[c][f]
Wild rice (*Zizania aquatica*) reestablishment Legacy Project Area with additional interest groups	Proposed to be established in as yet unspecified areas suitable for propagation	Wild rice (*Zizania aquatica*) reestablishment in coordination with the Native American community.	Overlaps within 10-mile vicinity, but does not "have specific or identified locations within" the 2007–2008 aboveground survey area (NRC 2013).	Proposed War of 1812 Bicentennial Legacy Commission project[c]; alternative designations likely.

a. Located within 1,260-acre Fermi 2 property and determined eligible by SHPO (Conway 2011).

b. Designated national battlefield site.

c. Designated heritage area or proposed legacy project recommended for consideration (in comments from Fermi 3 EIS public scoping meetings (NRC 2013:2-212). The extant Hull's Trace mentioned in the scoping meeting is NRHP-listed and therefore addressed earlier in the table. The Monroe Harbor, also mentioned in the scoping meeting, has since been determined not eligible for the NRHP and so is not included here.

d. (Demeter et al. 2012) from research of Michigan SHPO files for NRHP-listed and eligible properties.

e. Recommended during 2007–2008 CCRG aboveground survey (Demeter et al. 2008); with "eligible" as determined by SHPO (Conway 2009).

f. (MotorCities 2012)

Table 2
Known Archaeological Sites on or within a 1.5-Mile Band of the Fermi 2 Site

Site Number	Period/Description	Location	NRHP Status
20MR207 (Holmquist M-33)	Prehistoric/historic reference[a]	On Fermi property	Not relocated; recommended not eligible[a][b]
20MR417	Late Archaic, Late Woodland/undetermined[b]	Offsite, but within 1.5-mile band	More information needed[b]
20MR419	Prehistoric, Historic era /undetermined[b]	Offsite, but within 1.5-mile band	More information needed[b]
20MR694	Late Archaic and Late Woodland[b]	Offsite, but within 1.5-mile band	More information needed[b]
20MR702	Prehistoric/lithic scatter on beach[b]	On Fermi property	Not eligible[b][c]
20MR703 (Gustafson)	Archaic[b]	Offsite, but within 1.5-mile band	More information needed[b]
20MR818 (Charles Toll Farmstead)	Prehistoric/isolated flake; Early Twentieth Century/artifact scatter[c]	On Fermi property	Not eligible[b][c]
20MR819	Prehistoric/isolated flake[c]	On Fermi property	Not eligible[b][c]
20MR820	Prehistoric/isolated flake[c]	On Fermi property	Not eligible[b][c]
20MR821	Prehistoric/isolated flake[c]	On Fermi property	Not eligible[b][c]
20MR822	Prehistoric/isolated flake[c]	On Fermi property	Not eligible[b][c]
20MR823	Twentieth Century (1920–60)/building foundation, concrete pad, box cistern, artifact scatter	On Fermi property	Not eligible[b][c]
20MR825	Twentieth Century/artifact scatter, wooden markers (crosses; possible pet burials)[c]	On Fermi property	Not eligible; not recognized as a site by OSA[c]
20MR828	Late Nineteenth-Early Twentieth Century/structural remains (former foundation)[a] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[a]
20MR829	Twentieth Century/structural remains (former foundation), artifact scatter[a] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[a]

Table 2 (cont.)
Known Archaeological Sites on or within a 1.5-Mile Band of the Fermi 2 Site

Site Number	Period/Description	Location	NRHP Status
20MR830	Twentieth Century/structural remains (former foundation), cisterns, artifact scatter[a] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[a]
20MR831	Twentieth Century/structural remains (poured concrete pads), artifact scatter[a] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[a]
20MR832	Twentieth Century/structural remains (former foundation), artifact scatter[a] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[a]
20MR833	Twentieth Century/structural remains (former foundation), cistern[a] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[a]
20MR834	Twentieth Century/structural remains (former foundation, poured concrete pad), well pipe[a] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[a]
The *Adieu* shipwreck	Maritime archaeological resource: A steamer yacht that foundered on September 16, 1906[d]	Offsite, but within 1.5-mile band (Lake Erie)	Unassessed[d]
The *Fame* shipwreck	Maritime archaeological resource: A schooner loaded with general cargo that capsized and foundered off of the Monroe Piers on August 31, 1858[d]	Offsite, but (approximately) within 1.5-mile band (Lake Erie)	Unassessed[d]
The *Roy* shipwreck	Maritime archaeological resource: A tug that struck ice and sank southeast of Stony Point on December 16, 1895[d]	Offsite, but within 1.5-mile band (Lake Erie)	Unassessed[d]
The *General Franz Speigel* shipwreck	Maritime archaeological resource: A schooner that sank off of River Raisin in July 1903[d]	Offsite, but within 1.5-mile band (Lake Erie)	Unassessed[d]

a. 2012 Phase I CCRG recommendations (SHPO concurrence pending) (Demeter et al. 2012).

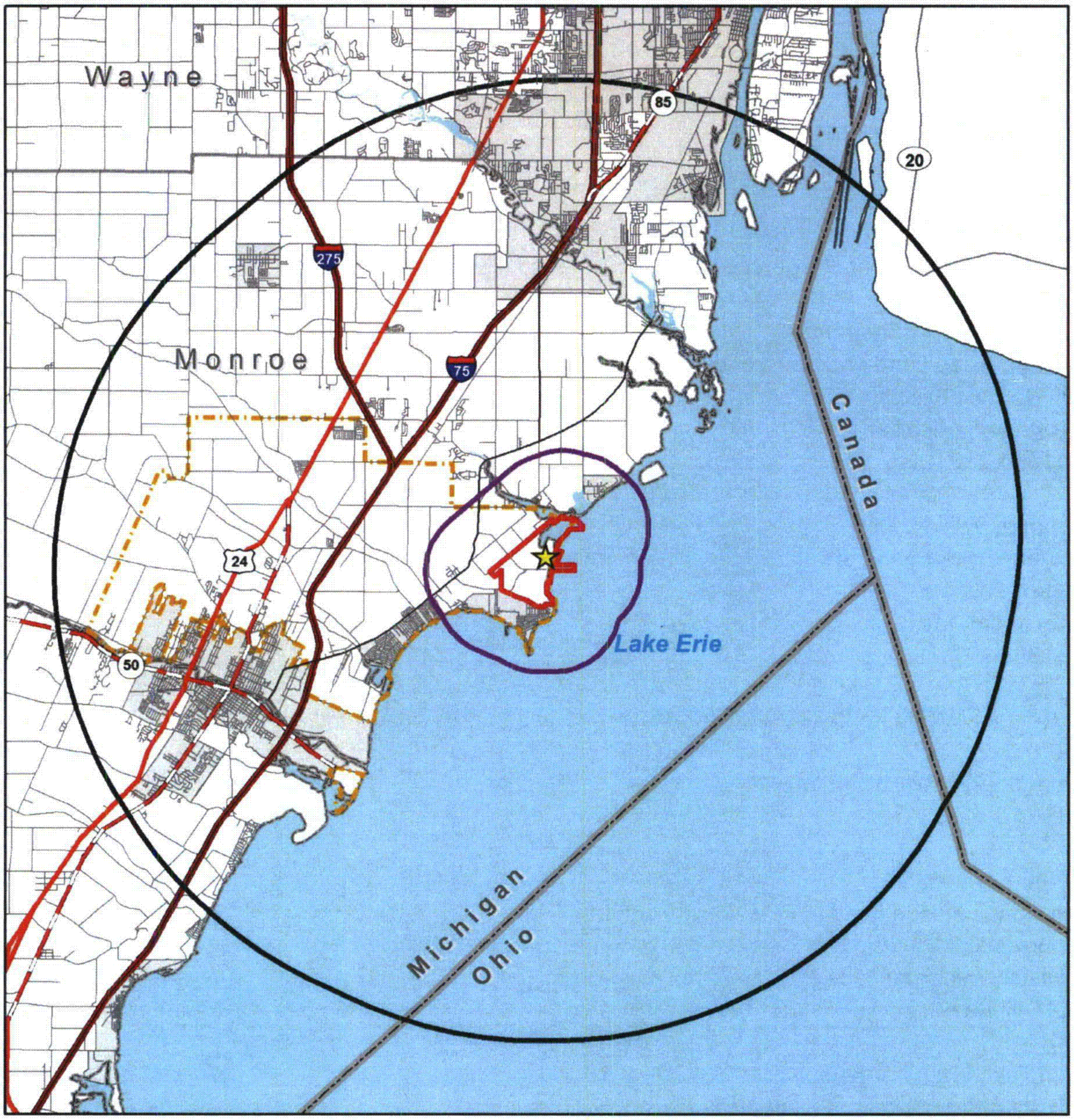
b. NRHP status as recorded on OSA files (Demeter et al. 2012; OSA 2012).

c. NRHP determinations in response to 2007–2008 CCRG investigations (Conway 2009; Demeter et al 2012; OSA 2012).

d. (GLMD 2013; Weir 2010).

Figure 1

Fermi 2 Site / Archaeological APE, 1.5-Mile Band, and 10-Mile Band/Aboveground APE



Legend

- Fermi 2
- 1.5 Mile Band
- 10 Mile Band
- Surface Water
- Municipality
- Frenchtown Township
- County
- State
- Property Boundary (Approximate)
- Interstate
- U.S. Route
- State Highway
- Road

0 3 6 Miles

Source: (DTE 2012 RFI 2.2-022; USCB 2012; NA 2012; USDOT 2012; NRCAN 2012)

Draft: March 8, 2013

Attachment A: Cultural Resources Consultation Contact List

Warren C. Swartz, Jr., President
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Bay Mills Indian Community
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Alvin Pedwaydon, Chairman
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Lac Vieux Desert Band of Lake Superior Chippewa Indians
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Mr. Dexter McNamara Chairman, Little Traverse Bay Bands of Odawa Indians
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Aaron Payment, Chairperson
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Chairman Kenneth Meshiguad
Hannahville Indian Community
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Attachment A (cont.): Cultural Resources Consultation Contact List

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David K. Sprague, Chairman
Match-e-be-nash-she-wish Band of Pottawatomi Indians of Michigan
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The Honorable Larry Romanelli, Tribal Ogema
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Attachment A (cont.): Cultural Resources Consultation Contact List

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SHPO contacts:

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Dean Anderson, PH.D., State Archaeologist
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517-373-1618

Possible Other Interested Parties:

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http://www.co.monroe.mi.us/government/departments_offices/museum/index.html
734-240-7780

Attachment A (cont.): Cultural Resources Consultation Contact List

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313-845-6376 (Harrison direct)
dharrisn@hfcc.edu

Bill Reiser, Library Manager
Louis Komorowski, Reference
Ellis Library & Reference Center
Monroe County Library System
3700 S. Custer Rd.
Monroe, MI 48161-9716
http://monroe.lib.mi.us/branches/ellis/main.htm
734-241-5277

Fermi 2
6400 North Dixie Hwy
Newport, MI 48166

DTE Energy

June 27, 2013
NANL-13-0035

Addressees as shown on Attachment A,
"Cultural Resources Consultation Addressee List"

SUBJECT: Request for Feedback Regarding the Fermi 2 Nuclear Power Plant Operating License Renewal Application

In 2014, DTE Electric Company (DTE) [formerly, The Detroit Edison Company] intends to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for Fermi 2. The Fermi 2 site is located in Monroe County, Michigan on the west shoreline of Lake Erie, approximately 30 miles southwest of Detroit, Michigan. The existing operating license for Fermi 2 was issued for a 40-year term that expires in 2025. A renewed license would give DTE the option to continue operating Fermi 2 until 2045.

The NRC requires that the license renewal application for Fermi 2 include an environmental report assessing potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the potential effect of license renewal on cultural resources including traditional cultural properties located on the Fermi 2 site and within a 10-mile band around the Fermi 2 site boundaries as shown in Figure 1. Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51.53). Later, during its review of the proposed license renewal environmental report pursuant to the National Environmental Policy Act (NEPA), the NRC may request information from your office to assess compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800).

DTE is contacting you now to obtain any input you may deem important regarding issues to be addressed in the Fermi 2 license renewal environmental report, and to assist DTE in the identification of any information your staff believes would be helpful during NRC's review.

The 1,260 acre Fermi 2 site primarily consists of developed areas, woodlands, and swamp or wetland areas. The land in a 10-mile band around the Fermi 2 site is mostly rural (see enclosed Figure 1). A portion of Lake Erie is also within the 10-mile band. The only transmission lines associated with Fermi 2 that are within scope of this evaluation are located in the developed industrialized area of the Fermi 2 site and within the property boundary. Based on previous consultations and other available information, DTE is providing the information below for your office in order to assist in your comments. This information includes a brief summary of the results of archaeological/cultural resource surveys and file reviews that have been completed onsite and for the 10-mile band around the Fermi 2 site, including an onsite survey and file review update conducted as recently as August, 2012 for the current Fermi 2 license renewal effort.

Historic properties on and within 10 miles of the Fermi 2 site, and archaeological sites located on and within 1.5 miles of the Fermi 2 site (Figure 1), identified during these investigations are listed in Tables 1 and 2.

DTE does not expect Fermi 2 operations during the license renewal term (an additional 20 years) to adversely affect above-ground or archaeological resources because a renewed license itself will not add or demolish any existing facilities on the 1,260-acre Fermi 2 site. No ground outside the currently developed area of the Fermi 2 site is expected to be disturbed, view sheds altered, or operational noise levels increased as a result of license renewal, and maintenance activities necessary to support continued operation of Fermi 2 are expected to be limited to currently developed areas of the Fermi 2 site. Administrative procedural controls will be in place for management of cultural resources ahead of any future ground-disturbing activities at the plant.

After your review of the information provided in this letter, your office is invited to send a letter to DTE by July 30, 2013. Please indicate any concerns you may have regarding cultural resources including traditional cultural properties on the Fermi 2 site and within the 10-mile band around the Fermi 2 site. Alternatively, you may concur with our conclusion that operation of Fermi 2 during the license renewal term would have no adverse effects on properties listed in or eligible for the NRHP. DTE will include copies of this letter and of any response(s) from your office within the environmental report that will be submitted to the NRC as part of the Fermi 2 license renewal application.

Please address all correspondence or inquiries to:
Lynne Goodman
6400 N. Dixie Hwy, 110NOC
Newport, MI 48166
goodmanl@dteenergy.com
734-586-1205

Sincerely,

Zackary W. Rad
Manager, Nuclear Licensing

Enclosures:

Table 1	NRHP-Listed, NRHP-Eligible, or Recommended Eligible Properties on or within a 10-Mile Band of the Fermi 2 Site
Table 2	Known Archaeological Sites on or within 1.5 miles of the Fermi 2 Site
Figure 1	Fermi 2 Site / Archaeological APE, 1.5-Mile Band, and 10-Mile Band/Aboveground APE
Attachment A	Cultural Resources Consultation Addressee List

Table 1
NRHP-Listed, NRHP-Eligible, or Recommended Eligible Properties on or within a 10-Mile Band of the Fermi 2 Site

Name	Address	Resource Description	City or Township/County	NRHP Status
Enrico Fermi Power Plant Unit 1[a]	6400 N. Dixie Hwy.	Early nuclear reactor; the nation's only *commercial-sized liquid-metal-cooled* fast breeder reactor, and the world's largest at the time of construction. Construction began 1956; the reactor reached criticality 1963 and was decommissioned in 1975.	Frenchtown *Township/Monroe*	Eligible[a]
River Raisin Battlefield Site[b][c] (20MR227)	E. Elm Ave	Site of the 1813 battles of Frenchtown (War of 1812).	Monroe/Monroe	Listed[b]
Hull's Trace North Huron River Corduroy Segment Historic Trail/Road[c]	36000 W. Jefferson Avenue	Only known extant segment of military road between Urbana, Ohio, and Detroit; segment dates to 1812.	Brownstown Township/Wayne	Listed[c]
Jefferson Avenue Bridge[d]	Jefferson Avenue over the Huron River	Three main spans; steel I-beam construction; representative example of new mill technology; erected in 1930.	Brownstown Township/Wayne	Listed[d]
Gibraltar Road Bridge[d]	Gibraltar Road over Waterway Canal	Reinforced concrete cantilevered-arch bridge; constructed in 1931.	Gibraltar/Wayne	Listed[d]
East River Road-North Hickory Canal Bridge[d]	East River Road over Hickory Canal	Three-span bridge; illustrates evolution of Wayne County road commission's bridge design; constructed in 1945.	Grosse Ile/Wayne	Listed[d]
South Pointe Drive Bridge[d]	Pointe Drive over Swan Island Canal	Concrete T-beam span; WPA construction project; bridge plate dated 1939.	Grosse Ile/Wayne	Listed[d]
Edward Loranger House[d]	7211 S. Stony Creek Road	Brick residence; example of early 19th-century French-Canadian architecture; constructed in 1925.	Monroe Vicinity/Monroe	Listed[d]

Table 1 (cont.)
NRHP-Listed, NRHP-Eligible, or Recommended Eligible Properties on or within a 10-Mile Band of the Fermi 2 Site

Name	Address	Resource Description	City or Township/County	NRHP Status
George Armstrong Custer Equestrian Monument[(d)]	SW corner Elm and North Monroe (M-125) streets	Monument depicting General Custer "sighting the enemy;" commemorates Custer's Michigan Cavalry Brigade on Rummel fields at Gettysburg (July 3, 1863); dedicated in 1910.	Monroe/Monroe	Listed[(d)]
East Elm-North Macomb Street Historic District[(d)]	Roughly bounded by the River Raisin, Lorain, Monroe, and Macomb streets	Historic district of high-style homes and working-class dwellings; represents all periods from 1820 to 1930.	Monroe/Monroe	Listed[(d)]
Governor Robert McClelland House[(d)]	47 E Elm Street	Greek Revival-style home of Michigan Governor Robert McClelland; constructed ca. 1841.	Monroe/Monroe	Listed[(d)]
Navarre-Anderson Trading Post[(d)]	West of Monroe at N. Custer (M-130) and Raisinville roads	Log structure; *pièce sur pièce* construction technique; restored to 1799 appearance.	Monroe/Monroe	Listed[(d)]
Rudolph Nims House[(d)]	206 W. Noble Avenue	Greek Revival-style dwelling; constructed ca. 1836–1846.	Monroe/Monroe	Listed[(d)]
Old Village Historic District[(d)]	Along the River Raisin, Navarre, Wadsworth, LaPlaisance, Seventh, Washington, Monroe, and Third streets	District containing 19th- and early 20th-century residential, commercial, ecclesiastical, and institutional architecture; represents the period spanning 1825 to 1925.	Monroe/Monroe	Listed[(d)]
Saint Mary's Church Complex[(d)]	Elm Avenue and M-125 (N. Monroe Avenue)	Gothic Revival-influenced stone and brick church (1836–1839), school (1903), rectory (ca. 1920s), and Brothers of Holy Cross Hall (Italianate-style former residence, 1870).	Monroe/Monroe	Listed[(d)]

Table 1 (cont.)
NRHP-Listed, NRHP-Eligible, or Recommended Eligible Properties on or within a 10-Mile Band of the Fermi 2 Site

Name	Address	Resource Description	City or Township/County	NRHP Status
Sawyer House[d]	320 E. Front Street	Red brick Italianate cube dwelling; constructed in 1873.	Monroe/Monroe	Listed[d]
Weis Manufacturing Company Building[d]	Union and Seventh streets	Former home of local employers Weis Manufacturing Company, Floral City Furniture Company, and La-Z-Boy Chair Company; constructed 1905–1912.	Monroe/Monroe	Listed[d]
Detroit River Light Station[d]	Lake Erie, 3.75 miles SE of Millerville Beach	Light tower and fog signal building; aka Bar Point Light Station; first established in 1885.	Rockwood vicinity/Monroe	Listed[d]
5046 Williams Road House[d]	5046 Williams Road	Two-story gable-front residence; constructed ca. 1940.	Frenchtown Township/Monroe	Eligible[d]
2187 Hurd Road House[d]	2187 E. Hurd Road	Red brick; gabled-ell residence; constructed ca. 1860s.	Frenchtown Township/Monroe	Eligible[d]
I-75 Bridge[d]	I-75 Bridge over Conrail and Raisin River	Three main spans; steel girder and floor beam spans; constructed in 1955.	Monroe/Monroe	Eligible[d]
Monroe Armory[d]	15483 S. Dixie Hwy.	Classic armory form head-house and drill hall; constructed 1926–1928.	Monroe/Monroe	Eligible[d]
St. Mary's Academy Historic District[d]	610 W. Elm Avenue	Catholic girls' school; founded in 1846.	Monroe/Monroe	Eligible[d]
Horse Island Drive Bridge[d]	Horse Island Drive Bridge over Horse Island Bayou	Concrete closed spandrel deck arch bridge; constructed in 1925.	Gibraltar/Wayne	Eligible[d]
Horse Island Drive Bridge[d]	Horse Island Drive Bridge over Adams Bayou	Concrete closed spandrel deck arch bridge; constructed in 1925.	Gibraltar/Wayne	Eligible[d]

Table 1 (cont.)
NRHP-Listed, NRHP-Eligible, or Recommended Eligible Properties on or within a 10-Mile Band of the Fermi 2 Site

Name	Address	Resource Description	City or Township/County	NRHP Status
St. Charles (Borromeo) Church and Complex[(e)]	8109 Swan Creek Road	Gothic revival Catholic church; polychrome brick masonry construction; constructed 1882–1886; rectory (built 1886); convent, auditorium, garages (all built in the 1930s).	Berlin Township/Monroe	Eligible[(e)]
2381 Hurd Road Farmhouse[(e)]	2381 Hurd Road	Red brick farmhouse; former home of early settler James Fix; constructed ca. 1850.	Frenchtown Township/Monroe	Eligible[(e)]
2122 N. Dixie Hwy. House[(e)]	2122 N. Dixie Hwy.	Brick residence; home of Columbus, Henry, and Oliver Fix (sons of early settler Joseph Fix); constructed ca. 1875.	Frenchtown Township/Monroe	Eligible[(e)]
6511 Leroux Road Farmstead[(e)]	6511 Leroux Road	Joseph Fix (son of early settler Joseph Fix) farmstead; brick gabled-ell residence and brick three-bay threshing barn; house constructed 1878.	Frenchtown Township/Monroe	Eligible[(e)]
Dixie Skateland Building[(e)]	5179 N. Dixie Hwy.	Barrel-vaulted recreational structure; yellow brick exterior cladding; constructed in 1958.	Frenchtown Township/Monroe	Eligible[(e)]
St. Anne's Catholic Church Grotto[(e)]	2430 N. Dixie Hwy.	Stone grotto housing statues of St. Anne and the Virgin Mary; constructed in 1958.	Frenchtown Township/Monroe	Eligible[(e)]
2983 Third Street House[(e)]	2983 Third Street	Storybook Tudor residence; constructed ca. 1930.	Frenchtown	Recommended eligible[(e)]
3360 Elmwood Street House[(e)]	3360 Elmwood Street	Mediterranean-style residence; yellow brick; constructed ca. 1940.	Frenchtown	Recommended eligible[(e)]
3390 Lawndale Street House[(e)]	3390 Lawndale Street	Modest Queen Anne-style residence; constructed ca. 1910.	Frenchtown	Recommended eligible[(e)]
3518 Nippising Street Building[(e)]	3518 Nippising Street	Concrete "log" resort clubhouse; constructed ca. 1930–1940s.	Frenchtown	Recommended eligible[(e)]

Table 1 (cont.)
NRHP-Listed, NRHP-Eligible, or Recommended Eligible Properties on or within a 10-Mile Band of the Fermi 2 Site

Name	Address	Resource Description	City or Township/County	NRHP Status
3677 Lakeview Drive House[(e)]	3677 Lakeview Drive	Possible Mershon & Morley "portable" (panelized) residence; constructed ca. 1945.	Frenchtown	Recommended eligible[(e)]
3535, 3555, 3575, and 3595 Pearl Drive houses [(e)]	Pearl Drive Historic District	Two-/two and one-half-story stucco-finished residences; constructed ca. 1927.	Frenchtown	Recommended eligible[(e)]
Frenchtown Township District No. 13 School[(e)]	3684 Brest Road	One-story brick schoolhouse; constructed 1926–1927.	Frenchtown	Recommended eligible[(e)]
3738 Brest Road house[(e)]	3738 Brest Road	Greek revival-style residence; possible home of prominent 19th-century fishing and business Dewey family; constructed ca. 1840.	Frenchtown	Recommended eligible[(e)]
6068 N. Dixie Hwy. farmstead [(e)]	6068 N. Dixie Hwy.	Side-gabled residence and three-bay threshing barn farmstead complex; constructed ca. 1885.	Frenchtown	Recommended eligible[(e)]
South of 4973 N. Dixie Hwy. building[(e)]	No visible address	Former Redemptorist Mission; constructed ca. 1850s.	Frenchtown	Recommended eligible[(e)]
3606 Lakeshore Drive house[(e)]	3606 Lakeshore Drive	Mediterranean-style residence; constructed ca. 1940.	Frenchtown	Recommended eligible[(e)]
Old St. Charles Cemetery[(e)]	N. Dixie Hwy. (no visible address)	Third burial ground associated with St. Charles (Borromeo) Catholic Church; aka White Cemetery, LaDuc Cemetery; established 1851.	Berlin	Recommended eligible[(e)]
St. Charles Cemetery[(e)]	N. Dixie Hwy. (no visible address)	Fourth burial ground associated with St. Charles (Borromeo) Catholic Church; established 1882.	Berlin	Recommended eligible[(e)]

Table 1 (cont.)
NRHP-Listed, NRHP-Eligible, or Recommended Eligible Properties on or within a 10-Mile Band of the Fermi 2 Site

Name	Address	Resource Description	City or Township/County	NRHP Status
6344 Trombley Road farmstead[e]	6344 Trombley Road	Farmstead complex held by early settler Jacob Masserant; contains building of possible notched log construction; farmstead established ca. 1853.	Berlin	Recommended eligible[e]
Motor Cities National Heritage Area[c][f]	Includes over 1,200 contributing sites in 13 Michigan counties[f]	Cohesive, nationally important landscape in the development of the automotive industry and the relationship between labor and industry. [f]	Overlaps within 10-mile vicinity but does not "have specific or identified locations within" the 2007–2008 aboveground survey area (NRC 2013).	Designated National Heritage Area, 1998[c][f]
Wild rice (*Zizania aquatica*) reestablishment Legacy Project Area with additional interest groups	Proposed to be established in as yet unspecified areas suitable for propagation	Wild rice (*Zizania aquatica*) reestablishment in coordination with the Native American community.	Overlaps within 10-mile vicinity, but does not "have specific or identified locations within" the 2007–2008 aboveground survey area (NRC 2013).	Proposed War of 1812 Bicentennial Legacy Commission project[c]; alternative designations likely.

a. Located within 1,260-acre Fermi 2 property and determined eligible by SHPO (Conway 2011).

b. Designated national battlefield site.

c. Designated heritage area or proposed legacy project recommended for consideration (in comments from Fermi 3 EIS public scoping meetings (NRC 2013:2-212). The extant Hull's Trace mentioned in the scoping meeting is NRHP-listed and therefore addressed earlier in the table. The Monroe Harbor, also mentioned in the scoping meeting, has since been determined not eligible for the NRHP and so is not included here.

d. (Demeter et al. 2012) from research of Michigan SHPO files for NRHP-listed and eligible properties.

e. Recommended during 2007–2008 CCRG aboveground survey (Demeter et al. 2008); with "eligible" as determined by SHPO (Conway 2009).

f. (MotorCities 2012)

Table 2
Known Archaeological Sites on or within a 1.5-Mile Band of the Fermi 2 Site

Site Number	Period/Description	Location	NRHP Status
20MR207 (Holmquist M-33)	Prehistoric/historic reference[(a)]	On Fermi property	Not relocated; recommended not eligible[(a)(b)]
20MR417	Late Archaic, Late Woodland/undetermined[(b)]	Offsite, but within 1.5-mile band	More information needed[(b)]
20MR419	Prehistoric, Historic era /undetermined[(b)]	Offsite, but within 1.5-mile band	More information needed[(b)]
20MR694	Late Archaic and Late Woodland[(b)]	Offsite, but within 1.5-mile band	More information needed[(b)]
20MR702	Prehistoric/lithic scatter on beach[(b)]	On Fermi property	Not eligible[(b)(c)]
20MR703 (Gustafson)	Archaic[(b)]	Offsite, but within 1.5-mile band	More information needed[(b)]
20MR818 (Charles Toll Farmstead)	Prehistoric/isolated flake; Early Twentieth Century/artifact scatter[(c)]	On Fermi property	Not eligible[(b)(c)]
20MR819	Prehistoric/isolated flake[(c)]	On Fermi property	Not eligible[(b)(c)]
20MR820	Prehistoric/isolated flake[(c)]	On Fermi property	Not eligible[(b)(c)]
20MR821	Prehistoric/isolated flake[(c)]	On Fermi property	Not eligible[(b)(c)]
20MR822	Prehistoric/isolated flake[(c)]	On Fermi property	Not eligible[(b)(c)]
20MR823	Twentieth Century (1920–60)/building foundation, concrete pad, box cistern, artifact scatter	On Fermi property	Not eligible[(b)(c)]
20MR825	Twentieth Century/artifact scatter, wooden markers (crosses; possible pet burials)[(c)]	On Fermi property	Not eligible; not recognized as a site by OSA[(c)]
20MR828	Late Nineteenth-Early Twentieth Century/structural remains (former foundation)[(a)] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[(a)]
20MR829	Twentieth Century/structural remains (former foundation), artifact scatter[(a)] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[(a)]

Table 2 (cont.)
Known Archaeological Sites on or within a 1.5-Mile Band of the Fermi 2 Site

Site Number	Period/Description	Location	NRHP Status
20MR830	Twentieth Century/structural remains (former foundation), cisterns, artifact scatter[(a)] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[(a)]
20MR831	Twentieth Century/structural remains (poured concrete pads), artifact scatter[(a)] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[(a)]
20MR832	Twentieth Century/structural remains (former foundation), artifact scatter[(a)] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[(a)]
20MR833	Twentieth Century/structural remains (former foundation), cistern[(a)] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[(a)]
20MR834	Twentieth Century/structural remains (former foundation, poured concrete pad), well pipe[(a)] Highly disturbed and without historical significance	On Fermi property, near southern perimeter, along Pointe Aux Peaux and Long Roads	Recommended not eligible[(a)]
The *Adieu* shipwreck	Maritime archaeological resource: A steamer yacht that foundered on September 16, 1906[(d)]	Offsite, but within 1.5-mile band (Lake Erie)	Unassessed[(d)]
The *Fame* shipwreck	Maritime archaeological resource: A schooner loaded with general cargo that capsized and foundered off of the Monroe Piers on August 31, 1858[(d)]	Offsite, but (approximately) within 1.5-mile band (Lake Erie)	Unassessed[(d)]
The *Roy* shipwreck	Maritime archaeological resource: A tug that struck ice and sank southeast of Stony Point on December 16, 1895[(d)]	Offsite, but within 1.5-mile band (Lake Erie)	Unassessed[(d)]
The *General Franz Speigel* shipwreck	Maritime archaeological resource: A schooner that sank off of River Raisin in July 1903[(d)]	Offsite, but within 1.5-mile band (Lake Erie)	Unassessed[(d)]

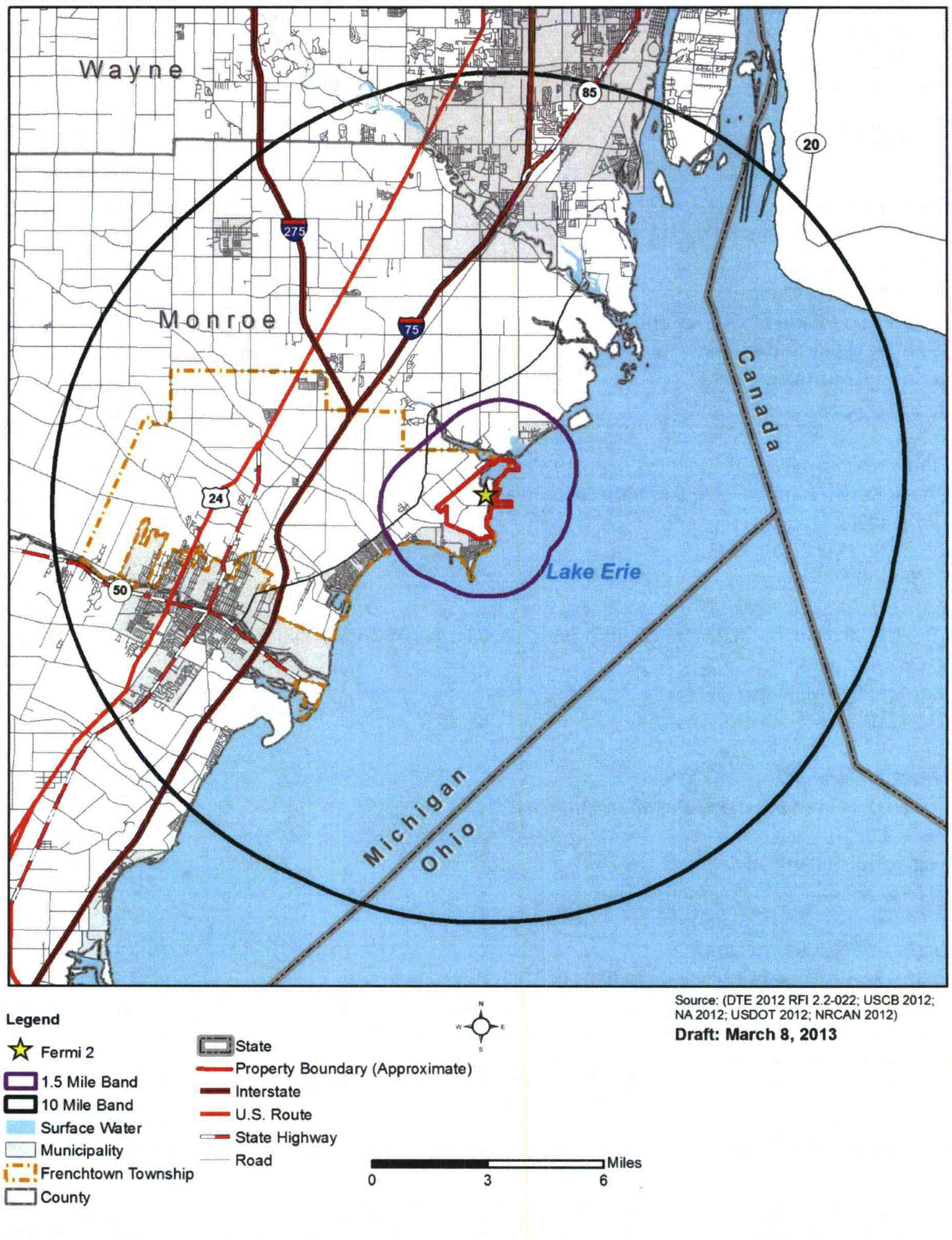
a. 2012 Phase I CCRG recommendations (SHPO concurrence pending) (Demeter et al. 2012).

b. NRHP status as recorded on OSA files (Demeter et al. 2012; OSA 2012).

c. NRHP determinations in response to 2007–2008 CCRG investigations (Conway 2009; Demeter et al 2012; OSA 2012).

d. (GLMD 2013; Weir 2010).

Figure 1
Fermi 2 Site / Archaeological APE, 1.5-Mile Band, and 10-Mile Band/Aboveground APE



Source: (DTE 2012 RFI 2.2-022; USCB 2012; NA 2012; USDOT 2012; NRCAN 2012)

Draft: March 8, 2013

Attachment A: Cultural Resources Consultation Addressee List

Warren C. Swartz, Jr., President
Keweenaw Bay Indian Community
16429 Beartown Road
Baraga, Michigan 49908
(906) 353-6623

Kurt Perron, Chairman
Bay Mills Indian Community
12140 W. Lakeshore Drive
Brimley, MI 49715
(906) 248-8500 (Human Resources #)

Alvin Pedwaydon, Chairman
Grand Traverse Band of Ottawa and Chippewa Indians
2605 N. West Bay Shore Drive
Suttons Bay, Michigan 49682
(231) 534-7103

Mr. James Williams Jr.
Lac Vieux Desert Band of Lake Superior Chippewa Indians
P.O. Box 249
Watersmeet, Michigan 49969
(906) 358-4577

Mr. Dexter McNamara Chairman, Little Traverse Bay Bands of Odawa Indians
7500 Odawa Circle
Harbor Springs, Michigan 49740
(231) 242-1411

Mr. Matt Wesaw
Chairman, Pokagon Band of Potawatomi Indians
P.O. Box 180
Dowagiac, Michigan 49047
(800) 517-0777

Aaron Payment, Chairperson
Sault Ste. Marie Tribe of Chippewa Indians of Michigan
523 Ashmun Street
Sault Ste. Marie, Michigan 49783
(906) 635-6050

Chairman Kenneth Meshiguad
Hannahville Indian Community
N14911 Hannahville B1 Road
Wilson, Michigan 49896-9728
(906) 466-9933

Attachment A (cont.): Cultural Resources Consultation Addressee List

Mr. Homer A. Mandoka
Tribal Council Chairperson,
Huron Potawatomi, Inc (Nottawaseppi Huron Band of the Potawatomi)
2221 – 1 ½ Mile Road
Fulton, MI 49052
(269) 729-5151

Mr. Dennis V. Kequom, Chief
Saginaw Chippewa Indian Tribe of Michigan
7070 East Broadway Road
Mt. Pleasant, Michigan 48858
(989) 775-4000

David K. Sprague, Chairman
Match-e-be-nash-she-wish Band of Pottawatomi Indians of Michigan
P.O. Box 218
Dorr, Michigan 49323
(616) 681-9510

The Honorable Larry Romanelli, Tribal Ogema
Little River Band of Ottawa Indians
375 River Street
Manistee, Michigan 49660
(231) 723-8288

Harold G. Frank
Forest County Potawatomi
Community of Wisconsin
PO Box 340
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Crandon, WI 54520
715-478-7200

Mr. Ron Sparkman
Shawnee Tribe
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29 S Hwy 69A
Miami, OK 74355
(918) 542-2441

CJ Watkins – Vice President
Delaware Nation
P.O. Box 825
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Anadarko, OK 73005
(405) 247-2448

Attachment A (cont.): Cultural Resources Consultation Addressee List

Billy Friend, Chief
Wyandotte Nation
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64700 E. Highway 60
Wyandotte, OK 74370
(918) 678-2297

Ethel E. Cook, Chief
Ottawa Tribe of Oklahoma
P.O. Box 110
13 S. 69 A
Miami, OK 74355
(918) 540-1536

Joseph Gilber, Chief
Walpole Island (Bkejwanong First Nation)
R.R. #3
Wallaceburg, ONN8A 459
(519) 627-1481

Monroe County Historical Museum
126 S. Monroe St.
Monroe, MI 48161
http://www.co.monroe.mi.us/government/departments_offices/museum/index.html
734-240-7780

Monroe County Labor History Museum
Phillip Murray Building
41 W. Front St.
Monroe, MI 48161
http://www.monroelabor.org/
734-693-0446

Michigan Archaeological Society, River Raisin Chapter
niesen@provide.net
Ralph_Naveaux@monroemi.org
Fritz4J@aol.com

Friends of the River Raisin Battlefield
River Raisin Battlefield Park Visitor Center
1403 E. Elm Ave.
Monroe, MI 48162
http://www.riverraisinbattlefield.org/
734-243-7136

Attachment A (cont.): Cultural Resources Consultation Addressee List

Frenchtown Charter Township
James McDevitt, Supervisor
2744 Vivian Road
Monroe, MI 48162
http://www.frenchtowntownship.org/

Mr. Daniel Harrison, Reference Librarian
Henry Ford Community College Eshleman Library
5101 Evergreen Rd.
Dearborn, MI 48128
800-585-HFCC
313-845-6376 (Harrison direct)
dharrisn@hfcc.edu

Bill Reiser, Library Manager
Louis Komorowski, Reference
Ellis Library & Reference Center
Monroe County Library System
3700 S. Custer Rd.
Monroe, MI 48161-9716
http://monroe.lib.mi.us/branches/ellis/main.htm
734-241-5277

From: "Giiwegiizhigookay Martin" <gmartin@lvdtribal.com>
To: <goodmanl@dteenergy.com>

Date: Monday, July 22, 2013 09:34AM
Subject: Consultation NANL-13-0035

History: ➾ This message has been forwarded.

A letter was sent to our Tribal Chairman, James Williams which was forwarded to me to take care of.

If there is a Section 106 review requested from the Ketegitigaaning Ojibwe Nation (aka) Lac Vieux Desert, I have attached a copy of our letter that defines what it is we would need to do our reviews. I am the NAGPRA and THPO for the Tribe.

Please contact myself for this project and any other projects regarding Section 106 reviews and consultation.

[signature]

Ms. giiwegiizhigookway Martin

Tribal Historic Preservation Officer

Ketegitigaaning Ojibwe Nation

Lac Vieux Desert Band of Lake Superior Chippewa

P.O. Box 249

Watersmeet, MI 49969

Phone: 906-358-0137

Fax: 906-358-4850

Cell: 906-284-1425

Attachments:
Interest Letter.doc

July 22, 2013

Project ID: Tower Notifications

Booshoo,

The Lac Vieux Desert Tribal Historic Preservation Office received your request for information related to properties of traditional religious and cultural significance within the vicinity of the proposed facility and any comments or concerns for affects to those properties as according to your obligations under Section 106 of the National Historic Preservation Act and the Native American Graves Protection Act.

The Ketegitigaaning Ojibwe Nation Tribal Historic Preservation Office does not release information related to properties of traditional religious and cultural significance to anyone. However, through government-to-government consultation, the LVD THPO will review project documents to determine whether or not any of these sites exist within the Area of Potential Effects and if so what those effects may be. If we have identified any sites of concern in our research of the project area, we will notify you of the fact.

Please forward the following information: a short summary of the proposed ground disturbing activity, Legal Description of the Area of Potential Effects, Topo maps identifying the proposed area, and copies of any studies that have already been conducted regarding cultural resources and archaeology in their full format, including reports on archaeological and cultural sites identified.

Effective: January 1, 2013:

To enable us to participate fully, t**he Ketegitigaaning Ojibwe Nations fee for such services is $100. $50.00 for historical/cultural records research and $50.00 for archaeological records review per section of land**. The fee must be submitted so that the research can be done. At that time we will review and make our determinations with the appropriate information that we have on file with our Tribe pertaining to this area.

All Collocation Projects will be handled in the same manner as new projects UNLESS the Ketegitigaaning Ojibwe Nation commented on the original project.

Should you have any questions, please feel free to contact me at 906-358-0137.

Miigwetch,

Giiwegiizhigookway Martin

giiwegiizhigookway Martin, THPO

Fee can be sent along with the requested information to:
Make Check Payable to:

Ketegitigaaning Ojibwe Nation THPO
P.O. 249
Watersmeet, Michigan 49969
Office: 906-358-0137
Fax: 906-358-4850
Email: gmartin@lvdtribal.com

Fermi 2
6400 North Dixie Hwy
Newport, MI 48166

DTE Energy

October 29, 2013
NANL-13-0092

Ms. Giiwegiizhigookway Martin
Tribal Historic Preservation Officer
Ketegitigaaning Ojibwe Nation
Lac Vieux Desert Band of Lake Superior Chippewa Indians
P.O. Box 249
Watersmeet, Michigan 49969

Reference: DTE Electric Company (DTE) Letter "Request for Feedback Regarding the Fermi 2 Nuclear Power Plant Operating License Renewal Application", NANL-13-0035, dated June 27, 2013

Subject: Response to DTE Consultation Letter on Fermi 2 License Renewal Application

Dear Ms. Martin:

Thank you for your response to the referenced letter. DTE (formerly the Detroit Edison Company) plans to submit a license renewal application for the Fermi 2 Nuclear Power Plant (Fermi 2), located in Newport, Michigan, to the Nuclear Regulatory Commission (NRC), in April of 2014. The NRC's environmental review of the Fermi 2 application will include, among other activities, National Historic Preservation Act considerations. The formal review per Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800) will occur after the license renewal application is filed with the NRC. The NRC will be the agency conducting the formal review.

Fermi 2 is a nuclear power plant in Monroe County, Michigan, on the west shoreline of Lake Erie, approximately 30 miles southwest of Detroit. Initial plant operation was in 1985, and the current operating license expires in 2025. The license renewal application will request renewal of the operating license until 2045. The planned license renewal will allow for continued operation of the facility on the existing site. The boundaries of the site will not be changed by the license renewal application.

Per your discussion with Ms. Lynne Goodman of DTE, we understand that you have not identified a specific concern with continued use of the Fermi site, since the site has already been disturbed and is already in use. However, you wish to be notified of the formal Section 106 review. This letter will be included in the Fermi 2 license renewal application within the Environmental Report, so that the NRC reviewers will be aware of your interest in the formal review process.

Enclosed please find the report you requested, which contains the historical and archeological review performed for the Fermi site and environs. The enclosed report contains information concerning the nature and location of potential archaeological resources; applicable pages must be withheld from public disclosure per Section 9 of the Archeological Resources Protection Act. The cover page and subsequent applicable pages are marked: "Section 9 of the Archeological Resources Protection Act Withhold from Public Disclosure Under 10 CFR 2.390" (10 CFR 2.390 describes withholding requirements for submittal to the NRC). Pages that are not so marked may be provided to members of the public.

Please continue to address any additional correspondence or inquiries to:
Lynne Goodman
6400 N. Dixie Hwy, 110NOC
Newport, MI 48166
goodmanl@dteenergy.com
734-586-1205

Sincerely,

Zackary W. Rad
Manager, Nuclear Licensing

Enclosure: Phase I Cultural Resources Evaluation of the Enrico Fermi Atomic Power Plant Unit 2 License Renewal Project, Monroe, Monroe County, Michigan

bcc (w/o enclosure):
G. D Cerullo
L. S. Goodman
K. J. Hlavaty
A. K. Lim
M. Lumpert-Coy
Z. W. Rad
R. D. Westmoreland
Information Management (140 NOC)

The requested report noted above that DTE sent to Giiwegiizhigookway Martin, Ketegitigaaning Ojibwe Nation, Lac Vieux Desert Band of Lake Superior Chippewa Indians, is not attached to this letter because it contains sensitive information.

STATE OF MICHIGAN
MICHIGAN STATE HOUSING DEVELOPMENT AUTHORITY
STATE HISTORIC PRESERVATION OFFICE

RICK SNYDER
GOVERNOR

GARY HEIDEL
EXECUTIVE DIRECTOR

January 24, 2014

RANDALL WESTMORELAND
TECHNICAL EXPERT – NUCLEAR
DETROIT EDISON COMPANY
2000 2ND AVENUE
DETROIT MI 48226-1279

RE: ER06-683 Fermi 2 Nuclear Power Plant Operating License Renewal, T6S, R10E, Frenchtown Township, Monroe County (NRC)

Dear Mr. Westmoreland:

We have reviewed the report entitled *Phase I Cultural Resources Evaluation of the Enrico Fermi Atomic Power Plant Unit 2 License Renewal Project.*

In relation to above-ground resources, the report lists fourteen properties (see pages 5-8 and 5-9) as Recommended Eligible. These properties were previously included in the July 2008 Phase I cultural resources evaluation report for Fermi 3, and at that time, we had concerns about the background historical information for those properties which was not adequate to make informed determinations of eligibility for each. Those concerns remain, and therefore we request that DTE Energy address the following comments regarding the above-ground component of the report, and provide additional information as needed:

- **2983 Third St., Frenchtown Twp.** (Detroit Beach): The report provides no historical background on this property. Historical research should be done in public records, through discussions with owners and other informants, etc., as needed to document who had this built, when, and whether built as a seasonal or year-round residence and to provide background on the original owner to assist in evaluating any significance under criterion B. For a resource potentially significant for its architecture, information as to the source of the design and who designed and built it should be sought.
- **3360 Elmwood St., Frenchtown Twp.** The report evaluates this building as possibly eligible, but the report provides no history and very little discussion of the house's potential significance in terms of architecture. Historical research should be done to identify the building's original owner, date of construction, and use (as seasonal or year-round residence); information about the original owner's background that might suggest any significance under criterion B; and any available information about who designed and built the building and the source of the design.
- **3390 Lawndale St., Frenchtown Twp.** This house is evaluated as possibly eligible under criterion A as one of the earliest homes in the early beach resort community, but no specific historical background is provided. Research should be done to document who had this building constructed, when, and whether built as a seasonal or year-round residence, and whether and how this resource fits into the early development of the shore resort community.
- **Clubhouse, 3518 Nippising St., Frenchtown Twp.** This building is described as a clubhouse and evaluated as possibly eligible under criteria A and C, but the club itself is not identified and no background history is provided. Research is needed to document who had this building constructed and when, and what was its original function. Was and is it a "clubhouse"? Background information on the club's history is needed. What information is available about who designed and built it? From the photo it appears the building's exterior is finished in Perma-Log construction of concrete shaped in the form of logs and applied to a steel mesh base. This type of construction was dome by the Mio-based Perma-Log Company that began its career in the 1940s (see Eckert, *Buildings of Michigan* (1993), 441). Perma-Log was sometimes installed over earlier exteriors. If this is a Perma-Log structure, information about whether the building was built in this form or remodeled with the Perma-Log

exterior added later should be sought. Finally, an evaluation of significance in terms of the information developed is needed.

- **3677 Lakeview Dr., Frenchtown Twp.** The report identifies this small house as likely "one of the portable homes promoted by firms such as Mershon & Morley of Saginaw" or the Hodgson Company, but provides no historical background information or any information to substantiate this claim. This building appears to be a later example, likely dating from the 1930s to 1950s. Research is needed to document who had this building constructed, when, and whether built as a seasonal or year-round residence. Research should also include an attempt to verify that this is an example of panelized or pre-cut construction and who was the manufacturer through questioning owners and looking at any available catalogs and literature for this type of building.
- **3535-3595 Pearl Dr., Frenchtown Twp. (Pearl Drive Historic District).** This group of four houses is evaluated as meeting criteria A and C, but no historical information is provided to back up that evaluation. Research is needed to document who had these houses built and when and the historical background of the original owners, and information on who designed and built these buildings and the background to the development of this enclave of larger-than-typical houses in this shoreline area should be sought. An argument for the eligibility of this group of houses should then be developed if the information suggests there is an eligible district.
- **Frenchtown Dist. No. 13 School, 3684 Brest Rd., Frenchtown Twp.** The report provides no historical background beyond the 1926-27 date of construction; thus no argument for significance under criterion A is made. Under criterion C the report notes the building exemplifies a standardized school plan, but provides no other information. We note that the building appears to identify Design No. 9 as published in the 1915-16 state Superintendent of Public Instruction's annual report for 1915-16, pages 48-49. It was one of a number of standard plans for smaller school buildings offered to school districts for free by the state. The one photo shows some of the windows apparently closed in and some other changes. Does the building retain enough integrity to be eligible under C?
- **3738 Brest Rd., Frenchtown Twp.** The history presented in the report seems to be mostly speculation. Is the house directly associated with the Dewey fishing interests? If it has a strong association with those historically important fishing interests, the case for eligibility can probably be made. Otherwise the house has some interest as an early Greek Revival building, but its integrity under Architecture is diminished by the fact that the front entry door has been replaced with an out-of-character modern one. Research to document or disprove that the house has an important association with the Dewey fishing interests is needed.
- **6068 N. Dixie Hwy., Frenchtown Twp.** The photographic coverage for the complex, described as having a "large number of associated farm buildings," is entirely inadequate, with only a single picture beyond the one showing the house itself. Additional photos that together illustrate all the farm buildings, plus descriptive information on all buildings and other features present, is needed. A site plan is also needed. Research to document how old this farm is and its early owners and a more informed date of construction for the house is needed. Is there a Rural Property Inventory form for this property that might provide some useful information?
- **No Visible Address (south of 4973 N. Dixie Hwy.), Frenchtown Twp.** This building is important if it really housed the Redemptorist Mission from the 1850s to the 1870s. Additional research is needed to establish the early history of this building and the background of the Redemptorist Mission, and to document or disprove this historical association. Contact with people at St. Charles Church along with the county historical society and local historians should form part of the research plan.
- **3606 Lakeshore Dr., Frenchtown Twp.** The report provides no history of this property. Research to document the building's original owner, date of construction, and seasonal or year-round residence use is needed, and should also include seeking information on the original owner's background to evaluate any potential eligibility under criterion B and also seeking information on the designer or design source and builder to evaluate potential eligibility under criterion C.
- **Old St. Charles Cemetery, N. Dixie Hwy., Berlin Twp.** The report provides only one photograph and little historical information. Additional research is needed to provide more history of the church's early burial grounds. If

this was the church's third burial ground established, are there two earlier church-related cemeteries in existence or is this the oldest existing one? If there are older church cemeteries, photos and descriptive and historical information about them are needed to help make an informed decision about how significant is this third cemetery. Is it clear that this cemetery was no longer used for new burials after the church moved to its present site and another cemetery was established?

- **St. Charles Cemetery, N. Dixie Hwy., Berlin Twp.** The report contains only a single general photograph of the grounds. Additional photographs showing different areas and samples of the oldest and some of the more interesting/unusual markers are needed.
- **6344 Trombley Rd., Berlin Twp.** This property is identified as possibly eligible based on the association with the early-settler Masserant family and possible existence of a log structure on the property, but there is only a single photo, which shows no evidence of the log structure and does not illustrate many of the buildings noted in the description. Additional photos that illustrate what can be seen from the outside of the log structure and illustrate the entire complex are needed. Research should be done to document when the family acquired the property and to provide corroboration of the existence of the log structure (and what's left of it) and document its history and the history of the other buildings on the property to the degree possible. Is there a Rural Property Inventory form for this property? The evaluation should include a discussion of possible eligibility under criterion D if none of the other criteria apply.

The archaeological survey resulted in the identification of seven historic-period archaeological sites: 20MR828 (likely barn or outbuilding remains), 20MR829 (likely 20th century dwelling remains), 20MR830 (likely 20th century dwelling remains), 20MR831 (likely 20th century garage and driveway remains), 20MR832 (likely 20th century dwelling or farmstead building remains), 20MR833 (likely 20th century dwelling remains), and 20MR834 (likely 20th century dwelling remains). Commonwealth Cultural Resources Group (CCRG) recommended that these sites are not NRHP-eligible due to mechanical disturbance, a lack of intact subsurface features, and a general lack of historic significance; we concur with these assessments and do not consider these sites to be eligible.

If you have any questions, please contact Brian Grennell, Cultural Resource Management Specialist, at (517) 335-2721 or by email at grennellb@michigan.gov. **Please reference our project number in all communication with this office regarding this undertaking.** Thank you for this opportunity to review and comment, and for your cooperation.

Sincerely,

Brian G. Grennell
Cultural Resource Management Specialist

for Brian D. Conway
State Historic Preservation Officer

BGG

Copy: Elaine Robinson, CCRG

Attachment D

Severe Accident Mitigation Alternatives Analysis

Attachment D

Severe Accident Mitigation Alternatives Analysis

Attachment D contains the following sections:

Table of Contents

List of Tables

List of Acronyms

AC	Alternating Current
ADS	Automatic Depressurization System
ANS	American Nuclear Society
AOPs	Abnormal Operating Procedures
ARI	Alternate Rod Insertion
ASME	American Society Of Mechanical Engineers
ATWS	Anticipated Transient Without Scram
BOC	Break Outside Containment
BWR	Boiling Water Reactor
BWROG	BWR Owners' Group
CCDP	Conditional Core Damage Probability
CCF	Common Cause Failure
CCW	Component Cooling Water
CDF	Core Damage Frequency
CET	Containment Event Tree
CLERP	Conditional Large Early Release Probability
CRT	Condensate Return Tank
CS	Core Spray
CST	Condensate Storage Tank
CTG	Combustion Turbine Generator
CV	Check Valve
DC	Direct Current
DCH	Direct Containment Heating
DFM	Dry Filter Method
DFP	Diesel Fire Pump
DW	Drywell
EAL	Emergency Action Level
ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EDMG	Extreme Damage Mitigation Guidelines
EECW	Emergency Equipment Cooling Water
EESW	Emergency Equipment Service Water
EOF	Emergency Operations Facility
EOP	Emergency Operating Procedure
EP	Emergency Plan
EPA	Environmental Protection Agency
EPG	Emergency Procedure Guideline
EPZ	Emergency Planning Zone
ERO	Emergency Response Organization
ET	Event Tree

FIVE	Fire-Induced Vulnerability Evaluation
FPIE	Full Power Internal Events
FPRA	Fire Probabilistic Risk Assessment
FT	Fault Tree
GE	General Emergency
GSW	General Service Water
HCVS	Hardened Containment Vent System
HEP	Human Error Probability
HFE	Human Failure Event
HFP	Heater Feed Pump
HPCI	High Pressure Coolant Injection
HPME	High Pressure Melt Ejection
HRA	Human Reliability Analysis
HVAC	Heating, Ventilation, And Air Conditioning
I&C	Instrumentation And Control
IAS	Interruptible Air Supply
IE	Initiating Event
IORV	Inadvertent Stuck Open Relief Valve
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination Of External Events
ISLOCA	Interfacing Systems Loss Of Coolant Accident
LERF	Large Early Release Frequency
LOCA	Loss Of Coolant Accident
LOSP	Loss Of Offsite Power (Also Referred To As "LOOP")
LPCI	Low Pressure Coolant Injection
MAAP	Modular Accident Analysis Program
MCCI	Molten Core Concrete Interactions
MCR	Main Control Room
MDCT	Mechanical Draft Cooling Tower
MOV	Motor Operated Valve
MSIV	Main Steam Isolation Valve
MUR	Measurement Uncertainty Recapture
MW	Megawatt
MWD	Megawatt-Day
NIAS	Non-Interruptible Air Supply
NPP	Nuclear Power Plant
NPSH	Net Positive Suction Head
NSSS	Nuclear Steam Supply System
OSC	Operations Support Center
PCS	Power Conversion System
PDS	Plant Damage State
PORV	Power (Or Pilot) Operated Relief Valve
PRA	Probabilistic Risk Assessment

RCIC	Reactor Core Isolation Cooling
RCS	Reactor Coolant System
RHR	Residual Heat Removal
RHRSW	Residual Heat Removal Service Water
RPS	Reactor Protection System
RPT	Recirculation Pump Trip
RPV	Reactor Pressure Vessel
RWST	Refueling Water Storage Tank
SAG	Severe Accident Guideline
SAMA	Severe Accident Mitigation Alternative
SAMG	Severe Accident Management Guideline (See Also SAG)
SBFW	Standby Feedwater
SBO	Station Blackout
SGTS	Standby Gas Treatment System
SLCS	Standby Liquid Control System
SMA	Seismic Margin Assessment
SNL	Sandia National Laboratory
SORV	Stuck Open Relief Valve
SRV	Safety Relief Valve
SW	Service Water
TAF	Top Of Active Fuel
TBV	Turbine Bypass Valve
WW	Wetwell

ATTACHMENT D.1
EVALUATION OF FERMI PRA MODEL

D.1 EVALUATION OF PROBABILISTIC RISK ANALYSIS MODEL

The severe accident risk for Fermi 2 was estimated using the Fermi 2 Probabilistic Risk Analysis (PRA) model and a Level 3 model developed using Version 3.7.0 of the Windows Interface for MACCS2, MELCOR Accident Consequence Code (WinMACCS). The CAFTA suite of codes was used to develop the Fermi 2 PRA Level 1 and Level 2 models. The following provides a description of Fermi 2 PRA levels 1 and 2 analyses, Core Damage Frequency (CDF) uncertainty, Individual Plant Examination of External Events (IPEEE) analyses, and PRA model peer review.

D.1.1 PRA Model – Level 1 Analysis

The PRA model (Level 1 and Level 2) used for the Fermi 2 SAMA analysis was the Fermi 2 Version 9 (FermiV9) PRA model which was issued in March 2013 [D.1-1]. This model is the result of an update of the Fermi 2 Version 8 (January 2010) model.

This model reflects the Fermi 2 as-built, as-operated configuration as of June 30, 2011. One plant modification implemented during Refueling Outage 15 (May 2012) is also included in the model. The modification added a third breaker row to the existing ring bus configuration in the 345 kV switchyard. The change was incorporated to enhance evaluation of online maintenance risk. In addition, one planned modification, the Measurement Uncertainty Recapture (MUR) power uprate, is included in the SAMA analysis. The small change in the current licensed power, an increase of 1.64%, does not have any impact on the PRA model, but the increase in power is included in the Level 3 analysis for the calculation of maximum averted cost risk. No other planned major plant modifications, which could adversely impact the SAMA analysis results, have been identified..

The Fermi 2 internal events baseline at power CDF is calculated to be 1.50E-06/Reactor-year (Rx-yr) [D.1-1]. These results were obtained by quantifying the models at a truncation frequency of 1E-12/yr. The initiator contribution to CDF is provided in Table D.1-1 [D.1-1]. A listing of the top basic events by Risk Reduction Worth (RRW) is provided in Table D.1-2. The approximate CDF contributions from Anticipated Transients Without Scram (ATWS) and Station Blackout (SBO) are included in Table D.1-1.

The Fermi 2 model quantification results were reviewed to identify those potential risk contributors that made a significant contribution to CDF. CDF-based RRW rankings were reviewed down to 1.005. Events below this point would influence the CDF by less than 0.5% and are judged to be highly unlikely contributors for the identification of cost-beneficial enhancements. These basic events, which include component failures, operator actions, and initiating events, were reviewed to determine if additional SAMA actions may need to be considered.

Table D.1-2 provides a listing of Level 1 RRW risk significant events (component failures, operator actions, and initiating events) down to a RRW of 1.005 obtained from the FermiV9 PRA model results and correlates each event to the SAMAs that are applicable to it.

Table D.1-1 – Fermi 2 PRA Model CDF Results by Initiator Group

Initiating Event Group	Initiator CDF (per Rx-yr)	% CDF
LOCAs	4.48E-07	29.8%
General Transients (without LOSP)	3.29E-07	21.9%
Total Loss of Offsite Power	2.13E-07	14.2%
Internal Flood	3.11E-07	20.7%
Partial Loss of Offsite Power	1.03E-07	6.8%
Special Initiators	9.96E-08	6.6%
Total	1.50E-06	100%
SBO Contribution(1)(2)	8.43E-08	5.6%
ATWS Contribution(1)(2)	2.00E-07	13.3%

Note (1) SBO and ATWS may occur following multiple initiators; thus their contributions to CDF are listed separately.

Note (2) CDF contribution from Table 3-9 of Reference D.1-1.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
CDFIRPSSMECH	2.10E-06	1.2458	CONTROL ROD DRIVE UNIT FAILS TO INSERT FOR MECHANICAL REASONS	This event represents the mechanical induced failure of control blades to insert on demand. SAMA 195 evaluates mechanical upgrades to the control rod drive units.
%LOSP	6.34E-02	1.1649	TOTAL LOSS OF OFFSITE POWER	This initiating event represents the total loss of external power sources, including the loss of the feed from the onsite combustion turbines. SAMAs 16, 23, and 24 address this initiating event by evaluating installing tornado protection for the gas turbine generators, developing procedures to repair or replace failed 4kV breakers, and to improve training to emphasize steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 (Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design-Basis External Events) includes upgrading the Acts of Nature procedure and providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
%TX	8.37E-01	1.1499	TURBINE TRIP WITH BYPASS INITIATING EVENT	This initiating event represents transients that do not result in an immediate loss of the main condenser as a heat sink, but may cause a trip of the feedwater system. SAMA 18 evaluates upgrades to the UPS system to make the 120V I&C system more reliable, reducing the likelihood of a turbine trip with bypass event.
HE1FRSP-CNTRL	1.90E-02	1.1307	OPERATORS FAIL TO SHUTDOWN FROM OUTSIDE THE MAIN CONTROL ROOM	This event represents the failure of operators to shutdown the reactor from the remote shutdown panel when the main control room is abandoned due to habitability concerns or loss of functionality caused by flood. Phase II SAMA 145 evaluates training improvements related to important human failure events.
HE1FSLCSLVLE	1.90E-01	1.1206	OPERATOR FAILS TO CONTROL LEVEL EARLY DURING ATWS SEQUENCE	This event represents the failure of operators to minimize positive reactivity insertions early during an anticipated transient without scram. SAMAs 115 and 121 evaluate upgrades to the ATWS procedure and SRVs to reduce the likelihood of a failure to control RPV level during an ATWS event. SAMA 145 evaluates training improvements related to important human failure events.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
%S1-WA	1.44E-04	1.1162	MEDIUM LOCA BELOW TAF (WATER)	This initiating event represents a medium size pipe break causing a loss of coolant below the top of active fuel. SAMA 101, improving leak detection procedures, addresses this event.
HE1FRXPCHWML	2.30E-02	1.1028	Operator fails to depr (Medium Water LOCA)	This event represents the failure of operators to depressurize the reactor after a medium sized break in the reactor coolant. SAMA 034 evaluates upgrades to the automatic depressurization system to improve reliability. SAMA 145 evaluates training improvements related to important human failure events.
%FL-AB-FPRO-RELAY-N	6.70E-06	1.0794	Nominal rupture in FPS line in AB propagating to Relay Room	This initiating event represents a flood in the relay room caused by a fire water pipe break in the aux building. SAMA 101, improving leak detection procedures, addresses this event. The implementation (in progress) of a risk informed in-service inspection program based on ASME Code Case N-716 explicitly addresses internal flooding initiators for inclusion in the in-service inspection program.
HE1FSLCSLVLL	2.10E-01	1.0755	OPERATOR FAILS TO CONTROL LEVEL LATE DURING ATWS SEQUENCE	This event represents the failure of operators to minimize positive reactivity insertions during an anticipated transient without scram. SAMAs 115 and 121 evaluate upgrades to the ATWS procedure and SRVs to reduce the likelihood of a failure to control RPV level during an ATWS event. SAMA 145 evaluates training improvements related to important human failure events.
%S1-LP	9.46E-05	1.0748	MEDIUM LOCA IN LPCI LINE	This initiating event represents a pipe rupture in the RHR connection line for low pressure coolant injection. SAMA 034 evaluates upgrades to the ADS system and SAMA 101 addresses improving leak detection procedures.
BTTSEDCSCC33_1	1.52E-07	1.0714	CC GROUP DC BATTERY FAILS DURING OPERATION 2A, 2B, 2C	This common cause failure represents the probability that all three 260/130V DC batteries fail to provide power to the DC electrical distribution system. SAMA 1 addresses the addition of DC power supplies.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)				
Event Name	**Probability**	**RRW**	**Event Description**	**Disposition**
DW-SHELL-RUPT	9.00E-02	1.0676	DRYWELL SHELL RUPTURE DISRUPTS INJECTION LINES AND FAILS RV SYSTEMS	This event represents the probability that a large containment failure caused by drywell overpressure failure results in the loss of injection from feedwater/condensate, standby feedwater, control rod drive, low pressure coolant injection, and core spray. SAMA 077 evaluates upgrades to the drywell spray system. Additionally, the response to order EA-12-050 (Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents) includes additional measures to increase the likelihood of successful containment venting to prevent containment overpressure.
HE1FHVNTACVT--	3.00E-01	1.0596	Failure to Vent Locally without AC power	This event represents the failure of operators to vent containment, given a loss of air or power to the containment vent valves. The response to order EA-12-050 includes adding HCVS valve solenoids with power supplied from the Division 2 130V DC supply and is backed up with small DC generators (EA-12-049, FLEX Phase 2). SAMA 145 evaluates training improvements related to important human failure events.
HE1D-D-HPIMLW	1.20E-02	1.0511	Common Failure to Operate High Pressure Injection Systems Given MLOCA Water	This event represents the failure of operators to operate high pressure injection system given a medium size break below the top of active fuel or a pipe rupture in the RHR connection line for low pressure coolant injection. SAMAs 34 and 74 evaluate upgrades to ADS and SRVs. SAMAs 029 and 031 evaluate upgrades to HPCI. SAMA 009 evaluates eliminating the DC dependency between ADS and high pressure injection systems. SAMA 145 evaluates training improvements related to important human failure events.
HE1FRXPCHEOD11	6.70E-02	1.0495	Operator fails to depressurize for LP injection (ATWS)	This event represents the failure of operators to manually depressurize the reactor vessel when needed during an anticipated transient without scram. SAMA 115 evaluates upgrading ATWS procedures involving vessel injection. SAMA 145 evaluates training improvements related to important human failure events.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
HE1FUHS1AC001	1.50E-04	1.0428	Operators manually start MDCT fan	This event represents the failure of operators to start the mechanical draft cooling tower fans if necessary. SAMA 055 evaluates upgrading the fire protection system cross tie to the RHRSW system. SAMA 145 evaluates training improvements related to important human failure events.
%S1-FW	8.72E-05	1.0415	MEDIUM LOCA IN FW LINE	This initiating event represents a feedwater piping break inside the drywell. SAMAs 34 and 74 evaluate upgrades to ADS and SRVs. SAMAs 029 and 031 evaluate upgrades to HPCI. SAMA 009 evaluates eliminating the DC dependency between ADS and high pressure injection systems. SAMA 101, improving leak detection procedures, addresses this event.
HE1FSLCSHEBI2E	1.60E-01	1.0404	Operator fails to initiate SLCS early	This event represents the failure of operators to inject sodium pentaborate solution into the reactor with the standby liquid control system. SAMA 145 evaluates training improvements related to important human failure events. SAMA 117 evaluates increasing the boron concentration in the SLC system.
HPI_CC_DCBATT_FACT1	1.67E-01	1.0399	FOUR HR MT RECOVERY FACTOR FOR EVENT BTTSEDCSCC33_1 TRUE	This multiplier is used to convert the 24 hour common cause DC battery failure probability to a 4 hour probability (4 ÷ 24 = 1.67E-01). SAMA 001 evaluates the addition of DC power supplies.
LOOP-IE-GR	7.73E-01	1.0371	COND. PROBABILITY LOOP DUE TO GRID RELATED EVENT	This event represents the fraction of loss of offsite power events that occur due to grid related failures. The plant response to order EA-12-049 includes providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power. SAMA 024 evaluates emphasizing the steps in recovery of offsite power after a station blackout.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
LOOP-IE-SW	6.76E-02	1.0369	COND. PROBABILITY DUE TO WEATHER RELATED LOOP EVENT	This event represents the fraction of loss of offsite power events that occur due to weather related failures. SAMAs 14, 16, 24 and 26 address this event by evaluating installing a buried off-site power source, tornado protection for the gas turbine generators, to improve training to emphasize steps in recovery of off-site power after a station black out, and burying off-site power lines. Additionally, the plant response to order EA-12-049 includes upgrading the Acts of Nature procedure and providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
%LOCV	1.61E-01	1.0367	LOSS OF CONDENSER VACUUM INITIATING EVENT	This initiating event represents malfunctions and operator errors that result in a loss of main condenser vacuum. SAMA 190 evaluates the implementation of a program that incorporates GRA (trip and shutdown risk modeling) into plant activities to reduce risk of a reactor trip/shutdowns.
ZMUAHPCIC001A	6.59E-03	1.036	HPCI PUMP/TURB MAINTENANCE E4101C001A UNAVAILABLE	This event represents the probability that the high pressure coolant injection turbine-driven pump is out of service due to maintenance. SAMA 205 evaluates the improvement of maintenance procedures for the HPCI pump and turbine.
%FL-TB-MCWS-TBXX-M	1.25E-03	1.0357	Major rupture in Circulating Water pipe or expansion joints in Turbine Building.	This initiating event represents a flood caused by a circulating water system break that causes MSIV closure, fails injection systems in the turbine building, and may fail additional injection systems if the flood source is not isolated and the watertight door between the auxiliary building and the turbine building fails. This event is addressed through the External Surfaces Monitoring Program for external degradation and the Internal Surfaces Miscellaneous Piping and Ducting Components Program for internal degradation (SAMA 129).
%ISLOCA-SDC	5.90E-08	1.0353	ISLOCA IN RHR SDC SUCTION LINE (X-12)	This initiating event represents an interfacing systems LOCA caused by opening an unintended flow path through the RHR shutdown cooling flow path. SAMA 107 evaluates leak testing of valves in ISLOCA paths to reduce the ISLOCA frequency.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)				
Event Name	**Probability**	**RRW**	**Event Description**	**Disposition**
OSPR4HR-GR	1.54E-01	1.0353	FAILURE TO RECOVER OSP WITHIN 4 HRS (GRID RELATED LOOP EVENT)	This event represents the failure to recover offsite power within four hours, given a grid related loss of offsite power. The plant response to order EA-12-049 includes providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power. SAMA 024 evaluates emphasizing steps in recovery of offsite power after a station blackout.
CPFFTBLDDOORFAIL	1.00E-04	1.034	TURBINE BUILDING TO AUXILIARY BUILDING ISOLATION DOOR FAILS	This event represents the failure probability of the door between the turbine building and auxiliary building, given that operators fail to terminate a major flood in the turbine building. This event is addressed through the External Surfaces Monitoring Program for external degradation and the Internal Surfaces Miscellaneous Piping and Ducting Components Program for internal degradation (SAMA 129).
HE1FCWSTRBMFL	4.50E-01	1.0336	FAIL TO TERMINATE MAJOR FLOOD IN CIRC WATER LINE IMPACTING TB	This event represents the failure of operators to isolate the source of flooding, given a major circulating water break in the turbine building. SAMA 145 evaluates training improvements related to important human failure events. This event is also addressed through the External Surfaces Monitoring Program for external degradation and the Internal Surfaces Miscellaneous Piping and Ducting Components Program for internal degradation (SAMA 129).
OSPR4HR-SW	3.82E-01	1.0334	FAILURE TO RECOVER OSP WITHIN 4 HRS (WEATHER RELATED EVENT)	This event represents the probability that offsite power is not restored after four hours, given a weather related loss of offsite power. SAMAs 16, and 24 address this event by evaluating installing tornado protection for the gas turbine generators and improving training to emphasize steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 includes upgrading the Acts of Nature procedure and providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
CPFFHPCIMLTSTART	5.43E-03	1.0307	HPCI fails during subsequent cycles, FW cntl = F, L8 trip =S	This event represents the probability of the HPCI turbine driven pump failing to start on subsequent start demands. SAMA 031 evaluates upgrading HPCI throttling capability to reduce the number of start/stops required.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)				
Event Name	**Probability**	**RRW**	**Event Description**	**Disposition**
%TMS	1.31E+00	1.0301	MANUAL SHUTDOWN INITIATING EVENT	This initiating event represents the probability of a manual scram. This event was evaluated in SAMA 190, which evaluates the implementation of a program that incorporates GRA (trip and shutdown risk modeling) into plant activities to reduce risk of a reactor trip/shutdowns.
CPFFRXFWTRAINA	5.00E-01	1.03	CONDITIONAL PROBABILITY THAT LOCA IS IN FW TRAIN A	This event represents the even chance that a feedwater piping break inside containment is located at the Train A piping. This is important because HPCI injects to Train A feedwater piping. SAMA 101, improving leak detection procedures, addresses this event.
CPFFCSSSOVERHT	5.00E-01	1.029	CONDITIONAL PROBABILITY OF CSS PUMP OVERHEATING GIVEN EECW FAILS	This event represents the probability that a core spray pump fails due to stopping and restarting on a loss of cooling water to the pump motor. SAMAs 53 and 54 evaluate providing self-cooled Core Spray seals and using cross-tied component cooling or service water pumps.
HE1FCTGBHEGT1B	1.40E-02	1.0289	OPERATOR FAILS TO BLACK START CTG UNIT IN 4 HOURS	This event represents the failure of operators to start the Unit 1 Combustion Turbine Generator (CTG) if offsite power is lost. SAMA 24 evaluates increasing training for recovery of off-site power after a station blackout. SAMA 145 evaluates training improvements related to important human failure events.
PHPHCTG1WEATHERLOSP	1.00E-01	1.0289	CTG FAILS DUE TO WEATHER RELATED EVENT - TOTAL LOSP	This event represents the probability that the combustion turbines fail due to weather related problems. SAMAs 16, and 24 address this event by evaluating installation of tornado protection for the gas turbine generators and improved training to emphasize steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 includes upgrading the Acts of Nature procedure and providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
HE1FRXPCHSML	1.00E-03	1.0276	Operator fails to depr (Medium Steam LOCA)	This event represents the failure of operators to depressurize the reactor after a medium size steam break. SAMAs 34 and 74 evaluate upgrades to ADS and SRVs. SAMAs 029 and 031 evaluate upgrades to HPCI. SAMA 009 evaluates eliminating the DC dependency between ADS and high pressure injection systems. SAMA 101, improving leak detection procedures, addresses this event. SAMA 145 evaluates training improvements related to important human failure events.
PHPHMCRABAND	1.00E-01	1.0267	OPERATORS ABANDON MAIN CONTROL ROOM DUE TO FLOOD	This event represents the chance that operators abandon the main control room, given a flood. Phase II. SAMA 145 evaluates training improvements related to important human failure events. Those improvements would reduce the importance of this event.
HE1D-D-HPISP	1.40E-06	1.0265	Common Failure to Operate High Pressure Injection and Support Systems	This event represents the failure of operators to operate high pressure injection and support systems (i.e. CST refill). SAMA 29 evaluates upgrades to the backpressure trip functions of HPCI and RCIC. SAMA 145 evaluates training improvements related to important human failure events. SAMA 198 evaluates adding an automatic method of refilling the CST.
%PLOOP301	2.11E-02	1.0261	PARTIAL LOSP FOR DIV. 2	This initiating event represents the probability of a recoverable loss of Division 2 offsite power caused by a failure of Bus 301. SAMAs 23 and 24 address this initiating event by developing procedures to repair or replace failed 4kV breakers, and improving training to emphasize steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 includes providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
XVFOSLCSCC22_1	1.40E-02	1.0252	CC GROUP SQUIB VALVES FAIL TO OPEN	This event represents the common cause failure of the squib valves to open when standby liquid control injection is necessary. SAMA 212 evaluates modifications to reduce the common cause failure probability.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)				
Event Name	**Probability**	**RRW**	**Event Description**	**Disposition**
%BS301	1.17E-02	1.0251	LOSS OF BUS #301 INITIATING EVENT	This initiating event represents the probability of a failure of Bus 301. SAMAs 23 and 24 address this initiating event by developing procedures to repair or replace failed 4kV breakers, and improving training to emphasize steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 includes providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
TPFSHPCIC001A	4.20E-03	1.0235	HPCI PUMP/TURBINE CCPTSS, 1/2 E4101C001A	This event represents the failure of the turbine-driven high pressure coolant injection pump to start. SAMA 009 evaluates reducing the DC dependence between high pressure injection and ADS.
%FL-AB-ECW2-B20XX-N	1.79E-06	1.0225	Nominal rupture in RBCCW/EECW Div 2 line in DC Switchgear Room	This initiating event represents a flood in the DC switchgear room that causes MSIV closure, loss of RBCCW, loss of EECW Div 2, loss of all DC power distribution, and potentially a loss of Div 2 switchgear if the flood is not isolated and the door to A3G10 breaks. SAMA 213 evaluates addition of leak detection and automatic isolation valves for the EECW piping in the DC Switchgear Room.
HE1RCSTSCSTEDM	3.00E-02	1.0213	OPERATOR FAILS TO FILL CST PER EDMG	This event represents the failure of operators to refill a depleted condensate storage tank. SAMA 198 evaluates improvements to reduce the likelihood of failure to provide CST makeup. SAMA 145 evaluates training improvements related to important human failure events.
STPFECCSM-LOCA	1.00E-04	1.0204	ECCS SUCTION STRAINER COMMON CAUSE PLUGGING (MLOCA/LLOCA)	This event represents the probability that debris from a medium or large break LOCA causes the torus suction strainers to plug such that the available net positive suction head does not match the required NPSH. SAMA 046 evaluates improvements for ECCS suction strainers.
FCTSUHSXCC44_1	7.45E-06	1.0202	CC GROUP CCPMR, 4/4 E1156C001A, E1156C001B, E1156C001C, E1156C001D	This event represents the common cause failure of the mechanical draft cooling tower fans to operate. SAMA 055 evaluates upgrading the fire protection system cross tie to the RHRSW system.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
HE1D-D-HPI--	1.00E-05	1.0193	Common Failure to Operate High Pressure Injection Systems	This event represents the failure of operators to operate high pressure injection systems. SAMA 29 evaluates upgrades to the backpressure trip functions of HPCI and RCIC. SAMA 145 evaluates training improvements related to important human failure events.
HE1D-D-OPERATOR	1.00E-06	1.0187	Global Dependent Operator Failure	This event represents an artificial floor for combinations of dependent human errors. An artificial minimum of 1E-6 is used to establish that a combination of errors do not result in a negligible failure probability for short term actions. SAMA 145 evaluates training improvements related to important human failure events.
HE1FRXPCHTRANS	2.00E-04	1.0186	Operator fails to depr (transient)	This event represents the failure of operators to depressurize the reactor, given a transient event. SAMA 009 evaluates reducing the dependency between ADS and high pressure injection. SAMAs 29, 30, and 31 evaluate improvements to high pressure injection systems. SAMA 34 evaluates improvements to the automatic depressurization system. SAMA 145 evaluates training improvements related to important human failure events.
HE1D-D-DHR--	5.00E-07	1.0173	Common Failure to Operate Containment Heat Removal Systems	This event represents the failure of operators to remove decay heat from containment. SAMA 145 evaluates training improvements related to important human failure events.
CPFFPLNTSUMER	3.33E-01	1.0171	FRACTION OF TIME IN PEAK SUMMER OPERATION	This event represents the fraction of time where two GSW pumps are required to operate during plant shutdown and four are required to run during normal operation. SAMA 200 evaluates the addition of another GSW pump to reduce the likelihood of a loss of GSW initiating event.
HE1D-D-CTG-480	7.00E-04	1.0167	OP FAILS TO START CTG, 480 XTIE, AND ALT. CHARGER	This event represents the failure of operators to restore offsite power with Combustion Turbine Generator Unit 1 and place alternate battery charger into service, given a loss of offsite power. SAMAs 24 and 154 evaluate improvements in training and procedures for bringing the combustion turbines online during a loss of offsite power. SAMA 145 evaluates training improvements related to important human failure events.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)				
Event Name	**Probability**	**RRW**	**Event Description**	**Disposition**
CPFFACP2-COND-WE	6.11E-01	1.0166	CONDITIONAL PARTIAL LOSP FOR DIV. 2 DUE TO WEATHER	This event represents the fraction of partial loss of offsite power events that occur due to weather. SAMAs 16 and 24 address this event by evaluating installation of tornado protection for the gas turbine generators and improved training to emphasize steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 includes upgrading the Acts of Nature procedure and providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
%FL-AB-FPRO-RELAY-M	1.46E-06	1.0163	Major rupture in FPS line in AB propagating to Relay Room	This initiating event represents a relay room flood which causes a loss of main control room controls. SAMA 101, improving leak detection procedures, addresses this event. The implementation (in progress) of a risk informed in-service inspection program based on ASME Code Case N-716 explicitly addresses internal flooding initiators for inclusion in the in-service inspection program.
%S2-WA	3.09E-03	1.016	SMALL LOCA BELOW TAF (WATER)	This initiating event represents a small break loss of coolant accident that occurs below the top of active fuel. SAMA 199 evaluates reductions in small break LOCA frequency.
%LOFW	7.30E-02	1.0159	LOSS OF FEEDWATER INITIATING EVENT	This initiating event represents a loss of reactor feedwater. SAMA 18 evaluates UPS upgrades that may reduce the likelihood of a loss of feedwater.
HE1FLPIXINJLVLF	2.20E-02	1.0149	OP FAILS TO MAINTAIN INJECTION FOLLOWING DEPRESS WITH NO FW OR HPCI	This event represents the failure of operators to maintain injection given an anticipated transient without scram followed by depressurization with no feedwater or high pressure coolant injection available. SAMA 115 evaluates upgrading ATWS procedures involving vessel injection. SAMA 145 evaluates training improvements related to important human failure events.
CPFFDCSGDOORFAIL	5.00E-01	1.0142	CONDITIONAL PROBABILITY OF DC SWGR DOOR FAILURE	This event represents the probability that the door to A3G10 fails to prevent a DC switchgear room flood from propagating to the Division 2 AC switchgear, given a failure to terminate the flood. SAMA 197 evaluates upgrading the door to reduce the likelihood of failure.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
HE1FLPIXOVERFILL	2.20E-02	1.0141	FAILURE TO CONTROL LP ECCS TO PREVENT OVERFILL	This event represents the failure of operators to control reactor coolant injection following an anticipated transient without scram. SAMAs 115 and 121 evaluate upgrades to the ATWS procedure and SRVs to reduce the likelihood of a failure to control RPV level during an ATWS event. SAMA 145 evaluates training improvements related to important human failure events.
PHPHCSTSLVLLOW	2.00E-03	1.0132	CST LEVEL TOO LOW	This event represents the probability that the condensate storage tank level is below an "adequate" level. SAMA 198 evaluates improvements to reduce the likelihood of failure to provide CST makeup.
PHPHGSWSERIE	4.00E-02	1.0131	PHENOMENA FAILS GSW	This event represents the probability that general service water may fail due to various reasons. Operators must transfer GSW to closed loop operation if this occurs. SAMA 189 evaluates training improvements related to important human failure events such as transferring GSW to closed loop recirculation.
FCFSUHSXCC44_1	4.66E-06	1.0124	CC GROUP CCPMS, 4/4 E1156C001A, E1156C001B, E1156C001C, E1156C001D	This event represents the common cause failure of the mechanical drafting cooling tower fans to start. SAMA 055 evaluates upgrading the fire protection system cross tie to the RHRSW system.
RDRLHPCID003	2.23E-03	1.0123	HPCI RUPTURE DISK E4150D003 RUPTURES OR LEAKS	This event represents the probability of a HPCI turbine trip caused by a failure of the HPCI turbine exhaust line rupture discs. SAMA 29 evaluates raising or bypassing the high exhaust pressure trip.
%FL-AB-FPRO-CCHV2-N	1.07E-05	1.0119	Nominal rupture of Fire protection piping in Div 2 CCHVAC Room.	This event represents the probability of loss of main control room controls caused by a fire water pipe rupture in the Division 2 CCHVAC Room. SAMA 101, improving leak detection procedures, addresses this event. The implementation (in progress) of a risk informed in-service inspection program based on ASME Code Case N-716 explicitly addresses internal flooding initiators for inclusion in the in-service inspection program.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)				
Event Name	**Probability**	**RRW**	**Event Description**	**Disposition**
CPFFLOSPLOCA	2.40E-02	1.0117	CONDITIONAL LOOP GIVEN TRANSIENT WITH LOCA SIGNAL	This event represents the conditional probability that a loss of offsite power occurs, given an ECCS initiation signal. The most significant risk is a power grid failure caused by an instability that occurs when the nuclear plant trips offline. The plant response to order EA-12-049 includes providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power. Additionally, SAMAs 21 and 22 evaluate upgrades to increase the reliability of permanent alternate AC power supplies.
HE1RXMXTPLNT4H	4.60E-01	1.0116	Operator fails to align 4160V maint X-tie 65T/64T in 4 hours	This event represents the failure of operators to power 4kV ESS Bus 65E and 65F from SST 64 via breaker 64T. SAMA 12 evaluates upgrades with regard to the ability to cross-tie buses. SAMA 145 evaluates training improvements related to important human failure events.
BTTSEDCSCC22_1	4.02E-07	1.0109	CC GROUP DC BATTERY FAILS DURING OPERATION (SAFETY) 2A, 2B	This event represents the common cause probability that both 260V DC ESF batteries 2A and 2B fail to provide power. SAMA 001 addresses the addition of DC power supplies.
OSPR30MIN-GR	8.25E-01	1.0109	FAILURE TO RECOVER GRID LOOP W/IN 30 MIN.	This event represents the probability that offsite power is not restored within 30 minutes after a grid related loss of offsite power. SAMA 24 addresses this event by evaluating additional training to emphasize the steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 includes upgrading the Acts of Nature procedure and providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
%BS101	2.34E-02	1.0107	LOSS OF BUS #101 INITIATING EVENT	This initiating event represents the probability of a loss of Division 1 offsite power caused by a failure of Bus 101. SAMAs 23 and 24 address this initiating event by evaluating developing procedures to repair or replace failed 4kV breakers and to improve training to emphasize steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 includes providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)				
Event Name	**Probability**	**RRW**	**Event Description**	**Disposition**
MPFSHPCIC005	1.85E-03	1.0101	HPCI AUXILIARY OIL PUMP E4101C005 FAILS TO START	This event represents the failure of the HPCI turbine to operate due to loss of hydraulic control pressure if the auxiliary oil pump fails to start. SAMA 196 evaluates upgrades to the HPCI hydraulic control system.
HE1FBPDCLDSHED	6.80E-02	1.0099	OPERATOR FAILS TO PERFORM BOP BATTERY LOAD SHEDDING	This event represents the failure of operators to trip the emergency oil pumps connected to the BOP batteries, given a station blackout. The plant response to order EA-12-049 includes upgrades to procedure 29.ESP.ExtSBO, "Extended SBO" to provide better guidance and training on both DC and AC load shedding.
HEPDRXPSN090--	3.60E-05	1.0096	COMMON CAUSE MISCALIBRATION OF PRESSURE TRANSMITTER N090A,B,C,D	This event represents the common cause miscalibration failure probability of reactor pressure transmitters that prevents the reactor low pressure permissive relays from energizing. SAMAs 165 and 166 evaluate modifying procedures or circuits to bypass the low pressure permissive relays. SAMA 145 evaluates training improvements related to important human failure events.
HEPFRXPSEFCV	3.60E-05	1.0096	EFCV UNAVAILABLE DUE TO ERROR IN EFCV FUNCTIONAL TEST	This event represents the probability that an error during the excess flow check valve testing prevents the reactor low pressure permissive relays from energizing. SAMAs 165 and 166 evaluate modifying procedures or circuits to bypass the low pressure permissive relays. SAMA 145 evaluates training improvements related to important human failure events.
CPFFPLNTSPRFAL	5.00E-01	1.0093	FRACTION OF TIME IN SPRING/FALL OPERATION	This event represents the fraction of time where one GSW pump is required to operate during plant shutdown and three are required to run during normal operation. SAMA 200 evaluates the addition of another GSW pump to reduce the likelihood of a loss of GSW initiating event.
HE1RX480PLNT4H	1.50E-01	1.0093	Operator fails to crosstie 480VAC buses within 4 hours.	This event represents the failure of operators to cross tie 480V buses within four hours if required. SAMA 12 evaluates upgrades to the cross tie such that the human error probability of failing to cross tie can be excluded. SAMA 145 evaluates training improvements related to important human failure events.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)				
Event Name	**Probability**	**RRW**	**Event Description**	**Disposition**
CPFFACP2-COND-YD	3.89E-01	1.0092	CONDITIONAL PARTIAL LOSP FOR DIV. 2 DUE TO SWITCHYARD FAILURE	This event represents the fraction of partial loss of Division 2 offsite power events that occur due to switchyard related failures. SAMAs 23 and 24 address this event by evaluating developing procedures to repair or replace failed 4kV breakers and improving training to emphasize steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 includes providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
CPFFLOSPTRAN	2.40E-03	1.0091	CONDITIONAL LOOP GIVEN TRANSIENT W/O LOCA SIGNAL	This event represents the conditional probability that a loss of offsite power occurs, given a transient that does not involve an ECCS initiation signal. The most significant risk is a power grid failure caused by an instability that occurs when the nuclear plant trips offline. The plant response to order EA-12-049 includes providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power. Additionally, SAMAs 20, 21 and 22 evaluate upgrades to increase the reliability of permanent alternate AC power supplies.
CPFFSLCESUCCESS	8.00E-01	1.0088	COMPLIMENT OF T-SLC-E	This event represents the probability that operators succeed to inject with standby liquid control and maintain proper reactor water level, given an anticipated transient without scram event. SAMA 145 evaluates training improvements related to important human failure events, including the ATWS related human failure events for which this event is the compliment.
%FL-AB-ECW2-A3G10-N	8.56E-07	1.0087	Nominal rupture of EECW Div 2 lines in the Div 2 Switchgear Room propagating to DC Switchgear Room	This initiating event represents a flood in the Division 2 AC switchgear which may cause a loss of 260V DC Distribution if the flood is not isolated and the door fails. SAMA 214 evaluates addition of leak detection and automatic isolation valves on EECW piping in the Division 2 Switchgear Room.
CPFFSWGRDOORFAIL	5.00E-01	1.0086	CONDITIONAL PROBABILITY DOOR TO DC ROOM FAILS	This event represents the probability that the door to the DC switchgear room fails, given a flood. SAMA 197 evaluates upgrading the door to reduce the likelihood of failure.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
HE1RACHRGPLNT-	1.50E-02	1.0085	Operator fails to tie in alternate charger.	This event represents the probability that operators fail to tie in an alternate charger, given a failure of the normal charger. SAMA 145 evaluates training improvements related to important human failure events. The plant response to order EA-12-049 includes providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
%CMSIV	3.84E-02	1.0084	MAIN STEAM ISOLATION VALVE CLOSURE INITIATING EVENT	This initiating event represents the probability of a MSIV closure. SAMA 74 evaluates upgrades to MSIV pneumatic components.
ZMUADG14S004	1.74E-02	1.0084	MAINTENANCE R3001S004 UNAVAILABLE	This event represents the probability that Emergency Diesel Generator 14 is out of service due to maintenance. SAMA 203 evaluates improvements in the maintenance procedures.
HE1D-D-SBOLT	1.00E-05	1.0083	Common Failure to Respond to LOSP/SBO	This event represents the common failure of operators to respond to a longer term loss of offsite power or station blackout. SAMAs 23 and 24 address this event by evaluating developing procedures to repair or replace failed 4kV breakers and to improve training to emphasize steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 includes upgrading the Acts of Nature procedure and providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power. SAMA 145 evaluates training improvements related to important human failure events.
%PLOOP101	2.88E-02	1.008	PARTIAL LOSP FOR DIV. 1	This initiating event represents the probability of a recoverable loss of Division 1 offsite power caused by a failure of Bus 101. SAMAs 23 and 24 address this event by evaluating developing procedures to repair or replace failed 4kV breakers and improving training to emphasize steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 includes providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
%S2-ST	2.73E-03	1.008	SMALL LOCA ABOVE TAF (STEAM)	This initiating event represents a small break loss of coolant accident that occurs above the top of active fuel. SAMA 199 evaluates reductions in small break LOCA frequency.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
SBFDRXL1N693A	5.44E-04	1.0079	TRIP UNIT (BISTABLE SWITCH) B21N693A FAILS ON DEMAND	This event represents the failure of a reactor high level trip unit to energize the RCIC Level 8 trip relays. SAMA 201 evaluates installing a redundant trip mechanism for RCIC to isolate on high reactor water level.
SBFDRXL1N693C	5.44E-04	1.0079	TRIP UNIT (BISTABLE SWITCH) B21N693C FAILS ON DEMAND	This event represents the failure of a reactor high level trip unit to energize the RCIC Level 8 trip relays. SAMA 201 evaluates installing a redundant trip mechanism for RCIC to isolate on high reactor water level.
SBFDRXL2N693B	5.44E-04	1.0079	TRIP UNIT (BISTABLE SWITCH) B21N693B FAILS ON DEMAND	This event represents the failure of a reactor high level trip unit to energize the RCIC Level 8 trip relays. SAMA 201 evaluates installing a redundant trip mechanism for RCIC to isolate on high reactor water level.
SBFDRXL2N693D	5.44E-04	1.0079	TRIP UNIT (BISTABLE SWITCH) B21N693D FAILS ON DEMAND	This event represents the failure of a reactor high level trip unit to energize the RCIC Level 8 trip relays. SAMA 201 evaluates installing a redundant trip mechanism for RCIC to isolate on high reactor water level.
ZTUASBFW	1.66E-03	1.0078	SBFW UNAVAILABLE DUE TO PUMP TEST OR MAINTENANCE	This event represents the probability that a standby feedwater pump is out of service due to maintenance. SAMA 204 evaluates upgrades to the maintenance procedures.
PVTSRBCWF403-IE	2.63E-02	1.0076	RBCCW PRESSURE REG VALVE F403 FAILS DURING OPERATION (YEARLY)	This event represents the probability that the pressure differential control valve that controls RBCCW system pressure fails during operation. SAMA 202 evaluates replacing or upgrading the RBCCW pressure control valve to reduce the likelihood of a loss of RBCCW initiating event.
HE1FSLCSHEBI3L	2.60E-02	1.0074	OPERATOR FAILS TO INITIATE SLC LATE - CONDITIONAL	This event represents the failure of operators to inject sodium pentaborate solution into the reactor with the standby liquid control system. SAMA 115 evaluates upgrading ATWS procedures involving vessel injection and SAMA 145 evaluates training improvements related to important human failure events. SAMA 117 evaluates increasing the boron concentration in the SLC system.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)				
Event Name	**Probability**	**RRW**	**Event Description**	**Disposition**
HE1FSRVSPORTPWR	5.00E-01	1.0074	CREW FAILS TO ALIGN PORTABLE POWER TO SRVs	This event represents the failure of operators to locally operate SRVs with alternate power source, given a loss of DC power distribution. SAMAs 1 and 145 address the addition of DC power supplies and training improvements related to important human failure events.
HE1D-D-SBO--	2.80E-05	1.0073	Common Failure to Respond to LOSP/SBO	This event represents the common failure of operators to respond to a loss of offsite power or station blackout. SAMAs 24 and 145 evaluate improved training to emphasize steps in recovery of off-site power after a station black out and training improvements related to important human failure events. Additionally, the plant response to order EA-12-049 includes upgrading the Acts of Nature procedure and providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
HE1FRSW1F068-48	1.20E-01	1.0073	OPERATORS LOCALLY OPEN RHR VALVES FOR TORUS COOLING	This event represents the failure of operators to open the RHRSW heat exchange injection valves (F068A/B) and close the heat exchanger bypass valves (F048A/B), given a loss of main control room controls or loss of motive power. SAMA 145 evaluates training improvements related to important human failure events.
%FL-AB-ECWB-CCHV2-NM	6.34E-06	1.0071	Nominal or major rupture in RBCCW/EECW Div 1 or 2 line in Div 2 CCHVAC Rooms	This event represents the probability that the main control room must be abandoned due to a flood caused by a RBCCW/EECW rupture in the Division 2 CCHVAC rooms. SAMA 101, improving leak detection procedures, addresses this event. The implementation (in progress) of a risk informed in-service inspection program based on ASME Code Case N-716 explicitly addresses internal flooding initiators for inclusion in the in-service inspection program.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
CPFFACP1-COND-YD	8.51E-01	1.0067	CONDITIONAL PARTIAL LOSP FOR DIV. 1 DUE TO SWITCHYARD FAILURE	This event represents the fraction of partial loss of Division 1 offsite power events that occur due to switchyard related failures. SAMAs 23 and 24 address this event by evaluating developing procedures to repair or replace failed 4kV breakers and improving training to emphasize steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 includes providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
DHFODGCC2020_1	2.51E-05	1.0066	CCF OF ALL DG HYDRAULIC DAMPERS FAILS TO OPEN	This event represents the common cause failure of all diesel generator hydraulic dampers to open, causing a loss of diesel generator room ventilation. SAMAs 175 and 176 evaluate revising procedures to provide portable cooling to the EDG rooms and developing a procedure to open doors to the EDG building on a high temperature alarm.
CPFFRBLDFAILDUCTL1	5.00E-01	1.0065	COND. PROB. THAT ADVERSE ENVIRONMENT FAILS EQUIPMENT IN RB BASEMENT (LEVEL 1)	This event represents the probability that a containment venting into the reactor building causes the failure of motor driven pumps located in the reactor building, given a failure of the hardpipe vent isolation valve to close. The response to order EA-12-050 includes additional measures to increase the likelihood of successful containment venting to prevent containment overpressure.
PHPHCSTSINITFAIL	1.00E-03	1.0064	CST INITIALLY FAILED	This event represents the probability that the condensate storage tank is initially failed. SAMAs 50, 51, 54, 55, 67 evaluate improvements related to suppression pool cooling availability. If the CST is lost, availability of suppression pool cooling and containment venting becomes more important.
VBFCVSSSCC312_1	1.71E-04	1.0064	CCF OF THREE OR MORE VACUUM BREAKERS	This event represents the common cause failure probability that three or more vacuum breakers fail to reclose. SAMAs 9, 34, and 74 evaluate upgrades to SRVs to reduce the likelihood of a severe accident occurring with high RPV pressure. This reduces the chance that high pressure blowdown causes wetwell failure and bypass of suppression pool.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
%TDCAB	1.40E-06	1.0063	LOSS OF MULTIPLE 130VDC BUSES	This initiating event represents the probability that both DC ESF buses fail. SAMA 1 addresses the addition of DC power supplies.
%TRLA	2.58E-03	1.0063	REACTOR WATER REFERENCE LINE 12A INITIATING EVENT	This initiating event represents the probability that a break occurs on the reactor water reference leg. SAMA 101, improving leak detection procedures, addresses this event.
HE1D-D-HPIML	1.41E-04	1.0063	Common Failure to Operate High Pressure Injection Systems Given MLOCA	This event represents the common failure of operators to operate high pressure injection systems, given a medium break LOCA. SAMA 34 evaluates improvements in ADS reliability. SAMA 145 evaluates training improvements related to important human failure events.
PVTSTBCWF402-IE	2.63E-02	1.0057	GSW TEMPCONTROL VALVE (TCV) FOR TBCCW P43F402 TRANSFERS CLOSED (YEARLY)	This event represents the probability of failure for the TBCCW temperature control valve to remain open to allow GSW to cool the TBCCW heat exchanger. The RRW of this event is below the value that corresponds to a simple procedure change ($50,000), when considering external events and uncertainty, therefore this event is screened from additional SAMA evaluation.
PVTSTBCWF405-IE	2.63E-02	1.0057	PRESSURE REGULATING VALVE P43F405 FAILS DURING OPERATION (YEARLY)	This event represents the probability that the pressure differential control valve that controls TBCCW system pressure fails during operation. The RRW of this event is below the value that corresponds to a simple procedure change ($50,000), when considering external events and uncertainty, therefore this event is screened from additional SAMA evaluation.
%SRV12	2.20E-02	1.0056	INADVERTENT OPENING OF RELIEF VALVE INITIATING EVENT	This initiating event represents the probability that an unintended opening of a safety relief valve occurs. SAMA 121 evaluates upgrades to equipment to reduce the likelihood of an inadvertent open relief valve.
HE1REECWISOLT-	2.40E-03	1.0055	Operator fails to isolate EECW drywell loads.	This event represents the failure of operators to isolate EECW from drywell loads, given a loss of coolant accident. SAMA 145 evaluates training improvements related to important human failure events.

Table D.1-2 – Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)

Event Name	Probability	RRW	Event Description	Disposition
PHPHHPCI-INSTB	1.00E-03	1.0054	INSTABILITY IN HPCI TURBINE TRIP EXHAUST CAUSES TRIP	This event represents the probability that dynamic changes in pressure result in a HPCI isolation on high exhaust pressure. SAMA 29 evaluates raising the HPCI backpressure trip setpoint.
CPFFTF64BS101	3.39E-01	1.0053	CONDITIONAL PROBABILITY BS101 FAILURE IS DUE TO TF64 FAILURE	This event represents the fraction of Bus 101 failures that are caused by a failure of transformer SST-64. SAMAs 23 and 24 address this event by evaluating developing procedures to repair or replace failed 4kV breakers, and improving training to emphasize steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 includes providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
ZMUADG12S002	1.74E-02	1.0053	MAINTENANCE R3001S002 UNAVAILABLE	This event represents the probability that Emergency Diesel Generator 12 is out of service due to maintenance. SAMA 203 evaluates improvements in the maintenance procedures.
CHFCCTG1S011BA6	2.55E-03	1.0051	BUS 1-2B CIRCUIT BREAKER R1400S011B-A6 FAILS TO CLOSE ON DEMAND	This event represents the probability that the alternate CTG feed through 13.8kV Peaker Bus 1-2B fails due to a failure of the feed breaker to close on demand. SAMAs 23 and 24 address this event by evaluating developing procedures to repair or replace failed 4kV breakers, and to improve training to emphasize steps in recovery of off-site power after a station black out. Additionally, the plant response to order EA-12-049 includes providing equipment, additional procedural steps, and training to mitigate an extended loss of AC power.
HE1FRXPCREF1	5.40E-04	1.005	CREW FAILS TO DEPRESS GIVEN SINGLE REF LEG LEAKDOWN AND NO HIGH PRESS INJ	This event represents the failure of operators to depressurize the reactor, given a break in one of the reference legs and the loss of all high pressure injection. SAMA 034 evaluates upgrades to the automatic depressurization system to improve reliability. SAMA 145 evaluates training improvements related to important human failure events.

CDF Uncertainty

The uncertainty associated with CDF was estimated and documented in the Fermi 2 Level 1 and 2 PRA Quantification and Summary Notebook [Figure 3-12, D.1-1]. The parametric uncertainty analysis was performed using cutsets resulting from quantification at a truncation of 1E-12/yr and resulted in the following results.

Table D.1-3 – Fermi 2 CDF Parametric Uncertainty

CDF Parameter	Fermi 2 Value
Mean	1.51E-06
Median	1.14E-06
95% Upper Bound	3.54E-06
5% Lower Bound	4.74E-07

The ratio of the 95^{th} percentile CDF to the point estimate CDF of 1.50E-06/Rx-yr is 2.36. A conservative uncertainty factor of 2.5 was selected to determine the internal and external benefit with uncertainty as part of the Fermi 2 SAMA analysis.

D.1.2 PRA Model – Level 2 Analysis

D.1.2.1 Containment Performance Analysis

The Fermi 2 Level 2 PRA model used for the SAMA analysis was developed as part of the FermiV9 internal events PRA model [D.1-1, D.1-15].

A Level 2 model includes two types of considerations: (1) a deterministic analysis of the physical processes for a spectrum of severe accident progressions, and (2) a probabilistic analysis component in which the likelihood of the various outcomes are assessed. The deterministic analysis examines the response of the containment to the physical processes during a severe accident. This analysis is performed by:

- Utilization of the Modular Accident Analysis Program (MAAP) 4.0.7 code to simulate severe accidents that have been identified as dominant contributors to core damage in the Level 1 analysis, and
- Reference calculation of several hydrodynamic and heat transfer phenomena that occur during the progression of severe accidents. Examples include debris coolability, pressure spikes due to ex-vessel steam explosions, scoping calculation of direct containment heating, molten debris filling the pedestal sump and flowing over the drywell floor, containment bypass, deflagration and detonation of hydrogen, thrust forces at reactor vessel failure, liner melt-through, and thermal attack of containment penetrations.

The Level 2 analysis examined the dominant accident sequences and the resulting plant damage states (PDS), or accident classes, defined in Level 1. The Level 1 analysis involves the assessment of those scenarios that could lead to core damage.

A full Level 2 model was developed for Fermi 2. The Level 2 model consists of containment event trees (CETs) with functional nodes that represent phenomenological events and containment protection system status. The nodes were quantified using subordinate trees and logic rules. A list of the CET functional nodes and descriptions used for the Level 2 analysis is presented in Table D.1-4 [D.1-15].

The Large Early Release Frequency (LERF) is an indicator of containment performance from the Level 2 results because the magnitude and timing of these releases provide the greatest potential for early health effects to the public. The frequency calculated is 3.73E-07/Rx-yr at a truncation of 1E-12/yr [D.1-1].

LERF represents ~25% of all release end states. Table D.1-5 provides a correlation between the Level 2 RRW risk significant events (severe accident phenomenon, initiating events, component failures, and operator actions) down to 1.005 identified from the Fermi 2 PRA LERF results.

Table D.1-4 – Functional Success Criteria

CET FUNCTIONAL NODE	SUCCESS CRITERIA
Containment Isolation (IS)	The success of the containment isolation node (IS) is satisfied if the containment penetrations that communicate between the drywell (or wetwell) atmosphere and the Reactor Building (or environment) are "closed and isolated". The criteria used to satisfy this requirement of "closed or isolated" is that no line, hatch, or penetration has an opening greater than 2 inches in diameter. This implies that all containment penetrations are adequately sealed and isolated during the entire accident progression until either: (1) a safe stable state is reached; or, (2) the accident conditions exceed the ultimate capability of containment as determined in the plant specific evaluation. The quantitative characterization of the isolation failure includes the incorporation of pre-existing (latent) containment failures based on industry data.
RPV Depressurization (OP)	This function questions whether the operator depressurizes the RPV after core damage but before vessel breach has occurred. Success of this action would allow low pressure injection, if available, and would minimize the challenge to containment due to a high pressure RPV rupture. The functional success criterion for this node is defined as having the RPV depressurized (i.e., less than 100 psig) until core melt is arrested in-vessel or until the RPV is breached by debris attack. The success of the depressurization function for the RPV following core damage initiation is similar to the criterion established in the Level 1 analysis, i.e., prior to core damage. However, there are additional phenomena (i.e., non-condensible gas generation contributing to a high containment pressure that prevents SRV operation, and potentially very high containment temperatures which could fail electrical and mechanical components of the SRVs) which can occur during the accident progression beyond core damage and pose further challenge to the operator's ability to depressurize the RPV. The success criteria is to depressurize the RPV to less than 100 psig. The success criteria, in terms of systems, are the following: • Any 2 SRVs [D.1-2, D.1-3] before core damage or • Any single SRV failed during core melt progression or • Failure of the primary system due to high temperature during core melt progression.[1] or

Table D.1-4 – Functional Success Criteria

CET FUNCTIONAL NODE	SUCCESS CRITERIA
	• A large or medium LOCA. Other alternatives(2) may be available but are not credited in this analysis. It is noted that in Level 1, RPV depressurization using the TBVs are credited if the main condenser is available. For past core damage (Level 2), the high radiation isolation of the MSIVs is assumed to preclude this path.
Arrest Core Melt Progression In-vessel (RX)	In-vessel recovery or arrest of core melt progression addresses the ability of the operating staff to restore adequate core cooling from the time the end state of the Level 1 PRA occurs (i.e., RPV water level less than 1/3 core height and decreasing) until restoration of water injection make-up cannot prevent the breach of the RPV bottom head by debris. As part of the definition of success, it is also useful to define what constitutes failure to maintain the RPV intact. The two primary failure modes that have been identified in the literature include: • Local penetration seal failure due to debris heat up and local failure at welds [D.1-4]. • Creep rupture failure of the entire bottom head [D.1-5]. The MAAP evaluation calculates that the RPV integrity would be challenged by debris contact with local penetration welds. This is supported by experiments by R. Leahey (RPI) which indicate for PWRs that drain plug configurations are susceptible to failure [D.1-6]. This configuration correlates to the BWR instrument tubes or CRD seals. The base quantification assumes that RPV failure occurs at local penetrations. The large, bottom head failure scenario is treated as a sensitivity case. Preventing the core melt from progressing outside the reactor pressure vessel requires the timely introduction of water onto the debris and intact fuel assemblies. Both timing and system requirements must be defined as part of the success criteria. There are differences in core melt progression models regarding the ability to recover adequate cooling under different circumstances. These vary from no credit for retention of debris in-vessel after significant core melting has begun (MAAP), to substantial credit for recovery even after debris has accumulated in the bottom head (MARCH). The best estimate success criteria used in this evaluation are based on the time available from the initiation of core degradation until just before substantial core relocation occurs. This typically is on the order of 30-40 minutes. In terms of system requirements, coolant injection is assumed necessary to re-flood the RPV to above 1/3 core height. It is judged, based on deterministic calculations, that this can be accomplished using makeup systems (identified in the EOPs) with capability greater than approximately 1000 gpm.(5)

Table D.1-4 – Functional Success Criteria

CET FUNCTIONAL NODE	SUCCESS CRITERIA
Combustible Gas Venting (GV)	The success branch of this node is straightforward: • There is a combustible mixture in containment (i.e., deinerted with hydrogen released to the containment) • The crew is successful in venting the mixture from the containment The functional success criterion at this node is that the containment vent and purge lines are opened to allow combustible gas mixtures to be removed from containment. The downward path of GV in the CET implies that combustible gas venting has not been initiated. Therefore, on the downward path either of two conditions may exist: • The containment is inerted(3) or • A combustible gas mixture is present (but not vented and potentially subject to ignition) The probabilistic evaluation of these two states on the downward branch are treated in the Containment Remains Intact Early (CZ) node. Note that hydrogen recombiners are of such low through-put capacity that the amount of hydrogen potentially generated during a severe accident cannot be effectively processed by the recombiners. Specifically, hydrogen fractions of the containment atmosphere of greater than 12% can be anticipated within the first 2 hours of core melt progression. Therefore, the hydrogen recombiner system is considered not to be effective in preventing a hydrogen deflagration in a severe accident situation. Hydrogen combustion that could lead to containment failure is prevented by either of the following: • Deinerted operation with no oxygen intrusion during the accident [D.1-7]. • Combustible gas purging and venting through the purge and vent lines [D.1-8]. If both these success paths fail, the hydrogen deflagration is assumed to occur, resulting in containment failure. The location of the failure is assumed to be in the drywell head region and is classified as a large failure.

Table D.1-4 – Functional Success Criteria

CET FUNCTIONAL NODE	SUCCESS CRITERIA
Containment Remains Intact (CZ)	The functional success criteria for the containment intact node are that the containment retains its pressure capability and that no early containment failure modes compromise the containment integrity. The early containment failures modeled by the CZ node are characterized by phenomenological events (e.g., steam explosions, missile generation, direct containment heating) that are estimated to challenge containment integrity relatively quickly following core melt. Late containment failures, modeled in subsequent nodes, are characterized by extreme pressure and temperature conditions that develop slowly over the course of the accident due to inadequate containment heat removal. Note that successful prevention of early containment failure does not necessarily preclude late containment failure. (See Appendix B of Reference D.1-15 for further discussion of energetic failure modes.) Therefore, successful prevention of early containment failure requires the following: • No direct containment heating (direct containment heating is precluded if the RPV is already depressurized) [D.1-7] • No ex-vessel steam explosion [D.1-9] • No failure of vapor suppression (i.e., the suppression pool is not bypassed if no more than 1 drywell to wetwell vacuum breaker fails open) • No in-vessel steam explosion (i.e., in-vessel steam explosions are precluded if either the RPV is at high pressure, e.g., greater than 100 psig or the core does not fragment into fine particles before dropping onto the bottom head) [D.1-10, D.1-11] • No high pressure spike sufficient to cause containment failure occurs at the time of vessel melt-through (i.e., extreme pressure spikes are precluded if the RPV bottom head penetration fails locally; or the RPV remains at low pressure) • No hydrogen deflagration or detonation (i.e., if the containment remains inert or combustible gas vent was operated successfully; then, hydrogen detonation or deflagration is guaranteed not to occur in the model). • No RPV blowdown from high pressure with the suppression pool temperature above 240 F [D.1-12]. • No recriticality due to an unusual core configuration that may be achieved during the melt progression. [D.1-13] If these failure modes cannot be prevented, containment failure is assumed to occur. The failure location is assumed to be in the drywell head region and is classified as a large failure.

Table D.1-4 – Functional Success Criteria

CET FUNCTIONAL NODE	SUCCESS CRITERIA
Drywell Shell Remains Intact and Ex-vessel Debris Coolability (SI) (This node subsumes the treatment of ex-vessel debris effects (SI) and the cooling of ex-vessel core debris)	Success at this node requires that water is available (greater than 1000 gpm) to the core debris at the time of vessel failure. Shell failure can occur relatively quickly (i.e., minutes) following RPV failure if water is not available to quench the core debris. It is assumed in the model that the core debris will come in contact with and fail the drywell shell if water is not available. Ex-vessel core debris coolability can be considered to be successful if very high containment temperatures, core concrete ablation, and substantial non-condensible gas generation that can result from poorly cooled debris can be prevented. These are considered preventable if on a best estimate basis a continuous water supply is available to the debris with a flow rate of greater than 1000 gpm. The two methods that may provide adequate coolant injection to the debris bed include continued make-up to the RPV and initiation of drywell sprays. Failure at this node could result in either of the following occurring: • High temperatures in the drywell, or • Excessive concrete ablation causing pedestal structural failure or basemat penetration. These effects would influence the integrity of containment. Note that inadequate water injection will be modeled for the purposes of consequence evaluation as inducing a drywell failure high in the containment. [D.1-7, D.1-14] However, there are some models that indicate that concrete attack and non-condensible gas generation will not be terminated even if substantial water injection is available to the debris. The temperatures in the drywell will be acceptable, but continued non-condensible gas generation will occur. In this case, venting would be an adequate mitigation measure. This is treated in the SI node and the VC node. This node subsumes the treatment of ex-vessel debris effects (SI) and the cooling of ex-vessel core debris. Time is available in which to restore debris cooling before very high containment temperatures develop and threaten additional containment failures. Note that cooling of core debris is considered successful if the SI function is successful.
Containment Flooding Initiated (FC)	Success at this node implies that the containment flooding contingency procedure has been initiated by the operating staff and that a system of adequate flow capacity from external sources is available to implement the procedure. In addition to these two requirements, the instrumentation must be available to initiate the flood operation.

Table D.1-4 – Functional Success Criteria

CET FUNCTIONAL NODE	SUCCESS CRITERIA
Containment Remains Intact (CX)	The CX phenomena are subsumed within the CZ node. The success branch of the CX node occurs if two situations can be prevented: • Blowdown of the RPV into a reduced free volume (i.e., the increased water level creates a reduced free volume that results in a decreased capability of the containment to accept blowdown loads), and • Core melt progression causing RPV failure and a large steam vaporization. These two failure modes are somewhat dependent upon the relative timing of containment fill versus core melt progression. In addition, the effects are dependent on the following: • Whether the RPV is depressurized allowing injection of external water sources (Node OP), and • Whether sources for containment flooding are available through injection nozzles from outside of the RPV (i.e., drywell sprays or RHR suppression pool cooling return lines).
Containment Flooded Above Debris (FD)	The FD failure modes and phenomena represent failure to complete the containment flooding evolution due to lack of drywell venting. It is subsumed within the FC node in the CET. This node evaluates the possibility that the operator suspends containment flooding because the staff is unable to maintain containment conditions within prescribed limits described in the EOPs. Success at FD includes drywell venting. Since it is presumed that containment pressurization will occur during the latter stage of flooding as a result of a diminishing drywell volume, the operator will be required to establish a drywell vent path (i.e., > 8 inch equivalent diameter). Drywell venting can have varying degrees of releases associated with it depending on the following: • When in the containment flood process drywell venting is required, and • Whether success of RHR suppression pool cooling and injection is effective in controlling containment pressure. Success at this juncture in the model is defined as the continuation of the flooding evolution with containment conditions remaining within the limits of the Maximum Primary Containment Water Level Limit (MPCWLL).
Containment Pressure Control (see node descriptions HR and VC below)	Successful containment pressure control is achieved if either of two functional nodes are successfully satisfied; (1) RHR containment heat removal, or (2) Containment venting. Because these have different potential impacts on the radionuclide releases they are treated in separate nodes.

Table D.1-4 – Functional Success Criteria

CET FUNCTIONAL NODE	SUCCESS CRITERIA
(1) RHR Containment Heat Removal (HR)	Successful containment pressure control is unattainable using RHR[4] suppression pool cooling if the following conditions are not satisfied: • Debris cooling (in-vessel or ex-vessel) • No "Early" containment failure modes RHR has the capability to remove heat from containment through the RHR heat exchangers. This capability requires: • A flow path from the suppression pool • One RHR pump • One RHR heat exchanger • RHRSW to cool the heat exchanger (1 RHRSW pump is adequate) • A return flow path to: o The suppression pool o The RPV (LPCI node with injection cooling – after RPV breach) o The drywell spray (wetwell spray flow rate is considered to low). • Bypass of the low RPV water level (2/3 core height) interlock if not using RPV return • Not using injection path from service water through the RHR cross tie Failure at this juncture in the sequence implies insufficient containment heat rejection to the environment and that the continued decay heat generation could subject the containment to continued pressurization. This condition may eventually cause structural failure, which could subsequently threaten continued successful core coolant injection. Note that RHR success is a moot point if adequate injection to the core or debris has failed. This is because of high temperatures from debris radiative heating or high pressure from non-condensible gases will cause drywell failure.

Table D.1-4 – Functional Success Criteria

CET FUNCTIONAL NODE	SUCCESS CRITERIA
(2) Containment Venting (VC)	The capability to vent the wetwell is a valuable supplement to the containment pressure control systems. As pressure and temperature increase, there is decreasing confidence in the ability to maintain the integrity of the containment pressure boundary. By instituting a controlled vent of the containment atmosphere, it is possible to maintain long term containment integrity by providing a viable means of containment pressure control and heat removal. Venting also constitutes a viable mitigative action to minimize the source term released to the environment. Containment venting is successful if it can remove the excess heat and non-condensible gases from the containment and, thereby, maintain the containment pressure within acceptable limits. Adequate pressure control can be obtained by containment venting if the following conditions are satisfied: • Reactivity control exists • No "early" containment failure modes occur • Containment flooding does not eliminate the venting pathways (i.e., DW vent is used) • Vent pathways can be opened and controlled. Based upon deterministic calculations, a containment vent of approximately 8 inches in diameter will provide sufficient vent capability to prevent containment failure for sequences involving the loss of containment heat removal or severe accidents. [D.1-2] Currently, no vent capability is considered successful for unmitigated ATWS or failure to scram events.
No Suppression Pool Bypass (SP)	This node in the CET is used to characterize the magnitude of radionuclides that may escape the containment if wetwell failure or venting occurs. Success means that radionuclides are directed through the suppression pool. Subsequent headings address specific release paths. Success in preventing suppression pool bypass requires that: • No vacuum breakers are stuck open • The suppression pool water level remains above the bottom of the downcomers • The vent pipes, downcomers, or ring header do not rupture.

Table D.1-4 – Functional Success Criteria

CET FUNCTIONAL NODE	SUCCESS CRITERIA

No Large Containment Failure (NC)	This event examines the size of containment leakage that may be induced by extreme pressure and temperature conditions. The downward path at this event tree node is defined as large leakage or failure, while the upward path depicts either no leakage or the existence of drywell leak paths that prevent further containment pressurization.
	
	Any failure of the containment structure greater than 1 ft^2 is considered to be a large containment failure and is modeled as a 2 ft^2 break in the MAAP runs. A small break is assumed to be 1 ft^2 or less in size, and is modeled in MAAP with a leak size of 27 in^2. A small containment break may be characterized by any of the following breach of containment:
	
	• Electrical penetration leak,
	• Hatch seal leak,
	• Bellows seal leak, or
	• Drywell head seal leak:
	    o Thermal degradation
	    o Inadequate pre-load
	
	Leak sizes up to 3 in^2 in equivalent area are assumed to present a negligible impact on the course of the accident.
	
	The downward branch of the "No Large Containment Failure" node is probabilistically based on the plant specific structural analysis. However, there are certain cases in which failure (i.e., large break) is guaranteed. These cases include the following:
	
	• Failure to scram sequences with continued injection and no SLCS,
	• No injection to containment, causing high temperature induced failure,
	• Any early containment failure (e.g., steam explosion, etc.), or
	• LOCA plus failure of vapor suppression

Table D.1-4 – Functional Success Criteria

CET FUNCTIONAL NODE	SUCCESS CRITERIA
Coolant Makeup Remains Available Post Containment Failure (MU)	This event node is used to examine the availability of water injection to the drywell and RPV following containment failure. Failure of coolant makeup to the debris results in delayed fission product release due to heat up and revaporization of fission products on the RPV internals and containment structures. Releases are reduced if coolant injection can be maintained. The success of coolant makeup following containment failure may be compromised by any of the following: • Harsh environment in Reactor Building • Steam binding of pumps • Disruption of injection pathways due to catastrophic containment failure The same success criteria established for accomplishing ex-vessel debris coolability and averting shell melt-through (node "SI") influence the analysis of whether functional success is achieved at this node. Successful debris cooling can be either enhanced or prolonged by the Extreme Damage Mitigation Guidelines (EDMG) implemented by DTE. Alignment of the following injection sources external to the Reactor Building (these systems are not hindered by steam binding or harsh conditions in the Reactor Building) may be used to achieve success: • RHRSW crosstie (if LPCI injection valve can be opened) • SBFW • Fire Protection system alignments(6) • Condensate
Drywell Intact (DI)	Containment failure has already been asked in the CET. If containment failure has not occurred, this node is bypassed. If containment failure is determined to have occurred, then "DI" node is included to distinguish whether the failure occurred in the drywell (failure branch) or wetwell ("success" branch). The probabilistic determination of the location of the failure is determined based on the plant specific structural analysis for slow overpressure events [Appendix E of D.1-15]. Additional guidance is also provided for other accident scenarios as follows: • High temperature induced failures result in drywell failures • Rapid or energetic failure modes are assumed to occur in the drywell (e.g., steam explosions, etc.)

Table D.1-4 – Functional Success Criteria

CET FUNCTIONAL NODE	SUCCESS CRITERIA
Wetwell Airspace Failure (WW) (Scrubbed Release)	This node appears after the Drywell Intact (DI) node. If the DI node determines that the containment failure occurred in the drywell this node is bypassed. If the containment failure occurred in the wetwell, this node distinguishes whether the wetwell failure occurred above or below the wetwell water line. As in the previous node, successfully avoiding a large containment failure requires successful containment heat removal. The probabilistic determination of the location of the failure is determined based on the plant specific structural analysis for slow overpressurization events [D.1-15].
Reactor Building Effectiveness (RB)	The Reactor Building provides a substantial capability to remove particulate fission products from the release pathway for scenarios where the containment has failed. Success of the Reactor Building to provide a substantial radionuclide reduction (i.e., a factor of 5 to 10 reduction in the radionuclide release magnitude) is based upon any of the following: • Very small containment failures (i.e., 2 inch equivalent diameter) for which the Reactor Building remains substantially intact (i.e., no deflagration event) • Primary containment failures low in the Reactor Building for which the release pathway consists of a circuitous route through the Reactor Building and no deflagration event occurs. • Cases in which substantial fire protection spray is occurring during the release (not credited due to limited area coverage at Fermi). [D.1-16, Appendix C of D.1-15] However, based on the experience with the March 2011 accident at Fukushima, credit for the Reactor Building as an effective fission product trap is not currently included in the Fermi model because there is not a qualified MAAP model to replicate hydrogen deflagration effects on the Reactor Building structure and the acceleration of fission products out of the Reactor Building. The RB node becomes a convenient place holder in the model for sensitivity calculations.

Notes to Table D.1-4:

(1) Primary system failure may be induced by very high internal temperatures generated by molten debris in an uncooled state within the RPV. Such high temperatures coincident with high RPV pressures may lead to localized failures at weak points high within the RPV.

(2) Opening MSIVs or the use of HPCI/RCIC steam lines are not credited because these are not directed by the EOPs, or are of insufficient capacity to lead to depressurization, respectively.

(3) For this situation the containment remains inerted and venting would not have been required. Therefore, in this case, the down branch is not considered as a failure of combustible gas venting but as a continuation of the sequence.

(4) Other modes of containment heat removal are not considered effective because of interlocks or procedural restrictions under severe accident conditions. (e.g., RWCU, Main Condenser).

(5) The 1000 gpm criterion is an approximation. There is a comparatively large degree of uncertainty surrounding this issue. However, ORNL calculations [D.1-16, D.1-29] seem to indicate that an injection rate close to 1000 gpm initiated at thirty minutes may be sufficient.

(6) DFP and B.5.b (Portable Pump) are treated as potential successful external injection sources when debris is ex-vessel. This acknowledges that the containment backpressure will remain sufficiently low to allow success of these low head injection systems.

Table D.1-5 – Correlation of Level II Risk Significant Terms to SAMAs (Based on LERF)[1]				
Event Name[1]	**Probability**	**RRW**	**Event Description**	**Disposition**
WWAT-BE	5.00E-01	1.3726	WW FAILURE ATWS (BELOW WATER LINE)	This event represents the probability that the torus is breached below the water line, given an anticipated transient without scram. SAMAs 115, 117, 195 and 212 evaluate reducing the likelihood or consequences of ATWS events by revising procedures to prevent boron loss or dilution following SLC initiation, increasing SLC boron concentration, improving the reliability of control rod drive mechanisms, and diversifying SLC explosive valve operation.
PHPHL2OPHITEMP	7.00E-01	1.2847	HIGH PRIMARY SYSTEM TEMP DOES NOT CAUSE FAILURE	This event represents the probability that high primary system temperature caused by melting fuel does not induce a LOCA. SAMAs 9, 34, and 74 evaluate upgrades to SRVs to reduce the likelihood of a severe accident occurring with high RPV pressure. This reduces the chance of an induced LOCA caused by excessive RPV temperatures.
PHPHL2OPSRVSTICK	4.50E-01	1.2847	SRVs DO NOT STICK OPEN	This event represents the probability that RPV safety relief valves do not stick open (and induce a LOCA) during a core melt progression. SAMA 121 evaluates increasing SRV reseating reliability. This reduces the chance of an induced LOCA caused by excessive RPV temperatures.
PHPHL2OPWHFL	8.00E-01	1.2847	WATER HAMMER DOES NOT CAUSE PRIMARY SYSTEM FAILURES	This event represents the probability that high temperatures and large increases in steam generation rates caused by melting fuel does not induce a LOCA via a water hammer event. SAMAs 9, 34, and 74 evaluate upgrades to SRVs to reduce the likelihood of a severe accident occurring with high RPV pressure. This reduces the chance of an induced LOCA caused by excessive RPV temperatures.
PHPHL2SPVBSL	1.00E-01	1.0598	TEMPERATURE INDUCED FAILURE OF ALL VACUUM BREAKER SEALS	This event represents the probability that ex-vessel cooling of debris on the floor of the drywell causes suppression pool bypass when the vacuum breaker seals fail due to excessive temperature. SAMAs 9, 34, and 74 evaluate upgrades to SRVs to reduce the likelihood of a severe accident occurring with high RPV pressure. This reduces the chance that core debris can cause suppression pool bypass due to high temperature failure of vacuum breaker seals.
PHPHCNTM-STINERT	5.00E-01	1.0503	CONTAINMENT NOT STEAM INERTED	This event represents the fraction of core damage accident sequences where containment is not steam inerted. SAMAs 93 and 103 evaluate installation of a post-accident inerting system and addition of a passive hydrogen control system.

Table D.1-5 – Correlation of Level II Risk Significant Terms to SAMAs (Based on LERF)[(1)]

Event Name[(1)]	Probability	RRW	Event Description	Disposition
PHPHL2DILOSSDHRF	1.85E-01	1.0393	DW NOT INTACT FOR LOSS OF DHR EVENTS (CLASS II) (LG)	This event represents the probability of containment failure being located in the drywell, given in-vessel recovery and a loss of decay heat removal. The response to order EA-12-050 includes additional measures to increase the likelihood of successful containment venting to prevent containment overpressure.
WWA-BE	1.67E-01	1.0292	WETWELL WATERSPACE FAILURES RPV INTACT	This event represents the probability that a wetwell failure occurs below the water line, given low temperature, high containment pressure, and large wetwell failure. The response to order EA-12-050 includes additional measures to increase the likelihood of successful containment venting to prevent containment overpressure.
HE1D-D-ATWS	1.85E-03	1.0133	Common Failure to Perform ATWS Response Actions	This event represents the common failure of operators to respond to an anticipated transient without scram. SAMA 115 evaluates upgrading ATWS procedures involving vessel injection. SAMA 145 evaluates training improvements related to important human failure events.
HE1FHVNTDWVT	1.90E-02	1.0101	OPERATING STAFF FAILS TO INITIATE VENT PER PROCEDURE	This event represents the failure of operations to vent containment according to procedure. The response to order EA-12-050 includes additional measures to increase the likelihood of successful containment venting to prevent containment overpressure.
%FL-RB-TORS-A1XXX-NM	9.96E-06	1.0085	Nominal or major rupture of the Torus or connected pipe in the Torus Area	This initiating event represents the probability that a rupture in the torus causes the reactor building to flood. SAMAs 41, 50, and 51 evaluate upgrades to systems that are capable of injecting coolant to the reactor without the use of the suppression pool.
PHPHRBLDBOCTNLF	5.00E-01	1.0085	BOC IN HPCI/RCIC CAUSES ADVERSE ENVIRONMENT IN REACTOR BUILDING	This event represents the probability that pumps in the reactor building fail due to a break outside of containment. SAMA 101, improving leak detection procedures, addresses this event.
%A-ST	1.39E-05	1.008	LARGE LOCA ABOVE TAF (STEAM LOCA)	This initiating event represents a large break LOCA located above the top of active fuel. SAMA 101, improving leak detection procedures, addresses this event.
WW-DW-LK-RUPT	7.20E-01	1.008	WW-DW RUPT/LEAK	This event represents the probability that a wetwell or drywell rupture or leak causes failure of all injection sources which depend on torus suction, reactor building access, or have equipment located in the reactor building. SAMAs 41, 50, and 51 evaluate upgrades to systems that are capable of injecting coolant to the reactor without the use of the suppression pool.

Table D.1-5 – Correlation of Level II Risk Significant Terms to SAMAs (Based on LERF)[1]

Event Name[1]	Probability	RRW	Event Description	Disposition
PHPHL2CZREFLOOD	1.00E-01	1.0072	FUEL ROD INTEGRITY IS MAINTAINED DURING THE REFLOOD	This event represents the probability that melted fuel rods do not experience catastrophic failure when a reflooding of the reactor vessel occurs, given re-criticality of the core can't be mitigated. SAMAs 115 and 121 evaluate upgrades to the ATWS procedure and SRVs to reduce the likelihood of a failure to inject SLC and control RPV level during an ATWS event.
PHPHHPCISPIKE	1.00E-03	1.007	PHENOMENA CAUSES CORE DAMAGE DUE TO PRESSURE SPIKES	This event represents the probability that high pressure coolant injection operation causes core damage due to excessive pressures experienced given the insertion of positive reactivity during an anticipated transient without scram event. SAMA 120 addresses relief valves to prevent a damaging overpressure during ATWS.
%A-ADS	1.15E-05	1.0066	INADVERTENT ADS	This initiating event represents the probability that two or more safety relief valves stick open. SAMA 121 evaluates increasing SRV reseat reliability.
%A-FW	1.13E-05	1.0066	LARGE LOCA IN FW LINE	This initiating event represents the probability of a large break LOCA in the feedwater piping. SAMA 101, improving leak detection procedures, addresses this event.
%A-LP	1.05E-05	1.0061	LARGE LOCA IN LPCI LINE	This initiating event represents the probability of a large break LOCA in the RHR LPCI piping. SAMA 101, improving leak detection procedures, addresses this event.
ZTUASLCSC001	8.70E-04	1.0061	SLCS UNAVAIL DUE TO QUARTERLY PUMP/VALVE OPERABILITY TEST	This event represents the probability that a particular train of the standby liquid control system is out of service due to maintenance. The RRW of this event is below the value that corresponds to a simple procedure change ($50,000), even when considering uncertainty, therefore this event is screened from additional SAMA evaluation.
%BOC-MS	2.03E-07	1.0055	BREAK OUTSIDE CONTAINMENT IN MS LINE	This initiating event represents the probability of a rupture in the main steam line located outside of containment. SAMA 101, improving leak detection procedures, addresses this event.
%BOC-RW	2.34E-09	1.0055	BREAK OUTSIDE CONTAINMENT IN RWCU LINE	This initiating event represents the probability of a rupture in the reactor water cleanup piping located outside of containment. SAMA 101, improving leak detection procedures, addresses this event.

Table D.1-5 – Correlation of Level II Risk Significant Terms to SAMAs (Based on LERF)(1)

Event Name(1)	Probability	RRW	Event Description	Disposition
%BS72F	1.17E-02	1.0052	LOSS OF BUS 72F INITIATING EVENT	This initiating event represents the probability of the loss of vital low voltage AC bus 72F. The RRW of this event is below the value that corresponds to a simple procedure change ($50,000), even when considering uncertainty, therefore this event is screened from additional SAMA evaluation.
HE1FLPIXATWSSORV	2.50E-02	1.005	FAILURE TO CONTROL LP ECCS TO PREVENT OVERFILL GIVEN SORV	This event represents the failure of operators to prevent automatic injection given reactor depressurization after an anticipated transient without scram. SAMA 115 evaluates upgrading ATWS procedures involving vessel injection.

(1) Basic events that are correlated in Table D.1-2 are not listed again in this table.

D.1.2.2 Radionuclide Analysis

D.1.2.2.1 Introduction

A major feature of a Level 2 analysis is the estimation of the source term for every possible outcome of the CET. The CET end points represent the outcomes of possible in-containment accident progression sequences. These end points represent complete severe accident sequences from initiating event to release of radionuclides to the environment. The Level 1 and plant system information is passed through to the CET evaluation in discrete plant damage states (PDS). An atmospheric source term may be associated with each of these CET sequences. Because of the large number of postulated accident scenarios considered, mechanistic calculations (i.e., MAAP calculations) are not performed for every end-state in the CET. Rather, accident sequences produced by the CET are grouped or "binned" into a limited number of release categories, each of which represents all postulated accident scenarios that would produce a similar fission product source term.

The criteria used to characterize the release are estimated magnitude of total release and the timing of the first significant release of radionuclides. The predicted source term associated with each release category, including both the timing and magnitude of the release, is determined using the results of MAAP calculations.

D.1.2.2.2 Timing of Release

Timing governs the extent of radioactive decay of short-lived radioisotopes prior to an off-site release and, therefore, has a first-order influence on immediate health effects. The release timing is characterized relative to the time at which the release begins and is measured from the time of accident initiation. The following three timing categories are used:

- Early releases (E) are CET end-states involving containment failure less than 4.0 hours from declaration of a General Emergency (GE) for which evacuation is assumed not fully effective.
- Intermediate releases (I) are CET end-states involving containment failure greater than or equal to 4.0 hours, but less than 24 hours from declaration of a GE, for which much of the offsite nuclear plant protective measures can be assured to be accomplished.
- Late releases (L) are CET end-states involving containment failure greater than or equal to 24 hours from declaration of a GE.

The time required for effective evacuation, 4 hours, is taken from a Fermi 2 specific study of evacuation timing. [D.1-15]

D.1.2.2.3 Magnitude of Release

Source term results from previous risk studies suggest that categorization of release magnitude based on cesium iodide (CsI) release fractions alone are appropriate [D.1-17]. The CsI release fraction indicates the fraction of in-vessel radionuclides escaping to the environment. (Noble gas release levels are non-informative since release of the total core inventory of noble gases is essentially complete given containment failure).

The source terms were grouped into five distinct radionuclide release categories or bins according to release magnitude as follows:

(1) High (H): A radionuclide release of sufficient magnitude to have the potential to cause early fatalities. This implies a total integrated release of > 10% of the initial core inventory of CsI.

(2) Moderate (M): A radionuclide release of sufficient magnitude to cause near-term health effects. This implies a total integrated release of between 1% and 10% of the initial core inventory of CsI.

(3) Low (L): A radionuclide release with the potential for latent health effects. This implies a total integrated release of between 0.1% and 1% of the initial core inventory of CsI.

(4) Low-Low (LL): A radionuclide release with undetectable or minor health effects. This implies a total integrated release of between 0% and 0.1% of the initial core inventory of CsI.

(5) Intact (CI) - A radionuclide release that is less than or equal to the containment design basis leakage.

Table D.1-6 summarizes the radionuclide release end state category characterizations in terms of magnitude and timing of the release. The combination of release magnitude and timing produce twelve distinct release categories for source terms. They are presented in Table D.1-7.

Table D.1-6 – Release Severity and Timing Classification Scheme Summary

Release Severity		Release Timing	
Classification Category	**CS Iodide % in Release**	**Classification Category**	**Time of Initial Release Relative to Declaration of a General Emergency**
High (H)	Greater than 10	Late (L)	Greater than 24 hours
Moderate (M)	1 to 10	Intermediate (I)	4.0 to 24 hours
Low (L)	0.1 to 1	Early (E)	Less than 4.0 hours
Low-low (LL)	Less than 0.1		
Intact (CI)	<<0.1		

Table D.1-7 – Fermi 2 Release Categories

Time of Release	Magnitude of Release			
	H	M	L	LL
E	H/E	M/E	L/E	LL/E
I	H/I	M/I	L/I	LL/I
L	H/L	M/L	L/L	LL/L

D.1.2.2.4 Mapping of Level 1 Sequences

Plant damage states (PDS) provide the interface between the Level 1 and Level 2 analyses (i.e., between core damage accident sequences and fission product release categories). In the PDS analysis, Level 1 results were grouped ("binned") according to plant characteristics that define the status of the reactor, containment, and core cooling systems at the time of core damage. This ensures that systems important to core damage in the Level 1 event trees and the dependencies between containment and other systems are handled consistently in the Level 2 analysis. A PDS therefore represents a grouping of Level 1 sequences that defines a unique set of initial conditions that are likely to yield a similar accident progression through the Level 2 CETs and the attendant challenges to containment integrity.

In the Level 1 PRA, accident sequences are postulated that lead to core damage and potentially challenge containment. The Level 1 PRA identifies discrete accident sequences that contribute to the core damage frequency and represent the spectrum of possible challenges to containment. In order for the Level 2 to be comprehensive, the Level 1 PRA must avoid prematurely truncating accident sequences (based solely on frequency) with unique characteristics that could reduce their mitigation potential in the Level 2 evaluation. Examples include: containment bypass sequences, sequences with core damage at high containment pressure, RPV rupture, and sequences with loss of AC or DC power. The binning logic described below ensures that accident sequences are not truncated prematurely.

Functional accident sequences can be defined to group similar systemic accident sequences in Level 1. The functional accident sequences relate the grouped sequences to: (a) the critical safety functions that have failed; (b) the plant conditions; and, (c) the need for information transfer to the Level 2 portion of the PRA.

The following is a list of parameters that determine the plant damage states:

- Integrity of the primary system
- Primary system pressure
- Decay heat removal
- Integrity of the containment
- Relative timing of core damage

Using the above parameters, five accident sequence classes were created. The similar accident sequences grouped within each accident class are further divided into several subclasses such that the potential for systems recovery in the short term, subsequent to a core/containment vulnerable condition, or in the long term subsequent to a core melt condition and possibly containment failure, can be modeled. This results in a total of 16 classes and subclasses of accident sequence types. Each Level 1 core damage sequence is assigned to one of these classes or subclasses (PDS) based on the definition of the accident sequence. This grouping of accident sequences is used to directly link the accident sequence fault trees to the containment event trees. This allows a direct computation of the system and operator dependencies for each sequence using the coupled fault tree logic of Level 1 and Level 2 that recognizes the status of systems and operator actions as determined in the Level 1 event trees as well as the nature of the initiating event.

The Level 1 to Level 2 "binning" logic provides the interface between the Level 1 core damage sequences and the Level 2 CETs. The logic for all sequences of an individual accident class (e.g., Class IA) are grouped under an "OR" gate and used as the input for the respective Level 2 CET. Similar "OR" gates are developed as the collection logic for other Level 1 accident classes (e.g., Class ID, IIIC, IVA). The collection logic maintains all Level 1 failure dependencies as well as the Level 1 sequence success logic such that all Level 1 dependencies are appropriately transferred to the Level 2 model quantification.

Table D.1-8 provides the definitions of the Fermi 2 functional accident sequences (i.e., PDSs) and displays the results of the binning.

Table D.1-8 – Summary of the Core Damage Frequency by Accident Sequence Subclass for Model FERMIV9

Accident Class Designator	Subclass	Definition	FermiV9 CDF (per Rx Yr)	Percent
Class I	A	Accident sequences involving loss of inventory makeup in which the reactor pressure remains high.	4.23E-07	28.1%
	B	Accident sequences involving a station blackout and loss of coolant inventory makeup. (Class IBE is defined as "Early" Station Blackout events with core damage at less than 4 hours. Class IBL is defined as "Late" Station Blackout events with core damage at greater than 4 hours.)	IBE (2.60E-09) IBL (8.17E-08)	(0.2%) (5.4%) 5.6%
	C	Accident sequences involving a loss of coolant inventory induced by an ATWS sequence with containment intact.	9.57E-08	6.4%
	D	Accident sequences involving a loss of coolant inventory makeup in which reactor pressure has been successfully reduced to 200 psi.	1.44E-07	9.6%
Class II	A	Accident sequences involving a loss of containment heat removal with the RPV initially intact; core damage; core damage induced post containment failure.	1.08E-07	7.2%
	L	Accident sequences involving a loss of containment heat removal with the RPV breached but no initial core damage; core damage induced post containment failure. (Not used)	1.59E-09	0.1%
	T	Accident sequences involving a loss of containment heat removal with the RPV initially intact; core damage induced post high containment pressure	2.46E-09	0.2%
	V	Class IIA and III except that the vent operates as designed; loss of makeup occurs at some time following vent initiation. Suppression pool saturated but intact.	1.55E-08	1.0%
Class III (LOCA)	A	Accident sequences leading to core damage conditions initiated by vessel rupture where the containment integrity is not breached in the initial time phase of the accident.	N/A	N/A

Accident Class Designator	Subclass	Definition	FermiV9 CDF (per Rx Yr)	Percent
	B	Accident sequences initiated or resulting in small or medium LOCAs for which the reactor cannot be depressurized prior to core damage occurring.	2.89E-07	19.2%
	C	Accident sequences initiated or resulting in medium or large LOCAs for which the reactor is a low pressure and no effective injection is available.	6.62E-08	4.4%
	D	Accident sequences which are initiated by a LOCA or RPV failure and for which the vapor suppression system is inadequate, challenging the containment integrity with subsequent failure of makeup systems.	1.36E-08	0.9%
Class IV (ATWS)	A	Accident sequences involving failure of adequate shutdown reactivity with the RPV initially intact; core damage induced post containment failure.	2.00E-07	13.3%
	L	Accident sequences involving a failure of adequate shutdown reactivity with the RPV initially breached (e.g. LOCA or SORV); core damage induced post containment failure.		
	T	Accident sequences involving a failure of adequate shutdown reactivity with the RPV initially intact, core damage induced post high containment pressure. (Not used)		
	V	Class IVA or IVL except that the vent operates as designed; loss of makeup occurs at some time following vent initiation. Suppression pool saturated but intact. (Not used)		
Class V	---	Unisolated LOCA outside containment.	5.93E-08	3.9%
		Total	1.50E-06	100%

D.1.2.2.5 Source Term Grouping

The approach used to evaluate radionuclide releases and develop release categories is similar to that applied in the NUREG-1150 [D.1-30] analysis. The objectives were to establish the timing of the first significant release of radionuclides and to estimate the magnitude of the total release.

The Fermi 2 Level 3 analysis requires, as an input, the frequency, type, timing and amount of fission products released to the environment during the core damage accidents postulated by the Fermi 2 Level 2 PRA analyses. In order to simplify the large number of potential release scenarios, a representative set of release fractions was chosen for each containment event tree end state along with an end state frequency.

The PDS designators listed in Table D.1-8 represent the core damage end state categories from the Level 1 analysis that are grouped together as entry conditions for the Level 2 analysis. The Level 2 accident progression for each of the PDS is evaluated using a CET to determine the appropriate release category for each Level 2 sequence. Note, however, that since not all the Level 2 sequences associated with each Level 1 plant damage state may be assigned to the same release category, there is no direct link between a specific Level 1 core damage PDS and Level 2 release category. Rather, the sum of the Level 2 end state frequencies assigned to each release category determines the overall frequency of that release category.

The end states of the containment and phenomenological event sequences may be characterized according to certain key quantitative attributes that affect offsite consequences. These attributes include two important factors:

1. Timing (e.g., early or late releases); and,
2. Total quantity of fission products released.

Therefore, the containment event tree end states represent the source term magnitude and relative timing of the radionuclide release using a discrete set of end states. The number of end state categories used in the source term characterization offers a level of discrimination similar to that included in numerous published PRAs. See Table D.1-6 and Table D.1-7.

The assignment of timing to the release bins is dependent on both the Level 1 accident sequence and the status of the CET functional events. Combining the results of the MAAP calculations, the Emergency Action Levels (EALs), and the evacuation leads to the assessment of the timing of the General Emergency (GE) declaration relative to the radionuclide release timing. This evaluation is used to characterize "early" radionuclide releases as any release initiated less than 4.0 hours following the declaration of a GE as well as assign the intermediate and late categories to CET sequences. MAAP calculations are also used to determine the magnitude of release for CET sequences. Each sequence is assigned a release magnitude category based on MAAP evaluations of the sequence or a representative surrogate MAAP case using the criteria discussed in Section D.1.2.2.3.

Appendix D of the Fermi 2 Level 2 PRA analysis [D.1-15] describes which Fermi 2 specific MAAP analyses are representative of each CET end state. It also bins each CET sequence into one of the release categories depicted in Table D.1-7.

To evaluate the Level 2 model results in a manner that provided the above information, each Level 2 CET sequence was linked to its respective CET end state (H/E, H/I, H/L, etc.). The results of the quantification of each end state are shown in Table D.1-9 [D.1-1]. Table D.1-9 summarizes the results of the CET quantification and identifies the total annual release frequency for each Level 2 release category. The information in Table D.1-9 was developed by quantifying the Level 2 model in PRAQuant. The results differ slightly from those listed in Table 3-11 of the Fermi 2 Level 1 and 2 PRA Quantification and Summary Notebook [D.1-1]. Release Category M/E is lower by 3.14E-09/yr in the PRAQuant results. This is because the 3.14E-09/yr frequency was added to M/E to address an issue with under counting of Class II contribution. Release Category M/E is approximately eight percent of the release frequency (excluding Intact) and inclusion of the added frequency would increase that total by only 0.5%. Since the M/E category is not expected to be a major contributor to risk and this correction is relatively small, it is not included in the SAMA analysis. The frequency for Release Category H/L in Table D.1-9 below is also lower than the value in Table 3-11 of the PRA Quantification and Summary Notebook [D.1-1] by 1.8E-11/yr. It was concluded that the value in the Summary Notebook is an error as quantification of the H/L gate results in the value listed below. In any case, this difference is also considered inconsequential because of the overall low contribution of the H/L category (~0.03); therefore, it is not specifically addressed.

To support the SAMA analysis, a MAAP case is generally identified as a representative case for each of the Fermi 2 Level 2 PRA release categories. For use in the SAMA analysis, the High Early (LERF) category was divided into two bins (one for containment isolation, and one without). Due to the small release category contributions from the three categories, the number of release category bins was reduced to eleven. Category M/L was subsumed into M/I; category L/L was subsumed into L/I; and category LL/L was subsumed into LL/I. The resulting release category bins are provided in Table D.1-10.

Table D.1-9 – Summary of Containment Event Tree Quantification

Release Category (Magnitude/Timing)	Release Frequency (Per Rx-yr)
H/E	3.73E-07
H/I	7.20E-08
H/L	2.46E-10
M/E	6.17E-08
M/I	3.71E-08
M/L	0.00E+00
L/E	4.36E-08
L/I	5.46E-08
L/L	0.00E-00
LL/E	5.02E-10
LL/I	7.75E-08
LL/L	5.08E-12
Intact (CI)	7.83E-07

Table D.1-10 – Summary of Release Category Bins

Release Category (Magnitude/Timing)	Description	Release Frequency (Per Rx-yr)(1)
H/E-BOC(2)	High Magnitude/Early Release (Accident Class V, Unisolated LOCA Outside Containment)	5.928E-08
H/E	High Magnitude/Early Release (With Containment Isolation)	3.132E-07
H/I	High Magnitude/Intermediate Release	7.201E-08
H/L	High Magnitude/Late Release	2.461E-10
M/E	Moderate Magnitude/Early Release	6.169E-08
M/I	Moderate Magnitude/Intermediate Release	3.714E-08
L/E	Low Magnitude/Early Release	4.357E-08
L/I	Low Magnitude/Intermediate Release	5.462E-08
LL/E	Low-Low Magnitude/Early Release	5.016E-10
LL/I	Low-Low Magnitude/Intermediate Release	7.754E-08
Intact (CI)	Containment Intact	7.833E-07

(1) Values use four significant figures to maintain consistency within the SAMA analysis. These values are from PRAQuant results.
(2) Frequency based on the contribution from Break Outside of Containment and Interfacing System LOCA initiators contribution to the overall H/E (LERF) release category.

D.1.2.2.6 Consequence Analysis Source Terms

MAAP 4.0.7 provides releases for 12 radioisotope groups as shown in Table D.1-11. MACCS2 uses nine radioisotope groups as shown in Table D.1-12. The 12 MAAP groups were mapped to the nine MACCS2 groups as shown in Table D.1-13. The results of the MAAP release analysis for each release category are provided in Table D.1-15 [Table 3.2-4, D.1-31].

Source term release fractions and other release data are based on plant specific MAAP data. The plume release height is estimated as one half of the Reactor Building height, consistent with NEI 05-01 guidance [D.1-20]. The Reactor Building roof elevation of 738'6' and the grade elevation of 583' provide a maximum height of 155.5 feet [D.1-31]. One half of this distance is 77.8 feet, which equates to 23.7 meters. Buoyant plume rise is modeled assuming a thermal plume heat content of 1.0E+7 watts for all releases except intact containment (where zero heat content is assumed). A value of 1.0E+7 watts bounds typical values of NUREG/CR-4551 [D.1-21], the supporting documentation for the NUREG-1150 study. This information is provided in Table D.1-14.

Table D.1-11 – MAAP 4.0.7 Radioisotope Groupings

Group #	Description
1	Noble (Xe, Kr) and Inert aerosols
2	CsI, RbI
3	TeO_2
4	SrO
5	MoO_2, RuO_2, TcO_2
6	CsOH, RbOH
7	BaO
8	La_2O_3, Pr_2O_3, Nd_2O_3, Sm_2O_3, Y_2O_3, ZrO_2, NbO_2
9	CeO_2, NpO_2, PuO_2
10	Sb
11	Te_2
12	UO_2

Table D.1-12 – MACCS2 Radioisotope Groupings

Group #	Description
1	Xe, Kr
2	I
3	Cs, Rb
4	Te, Sb
5	Sr
6	Ru, Co, Mo, Tc, Rh
7	La, Y, Zr, Nb, Pr, Nd, Am, Cm
8	Ce, Np, Pu
9	Ba

Table D.1-13 – MAAP 4.0.7 TO MACCS2 Radioisotope Binning

MACCS2 Group #	MAAP Group #
1	1
2	2
3	6
4	3, 10, 11
5	4
6	5
7	8
8	9, 12
9	7

Table D.1-14 – Timing, Heat and Height Release Characteristics

Release Category	Alarm (s)	Plume Delay (s)	Duration (s)	Plume Heat (MW)	Release Height (m)
H/E-BOC	1,800	1,800	7,200	10	23.7
H/E	1,800	5,400	27,000	10	23.7
H/I	17,280	41,400	25,200	10	23.7
H/L	1,800	122,400	36,000	10	23.7
M/E	1,800	3,600	18,000	10	23.7
M/I	1,800	36,000	36,000	10	23.7
L/E	1,800	13,500	11,700	10	23.7
L/I	1,800	35,640	36,000	10	23.7
LL/E	1,800	36,000(1)	5,400	10	23.7
LL/I	1,800	96,300(2)	36,000	10	23.7
CI	1,800	64,800	36,000	0	23.7

Table D.1-14 Notes:

1. There were no representative "early" cases for the low-low magnitude releases. Therefore the case with the quickest release of all low-low magnitude cases following a GE declaration was chosen to represent the LL/E category.
2. This case was chosen to represent the LL/I category even though the plume delay timing is greater than 24 hours, since it was judged to be most representative of the release category.

Table D.1-15 – Release Category Radioisotope Release Fractions [(1)]

Release Category	Xe/Kr	I	Cs	Te	Sr	Ru	La	Ce	Ba
H/E-BOC	9.90E-01	3.40E-01	2.40E-01	5.30E-01	2.60E-02	3.10E-01	1.70E-03	9.70E-03	8.70E-02
H/E	1.00E+00	2.40E-01	3.10E-01	2.90E-01	1.50E-02	1.40E-03	1.10E-03	1.20E-02	6.40E-03
H/I	1.00E+00	3.20E-01	8.40E-01	9.20E-01	1.00E-02	5.10E-05	1.60E-04	3.40E-03	4.30E-03
H/L	5.50E-01	3.40E-01	6.20E-02	2.60E-01	9.20E-03	1.70E-01	7.60E-04	4.10E-03	3.10E-02
M/E	1.00E+00	2.60E-02	4.10E-02	3.00E-02	1.60E-03	1.40E-04	1.40E-04	1.30E-03	6.90E-04
M/I	1.00E+00	1.50E-02	1.50E-02	1.30E-01	1.90E-02	4.30E-07	3.10E-04	7.80E-03	8.20E-03
L/E	8.40E-01	1.50E-03	9.20E-04	7.70E-04	6.40E-07	1.90E-05	1.70E-08	1.80E-07	3.20E-06
L/I	1.00E+00	1.00E-02	4.60E-02	4.10E-02	1.50E-03	1.10E-08	1.60E-05	4.30E-04	6.20E-04
LL/E	8.50E-01	3.50E-07	2.10E-06	5.60E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LL/I	5.40E-01	2.40E-05	6.70E-04	5.60E-04	9.80E-09	8.30E-09	9.50E-10	5.10E-09	4.60E-09
CI	4.00E-07	1.50E-06	1.90E-07	6.80E-07	6.00E-10	1.30E-11	3.30E-11	4.00E-10	3.00E-10

(1) The release fractions are from Table 3-12 of Reference D.1-31. The values from the referenced table have been summed into one plume for use in the Level 3 analysis.

D.1.3 IPEEE Analysis

The Fermi 2 IPEEE analysis was submitted to the NRC on March 29, 1996 [D.1-22]. It was supplemented by responses to NRC requests for additional information on April 2, 1998 [D.1-26] and July 22, 1999 [D.1-27].

D.1.3.1 Seismic Analysis

Fermi 2 performed a Seismic Margins Assessment (SMA) following the IPEEE guidance of NUREG-1407 [D.1-18] and the seismic margins methodology of EPRI NP-6041-SL [D.1-19]. The SMA approach is a deterministic and conservative evaluation that does not calculate risk on a probabilistic basis. Seismic design margins were based on a conservatively severe earthquake referred to as the Review Level Earthquake (RLE) with a median ground spectrum anchored at 0.3g maximum ground acceleration. Therefore, its results should not be compared directly with the best-estimate internal events results.

The conclusions of the Fermi 2 IPEEE seismic margin analysis are as follows:

> "With the completion of the identified plant modifications and corrective maintenance activities discussed below, all outliers identified during the seismic evaluation and walkdowns are shown to have adequate capability to withstand the prescribed Review Level Earthquake without degradation of the components or pertinent systems. As a result, this study has demonstrated, by using the above-described methodology, that the plant seismic HCLPF at Fermi 2 is equal to or greater than 0.3g. While no significant seismic vulnerabilities were identified, there were several observations made and insights gained that led to corrective action and planned plant improvements.
>
> As a result of the seismic evaluation, the seismic review team (SRT) found that plant equipment is securely mounted and in compliance with the design configuration drawings. However, for some components, minor deviations were noted which mostly involved missing or damaged mounting hardware. These deviations were addressed by initiating maintenance work requests (WR) to correct the anomalies....Several plant improvements were identified. Four are modest hardware changes. Two involve additional training. These plant improvements are summarized below:
>
> - Several adjacent panels containing relays are not bolted together. These panels are located in the relay room, switchgear rooms, and RHR Division 2 switchgear rooms. Banging of these panels during a seismic event may cause contact chatter in sensitive relays mounted in the panels. Provisions for fastening these panels together have been made and are scheduled for implementation by the end of the 1996 fall refueling outage (RF05). The design is documented in an approved Engineering Design Package (EDP-27108) and tracked through DER 94-0644.
> - Four low-ruggedness relays used in the emergency diesel generator voltage sensing circuits are to be replaced upon selection of a suitable replacement. This planned change is documented in Technical Service Request (TSR 27566) and tracked through DER 95-0104

- The anchorage for a large non-safety related air dryer tank on the second floor of the reactor building is not robust. Since there are safe shutdown path components in the vicinity, installation of additional seismic restraints will be evaluated. This potential change is documented in TSR 28195 and tracked through DER 94-0644.
- A weakness in the seismic load path was identified for two large CCHV AC instrumentation panels on the fifth floor of the auxiliary building. DER 96-0289 was initiated to treat the resolution of this issue and the implementation of any necessary improvements.
- A large fraction of the mounting hardware deficiencies found were believed to be associated with maintenance activities rather than original installations. Therefore, additional training will be incorporated in the continuing maintenance training program to increase the awareness level and emphasize the importance of mounting hardware installation and restoration during and after maintenance activities. Training is planned for completion by the second quarter of 1996. This training activity is being initiated through a Training Work Request.
- Operations training does not include a loss of off-site power and permanent loss of CTG 11 Unit 1 (CTG 11-1) scenario as may result from a severe seismic event. Current simulator training assumes CTG 11-1 is restorable within the first 30 to 60 minutes after a loss of offsite power. Also, during a severe seismic event, it is expected that many spurious alarms could be received in the control room due to low seismic ruggedness relay chatter. Although this may not have a direct effect on safe plant shutdown, it may cause some confusion in the control room. These two features will be included in the seismic simulator training event to be incorporated into the operator training program by the end of 1996. This training activity is being initiated through a Training Work Request."

All of the above items have been addressed and are considered resolved [D.1-24]. This was recently confirmed as part of DTE actions to address Recommendation 2.3: Seismic Walkdowns which was included in the 50.54(f) Letter [D.1-23] that requested information related to the Fukushima Daiichi Near Term Task Force (NTTF) recommendations.

D.1.3.2 Fire Analysis

DTE performed an analysis of internal fires using the Fire Induced Vulnerability Evaluation (FIVE) [D.1-25] methodology for Fermi 2. FIVE is fundamentally a prescriptive fire PRA-based screening approach, which uses progressively more detailed phases of screening. Most of the Fermi 2 fire areas were screened in the early screening phase. The CDF of the areas that did not screen totaled 1.70E-05/yr in the original IPEEE submittal [D.1-22]. As a result of a response to a NRC request for additional information the total CDF increased to 2.15E-05/yr [D.1-27]. Table D.1-16 provides a summary of the final phase of screening results from the Fermi 2 IPEEE fire analysis.

The single fire insight from the IPEEE fire analysis resulted from the evaluation of the second floor reactor building (RB06). The dominating contributors for this area are cabinets used for dedicated shutdown and whose loss would isolate the affected equipment from the main control room thereby causing loss of the equipment function. Even though the potential for this loss was considered to be adequately addressed by the current operator training, additional Fire Brigade drills in the vicinity of these cabinets were planned to increase the awareness of the brigade members to the need to quickly isolate and extinguish such cabinet fires. This training activity was tracked with a Training Work Request and was subsequently incorporated into the training program. No other changes to the physical configuration, maintenance, operating and emergency procedures, surveillance, or staffing programs were identified due to the evaluations performed for the internal fire event. No other plant improvements were identified as a result of the Fermi 2 IPEEE fire analysis.

Table D.1-16 – Fermi 2 Fire IPEEE

Fire Areas Included in Final Phase of Screening	
Significant Fire Area	**Total Compartment CDF (/yr)**
Control Room (09AB)	7.36E-06
Div. 1 Switchgear (04ABN)	4.51E-06
Relay Room (03AB)	2.77E-06
Div. 2 Switchgear (12AB)	2.54E-06
Div. I Portion Miscellaneous Room (11ABE)	1.90E-06
NE quadrant reactor building (02RBNE)	1.45E-06
Reactor Building 2nd Floor (RB06)	1.00E-06
Total	2.15E-05

D.1.3.3 Other External Hazards

The Fermi 2 IPEEE submittal, in addition to the internal fires and seismic events, examined a number of other external hazards:

- high winds and tornadoes;
- external flooding; and
- transportation, and nearby facility incidents

Fermi 2 performed the screening described in Supplement 4 to General Letter 88-20 and NUREG-1407 to address the other external hazards. Because Fermi 2 was designed prior to the 1975 Standard Review Plan (SRP) the approach taken was to review the design bases and compare them to the SRP requirements. Any changes to the plant since the design analyses were performed were also reviewed to verify compliance with SRP criteria. It was found that no vulnerabilities exist for other external events which are not within the screening thresholds of the SRP. The site review and design comparison relative to the 1975 Standard Review Plan revealed no vulnerabilities or insights relative to these other external events. This review included a screening process that assured there were no additional external events relevant to the Fermi 2 site. An issue related to the potential for a common cause failure of diesel generator cooling function due to ice formation (reported in LER 96-001) was identified during the same time frame that the IPEEE was performed. This was addressed subsequent to the IPEEE submittal. In order to prevent ice formation in service water pumps causing common mode failure of DG the following actions were taken: (1) implemented procedures to check on this condition, (2) installed permanent temperature monitoring equipment, (3) installed fiberglass curtain to reduce wind chill effects on portion of pump columns below RHR Complex slab and above reservoir water surface, and (4) modified terminations of RHR cold weather (bypass of mechanical draft cooling tower) lines to below reservoir water level to eliminate water forces on the curtain.

D.1.3.4 SAMA External Events Multiplier

Since there are not up to date quantitative external events models for Fermi 2, it is necessary to develop a multiplier that can be applied to the internal events PRA results to account for the risk contribution from external events in SAMA evaluations.

As indicated above, the Fermi 2 "other" external events were addressed by demonstrating compliance with the 1975 SRP. Compliance with the SRP and no adverse finds from walkdowns, justifies the conclusion that the hazard's contribution to CDF is less that 10^{-6} per year. Therefore, these events are not significant contributors to external event risk and since quantitative analysis of these events is not practical, the external event multiplier will be developed based on seismic and fire risk. This is consistent with the guidance of NEI 05-01 [D.1-20].

Fermi 2 used a SMA method to address seismic risk and thus no seismic core damage estimate was developed. However, there is a relatively current estimate for the seismic risk for Fermi 2 which was developed by the NRC as part of its work to address Generic Issue 199, "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern U.S. for Existing Plants." These results are provided in a safety/risk assessment that the NRC performed in 2010 for addressing GI-199 [D.1-28]. This assessment determined that the weakest link model seismic risk for Fermi 2 is 4.2E-06 per year. While this is likely a conservative estimate, it will be used to develop the external event multiplier for the SAMA evaluations.

The conclusion of the Fermi 2 FIVE analysis was that all areas were screened from further consideration and there are no fire-induced vulnerabilities associated with the continued operation of the Fermi 2. However, the core damage estimates for the areas in the final phase of screening are typically used to represent the fire risk. Table D.1-16 provides a listing of those areas and their associated CDF which totals to 2.15E-05/yr. As indicated in NEI 05-01, the EPRI FIVE methodology results are conservative and are not comparable to internal events core damage frequencies. This is especially true when considering that the original FIVE analysis used the Fermi 2 IPE as the basis for the core damage assessments used in FIVE. The IPE model has been updated many times and the current internal events CDF is 1.5E-06/Rx-yr compared to the IPE CDF of 5.7E-06/Rx-yr. This is approximately a factor of four less than original IPE CDF and it could be reasonably assumed that an update of the FIVE analysis with this model would result in a fire CDF of 5.4E-06/Rx-yr, one-fourth of the original fire CDF. This would account for updated modeling of the internal events portion of the model that was used in the FIVE analysis, but not necessarily address all of the conservatisms inherently to the FIVE methodology. Even though a larger reduction in the Fire CDF may be justifiable, the Fermi 2 fire CDF has been conservative reduced by a factor of two to 1.08E-05/Rx-yr for the SAMA analysis. This is well within the range suggested in the NEI 05-01.

Therefore, the external event multiplier for Fermi 2 is determined as follows:

EE Multiplier = (Internal Event CDF + Seismic CDF + Fire CDF)/Internal Event CDF

= (1.50E-06 + 4.2E-06 + 1.08E-05)/1.50E-06

= 11

Therefore, an external event multiplier of 11 is used for the SAMA analysis.

D.1.4 PRA Model Revisions and Peer Review Summary

A summary of the Fermi 2 PRA models CDF and LERF is presented in the table below.

Table D.1-17 – PRA Revision History

Model	Description	CDF (Per Yr)	LERF (Per Yr)	Includes Internal Flooding(2)
PLG-0676 (1989)	Original Fermi PRA	2.2E-05	NA	No
IPE (1992)	Model developed in response to NRC Generic Letter 88-20.	5.7E-06	8.0E-07	No
PSA97C (1997)	RISKMAN model which was reviewed using the NEI Peer Review process.	7.1E-06	1.2E-06	No
FermiV2 (2002)	CDF Model Converted from RISKMAN to CAFTA	5.0E-06	N/A	No
FermiV3 (2002)	Normal PRA Maintenance and CAFTA Level 2 Model developed.	3.3E-06	2.5E-07	No
FermiV4 (2003)	Model updated as part of normal PRA Maintenance.	5.8E-06	9.3E-07	Yes(3)
FermiV5 (2004)	Model updated as part of the Extended Power Uprate (EPU) evaluation (Model was not issued)(1).	N/A	N/A	Yes(3)
Fermi V6 (2004)	Model updated as part of normal PRA Maintenance.	6.1E-06	4.8E-07	Yes(3)
FermiV7 (2006)	Model updated to close all A and B NEI Peer Review F&Os which may impact MSPI results.	1.4E-05	5.5E-07	Yes(3)
Fermi V8 (2010)	Periodic update to incorporate accident sequence changes to improve MSPI margin and to address the backlog of identified issues in the modeling database.	2.3E-06	3.1E-07	Yes(3)
Fermi V9 (2013)	Complete model upgrade including Initiating Events, Success criteria, Data, System Notebooks, HRA, Internal Flood, MAAP 4.0.7 Analyses, and Level 2/LERF	1.5E-06	3.7E-07	Yes

(1) EPU was not implemented at Fermi 2.
(2) Includes Internal Flood Initiating Events.
(3) Limited scope internal flooding model based on PLG analysis.

D.1.4.1 Major Differences between the IPE Model and the PSA97C Model

The PSA model used for the IPE was later revised to reflect plant modifications made since the IPE was submitted to the NRC. These changes and other modeling enhancements were made in several incremental steps which resulted in model version PSA97C. The changes include the following [D.1-32, D.1-33, and D.1-34]:

- When the IPE was performed, most system maintenance was not routinely done during power operation. That philosophy changed and the PSA model was changed to reflect not only the physical plant, but the existing operating practices. A divisional system outage philosophy was implemented and those outages were scheduled and performed during power operation. It was anticipated that on-line outages of risk significant systems will increase in frequency and duration in the near future. To evaluate the impact on risk associated with the increased on-line maintenance, the assumptions in the PSA model dealing with maintenance were revised. These revised assumptions were intended to reflect the expected mean frequency and duration of on-line maintenance activities for the foreseeable future.
- Revised Station Air Fault Tree to reflect new rotary type air compressors and revised piping and valve configuration.
- Revised RHR Injection Valves (F015A/B and F017A/B) Maintenance Unavailability to remove over-counting.
- Revised success criteria for Nitrogen system (containment pneumatics) to consider preference for non-interruptible air over manual connection of nitrogen bottles.
- Revised modeling of maintenance to reflect plant operating experience for the CRD pumps.
- Added manual closure for T4600F407 to the hardened vent fault tree for when the division 1 non-interruptible air fails thus improving hardened vent reliability.
- Added the circulating water pumps and the flow path from the pumps through the condenser to the circulating water cooling towers to top event MC (main condenser).
- The fault tree for the RHR complex cooling towers (top events T1 and T2) was modified to included separate components for the two isolation valves on the cold weather bypass lines to the reservoir (E1150F603A/B).
- Modified the success criteria for recovery of the main condenser to include the availability of division 1 DC power.
- Modified success criteria for large LOCA to include success given injection with RHRSW or standby feedwater and failure of LPCI due to EECW failure.
- Addition of redundant trip breakers for the recirculation pump trip fault tree.
- Corrected typo in system alignment for EDGs and revised the split fractions for the EDGs.
- Revised conditional gate for General Service Water from 2 of 5 pumps to 4 of 5 pumps.

D.1.4.2 Major Differences between the PSA97C Model and the FermiV2 Model

The EOOS FermiV2 model was generated utilizing data from the RISKMAN (PSA97C) model. This data transfer included system fault trees, event tree logic, initiating event and basic event frequencies. The system fault trees were attached to top logic trees. EOOS top logic trees replace RISKMAN's event tree logic. Support system trees were linked directly to the systems they support. A conscience effort was made to minimize deviations from the RISKMAN database values to allow meaningful comparison of results. During the modeling effort several recommendations from the Peer Review were incorporated which resulted in changes to CDF results.

D.1.4.3 Major Differences between the FermiV2 Model and the FermiV3 Model

The EOOS FermiV3 model was generated utilizing data from the FermiV2 model. This data transfer included system fault trees, Level 1 core damage event tree logic. The FermiV2 model was then expanded to include Level 2 PSA logic. Also included in this model release, were updates to initiating and basic event frequencies. Fermi specific data was used to update Initiating Event frequencies, component failure frequencies, and common cause event data.

D.1.4.4 Major Differences between the FermiV3 and the FermiV4 Model

The CAFTA FermiV4 model was generated utilizing data from the FermiV2 model. This data transfer included system fault tree and Level 1 core damage top logic. The FermiV2 model was then expanded to include Level 2 PSA logic. Also included in this model release were updates to initiating and basic event frequencies. Fermi specific data was used to update Initiating Event (IE) frequencies, component failure frequencies, and common cause event data. During this update effort, several recommendations from the Peer Review were incorporated into the model.

D.1.4.5 Major Differences between the FermiV4 Model and the FermiV6 Model

The CAFTA FermiV6 model was generated utilizing data from the FermiV4 model. This data transfer included system fault tree, Level 1 core damage top logic, and Level 2 containment integrity top logic. The modeling modifications, which were made from the FermiV4 baseline model to the FermiV6 updated model, are outlined in Table D.1-18. The most significant change to the model implemented in this version was the inclusion of HRA Calculator generated basic events. During this update effort, several recommendations from the 1997 Peer Review were incorporated into the model, which together with additional modifications, resulted in changes to the Core Damage Frequency (CDF) results.

Table D.1-18 – FermiV6 PRA Changes

Item	Description	Impact
Fault Tree	Added Vacuum Breaker failure for Containment Failure during LOCA.	Negligible, but now allows quantification of risk for SDP.
	Corrected bus configuration for Maintenance Crosstie	Decrease of CDF contribution for divisional loss of offsite power.
	The Condensate success criterion was changed from 1 pump to 2 pumps. Single pump operation (Procedure 23.107) requires operator action not included in the model. Also removed RHRSW X-tie for external injection due its inadequate discharge pressure. Initiator TF65 fails Condensate which was not true in V4.	Increased TLO (core damage due to loss of injection with RPV at low pressure) CDF contribution
	Removing success of PCS when operators fail to line up a decay heat removal option.	This increased DHR contribution
	Added explicit delterming for core damage end states	Eliminates double counting of sequences for DHR and TLO endstates.
	Added credit for short term high	This reduces both the CDF and LERF

Item	Description	Impact
	pressure injection.	contribution due to TLO sequences.
Initiating Events (IE)	Updated LOSP IE frequency utilizing plant specific data	LOSP CDF contribution increased
	Divided Large LOCA IE into individual lines and separated out Medium LOCA as its own IE.	Overall reduced conservatism for both Large and Medium LOCAs.
	Added RPV Rupture, Flood initiators	Negligible CDF, but slightly increases LERF.
HRA	Updated all Pre-Initiator Human Actions	HRA CDF contribution increase is mainly due to increase of misalignment of SLCS failure rate HEAFSLCSHE100PV (4313%). HRA LERF contribution increase is due to increase of misalignment failure of the pressure permissive function HEAFRXPSEFCV (266%)
	Updated all Post-Initiator Human Actions	HRA CDF contribution increased. Increase is mainly due to increase in failure of operator to line up DHR options (HEOFPCHROL6A by 360%) and operator failure to vent HEOFHVNTHEOLA by 42%). This is offset by reduction in HE failure to depressurize (HEOFRXPCHEODK by -86%)
Recovery	Updated Power Recovery for Total Loss of Offsite Power (LOSP) to correspond to updated IE frequency	Increased CDF contribution due to increased recovery failure.
T/M Out of Service	Increased Unavailability for EECW	Negligible increase

D.1.4.6 Major Differences between the FermiV6 Model and the FermiV7 Model

The CAFTA FermiV7 model was generated utilizing data from the FermiV6 model. This data transfer included system fault tree, Level 1 core damage top logic, and Level 2 containment integrity top logic. The modeling modifications, which were made from the FermiV6 baseline model to the FermiV7 updated model, are outlined in Table D.1-19. The most significant change to the model implemented in this version was the inclusion of HRA Dependent Action basic events. During this update effort, several recommendations from the NEI 1997 Peer Review were incorporated into the model, which together with additional modifications, resulted in changes to the Core Damage Frequency (CDF) results.

Table D.1-19 – FermiV7 PRA Changes

Item	Description	Impact
Fault Tree	Added LOP1 and LOP2 initiator tree	Negligible impact due to tree changes
	Removed all Main condenser recovery for initiators that isolate the condenser	Negligible impact on DHR contribution

Item	Description	Impact
	Added Black Start DG with 11-2,11-3, and 11- 4 CTGs	This reduced both the CDF (65%) and LERF (41%) contribution due to SBO sequences.
	Added credit for short term high pressure injection for CTG.	This reduces both the CDF and LERF contribution due to TLO sequences.
Initiating Events (IE)	Updated LOSP (LOSP, LOP1, LOP2) IE frequencies utilizing a series of reports (EPRI NUREG/CR-5496 etc) which were screened and categorized for applicability to Fermi2.	CDF contribution decreased for LOSP (50%), LOP1 (24%) while CDF contribution increased for LOP2 (408%).
	Updated Vessel Rupture (%XL) frequency	Negligible impact
	Split LOP 1 and LOP2 initiating events into switchyard centered (LOP1_SC and LOP1_SC) and other (LOP1_OTH and LOP2_OTH) events	Impact reflected in IE frequency and recovery impact.
HRA	Included results from the Post-Initiator Human Action Dependency analysis	HRA CDF contribution increased mainly due to inclusion of dependent HRA events (HEOFHVNTHEOLX, HEOFRXPCHEODX etc)
	Added HRA for failing to control level during an ATWS	Increased ATWS contribution by 93%
	Refined the HPCI 3 cycle model. This involved increasing failure frequency of the operator to control HPCI for two additional cycles	Slight increase in RAW importance for systems used to mitigate THI (core damage due to loss of injection with the RPV at high pressure).
Recovery	Updated Power Recovery for Total Loss of Offsite Power (LOSP) to correspond to updated IE frequency	Increased conditional CDF for LOSP (129%).
	Split LOP 1 and LOP2 power recovery into corresponding (switchyard centered and other) contributions	Increased conditional CDF for LOP2 (1020%) and LOP1 (16%)
T/M Out of Service	No Change	N/A

D.1.4.7 Major Differences between the FermiV7 Model and the FermiV8 Model

The CAFTA FermiV8 model was generated utilizing data from the FermiV7 model. This data transfer included system fault tree, Level 1 core damage top logic, and Level 2 containment integrity top logic. The modeling modifications, which were made from the FermiV7 baseline model to the FermiV8 updated model, are outlined in Table D.1-20. The FermiV8 model release resulted in changes to the Core Damage Frequency (CDF) and associated importance measure results.

Table D.1-20 – FermiV8 PRA Changes

Item	Description	Impact
Fault Tree	Added credit for post-containment failure SBFW injection as core damage mitigation in certain scenarios. Note that credit for filling of the CST via the fire protection header per the EDM procedures was added to support this logic.	Reduced DHR percentage contribution to core damage. Reduced overall core damage frequency. Reduced importance of RHR system and associated support systems.
	Reworked depressurization logic (emergency depressurization only with SRVs, early depressurization only with TBVs, and stuck open SRVs result in successful injection with early high pressure system injection success. This logic change was worked in conjunction with removing credit for long-term HPCI depressurizing the RPV.	Increased the percentage contribution to CDF from TLO sequences.
	Time-phased HPCI and RCIC run failures (now separated into 4 hour and 24 hour mission times).	Reduced the significance of HPCI and RCIC "failure to run" events. Reduced the significance of LOSP scenarios (note that this was offset by other modeling changes).
	Changed the model logic to sequence the TLO end stated before the DHR end state.	Reassigned core damage sequences involving the loss of NPSH on ECCS pumps from DHR to TLO core damage end state. Increased the TLO contribution to LERF
Initiating Events (IE)	Updated loss of offsite power (LOSP, LOP1, and LOP2) IE frequencies and associated non-recovery probabilities.	CDF contribution from short term loss of power scenarios increased, while the contribution from long term loss of power scenarios decreased.
	Made the Inadvertent Scram (%RX) initiator susceptible to ATWS.	Increased the contribution of the ATWSA core damage end state (note that this was offset by other modeling changes).
HRA	Incorporated numerous changes to HRA basic event values based upon re-analysis emanating from 2007 and 2010 Component Design Basis Inspections (CDBIs).	In general, these changes tended to increase the CDF. This increase was offset by other modeling modifications.
	Added credit for the intra-divisional crossties for the 480V RHR Complex ESF busses.	Reduced the importance of EDGs which support EESW pumps in the normal electrical alignment.
	Removed credit for 4kV intra-divisional crossties.	Increased the importance of EDGs supporting their associated 4KV ESF busses. Increased the importance of the 4kV inter-divisional crosstie.
	Removed credit for 1 hour operation of blackstart diesel for CTGs 11-2, 11-3, and 11-4.	Increased importance of CTG 11-1. Increased the significance of LOSP initiators.

Item	Description	Impact
Mutually Exclusive	Significantly expanded the mutually exclusive event file to exclude many non-representative maintenance configurations.	Significantly lowered the overall CDF. Reduced significance of maintenance unavailability terms.
Data Analysis	Changed the maintenance unavailability terms to those in the MSPI basis document for planned unavailability.	Significantly lowered the overall CDF and the DHR end state contribution to CDF.
	Changed common cause SRV "failure to open" data to current industry standard.	Lowered the THI end state contribution to CDF.
	Changed RPS mechanical and electrical "failure to scram" data to align with current accepted industry benchmark values.	Lowered the value of the CDF emanating from the ATWS end state.

D.1.4.8 Major Differences between the FermiV8 Model and the FermiV9 Model

The FermiV9 model was the result of a complete model upgrade. Major changes incorporated into the model include the following: model, success criteria, thermal hydraulic analysis, data, plus changes associated with plant modifications, procedure changes, and analysis changes. The following specifics are incorporated:

- Bayesian updated initiating event frequencies utilizing the most recent Fermi 2 operating experience.
- Revised component failure data including extensive use of plant-specific component failure data gathered from the Fermi 2 MSPI and Maintenance Rule programs.
- Individual component random failure probabilities were Bayesian updated (as applicable) based upon the most recent plant specific data and the most current generic data sources.
- Common cause failure (CCF) calculations revised to incorporate the updated individual random basic event probabilities and the most up to date Alpha Factor parameters from NUREG/CR-5497 and NUREG/CR-5485 on the NRC website derived from the latest INEEL update.
- Maintenance unavailability data based on the most recent Fermi 2 operating experience.
- HRA re-assessment based on operating crew interviews using the latest EOPs and support procedures plus insights from simulator observations.
- PRA re-assessment based on enhanced thermal hydraulic calculations (e.g., time available to emergency depressurize the RPV).
- Use of MAAP 4.0.7 deterministic calculations to support the success criteria and HRA calculations (i.e., cues and time available for actions).
- Other open item comments from the model change database which captures and collects model input for enhancements and discrepancy resolution for the periodic updates.
- Update of the Fermi 2 evacuation study and Emergency Action Levels (EALs) for use in evaluating offsite consequence categories (i.e., LERF).

- Revised containment vent valve power supplies and their backups.
- Revised mitigation capability during total Loss of 130 VDC events.
- Revised credit for operator action to control containment vent evolution (i.e., control containment pressure within narrow band).
- Incorporated the latest realistic room cooling calculations.
- Conversion of the RISKMAN-based CAFTA Level 2 to an upgraded CAFTA Level 2 model (based on first principles).
- An extensive re-evaluation of the Internal Flooding Analysis was performed that included initiators, accident sequences, spray effects, HRA, and consequential failures.
- Internal Flood initiators are recalculated using updated pipe break frequencies from the latest EPRI analysis report on flooding initiators.
- Internal flood accident reanalysis was completed identifying new flood areas and associated propagation paths.
- Extreme Damage Mitigation Guidance (EDMG) for local SRV control and local venting are included with minimal quantitative credit.
- Incorporation of changes for findings from the 2012 PRA Peer Review.

The decrease in the CDF risk metric from previous estimates is primarily due to incorporation of the following changes in the PRA model:

- Reductions in the transient initiating event frequencies based on incorporation of recent generic and Fermi 2 operating experience.
- Update of maintenance unavailability probabilities.
- Improved success criteria using MAAP 4.0.7.
- Update of component failure data and common-cause failure (CCF) data. The evaluation of random and common cause data using plant specific and NRC updated data resulted in lower common cause failure probabilities. Specifically, the updated common cause failure probabilities using the latest NRC/INEL Common-cause failure database are lower than those used previously.
- Update of pre-initiator and post-initiator HEPs to latest values.
- Update of Level 1 and Level 2 dependent HEPs.

D.1.4.9 PRA Model Peer Review

Regulatory Guide (RG) 1.174, Section 2.2.3, states that the quality of a PRA analysis used to support an application is measured in terms of its appropriateness with respect to scope, level of detail, and technical acceptability, and that these are to be commensurate with the application for which it is intended.

The Fermi 2 BWROG PRA Peer Review was performed in August 2012 consistent with the RG 1.200 (Rev. 2) and NEI PRA Peer Review Process Guidance. The purpose of this review was to provide a method for establishing the technical adequacy of the PRA for the spectrum of potential risk-informed plant licensing applications for which the PRA may be used. The 2012 Fermi 2 PRA Peer Review was a full-scope review of the Technical Elements of the internal events and flooding, at-power PRA. The full scope Level 2 was also reviewed. The insights from the review findings have been incorporated into Version 9 of the Fermi 2 PRA model.

The ASME PRA Standard has 325 individual SRs and the Fermi 2 Peer Review considered all of them since it was a full-scope review. Of the 314 of the 325 ASME PRA Standard SRs that were applicable to Fermi 2, 97% are supportive of Capability Category II or greater. Of the 100 unique Facts and Observations (F&Os) generated by the Peer Review Team, 28 were considered peer review Findings and 68 were Suggestions. There were also four Best Practices cited.

Each of the findings in the Peer Review report was examined and a plan for addressing each was developed. In developing resolution to each finding, an attempt was made to utilize the recommended resolutions of the Peer Review Team to the greatest extent practical (realizing that in some instances a more appropriate resolution was developed by DTE to address the issue). The following is a summary of the Peer Review findings following the resolution effort. It should be noted that the large majority of the findings were closed.

Several findings were related to the methodology employed by DTE in performing the HRA dependency analysis. The findings are the result of a difference in professional opinion (between the Peer Review Team and the DTE PRA Team) surrounding the appropriateness of the HRA dependency methodology which was utilized. Although the methodology employed was not considered an industry standard method by the Peer Review Team, a review of the quantitative results by an Expert Panel (composed of personnel from two non-affiliated PRA consulting firms and members of the DTE PRA staff) prior to the Peer Review concluded that the quantification results (including HRA dependency groupings) were representative of the as-built, as-operated plant and were reasonable with respect to similar plants. Based upon this quantification analysis, findings related to the HRA dependency analysis are deemed to not significantly affect risk informed applications including the SAMA analysis for license renewal.

Summaries of the findings and their resolution are provided in Table D.1-21.

Table D.1-21 – Fermi 2 PRA Peer Review Findings

Item No. /Status	Finding	Resolution
1-2 / Closed	For loss of two DC buses (Section 3.5.5.2), a 0.5 recovery factor is applied based on NUREG-0666 recommendations (a 1981 study), as well as the overall IE frequency and other semi-qualitative adjustments to the frequency based on differences in system design. Per this SR, recovery actions must be justified (e.g., reference to plant procedures or training), but the IE notebook does not provide justification that the recovery factor used is representative of Fermi response.	Latest available data in the industry is used in the development of this initiating event. The method and value evaluated were shown to be appropriate per comparison with other plant's PRAs. Credit for recovery was conservatively removed from the consideration for the event, thus removing the concern regarding this issue raised in the finding. It should be noted that the recovery factor was never actually applied to the initiator in the model, so no modeling or initiating event value change was necessary to resolve this finding. The value for the initiator (%TDCAB) was adjusted per the response to Finding 4-5.
1-20 / Closed	It was noted that qualitative screening has been employed at the component level for the AC system. For instance "on low voltage the auto throwover switch will reposition and power 72S from 72R breaker 1B. This is not explicitly modeled in the PRA and therefore is modeled as an inherent success'. The justification for the screening was not built on quantitative analysis; It is based on engineering judgment. The screening will not affect this SR since the bus failure doesn't affect more than one system, but should be evaluated against SY-A15.	Basic event ATOPB72SS024 and type code ATOP were added to the model and associated database to represent the auto-transfer of the Bus 72S feed from Bus 72M to Bus 72R.
1-22 / Addressed(1)	The current approach of using a single such event that is applied to most post-initiator and recovery HFEs, using a single joint probability, while probably generally conservative, may introduce non-conservatisms in specific cases. The probabilities of the events included in the HE1D-D-OPERATOR event range from the E-2 range down to the E-4 range. A cutset containing only two E-2 HFEs would be underestimated by the 1E-6 global value. Additional sensitivity studies should be performed. The Uncertainty notebook includes a sensitivity study with all HEPs increased to the 95 percentile, which results in a factor of 3 increase in CDF. However, the assigned error factor for HE1D-D-OPERATOR is set to 10, which may understate its uncertainty.	A special sensitivity analysis was developed for confirmation of this resolution and for use in future model updates and applications. The review of the cutsets from the sensitivity analysis confirms that the use of the global HEP, HE1D-D-OPERATOR, properly engenders the dependency for combinations of HEPs that are only loosely dependent. This approach avoids an overly conservative bias, but ensures that the model quantitatively reflects combinations of actions that may have a dependence. Based on the cutset review, it was judged that the Fermi HEP Dependency modeling is reasonable, realistic, and accurately addresses plant design and operation.
1-23 / Addressed(1)	Dependency amongst post-initiator HEPs and recovery HEPs is discussed in Section 5 and Appendix D of the HRA notebook (EF2-PRA-004).	"Lesser" combinations of events, as loosely defined by the Fermi PRA Peer Review team, are those comprised of two elements. Such combinations are discussed in Appendix D of the HRA Notebook. The method used applies a

Item No. /Status	Finding	Resolution
	It is not clear whether lesser combinations of events were considered when developing the dependent HFEs. For example, if a dependent event was defined based on three or four independent events, this dependent event would also be applied to combinations of two events. In that case, the joint probability assigned could be too low for that specific combination.	Dependent HEP once a second dependent human action failure has occurred in a cutset. Thus, once the operators have failed in a dependent case, all other dependent actions in the cutset are taken as failed. Thus, failure of two human actions forms the foundation of the dependent HEP modeling. No method of dependent HEP modeling can address all possible combinations of events; combinations are simply too numerous. Thus, the Fermi approach is to identify the dominant HEP combinations and assure their treatment was included in the model. In order to accomplish this, dependent HEPs are developed based on accident sequence modeling. This approach utilizes knowledge of the plant, operator response actions (See Simulator Observations and Operator Interviews in HRA Notebook Appendix E and F, respectively), and model structure to identify groups of actions with common procedures, timing, location, and cognitive challenges. Dependency groups for ATWS, SBO, Loss of Injection, Internal Flooding and others are developed to be integral to the model and address timing, sequential ordering, and cognitive challenges in a realistic manner. In order to verify a reasonable level of completeness in the HEP groups developed from Accident Sequence and model review and to reduce the possibility of any important modeling oversights, the model is calculated with all HEPs set to 0.1 or higher and then the HRA Calculator is used to identify HEPs which occur in various combinations. These combinations are rank-ordered by dependency importance and these rank ordered combinations are reviewed for inclusion in the model. The review defined combinations based on importance to the model. Thus, it may very well be that two or three element combinations are treated with some optimism in the model. However, based on the combination screening in the PRA, these are not important to results. In order to further verify this, all HEPs were set to 0.1 and the final Fermi model was rerun as a sensitivity. This yielded a CDF of 6.84E-4/yr. The HRA calculator was then used to identify the combinations of HEPs that occur in resulting cutsets. Relative to the "lesser" combinations issue, combinations with an independent probability of 1E-3 to 1E-6 were identified and explicitly reviewed. Combinations with a probability greater than 1E-3 are not expected to be impacted by dependency issues as constituents already have a high failure probability. Combinations less than 1E-6 are adequately addressed by the dependent HEP groups included in the model. Since these range from 1E-5 to 5E-7, combinations less than 1E-6 would fall into these groups.

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		Table DC-1 attached in the markup of the lists those "lesser" HEP combinations that have been reviewed in more detail. The last column of this table provides a discussion of each combination. During this review, as expected, some combinations were identified as optimistically treated. As mentioned above, all combinations cannot be addressed and some unimportant combinations are left to be handled solely by their independent values. Table DC-2 lists those combinations. As can be seen from the Risk Achievement (RA) and Dependency Importance (DI) columns of Table DC-2, these combinations have a very small importance. In order to verify this conclusion, another sensitivity was performed. The dependent groups included in Table DC-2 are modeled with a QRECOVER recovery file which is designed to explicitly add these cases to results; see Figure DC-1. The draft base model quantified (at the time of addressing this finding) at a truncation of 1E-12/yr yields a CDF of 1.5366E-6/yr. With the additional "lesser" combinations added explicitly to the model as a sensitivity, CDF rises to 1.5367E-6/yr. This is a difference of 1E-10/yr (0.0065%). This demonstrates that the dependent modeling of the HRA Calculator identified important groups is appropriate and any optimism in the HEP dependency treatment is negligible.
1-25 / Closed	Appendix D.3.3 of the HR notebook (EF2-PRA-004) discusses the evaluation of internal flood impacts on HFEs. Various HFEs credited in the internal events model are assumed to be failed during certain flood scenarios. A spot check of the model confirms that these HFEs would not be credited in the applicable flood scenarios. An evaluation was also performed, as documented in Table D.3-2, to confirm that the various flood isolation HFEs added to the model would not be impacted by the floods for which they are credited. One event, HE1FRHRSRHRRMFL, was determined to be impacted by the flood and was set to 1.0 in the model. It was noted that several events in Table 5-3 were not evaluated in Appendix D.3.3. One of these events was determined by DTE to be potentially impacted by the flood event the action was intended to isolate.	Three HFEs were inadvertently not included in Table D.3-2. • HE1FGSWTRBMFL terminates a major GSW line impacting the Turbine Building. This flood can be terminated by shutting down the GSW pumps from the MCR. This is a documentation issue. • HE1FCSWTRBMFL terminates a major CW line rupture impacting the Turbine building. This flood can be terminated by shutting down the CW pumps from the MCR. This is a documentation issue. • HE1FRBCW-FL-ISOL-AB3 terminates a nominal flood of EECW in the Auxiliary Building 3rd floor Division 2 switchgear room (A3B10) or in the DC switchgear room (B20). Credited actions all occur in the MCR, but there is the potential for water accumulation in one or both of these rooms to fail power to the valves required to isolate the flood. To address this finding in the model the value for this HEP was set to 1.0 in the model; the impact of this HFE being set to 1.0 is less than a 2% increase in CDF The basic event HE1FRBCW-FL-ISOL-AB3 was added to the model as a 1.0 HEP.
1-26 / Closed	As noted in section 2.2.9.1 of EF2-PRA-012, maintenance-	Supporting requirement IFEV-A7 is considered to be met because generic

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	induced floods were not included on the basis of the fact that only a few minor floods occurred over the past few years. However, past history has shown that significant floods can occur due to maintenance errors, especially on large volume systems such as circulating water, fire protection, condensate, etc. Historical data (as tabulated in Appendix H) confirms the existence of such events, although none have recently occurred. The Fermi internal flooding PRA should consider maintenance-induced flood events on at least the large water volume systems.	data was considered in the evaluation (as revised by the information presented in the resolution to this finding). The evaluation is complete and has been added to the internal flood analysis under the discussion of maintenance induced floods. The large Circ Water failure flooding the Turbine Building is increased by 1E-3/Rx Yr to reflect this calculated maintenance induced failure frequency.
1-30 / Closed	Fermi 2 notebook EF2-PRA-012, section B.3, discusses screening criteria H. Criteria H provides for screening flood sources provided the flood source produces a CDF less than 1E-10/ry. SR IFSN A-15 and A-16 are the only SRs that provide for screening of flood sources. The basis for screening flood sources per criteria H does not meet the requirements of these SRs.	Revisions were made to the Section C.4 of the Internal Flooding Notebook to discuss the Standard screening guidance and provide a basis for using 1E-10/yr to screen individual flood sources in an area. In addition, Section B.3 was revised to reference the discussion provided in Section C.4.
2-16 / Addressed(1)	It was noted that an HEP dependency analysis was performed. However, in Section 5.3.2.2 of Fermi 2 HRA Notebook (EF2-PRA-004), it is stated that the chronological sequencing of HEPs is not used as a criterion in the dependency quantification. SR HR-G7 indicates however that the dependency analysis must account for the influence of success or failure in preceding human actions and system performance on the human event under consideration. Therefore the order in which the operator is presented with opportunities in an accident sequence is important and must be considered. Although it was stated that the chronology of the events is not known with precision when modeling groups of events, which is the approach taken by the Fermi HRA analysis, the order in which the HFEs occur in any one cut set or scenario should be apparent. Any alternative approaches used that vary from industry standards must be documented and studies performed to demonstrate the appropriateness of the approach used.	Deleted the words in Section 5.3.2.2 of the HRA Notebook that indicates chronology of the HEPs is not used as a criterion. Replaced this with a discussion which justifies the treatment of chronological HEP dependence in BWR PRAs.
3-14 / Closed	This F&O presents isolated instances of errors noted during the DA review. These are tabulated here for tracking. MVFORSWIF073 and 75 inappropriately are set to calc method 2, which is making their probability half what they should be.	The cited changes in the database are included as suggested in the PRA model, technical basis, and documentation.

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	Doing a spot check of data in the RR file, it was noted that the CS pump basic events (MPFSCSS1C001A and C) are using the MPFS type codes, while they should be using MPFS_RHCS. The same is seen for the RHR pumps. The SLC pump BEs MPFSSLCSC001A and B use type code MPFS, but per the Data Notebook, EF2-PRA-010, Table C.2-3, they should be MPFS_SLCS. Other BEs reviewed use the proper type code. It appears to be an issue for the type codes separated into FTR >1hr and FTS/run up to 1 hour. In Table C.2-3, the calculation of the TPFS_HPRI Fermi alpha and beta values (when the FTS and FTR for the 1st hour were combined) is incorrect. The values in the table (3.42 and 5.931E+5) yield a mean of 5.77E-6, while they should yield a mean of 9.52E-3 (before Bayesian updating). Basic event VVFOSRVS5OF15 is not calculated correctly in the Data Notebook, EF2-PRA-010, Appendix G, Section G.21. The independent failure in the calculation is raised to the third power instead of the 5th power for this calculation. The basic event probability for VVFOSRVS5OF15 needs recalculated and incorporated into the model and the documentation.	
3-15 / Closed	There was no formal examination of the Bayesian posterior values for reasonableness. Therefore, this SR is not met. (DA-D4)	The discussion is inserted into the Data Notebook describing the review of the data posteriors after the Bayesian update. It should be noted that a reasonability check was performed as part of the review of the Component Data analysis prior to the Peer Review; however, there was nothing in the documentation stating that this reasonability check had been performed.
3-18 / Closed	Success Criteria (EF2-PRA-003) Section 2.4 describes mission time minimum of 24 hours and appropriate SSC individual mission times, with a lesser time for some components (e.g., batteries and diesels during a LOOP or SBO). Additional evaluation is conducted by extending the T/H analyses where safe and stable is not met at 24 hrs. as documented in Level 1 and Level 2 MAAP Thermal Hydraulic Calculations (EF2-PRA-007). However, for sequences that go beyond 24 hours, the SR requires additional evaluation or modeling of an extended mission time. An example of such a scenario is a LOCA with failure of containment heat removal but success of long term makeup (OK end state in the event tree). The Fermi PRA does not document an evaluation of these sequences. The PRA	Additional discussion of the impact of extending mission for decay heat removal which provided justification for not extending decay heat removal pump mission time was added to the mission time discussion in the Success Criteria Notebook.

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	team stated that such sequences would be dominated by the containment failure event (DW-SHELL-RUPT=0.09), but this is only applied to the sequences with venting failed. The venting successful sequences require further analysis or modeling.	
3-26 / Closed	Per Section 7.1.8 of the system notebooks, common cause failures of check valves and circuit breakers were screened due to low probability. Circuit breaker independent FTO is 2.55E-3/demand per PRA-010 Table D-2, and its 2/2 alpha factor is 3.68E-2 (in the 2010 NRC CCF factors; not certain what it was in the 2007 factors used in the Fermi PRA). Together, this yields a 2/2 CCF of 9.38E-5, which is much higher than other failures in electrical systems. Check valve CCF is slightly more than 2 orders of magnitude lower in CCF probability than MOV failures, but less than 2 orders below pump CCFs. Therefore, it is not appropriate to screen check valve CCF unless there are MOVs (or other high CCF failures) in the system. Of particular concern with check valves is if there are any injection pathways to the reactor shared by multiple systems in which the shared lines only have check valves. CCF modeling of such check valves would be important. The Fermi PRA team found that one such instance is the shared HPCI/ RCIC/SBFW/ condensate injection line, where a 2/2 check valve failure (B2100F010 A/B) would fail the injection from all four systems.	Per Section 7.1.8 of the system notebooks, common cause failures of check valves and circuit breakers were screened due to low probability. Circuit breaker independent FTO is 2.55E-3/demand per PRA-010 Table D-2, and its 2/2 alpha factor is 3.68E-2 (in the 2010 NRC CCF factors; not certain what it was in the 2007 factors used in the Fermi PRA). Together, this yields a 2/2 CCF of 9.38E-5, which is much higher than other failures in electrical systems. Check valve CCF is slightly more than 2 orders of magnitude lower in CCF probability than MOV failures, but less than 2 orders below pump CCFs. Therefore, it is not appropriate to screen check valve CCF unless there are MOVs (or other high CCF failures) in the system. Of particular concern with check valves is if there are any injection pathways to the reactor shared by multiple systems in which the shared lines only have check valves. CCF modeling of such check valves would be important. The Fermi PRA team found that one such instance is the shared HPCI/ RCIC/SBFW/ condensate injection line, where a 2/2 check valve failure (B2100F010 A/B) would fail the injection from all four systems.
3-28 / Closed	It was noted that for the evaluation of the group of HEPs in Section D.3.2.3 of the Fermi 2 HRA Notebook (EF2-PRA-004), the use of the event HEIFRXPCHSML (a steam LOCA) to represent cutsets in which HEIFRXPCHWML (a water LOCA) was non-conservative. The steam LOCA HEP is 1.0E-3, compared to 4.6E-2 for the water LOCA.	This is a single error identified by the PRA Peer Review Team relative to the HEP dependency treatment. It does not represent a systematic error and does not rise to the level of a Finding. Nevertheless, the PRA model and all documentation related to the variation in the HEP for depressurization for medium water and medium steam LOCAs are modified to make sure that the differences in HEP are properly reflected. This includes the dependency HEPs.
3-30 / Addressed[(1)]	The Level 2 HEP dependency analysis was documented in Section D.6 of the HRA notebook (PRA-004). A simple discussion of each Level 2 HEP is provided, and the potential for any of them to have dependency with any other Level 1 or Level 2 HEPs is qualitatively dismissed. The statement is made 'Entry into the emergency plan, even if the ERO is not yet staffed, would provide an additional diverse context for these actions.' In some instances, the basis for zero dependency is stated as 'High independent failure probability,	The PRA Peer Review Team issued a finding based on the perception that Level 2 HEP dependencies were not assessed. Section D.6 of the HRA Notebook provides a summary of the evaluation of dependency regarding Level 2 HEPs. Also, such Level 1-Level 2 cases were assigned, at a minimum, to the HE1D-D-OPERATOR dependent group to assure that any potential optimism related to cutset combinations was controlled and minimized. This process included a sensitivity assessment which involved setting Level 2 HEPs to 0.1 or higher and evaluating their importance at this

Item No. /Status	Finding	Resolution
	no dependent HEP treatment required.' One such event, HE2FADSLDEPRES (FV=1.03E-1 according to Table D.6-1) has an HEP of 0.21. While this is indeed a high HEP, it (and the other HEPs) have the potential to have a dependency value as high as 1.0 if assessed against the other HEPs (Level 1 and Level 2) depending on sequence-specific timing and accident progression. To meet the full intent of the SR, a detailed dependency analysis is required with the same rigor required for the Level 1.	arbitrarily high value. Generally, Level 2 HEPs have a high failure probability such that adding dependent groups leads to an overly conservative bias in the results. One HEP, HE2FADSLDEPRES "Operator fails depressurization function (Level 2)" stands out as a potential candidate for dependent treatment, as suggested by the peer review team. This HEP has a value of 0.21 and the existing documentation indicates that it is obvious that additional modeling is not required because of the already high conditional dependent failure probability. In particular, the HRA notebook dispositioned dependency for this HEP in Table D.6-1: "High independent failure probability, no dependent HEP treatment required." This comment should be enhanced to point out that the HEP was modeled as conditionally dependent on failure to depressurize action in the Level 1 model. Additionally, there is a great deal of time and additional cues involved in the Level 2 action such that a low or zero dependency would apply with other HEPs. Since the HEP is 0.21 and this is greater than the nominal Medium dependency value (i.e., MD=0.14) and any additional dependency modeling would be overly conservative. The LERF model was also quantified with all HEPs set to at minimum value of 0.1 as a sensitivity. The cutsets were then imported to HRA Calculator for identification of HEPs which occur in common cutsets. This sensitivity did identify the need to consider dependent events for the Level 2 HFEs.
3-35 / Closed	The 13 unscreened containment isolation pathways are summarized in Table 5-2 of the EF2-PSA-005-15 notebook. However, only 8 of the unscreened pathways are modeled in a fault tree, as seen under CAFTA gate IS1. The first 5 in the table are not modeled in the fault tree.	The containment isolation fault tree was updated to incorporate the identified failure modes.
4-5 / Closed	1) The Loss of a DC bus frequency given in NUREG/CR-6928 is given as 1.17E-3/Reactor Critical Years. The table in section 3.5.5.1 lists the frequency as 'Frequency (per Reactor year),' while it should be 'Frequency (Per Reactor Critical Year).' The treatment in sections 3.5.5.2 and 3.5.5.3 correctly describes the frequency as per reactor critical years, however in Table 4.1-1, the frequencies calculated in sections 3.5.5.2 and 3.5.5.3 are listed under the Frequency/calendar year column. The frequencies in the fermi.rr database are based on the	The frequencies calculated in Sections 3.5.5.2 and 3.5.5.3 correctly report the frequencies values and units (per reactor critical year). Table 4.1-1 had placed the frequencies in the wrong column. Table 4.1-1, Table 4.1-2 and Table G-1 should be corrected, as well as the RR database. In addition, the units in section 3.5.5.1 are edited to cite the units as per critical year. The %DC-BOP initiating event frequency needs to be increased to account for the Two DC Buses. Section 3.5.5.2 and Table 4.1-1 are made consistent.

Item No. /Status	Finding	Resolution
	Frequency/calendar year column, and since the Fermi 2 model multiples every cutset with a basic event for the power factor (1--SYAVAILFAC---), an incorrect value is used for the loss of DC Bus initiators, %TDCAB and %TDC-BOP. NOTE: The 1.40E-6 calculated in 3.5.5.2 does not match the 1.46E-6 in Table 4.1-1. 2) The frequency for the loss of a Balance of Plant (BOP) DC bus is based on the generic frequency for the loss of a DC bus. Since there are two BOP busses and either one could cause a plant trip, the frequency should be doubled in calculating the %TDC-BOP frequency.	The two DC BOP Buses are assigned the same impact within the model: TBVs Fails Closed FW Control Fails
4-8 / Closed	No justification has been provided for the conditional probability of 0.1 that operators prevent a SCRAM given a loss of AC Busses 64B, 64C, or 65E (%BS64B, %BS64C, and %BS65E).	The value of 0.1 is not a recovery action included to prevent an initiator from occurring. The following information was added to the Initiating Events Report. An evaluation of three AC buses 64B, 64C, and 65E indicated that their failure will not result in an initiating event. This was confirmed by use of the Fermi 2 simulator. Due to the effects of the loss of these buses, the loss of some mitigating equipment that the respective buses feed, and the potential for a latent single failure to exist, each is included as a special initiator. It is considered prudent to quantitatively include in the PRA the possibility that a latent failure or maintenance unavailability in conjunction with each of these bus failures could lead to an initiating event. Therefore, the bus failure rate was multiplied by the conditional probability that a latent failure or maintenance unavailability also existed at the time of the bus failure. The conditional probability of the random failure of additional equipment can be approximated to be between an additional random failure (or latent failure) or a common cause conditional failure probability, i.e., 1E-3 to 0.05, respectively. Therefore, the choice of 0.1 is conservative even relative to the upper bound estimate. The 0.1 conditional probability is derived from a conservative estimate that the other steam tunnel cooler is unavailable due to maintenance or fails before the bus is restored (for 64B and 65E). For Bus 64C, it is a conservative estimate that the plant will scram if operator actions are not successful in preventing conditions from further degrading following the conditions created by the loss of the bus (a loss of RRMG set cooling to RRMG Set A, a RR scoop tube lockout, and an MSIV trip logic “half isolation”).

Item No. /Status	Finding	Resolution
		Due to the conservative determination of the conditional probability, no sensitivity analyses were performed on this probability.
4-9 / Closed	To address item SR IE-A7 (a), section 2.4 and Appendix I include industry Operating Experience summaries that include some low power and shutdown events, but may not include all events that occurred at Fermi (e.g., if they were not significant enough to warrant inclusion in industry databases.) Appendix J also considers some shutdown events for at-power applicability, but this appendix is based on generic industry initiator lists and does not consider Fermi-specific experience. While operations and system engineer interviews that were performed for the SY and HR notebook development tasks asked about potential initiators, the responses are probably limited to only those systems modeled in the PRA and those initiators that may be related to the specific operator actions being investigated. While the above items provide some review of the items required by this SR, these interviews/reviews were conducted for different purposes than this SR addresses. Hence, the requirements for this SR are only partially met.	To address the question with this finding regarding plant-specific initiators in shutdown (or during low power operation) that are applicable to power operation, a search was performed for such events at Fermi. Based upon this search, an event during low power operation (see LER 2007-002) was analyzed and conservatively included as a plant-specific turbine trip event in the Bayesian update process for the Turbine Trip (%TX) initiator. The IE frequency for this initiator was adjusted based upon this information (a very minor change in the mean value occurred). Documentation changes were incorporated into the IE Notebook.
4-11 / Closed	Table 2-1 of the Accident Sequences Notebook specifies that Containment Temperature Control is addressed qualitatively. Sections 3 through 34 give the event trees which gives each of the accident sequences. However, there are some SBO sequences that would prevent potentially valid core damage sequences from appearing in the results. For example, in sequences SBO-007 and SBO-009, the final event tree node, INJECTION POST CONTAINMENT CHALLENGE (QUV) calls functional fault trees with top gates T-ZZ-VNT-NL and T-ZZ-FAIL-NL, respectively. These gates are NAND gates that include any failure of a diesel or CTG on the NOT side of the gate, which prevents the gates from being TRUE, since the event tree is for a station blackout with guaranteed diesel and CTG failures.	The ability to examine BOP and ECCS systems for RPV injection and heat removal after offsite AC power is restored requires that care be taken to avoid double counting of failures that may exist on other sequences. This is addressed by using failure branch logic that includes the fact that sequences with diesel failures do not show up in both the LOSP event tree and the SBO event tree. The primary use of the NL gates is in the LOSP event tree. There, the NL gates allow the LOSP event tree sequences to calculate sequences that have equipment or operator failures that lead to core damage if AC power is available, but one or more diesels or CTGs have failed. This is where the NL gates are required to assure that only the equipment or operator error failures propagate to core damage cutsets since offsite AC power is restored. In other words, cutsets with diesel or CTG failures in them are no longer contributors to a CDF end state once offsite AC power is restored. The use of the NL gates in the SBO event tree is to ensure that operator actions in cutsets that fail all EDGs and CTGs will be properly processed

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		through the SBO accident sequences. The comment is correct for core damage Sequences SBO-007 and SBO-009 (it should be noted that all other instances of use of NL logic in the SBO tree are correct). All of the sequences in the SBO tree with NL gates will disallow cutsets with any EDG/CTG failed. This could be also represented by a pass through to a success end state (i.e., no cutsets). It was chosen in the Fermi 2 PRA to use NL gates. This modeling approach is appropriate because any cutsets involving equipment or operator failures late in the SBO event tree sequences would be considered duplicate or non-minimal compared to similar cutsets quantified as part of the LOSP event tree sequences. For SBO-007 and SBO-009, DTE agrees that the gates currently used for TDV and QUV should not be NL gates (they are changed in response to this finding). SBO-007 and SBO-009 contributions to CDF are 0.0 because "T-LP-PORT" is guaranteed to fail. Because "T-LP-PORT" is guaranteed to fail, these changes will not affect the quantification. The event tree model is modified as recommended (as discussed above) by the Peer Review Team and documented in the Accident Sequence Notebook to eliminate the inappropriate placement of NL logic.
4-12 / Closed	Appendix A of the Accident Sequences Notebook, EF2-PRA-002, describes the analysis for a potential water hammer event given an ECCS system in test return/suppression pool cooling mode during a Loss of Offsite Power initiating event (or consequential LOSP event). The system is postulated to drain down while the test return valve is open prior to power being available from an EDG to close it. As it is modeled in the fault tree (e.g. under gate RHRA-WH) operator action is credited to prevent the system from restarting, unless the initiator was a LOCA (and consequential LOSP). However, the modeling does not take into account the probability that operator action is successful in restoring the system to enable its use in mitigating the accident. Assumption 5 in section A.3 credit for the waterleg pump refilling the system is not taken unless operators take action to fill and vent the system. There is no	An operator action HE1FRHRSFILLVENT has been added to the HRA calculator and the fault tree model and to account for the operators performing a fill and vent. The securing of the RHR pumps and the precluding of pump restart before a fill and vent is complete is subsumed by this in the above HEP. Credit is not taken for the fill and vent in the event of a LOSP and coincident LOCA, since there is an automatic action to start the system in that case; failure of the RHR system in the event of a water hammer is based upon phenomenological probabilities. In addition to modeling the failure probability per the finding, the model was revised to account for the fact that non-ESF power is necessary to power the keep-fill system for RHR to perform the fill and vent evolution. Therefore, for total LOSP scenarios, credit for the fill and vent is precluded if offsite power is not recovered within four hours.

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	HEP for the operators failing to fill and vent the affected system in the model.	Several other changes to the model and associated documentation were made to align the modeling, documentation , and plant design and operation; these include: Accounting for the fact that either division of RHR can be in torus cooling. Conservatively not crediting the fill and vent of RHR for manual LPCI injection mode (since LPCI may be necessary in certain scenarios to preclude core damage before the fill and vent is completed). Correcting the nomenclature in the gate naming to account for the Fermi Divisional / Train configuration for RHR.
4-16 / Closed	Section 4.6 of the Quantification Notebook, EF2-PRA-013, provides a comparison of CDF and accident class to other BWR plants. However, this comparison fails to explain why the CDF at Fermi 2 is less than or equal to half the CDF of all of the other plants. In addition, there is no breakdown of how the various initiators compare to the other plants such as turbine trip, loss of condenser, etc. that could be used to explain where the major reductions in CDF at Fermi come from and why they are appropriate.	The Quantification Notebook was revised to reference the comparison of the results from a similar plant included in the Uncertainty Analysis Notebook and to explicitly discuss the significant differences.
4-21 / Closed	Section 2.2.5 of the Internal Flood Analysis Notebook, EF2-PRA-012, credits the analysis done in the UFSAR to justify not assessing component damage from missiles, pipe whip, and the jet force of fluid discharge for safety-related systems, but does not address the effect of those events on non-safety systems. Section B.2.1 states that the effects of humidity, condensation, temperature, pipe whip, and jet impingement on equipment operability are assessed to be non-significant impacts based on section 2.2. Since the quoted section of the UFSAR did not address humidity, condensation, or temperature and did not consider jet impingement or pipe whip for non-safety systems, the basis for neglecting the effects does not appear to be valid.	The mechanisms were assessed qualitatively and were found not to contribute to the Reactor Building flooding events because of the equipment qualification program at DTE. The Auxiliary Building internal flooding scenarios (with the exception of those emanating from the RBCCW Room, which is considered to be part of the Turbine Building for the purpose of this discussion and these emanating from the HPCI/CRD Pump Room which are considered to be part of the Reactor Building for the purpose of this discussion) involve low pressure, low temperature systems that do not pose challenges to other systems due to pipe whip, jet impingement, or high humidity. Therefore, these considerations are not relevant for scenarios in that building. For equipment in the Turbine Building, the conservative assessment is included to assume failure of all equipment in the building given a failure associated with the specified mechanisms.
4-22 / Closed	In Section 2.2.7 of the Internal Flood Analysis Notebook, EF2-PRA-012, and Section 7.3.2.2.9 of the UFSAR is referenced to state that MOVs outside the containment have weatherproof	The treatment of MOVs and other components with respect to spray in the internal flood model includes several layers of investigation: • Walkdown evaluation

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	type enclosures. Section 7.3.2 of the UFSAR covers the Containment and Reactor Vessel Isolation Control System (CRVICS), and the sub-section 7.3.2.2.9 is discussing CRVICS valves. The statement in the UFSAR is not a global statement about all MOVs in the plant. In the Internal Flood Walkdown Summary Notebook, EF2-PRA-011, picture 251 shows an MOV in the plant that does not appear to be inside a weatherproof enclosure. The rationale for screening MOVs from spray effects does not appear to be valid. Picture 248 in the IF Walkdown Notebook shows two AOV and SOVs which also do not appear to be protected from spray.	• Use of design and deterministic criteria for Reactor Building Equipment • Comparison of the design, installation, and maintenance treatment of safety related and non-safety related, PRA credited valves in the Reactor Building Conservative treatment of MOVs in Turbine Building These are discussed as follows: 1. The safety related valves located in the Reactor Building are qualified for HELB conditions and are therefore considered robust in their ability to survive spray effects. 2. SSCs are assumed failed if the SSC is submerged. For the assessment of spray impacts on SSCs, the primary emphasis is on electrical equipment that could cause failures of multiple pieces of equipment. EPRI in "Guidelines for Performance of Internal Flooding Probabilistic Risk Assessment", 1019194, December 2009 indicates the following with respect to water spray effects: • Water spray is assumed to fail electrical equipment such as switchgear and motor control centers (MCCs), unless protected by suitably installed shields. The evaluation should differentiate between moderate-energy piping systems (maximum operating pressure less than 275 psig) and high-energy piping systems. For Fermi, the switchgear and MCCs are explicitly evaluated for spray effects. This is documented in Appendix B.5 where it is stated that the EPRI guidelines for internal flooding analysis are followed which require the examination of spray effects on switchgear and MCCs. 3. The valves that are cited in the proposed finding are: • Picture 251: There are no spray sources that can affect this valve. Rupture failure of GSW fails all mitigation equipment in the Turbine Building. • Picture 248: The two AOVs and SOVs are BOP hotwell makeup valves. As pointed out, these valves are assumed to be failed for all floods in the Turbine Building. Therefore, no credit is attached to these for flood scenarios and as can be seen no other systems are present such that spray from another system can simultaneously fail these valves and an additional mitigation system. 4. The Fermi MOV/AOV Valve Engineer examined the Internal Flooding

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		Walkdown documentation with respect to the valves (including SOVs) identified in the pictures discussed in this finding and also regarding non-safety related, PRA-credited valves. It was noted that the valves in the pictures were very similar to valves throughout the plant, including safety related valves, in terms of spray resistance. It was also his judgment (based upon information in the response to Finding 4-21 and Table 4.21-1) that, since safety related and non-safety related, PRA-credited valves in the plant are similar in design, installation, and maintenance treatment (see Table 4-21.1), the two classes of valves would perform similarly during spray events. Based on the DTE implementation of the EPRI Internal Flood Guidelines that require a search for spray effects on MCCs and switchgear and the information presented here regarding spray effects on valves, the SR IFSN-A7 is met.
4-23 / Closed	In Appendix B, Section B.4 of the Internal Flood Analysis Notebook, EF2-PRA-012, each flood area is listed with the propagation paths to other flood areas in Area Propagation section. Examples of potential propagation paths through drain lines, doors, stairways, HVAC ducting, hatches, and failures of doors were provided. However, it appears that backflow through drain lines with failed check valves was not considered. The only section in the documentation that explicitly discusses the back flow through check valves in drain lines appears in Section 2.2.12.	The wording in Section 2.2.12 of the Internal Flooding Notebook provides a good foundation for the resolution of the finding. The following wording has been inserted into that section to close out this issue. In addition, there are several other considerations that are relevant regarding the possibility and likelihood of backflow through check valves. 1. Check valves that are "in the flood initiating system's process flow" and can result in mitigation of the event if they close as designed to prevent backflow were analyzed as part of the screening, initiating event, and accident sequence analysis. 2. The check valves in the drainage system are associated with sump pump discharge. 3. In turbine building scenarios, no credit is taken for the drainage system; therefore, any postulated backflow returning water to the turbine building would merely result in damage to equipment that has already been postulated as failing in the turbine building flooding scenarios. 4. The check valves in the Reactor Building drainage system are associated with the sump discharge piping from the sub-basement "quads" to the Radwaste Building. A sump pump start signal is automatically initiated when the level in the sump is high. If the pump starts successfully, then the check valve failure and reverse flow is rendered moot, since the discharge pressure of the sump pump can overcome the elevation head (and other pressure losses) downstream of the pump discharge. 5. Failure of a check valve to close (1.04E-4) combined with a failure of the sump pump (1.07E-3) to start results in a combined failure probability (1.11E-

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		7) that is sufficiently low to justify screening from the analysis when one considers a representative flooding frequency for an area of 1.0E-3/yr and a bounding CCDP of 0.1, the flooding scenario frequency (1.11E-11/yr) screens via SR IFQU-A3. 6. In most potential scenarios, backflow through the discharge check valves coupled with failure of the sump pumps merely results in submergence of equipment that has already been postulated to fail in the scenario. 7. Per drawing M-5710-2, there is a potential for reverse flow from the Floor Drain Collector Tank (Radwaste Building) to multiple sumps in certain scenarios if multiple check valves isolating various sumps open and then fail to reclose during a scenario. This scenario is considered to be significant based upon the argument presented in Item #5 above. Common cause check valve failure probability is lower than the single failure probability and given the presence of the SBFW system (which is located outside the reactor building) to mitigate RB flooding events, it is unlikely that a CCDP of above 0.1 would exist for any postulated scenario. Added discussion above to the Internal Flooding Notebook that describes the method by which backflow was addressed.
4-24 / Closed	Fermi 2 PRA notebook EF2-PRA-012, Table B.2-4, identifies the capacity of the source, the pressure and temperature, and pump flow rate (if any) for each flooding source. Table B.4-X provides a characterization of the breach for each flood source. However, it appears that the maximum flow rates for the systems may be non-conservative. The flow rates chosen for major floods are based on the nominal pump capacity at the normal discharge rate. In some cases, this may be appropriate, such as a break from a RCIC discharge line downstream of the flow sensor, since the pump speed is regulated to produce 600 gpm. In other cases, such as Fire Protection System, this is not true, and pump runout capacity with two pumps in parallel would be more appropriate.	EPRI in "Guidelines for Performance of Internal Flooding Probabilistic Risk Assessment", 1019194, December 2009 has provided an estimate that can be used to characterize major floods by system type and pipe size. Attached Table 4-24-1 provides the comparison of the Fermi major flood rates with the EPRI characterizations. The PRA is a realistic assessment of the risk. Unnecessary conservative bias is not beneficial to a realistic assessment. The representative flow rates primarily affect the crew response time to terminate the flood. Realism in the calculation of crew response requires that realistic assessments of the spectrum of consequences are used. The times used are considered appropriate and realistic. Based on the comparison with the EPRI Internal Flood guidelines (for which consideration of runout flow is implicit) all of the major flood characterizations used for Fermi are equal to or greater than the EPRI characterization except for the following: • FPS (5,000 gpm vs. 7,000 gpm) • RHRSW (11,000 gpm vs. 16,000 gpm) These differences are not judged to be significant and are considered more

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		appropriate for the realistic evaluation of major flooding rather than introducing significant conservative bias and potentially masking the real contributors to risk by inappropriately using very large flow rates. These differences are also not judged to be significant based upon the assessment of credited flood isolation human actions shown below. A review of the flood scenario screening process was performed and, since screening human action values were not utilized as part of the quantitative screening process, there were no instances where using a higher representative flow value for a scenario would impact the screening decision. Similarly, for flooding sources that were qualitatively screened based upon highly reliable human actions to isolate the flood, there were no instances where a higher representative flow value for a major flood would impact the conclusion; it should be noted that there are few instances of screening of flooding scenarios/sources based upon this criteria. An assessment was performed with respect to the flooding scenarios for which human action to isolate the flood is credited. Since minor flooding (spray events) and nominal flooding scenarios are not impacted by increased flow due to pump runout conditions (the flow rates for nominal flooding are usually set to a reasonable midpoint value between the cutoff flow rates for spray events and major flooding), the only scenarios that were examined in detail were those for major flooding. There were 14 human actions which are credited in the model as mitigating major floods in the Fermi model. The assessment of those actions is shown in Table 4-24-2. The overall conclusion of this analysis is that there would be insignificant quantifiable impact in using more conservative flow rates (bounding the runout flow) for the major flooding scenarios in question. Wording was added to the internal flooding notebook to clarify the consideration of runout flow in the current model and associated documentation, as well as stating the requirement for new or revised flooding scenarios that runout flow be considered when selecting a representative flow rate for a scenario. The preponderance of the flood flow rate treatment is consistent with the EPRI Guidelines and represents a realistic evaluation of the flood sources and discharge flow rates. An examination of the human action basic events which use the representative flow rates for timing information revealed that there would be insignificant quantifiable impact in using more conservative flow rates (bounding the runout flow) for the major flooding scenarios in question.

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5-7 / Closed	Human Reliability Analysis (EF2-PRA-004) Section 3.13 was reviewed and determined not to meet the intent of this SR. Section 3.13 of the HRA notebook simply reviews Fermi 2 human performance indicators and attempts to draw a correlation to this SR. Table 5-4 does not provide a means to evaluate HFEs given the scenario context of an accident sequence. A review of Table 5-4 did not reveal that a comparison for reasonableness was made at the time of the analysis. The intent of this standard is to assess the HFEs relative to each other, i.e., for all of the HFEs that fall within a specific range, is the expected failure rate of the operators considered reasonable? For example, are all of the events that have a 1E-1 probability considered more difficult than the HFEs that have probabilities in the 1E-2 range. Similarly all of the HFE's that have probabilities on the 1E-3 range should be generally considered to have the same level of difficulties compared to the ones in the 1E-2 range.	A comparison of the HFEs is provided to assess the reasonableness of the HEPs. The HEPs are ranked by their HEP value. Then a comparison is made of all of the HEPs within a single decade. This comparison shows that the HEPs are consistently assessed quantitatively with respect to each other. Finally, the HEPs from one decade are compared with HEPs of other decades to verify that they are indeed of a significantly different character such that it justifies their different quantification. This tabular comparison and the resulting insights provide an additional reasonableness check as requested by the PRA Peer Review Team.
6-1 / Closed	PSA-WI-008 (Paragraph 8 and section 8.7, page 13 and 16) includes the consideration to assess the impact of an individual change on risk application. However, there was no identified process that requires the assessment of the cumulative impact of pending changes in the performance of risk application. It is noted, however, that a Common Development Model is maintained current with all plant changes. However, there is no procedural requirement to keep this model current, and a requirement to issue the Common Development Model as the updated model when the cumulative changes reach a trigger point.	Added the following wording to the PSA Group Work Instruction for model configuration control (PSA-WI-008) to address assessing the impact to risk applications of changes made to the development model. The cumulative impact of the pending changes in the Common Development model shall also be assessed (if the Work Request has quantitative impact) by the reviewer (in consultation with the evaluator of the WR). This impact shall be assessed with respect to the criteria below: a) ≥25% change in Baseline CDF or LERF. b) ΔCDF ≥ 1E-5/yr. c) ΔLERF ≥ 1E-6/yr. d) ΔCDF or ΔLERF causes entry into Region I of Figure 3 or Figure 4, respectively, of Regulatory Guide 1.174, Revision 1. e) A significant shift in the Accident Class Contribution (≥ factor of 2 increase in the % contribution of an accident class that already contributes at least 5% of CDF). f) Significant changes in Basic Event Importances (e.g. RAW or FV) that affect risk informed applications (for example a change that could result in a change in risk significance classification for a system function in the Maintenance Rule). The list of risk informed applications to be

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		considered is contained in Section 10.3. It should be noted that "consideration" of an application impact does not necessarily imply an explicit quantification of the impact; the impact may be assessed in a qualitative or "quasi-quantitative" manner. The evaluation technique used is based upon the discretion of the WR evaluator and reviewer. There is no requirement to document this interim evaluation of cumulative model impact. g) Significant, based on RAW and/or FV, change to the Zero Maintenance Model that would affect online maintenance risk assessment colors for equipment outages. Based upon the assessment of cumulative model change impact by the WR reviewer, the Supervisor RXE/PSA shall determine (based upon engineering judgment) if a version release should be immediately be performed (per Section 10). The following is a list of items that should be considered when making this decision: a) Conservatism that may be inherent in the model changes that have been submitted to date and saved in the Common Development Model (a decision may be made to perform additional analysis to remove some of the conservatism). b) The potential impact of WRs that will be addressed in the immediate future (for example, if a modification was made to the Common Development Model that resulted in raising the Loss of Offsite Power initiating event frequency and a WR will be addressed in the immediate future that lowers the offsite power non-recovery probability, the net result may be a negligible quantitative impact). c) The impact of the impacted risk-informed application(s) which are affected by the results [for changes that are not indicated by an "absolute" threshold, i.e. Criteria a) through e) above]. If it is determined that a version release is required, the process for doing so outlined in Sections 9 and 10 shall be performed. It should be noted that the cumulative risk impact assessment described above is not required during the course of a PRA Upgrade.
7-1 / Closed	Notebook EF2-PRA-012, sections 2.2.11, 2.2.12, and Appendix H (page H-19) discuss an MOV in the drain line between the HPCI Room and the RHR Div II Room sump that isolates automatically on high-high sump level. Per item 6 in	This propagation path has been added to the PRA model. The implementation in the logic model includes basic event MVFCSUMPT4500F601, which represents the failure to isolate the flow path from the HPCI to the Division 2 RHR Room. Gate B72ENORM_TF65 was added to the model to represent

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	Table 3-1 of the uncertainty notebook (EF2-PRA-019, Rev. 1), this automatic isolation is judged highly reliable and failure of the MOV to isolate is not explicitly modeled and is also judged to not be a source of model uncertainty. However, exclusion of this failure does not meet the requirements of SR SY-A14 and SR SY-A15.	the power dependence of the valve while eliminating circular logic issues; this represents a slight conservative treatment since it only credits offsite power support for Bus 72E. Gate RHR2-HPCI-ISOL, RHR2FLOOD-HPCI, and HPCIFLOOD-RHR2 were added to implement the propagation of flooding from the Division 2 RHR Pump Room to the HPCI Room and from the HPCI Room to the Division 2 RHR Pump Room. It should be noted that there is a conservative bias in the PRA model for Reactor/Auxiliary Building sub-basement flood propagation. The treatment of this isolation failure between the HPCI Room and the Division 2 RHR Pump Room extends this treatment and is deemed consistent with the current modeling approach.

(1) HRA dependency related finding.

D.1.4.10 PRA Maintenance and Update

The Fermi 2 PRA process ensures that the PRA models adequately reflect the as-built and as-operated plant configurations. This process is defined in procedure PSA-WI-008, "PSA Model Maintenance and Configuration Control." The procedure defines the process for implementing regularly scheduled and interim PRA model updates, for tracking issues identified as potentially affecting the PRA models (e.g., due to changes in the plant, errors or limitations identified in the model, industry operational experience), and for controlling the model and associated computer files. Various information sources are monitored on an ongoing basis to identify changes or new information that will affect the model, model assumptions, or quantification. Information sources include:

- Plant modifications,
- Operating experience,
- Technical Specification changes,
- Maintenance Rule changes,
- Engineering calculation revisions,
- Procedure changes, and
- Industry studies,

PRA updates are generally completed at least once every other fuel cycle or sooner if estimated cumulative impact of plant configuration changes exceeds an established thresholds for percentage change in CDF, LERF or any of the following risk metrics.

- $\geq$ 25% change in Baseline CDF or LERF.
- Δ CDF $\geq$ 1E-5/yr.
- Δ LERF $\geq$ 1E-6/yr.
- ΔCDF or ΔLERF causes entry into Region I of Figure 3 or Figure 4, respectively, of Regulatory Guide 1.174, Revision 1.
- A significant shift in the Accident Class Contribution (factor of 2 increase in the % contribution of an accident class that already contributes at least 5% of CDF).
- Significant changes in Basic Event Importances (e.g. RAW or FV) that affect risk informed applications (for example a change that could result in a change in risk significance classification for a system function in the Maintenance Rule).
- Significant, based on RAW and/or FV, change to the Zero Maintenance Model that would affect online maintenance risk assessment colors for equipment outages

Changes in PRA inputs or discovery of new information are evaluated to determine whether such information warrants a PRA update. Items exceeding one or more of the thresholds are tracked in the Corrective Action Program.

Potential and/or implemented plant configuration changes that do not meet the threshold for immediate update are tracked in the DTE Work Tracking Database. The database is a resource and working tool used by the Fermi 2 PRA Group. This database has been fully integrated into the PRA Group's work instructions and work practices. The database has robust query and report capability for tracking open items and model history. The database table structure and associated forms are designed to effectively track issues associated with the PRA models, processes, and applications from initiation to completion.

The procedure includes requirements for an independent review of PRA model updates. Individual work products (such as, a system notebook) are reviewed and checked by a second qualified PRA analyst after preparation. That is followed by review and approval by the PRA supervisor. Items specifically included in the review prior to a model release are the affected fault trees, updated data, event trees, revised system notebooks, top 100 core damage sequences/cutsets, top 20 detailed core damage sequence/cutset descriptions and importance calculations. In addition, a random sampling of final cutsets making up the low frequency contributors to CDF are investigated to assess whether such sequences exhibit any anomalies and whether they are both reasonable and have physical meaning within the PRA context. A comparison of updated results to the previous model is also performed to identify unexpected changes which must be addressed and resolved.

Requirements for PRA documentation and control of model files are also addressed in the procedure. PRA models are required to be documented in a manner that facilitates peer review as well as future updates and applications by describing the processes that were used and providing details of the assumptions made and their bases documentation, and any other supporting computer evaluations.

D.1.5 The WinMACCS Model – Level 3 Analysis

D.1.5.1 Introduction

SAMA evaluation relies on Level 3 PRA results to measure the effects of potential plant modifications. A Level 3 PRA model using Version 3.7.0 of Windows interface for MACCS2, MELCOR Accident Consequence Code (WinMACCS) was created for Fermi 2. This model which requires detailed site-specific meteorological, population, and economic data, estimates the consequences in terms of population dose and offsite economic cost. Risks in terms of population dose risk (PDR) and offsite economic cost risk (OECR) were also estimated in this analysis. Risk is defined as the product of consequence and frequency of an accidental release.

This analysis considers a base case and two sensitivity cases to account for variations in data and assumptions for postulated internal events. The base case uses estimated speed and population fraction for evacuation. Sensitivity case 1 is the base case with higher and lower evacuation speeds. Sensitivity case 2 is the base case with smaller and larger fractions of the population that evacuate.

PDR was estimated by summing over all releases the product of population dose and frequency for each accidental release. Similarly, OECR was estimated by summing over all releases the product of offsite economic cost and frequency for each accidental release. Offsite economic cost includes costs that could be incurred during the emergency response phase and costs that could be incurred through long-term protective actions.

D.1.5.2 Input

The following sections describe the site-specific input parameters used to obtain the off-site dose and economic impacts for cost-benefit analyses.

D.1.5.2.1 Projected Total Population by Spatial Element

The total population within a 50-mile radius of Fermi was estimated for the year 2045 including transient population. Areal weighting was used to transfer the 2045 projected total population from source areas (county) to target areas (spatial elements) using SECPOP2000 version 3.13.1. Michigan, Ohio, and Ontario Canada tourism data was used to calculate a transient population to increase permanent population to account for transient populations. The SECPOP2000 projected population in the 50-mi zone of analysis is 6,055,678, and the distribution of the 2045 total population is summarized in Table D.1-22.

Table D.1-22 – Estimated Population Distribution within a 50-Mile Radius

Direction	0 to 10 Miles	11 to 20 Miles	21 to 30 Miles	31 to 40 Miles	41 to 50 Miles	Total
N	18,128	164,176	570,002	703,947	460,536	**1,916,789**
NNE	8,656	115,750	318,120	862,494	538,813	**1,843,833**
NE	547	0	0	0	13	**560**
ENE	0	0	0	0	0	**0**
E	0	0	0	0	0	**0**
ESE	0	0	0	0	0	**0**
SE	0	0	81	9,594	50,286	**59,961**
SSE	0	0	1,526	17,578	28,552	**47,656**
S	939	10	8,799	20,041	40,007	**69,796**
SSW	901	2,309	111,804	37,856	48,694	**201,564**
SW	2,451	13,487	333,211	151,605	37,560	**538,314**
WSW	47,737	11,065	12,875	12,245	9,479	**93,401**
W	7,503	6,719	12,096	39,233	42,476	**108,027**
WNW	6,454	6,783	23,812	23,597	20,389	**81,035**
NW	8,647	23,078	146,506	166,719	78,483	**423,433**
NNW	5,863	28,698	263,471	204,130	169,147	**671,309**
Totals	**107,826**	**372,075**	**1,802,303**	**2,249,039**	**1,524,435**	**6,055,678**

D.1.5.2.2 Land Fraction

The land fractions are populated by SECPOP2000. SECPOP2000 uses county-level databases which contain the land-fraction data for every county in the continental U.S. A value of 1.00 indicates the spatial element area is all land, with no significant surface water.

D.1.5.2.3 Watershed Class

Watershed Index is defined by WinMACCS as areas drained by rivers (Class 1) or large water bodies (Class 2). Class 2 is intended only for use with a very large lake, similar in size to Lake Michigan. For Fermi, a watershed index of 1 (drained by rivers) was used for all spatial elements for conservatism.

D.1.5.2.4 Region Index

SECPOP2000 defines each region in the spatial grid as a given number between 1 and 97. These values are then given an economic index. However, this economic data is based on 2002 economic data and would not be an accurate representation in 2013. Therefore, an economic multiplier was determined based on past data to determine the dollar value in 2013. In order to estimate the dollar value in 2013, the consumer price index (CPI) from 2000 through 2012 was plotted. A trend line was added to this plot to determine the slope of the line. This line was then extrapolated through 2013 to determine the CPI in 2013. The economic multiplier is calculated to be 1.2964 for 2013 when compared with 2002 dollar values.

D.1.5.2.5 Agricultural Data

The generic data was used to represent regional crop data surrounding the Fermi site. This data is not used in the calculation, as it is assumed that all crops that have been exposed to radiation are destroyed (which is captured in the OECR).

D.1.5.2.6 Meteorological Data

The WinMACCS model requires meteorological data for wind speed, wind direction, atmospheric stability, accumulated precipitation, and atmospheric mixing heights. The required data was obtained from the Fermi meteorological monitoring system and the US Environmental Protection Agency.

Site-Specific Data

Meteorological data collected at the site from calendar years 2003, 2005, and 2007 were compiled for the WinMACCS input file. Missing data for parameters of interest were estimated using data substitution methods. When only one hour of data was missing, values were interpolated based on the values immediately before and after the data gap. When more than one hour of data was missing in series, then the data was replaced with data from days with similar meteorological conditions immediately before and after the missing data. The 2007 data resulted in the highest PDR and OECR and was therefore used to perform the base case analysis and sensitivity cases.

Regional Mixing Height Data

Mixing height is defined as the height of the atmosphere above ground level within which a released contaminant will become mixed (from turbulence) within approximately one hour. Fermi mixing height data were estimated using the SCRAM Mixing Height Data from the US Environmental Protection Agency.

D.1.5.2.7 Emergency Response Assumptions

A detailed analysis of evacuation scenarios in the 10-mile emergency planning zone (EPZ) were addressed in the Fermi Nuclear Power Plant Development of Evacuation Times Estimates [D.1-35].

Evacuation Delay Time

The Fermi Nuclear Power Plant Development of Evacuation Times Estimates report estimated that the maximum preparation time for evacuation to begin of all people within the EPZ would be 135 minutes. This includes 90 minutes to return home during the evacuation time period and a 45 minute delay to complete mobilization activities.

Evacuation Speed

The Fermi Nuclear Power Plant Development of Evacuation Times Estimates report estimated that the network-wide average speeds for all evacuation scenarios would be 28.6 mph (12.8 m/s). Conservatively, a 22.4 mph (10 m/s) evacuation speed was used for the base case since the population in 2045 is estimated to increase by approximately 10% when compared to when the report was written. Additional margin was also added for conservatism.

D.1.5.2.8 Core Inventory

The Fermi core inventory is shown in Table D.1-23 [D.1-36].

Table D.1-23 – Fermi Core Inventory

Element	Isotope	Inventory (Bq)	Element	Isotope	Inventory (Bq)
Krypton	Kr-85	4.74E+16	*Tellurium*	Te-127	2.85E+17
	Kr-85m	8.49E+17		Te-127m	4.82E+16
	Kr-87	1.70E+18		Te-129	1.03E+18
	Kr-88	2.36E+18		Te-129m	2.08E+17
Xenon	Xe-131m	4.53E+16		Te-131m	6.66E+17
	Xe-133	6.87E+18		Te-132	4.85E+18
	Xe-133m	2.19E+17		Te-134	6.15E+18
	Xe-135	1.84E+18	*Antimony*	Sb-127	2.89E+17
	Xe-135m	1.45E+18		Sb-129	1.08E+17
	Xe-138	5.94E+18	*Strontium*	Sr-89	3.31E+18
Iodine	I-131	3.37E+18		Sr-90	4.18E+17
	I-132	4.95E+18		Sr-91	4.14E+18
	I-133	6.98E+18		Sr-92	4.40E+18
	I-134	7.71E+18	*Barium*	Ba-139	6.15E+18
	I-135	6.64E+18		Ba-140	6.19E+18
Cesium	Cs-134	6.08E+17	*Ruthenium*	Ru-103	5.31E+18
	Cs-136	1.86E+17		Ru-105	3.59E+18
	Cs-137	5.42E+17		Ru-106	1.98E+18
Rubidium	Rb-86	6.05E+15	*Rhodium*	Rh-105	3.33E+18
	Rb-88	2.43E+18	*Technetium*	Tc-99m	5.61E+18
	Rb-89	3.17E+18	*Cerium*	Ce-141	5.68E+18
Yttrium	Y-90	4.32E+17		Ce-143	5.26E+18
	Y-91	4.30E+18		Ce-144	4.81E+18
	Y-92	4.44E+18	*Plutonium*	Pu-238	1.04E+16
	Y-93	3.37E+18		Pu-239	1.32E+15
Zirconium	Zr-95	5.81E+18		Pu-240	2.32E+15
	Zr-97	5.48E+18		Pu-241	4.88E+17
Niobium	Nb-95	5.85E+18	*Neptunium*	Np-239	6.41E+19
Molybdenum	Mo-99	6.33E+18	*Neodymium*	Nd-147	2.28E+18
Lanthanum	La-140	6.45E+18	*Praseodymium*	Pr-143	5.13E+18
	La-141	5.61E+18	*Americium*	Am-241	6.22E+14
	La-142	5.48E+18	*Curium*	Cm-242	1.56E+17
				Cm-244	6.75E+15

D.1.5.2.9 <u>Source Terms</u>

Eleven release categories were part of the WinMACCS input. Section D.1.2.2 provides details of the source terms for each release category. A linear release rate was assumed between the time the release started and the time the release ended.

D.1.5.3 Results

Risk estimates for one base case and two sensitivity cases were analyzed with WinMACCS. Sensitivity case one evaluates slower (5 m/s) and faster (15 m/s) evacuation speeds. Sensitivity case two evaluates a lower (90%) and higher (99.5%) evacuating fraction of the public.

Table D.1-24 shows the base case mean risk values for each release mode for Fermi. The estimated mean values of population dose risk and offsite economic cost risk for Fermi are 4.91 person-rem/yr and $15,600/yr, respectively.

Table D.1-24 – Fermi Base Case Results

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	3.13E-07	8.10E+06	2.80E+10	2.54E+00	8.77E+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	**4.91E+00**	**1.56E+04**

The results of the evacuation speed sensitivity showed a slight increase in population dose risk with slower evacuation speeds and a slight decrease in population dose risk with faster evacuation speeds as shown in Table D.1-25.

Table D.1-25 – Evacuation Speed Sensitivity

Evacuation Speed	Fermi Dose Risk
m/s	person-rem/yr
5	4.96
10	4.91
15	4.89

The results of the evacuation fraction sensitivity showed a slight increase in population dose risk with a lower evacuation fraction and a slight decrease in population dose risk with a higher evacuation fraction as shown in Table D.1-26.

Table D.1-26 – Evacuation Fraction Sensitivity

Evacuating Fraction	Fermi Dose Risk
%	person-rem/yr
90	4.92
95	4.91
99.5	4.90

D.1.5.4 Baseline Risk Monetization

D.1.5.4.1 Off-Site Exposure Cost

The annual off-site exposure risk was converted to dollars using the conversion factor of $2,000 per person-rem, and discounted to present value using the following standard formula from NUREG/BR-0184 [D.1-37]:

$$W_{PHA} = R \times D_{PA}\left(\frac{1 - e^{-rt_f}}{r}\right)$$

Where:
W_{PHA} is the monetary value of off-site exposure cost after discounting ($);
R is the monetary equivalent of dose ($2,000 per person-rem);
D_{PA} is the avoided public dose (person-rem/yr);
r is the real discount rate (7%) with a sensitivity performed at 3%; and
t_f is the years remaining until end of facility life (20 years).

Using the population dose risk from Table D.1-24, and the two discounting rates, W_{PHA} is calculated in Table D.1-27 for Fermi 2.

Table D.1-27 – Off-Site Exposure Cost for Fermi 2

	Fermi 2	
D_{PA} (person-rem/yr)	4.91E+00	
R ($/person-rem)	2,000	
t_f (yr)	20	
r (%/yr)	0.07	0.03
W_{PHA} ($)	**105,676**	**147,667**

D.1.5.4.2 Off-Site Economic Cost

The annual off-site economic risk was calculated and discounted to present value using the following standard formula from NUREG/BR-0184 [D.1-37]:

$$W_{EA} = Z_{EA}\left(\frac{1 - e^{-rt_f}}{r}\right)$$

Where:
W_{EA} is the monetary value of economic risk after discounting ($);
Z_{EA} is the monetary value of economic (accident) risk per year before discounting ($/yr);
r is the real discount rate (7%) with a sensitivity performed at 3%; and
t_f is the years remaining until end of facility life (20 years).

Using the monetary value of economic (accident) risk per year before discounting (Z_{EA}) from Table D.1-24, and the two discounting factors, W_{EA} is calculated in Table D.1-28 for Fermi 2.

Table D.1-28 – Off-Site Economic Cost for Fermi 2

	Fermi 2	
Z_{EA} ($/yr)	1.56E+04	
t_f (yr)	20	
r (%/yr)	0.07	0.03
W_{EA} ($)	**167,403**	**233,921**

D.1.5.4.3 On-Site Exposure Cost

The values for on-site (occupational) exposure consist of "immediate dose" and "long-term dose." The best estimate value provided in NUREG/BR-0184 [D.1-37] for immediate occupational dose is 3,300 person-rem per event and long-term occupational dose is 20,000 person-rem (over a ten year clean-up period). The following equation is used to calculate "immediate dose" on-site exposure cost:

$$W_{IO} = D_{IO} \times CDF \times R\left(\frac{1 - e^{-rt_f}}{r}\right)$$

Where:
W_{IO} is the immediate monetary value of on-site exposure after discounting ($);
D_{IO} is immediate occupational dose (3,300 person-rem per event);
CDF is the core damage frequency;
R is the monetary equivalent of dose ($2,000 per person-rem);
r is the real discount rate (7%) with a sensitivity performed at 3%; and
t_f is the years remaining until end of facility life (20 years).

Table D.1-29 provides the results for the immediate monetary cost of on-site exposure for Fermi 2.

Table D.1-29 – Immediate On-Site Exposure Cost for Fermi 2

	Fermi 2	
CDF(events/yr)	1.50E-06	
D_{IO} (person-rem/event)	3,300	
R ($/person-rem)	2,000	
t_f (yr)	20	
r (%/yr)	0.07	0.03
W_{IO} ($)	**107**	**149**

The following equation is used to calculate "long-term dose" on-site exposure cost [D.1-37]:

$$W_{LTO} = \left(\frac{D_{LTO} \times CDF \times R}{mr^2}\right)(1 - e^{-rt_f})(1 - e^{-rm})$$

Where:
W_{LTO} is the long-term monetary value of on-site exposure after discounting ($);
D_{LTO} is the long-term occupational dose (20,000 person-rem per event);
CDF is the core damage frequency;
R is the monetary equivalent of dose ($2,000 per person-rem);
m is the number of years over which the long-term dose occurs (10 years);
r is the real discount rate (7%) with a sensitivity performed at 3%; and
t_f is the years remaining until end of facility life (20 years).

Table D.1-30 provides the results for the long-term monetary cost of on-site exposure for Fermi 2.

Table D.1-30 – Long-Term On-Site Exposure Cost for Fermi 2

	Fermi 2	
CDF(events/yr)	1.50E-06	
D_{LTO} (person-rem/event)	20,000	
R ($/person-rem)	2,000	
t_f (yr)	20	
m (years)	10	
r (%/yr)	0.07	0.03
W_{LTO} ($)	**465**	**781**

The on-site exposure cost (W_O) is the sum of the immediate monetary value of on-site exposure after discounting (W_{IO}) and the long-term monetary value of on-site exposure after discounting (W_{LTO}). On-site exposure cost (W_O) is calculated in Table D.1-31 for Fermi 2.

Table D.1-31 – On-Site Exposure Cost for Fermi 2

	Fermi 2	
r (%/yr)	0.07	0.03
W_{IO} ($)	107	149
W_{LTO} ($)	465	781
W_O ($)	**572**	**930**

D.1.5.4.4 On-Site Cleanup Cost

The on-site cleanup cost is the estimated cost for cleanup and decontamination of the site. The total undiscounted cost of cleanup and decontamination for a single accident in constant year dollars is $1,500,000,000 [D.1-37]. The following equation is used to calculate the on-site cleanup cost:

$$W_{CD} = CDF\left(\frac{C_{CD}}{mr^2}\right)(1 - e^{-rm})(1 - e^{-rt_f})$$

Where:
W_{CD} is the on-site cleanup cost ($);
CDF is the core damage frequency;
C_{CD} is the total undiscounted cost of cleanup and decontamination in constant year dollars ($1,500,000,000);
m is the number of years over which cleanup occurs (10 years);
r is the real discount rate (7%) with a sensitivity performed at 3%; and
t_f is the years remaining until end of facility life (20 years).

Using the core damage frequency (CDF) and the two discounting factors, on-site cleanup cost (W_{CD}) is calculated in Table D.1-32 for Fermi 2.

Table D.1-32 – On-Site Cleanup Cost for Fermi 2

	Fermi 2	
CDF (events/yr)	1.50E-06	
C_{CD} ($)	1,500,000,000	
t_f (yr)	20	
m (yr)	10	
r (%/yr)	0.07	0.03
W_{CD} ($)	**17,450**	**29,293**

D.1.5.4.5 Replacement Power Cost

Long-term replacement power costs were determined following the methodology in NUREG/BR-0184 [D.1-37]. Determining replacement power cost requires calculating the net present value of replacement power for a single event (PV_{RP}). The equation for PV_{RP} is shown below:

$$PV_{RP} = \left(\frac{\varphi \times \frac{P_{SQN(x)}}{P_{GEN}}}{r} \right) (1 - e^{-rt_f})^2$$

Where:
PV_{RP} is the net present value of replacement power for a single event ($);
φ is a constant representing a string of replacement power costs that occur over the lifetime of a reactor after an event (for a 910 MWe "generic" reactor, NUREG/BR-0184 uses a value of $120,000,000/yr;
P_{FERMI2} is the power output of Fermi 2 (1170 MWe);
P_{GEN} is the power output of the "generic" reactor used in NUREG/BR-0184 (910 MWe);
r is the real discount rate (7%); and
t_f is the years remaining until end of facility life (20 years).

For a 3% sensitivity discount rate, NUREG/BR-0184 states that PV_{RP} is $1,400,000,000. Table D.1-33 provides the values for net present value of replacement power for a single event.

Table D.1-33 – Net Present Value Replacement Power for Fermi 2

	Fermi 2	
φ ($)	120,000,000	
P_{FERMI2} (MWe)	1,170	
P_{GEN} (MWe)	910	
t_f (yr)	20	
r (%/yr)	0.07	0.03
PV_{RP} ($)	**1,251,072,297**	**1,400,000,000**

Long-term replacement power costs can then be determined using the following equation:

$$W_{RP} = \frac{CDF \times PV_{RP}}{r} (1 - e^{-rt_f})^2$$

Where:
W_{RP} is the long-term replacement power cost ($);

CDF is the core damage frequency;
PV_{RP} is the net present value of replacement power for a single event ($);
r is the real discount rate (7%) with a sensitivity performed at 3%; and
t_f is the years remaining until end of facility life (20 years).

Using the core damage frequency (CDF), the calculated values for PV_{RP} as calculated above, and the two discounting factors, long-term replacement power cost (W_{RP}) is calculated in Table D.1-34 for Fermi 2.

Table D.1-34 – Long-Term Replacement Power Cost for Fermi 2

	Fermi 2	
CDF (events/yr)	1.50E-06	
t_f (yr)	20	
PV_{RP} ($)	1,251,072,297	1,400,000,000
r (%/yr)	0.07	0.03
W_{RP} ($)	**15,247**	**14,278**

D.1.5.4.6 Total Cost of Severe Accident Risk / Maximum Benefit

The sum of the baseline costs is shown in Table D.1-35 for Fermi 2.

Table D.1-35 – Maximum Averted Cost Risk for Fermi 2

	Fermi 2	
Cost	7% Real Discount Rate	3% Discount Rate Sensitivity
Off-Site Exposure Cost (W_{PHA})	$105,676	$147,667
Off-Site Economic Cost (W_{EA})	$167,403	$233,921
On-Site Exposure Cost (W_O)	$572	$930
On-Site Cleanup Cost (W_{CD})	$17,450	$29,293
Replacement Power Cost (W_{RP})	$15,247	$14,278
Maximum Averted Cost Risk (MACR)	**$306,348**	**$426,090**
External Event Multiplier	11	11
Modified MACR (MMACR)	**$3,369,832**	**$4,686,991**

The MACR, $306,348 for Fermi 2, is based on at-power internal event contributions.

The internal event MACR is multiplied by a factor of 11 to account for external event contributions. The resulting modified MACR (MMACR) is $3,369,832. These values will be used in the Severe Accident Mitigation Analysis (SAMA) screening process.

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ATTACHMENT D.2
EVALUATION OF SAMA CANDIDATES

D.2 EVALUATION OF FERMI SAMA CANDIDATES

D.2.1 SAMA List Compilation

A list of SAMA candidates was developed by reviewing industry documents, and considering other plant-specific enhancements not identified in the published industry documents. Since Fermi 2 is a BWR 4 with a Mark I containment, considerable attention was paid to the SAMA candidates from SAMA analyses for similar plants. Industry documents reviewed included the following:

1. NEI 05-01 "Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document (NEI 2005);
2. NRC and industry documentation discussing potential plant improvements
   - FitzPatrick Nuclear Power Plant SAMA Analysis (Ref. D.2-2)
   - Columbia Generating Station SAMA Analysis (Ref. D.2-3)
   - Cooper Nuclear Station SAMA Analysis (Ref. D.2-4)
   - Oyster Creek Nuclear Generating Station SAMA Analysis (Ref. D.2-5)
   - Monticello Nuclear Generating Plant SAMA Analysis (Ref. D.2-6)
   - Brunswick Steam Electric Plant SAMA Analysis (Ref. D.2-7)
   - Pilgrim Nuclear Power Station SAMA Analysis (Ref. D.2-8)
   - Susquehanna Steam Electric Station SAMA Analysis (Ref. D.2-9)
   - Vermont Yankee Nuclear Station SAMA Analysis (Ref. D.2-10)
   - Duane Arnold Energy Center SAMA Analysis (Ref. D.2-14)
   - Grand Gulf Nuclear Station SAMA Analysis (Ref. D.2-15)
3. Fermi Individual Plant Examination (IPE), Fermi Individual Plant Examination of External Events (IPEEE) reports and their updates,
4. NUREG-1742, Perspectives Gained From the Individual Plant Examination of External Events (IPEEE) Program; and
5. Fermi updated PRA model lists of risk significant contributors (Ref. D.2-12).

The comprehensive list contained a total of 220 Phase I SAMA candidates and is available in onsite documentation.

D.2.2 Phase I SAMA Analysis – Qualitative Screening

The purpose of the Phase I analysis is to use high-level knowledge of the plant and SAMAs to preclude the need to perform detailed cost-benefit analyses on them. Since many of the SAMAs were derived from industry sources, they include a variety of potential enhancements that may or may not be directly applicable to Fermi 2. In addition, several candidate SAMAs initially considered may or may not have already been implemented at Fermi 2. Each SAMA was initially categorized by successive screening by one of six criteria discussed below. Potential SAMA candidates were screened out if they modified features not applicable to Fermi 2, if they had already been implemented at Fermi 2, if they were similar in nature and could be combined with another SAMA candidate to develop a more comprehensive or plant-specific SAMA candidate, if they had excessive implementation cost, if they had very low benefit to Fermi 2, or if implementation of this SAMA is already in progress.

- Not Applicable: If a proposed SAMA does not apply to the Fermi 2 design, it is not retained.
- Already Implemented: If the SAMA or equivalent was previously implemented, it is not retained.
- Combined With Another SAMA: If a SAMA is similar in nature and can be combined with another SAMA to develop a more comprehensive or plant specific SAMA, only the combined SAMA is further evaluated.
- Excessive Implementation Cost: If the estimated cost of implementation is greater than the modified Maximum Averted Cost-Risk, the SAMA cannot be cost beneficial and is screened from further analysis.
- Very Low Benefit: If the SAMA is related to a non-risk significant system which is known to have negligible impact on the risk profile, it is not retained.
- Implementation in Progress: If plant improvements that address the intent of the SAMA are already in progress, it is not retained.

During this process, 141 SAMA candidates were screened out based on the criteria listed above. Table D.1-1 provides a description of each of the 79 Phase II SAMA candidates.

D.2.3 <u>Phase II SAMA Analysis – Cost Benefit Evaluation</u>

A cost/benefit analysis was performed on each of the remaining 79 SAMA candidates. If the implementation cost of a SAMA candidate was determined to be greater than the potential benefit (i.e. there was a negative net value) the SAMA candidate was considered not to be cost beneficial and was not retained as a potential enhancement.

The expected cost of implementation of each SAMA was established from existing estimates of similar modifications combined with engineering judgment. Most of the cost estimates were developed from similar modifications considered in previous performed SAMA analyses. In particular, these cost-estimates were derived from the following major sources including:

- Columbia Generating Station SAMA Analysis (Ref. D.2-3)
- Cooper Nuclear Station SAMA Analysis (Ref. D.2-4)
- Brunswick Steam Electric Plant SAMA Analysis (Ref. D.2-7)
- Duane Arnold Energy Center SAMA Analysis (Ref. D.2-14)
- Grand Gulf Nuclear Station SAMA Analysis (Ref. D.2-15)
- D.C. Cook Nuclear Plant SAMA Analysis (Ref. D.2-16)
- Sequoyah Nuclear Plant SAMA Analysis (Ref. D.2-17)

- Columbia Generating Station License Renewal RAI (D.2-18)

Detailed cost estimates were often not required to make informed decisions regarding the economic viability of a potential plant enhancement when compared to attainable benefit. Several of the SAMA candidates were clearly in excess of the attainable benefit estimated from a particular analysis. For less clear cases, engineering judgment was applied to determine if a more detailed site specific cost estimate was necessary to formulate a conclusion regarding the economic viability of a particular SAMA. In most cases, more detailed site specific cost estimates were not required, particularly if the SAMA called for the implementation of a hardware modification. Nonetheless, the cost of SAMA candidates was conceptually estimated to the point where conclusions regarding the economic viability of the proposed modification could be adequately gauged.

Based on a review of previous submittals SAMA evaluations and an evaluation of expected implementation costs at Fermi 2, the following estimated costs for each type of proposed SAMA implementation were used. In most cases, the lower value in each range was assumed to be the minimum cost for that type of SAMA implementation. If a procedure change was deemed to require complex changes that would require input from engineering or an increase in training, an estimated cost of implementation in the middle of the range was applied.

Type of Change	Estimated Cost Range
Procedural only	$50,000
Procedural change with engineering or training required	$50,000 - $200,000
Procedural change with engineering and testing/training required	$200,000 - $300,000
Hardware modification	$100,000 - >$1,000,000

When required, detailed cost estimates were based on the engineering judgment of project engineers experienced in performing design changes at the facility and these values were compared, where possible, to estimates developed and used at plants of similar design and vintage.

Bounding evaluations were performed to address the generic nature of the initial SAMA concepts. Such bounding calculations overestimate the benefit and thus are conservative calculations. For example, one SAMA dealt with the diesel fuel oil transfer pump; the bounding calculation estimated the benefit of this improvement by total elimination of risk due to the diesel fuel oil system (see analysis in Phase II SAMA 149 below). Such a calculation obviously overestimated the benefit, but if the inflated benefit indicated that the SAMA is not cost-beneficial, then the purpose of the analysis was satisfied.

A description of the analyses used in the Phase II analysis follows.

SAMA 009: Reduce DC dependence between high-pressure injection systems and ADS

High Pressure Coolant Injection (HPCI) uses Division 2 DC power while ADS valves are powered by Division 1, therefore the intent of this SAMA is met with the current design. However, to assess the benefit from eliminating the DC dependence of ADS, failure of the Division 1 130V DC batteries was eliminated.

With the model changes discussed above, the averted cost risk relative to the base case is $5,597.

SAMA 012: Improve 4.16-kV bus cross-tie ability

Improving the ability to cross-tie the 4.16-kV busses would increase the availability of on-site AC power. To assess the potential benefit, the existing cross-ties between the Division 1 and Division 2 ESF buses are assumed to never fail.

With the model changes discussed above, the averted cost risk relative to the base case is $79,294.

SAMA 014: Install an additional, buried off-site power source

SAMA 026: Bury off-site power lines

Installing an additional, buried off-site power source, or burying off-site power lines would decrease the probability of loss of off-site power due to weather related events. To assess the potential benefit, a bounding analysis was performed by eliminating all weather related loss of off-site power (LOOP) and partial loss of off-site power (PLOOP) events.

With the model changes discussed above, the averted cost risk relative to the base case is $345,255.

SAMA 016: Install tornado protection on gas turbine generator

Installing tornado protection on the gas turbine generator would eliminate or reduce weather related failures of the combustion turbine generator (CTG). A bounding analysis was performed by eliminating all weather induced failures of the CTG.

With the model changes discussed above, the averted cost risk relative to the base case is $244,796.

SAMA 018: Improve uninterruptible power supplies

Improving the reliability of uninterruptible power supplies would reduce the frequency of loss of power to essential plant instruments. A bounding analysis was performed by eliminating the failure of the modular power units (MPU) which provide the uninterruptible power supply to essential plant instruments.

With the model changes discussed above, the averted cost risk relative to the base case is $8,447.

SAMA 021: Use fire water system as a backup source for diesel cooling

This analysis was used to evaluate the change in plant risk from improving the reliability of diesel cooling by adding a backup source of cooling. The analysis was performed by assuming that the diesel driven fire pump would be manually aligned to provide backup diesel cooling. The manual action was given a failure probability of 0.1. The benefit of adding an entirely new source of diesel cooling would be comparable to that of using the fire water system, but the cost of implementation would be much higher.

With the model changes discussed above, the averted cost risk relative to the base case is $256,946.

SAMA 023: Develop procedures to repair or replace failed 4 kV breakers

Developing procedures to repair or replace failed 4 kV breakers would increase the probability of recovery from failure of breakers that transfer 4.16 kV non-emergency buses from unit station transformers. An analysis was performed by eliminating failure of the operator to cross-tie non-emergency buses, failure to recover AC power from plant and switchyard centered events, as well as failure during operation of non-emergency 4.16 kV buses.

With the model changes discussed above, the averted cost risk relative to the base case is $8,155.

SAMA 024: In training, emphasize steps in recovery of off-site power after an SBO

Increased training with emphasis on recovery could reduce the human error in steps to recover off-site power after an SBO. Since enhanced training is not likely to improve the ability to recover off-site power from grid and severe weather related events, this evaluation assumed that only the probability to recover off-site power after plant centered and switchyard centered events would be impacted. The analysis assumed a 25% improvement in recovery of off-site power for Level 1 events (i.e., 30 minute, 4 hour and 12 hour recovery). The common failure to respond to SBO was also eliminated.

With the model changes discussed above, the averted cost risk relative to the base case is $6,268.

SAMA 028: Provide an additional high pressure injection pump with independent diesel

Installing an additional high pressure injection pump with an independent diesel would reduce the frequency of core melt from small LOCA and SBO sequences. To assess the change in plant risk from installing an additional high pressure injection pump, the analysis was performed by eliminating failures of the existing standby feedwater pumps to provide sufficient flow, which includes power dependencies. The analysis also conservatively eliminated SBFW failures induced from failure of balance of plant (BOP) batteries.

With the model changes discussed above, the averted cost risk relative to the base case is $287,507.

SAMA 029: Raise HPCI/RCIC backpressure trip set points

Raising the HPCI and RCIC backpressure trip set points would increase the system availability when the suppression pool temperature is high. To assess the change in plant risk, the HPCI and RCIC turbine trip and automatic turbine isolation due to high or instable exhaust pressure were eliminated.

With the model changes discussed above, the averted cost risk relative to the base case is $9,854.

SAMA 031: Revise procedures to allow intermittent operations of HPCI and RCIC

This analysis was used to evaluate the change in plant risk from increasing the throttling ability of HPCI and RCIC pumps to limit the number of system stops/restarts. The analysis was performed by eliminating the failure of both HPCI and RCIC during subsequent cycles..

With the model changes discussed above, the averted cost risk relative to the base case is $15,700.

SAMA 034: Modify automatic depressurization system components to improve reliability

Modifying automatic depressurization system components to improve their reliability would reduce the frequency of high pressure core damage sequences. To assess the change in plant risk for this SAMA, analysis was performed by eliminating the failure to open on demand of all Safety Relief Valves (SRVs), both Automatic Depressurization System (ADS) and non-ADS SRVs.

With the model changes discussed above, the averted cost risk relative to the base case is $0.

SAMA 041: Provide capability for alternate injection via reactor water cleanup (RWCU)

SAMA 167: Improve training on alternate injection via the fire water system, increasing the availability of alternate injection

This analysis was used to evaluate the change in plant risk from improving injection capability through either the diesel-driven fire pump or reactor water cleanup (RWCU). The analysis was performed by assuming that the diesel fire pump never failed (for injection and all other modeled functions), as well as assuming that the flowpath for RPV injection via the diesel fire pump never failed.

With the model changes discussed above, the averted cost risk relative to the base case is $5,904.

SAMA 046: Improve ECCS suction strainers

This analysis was used to evaluate the change in plant risk from improving the reliability of the ECCS suction strainers. A bounding analysis was performed by eliminating all plugging of the ECCS suction strainers.

With the model changes discussed above, the averted cost risk relative to the base case is $73,034.

SAMA 050: Change procedures to allow cross connection of motor cooling for RHRSW pumps

This analysis was used to evaluate the change in plant risk from revising procedures to increase the availability of RHRSW by allowing cross connection of motor cooling for the RHRSW pumps. A bounding analysis was performed by eliminating all failures of both Division 1 and Division 2 RHRSW pumps.

With the model changes discussed above, the averted cost risk relative to the base case is $13,154.

SAMA 051: Add redundant DC control power for Service Water pumps

Adding redundant DC control power for Service Water (SW) pumps would increase the availability of SW. To analyze the change in plant risk, it was assumed that long term power to the RHRSW pumps where battery chargers are required never fails.

With the model changes discussed above, the averted cost risk relative to the base case is $1,399.

SAMA 053 - Provide self-cooled ECCS seals

Providing self-cooled ECCS seals would eliminate the dependency of ECCS on the component cooling system. Since the Core Spray pumps are the only ECCS pumps that require pump cooling for the PRA mission time, a bounding analysis was performed by eliminating the failure of Core Spray pump cooling.

With the model changes discussed above, the averted cost risk relative to the base case is $264,424.

SAMA 054: Enhance procedural guidance for use of cross-tied component cooling or service water pumps

Enhancing procedural guidance for use of cross-tied component cooling or service water pumps would reduce the frequency of the loss of these systems. An analysis was performed by allowing cross-connection of Division 1 and 2 Emergency Equipment Cooling/Service Water. Additionally, the analysis also eliminated all hardware failure initiating events of the General Service Water.

With the model changes discussed above, the averted cost risk relative to the base case is $3,237.

SAMA 055: Implement modifications to allow manual alignment of the fire water system to RHR heat exchangers

Implementing modifications to allow manual alignment of the fire water system to RHR heat exchangers would improve the ability to cool the RHR heat exchangers. To evaluate the change in plant risk, the fire water system was modeled as an additional train for both Division 1 and Division 2 RHR complex.

With the model changes discussed above, the averted cost risk relative to the base case is $1,858.

SAMA 067: Enhance procedure to trip unneeded RHR or CS pumps on loss of room ventilation

This analysis was used to evaluate the change in plant risk from extending the availability of the RHR or CS pumps due to reduction in room heat load. To evaluate the change in plant risk, probability of failure of the crew to limit the number of operating RHR pumps was decreased by an order of magnitude to simulate enhanced procedures.

With the model changes discussed above, the averted cost risk relative to the base case is $1,185.

SAMA 068: Stage backup fans in switchgear rooms

Room cooling is not required for AC power switchgear rooms. However, Division 2 ESF DC battery charger room does require cooling or ventilation. An operator action currently exists to open a door per procedure in case room cooling is lost. The analysis performed decreased the failure probability of this operator action by two orders of magnitude.

With the model changes discussed above, the averted cost risk relative to the base case is $10.

SAMA 071: Modify procedure to provide ability to align diesel power to more air compressors

Providing the ability to align diesel power to more air compressors would increase the availability of instrument air after a loss of offsite power event. To evaluate the change in plant risk from providing diesel power to the air compressors, all power dependencies of the air compressors were removed.

With the model changes discussed above, the averted cost risk relative to the base case is $895.

SAMA 072: Replace service and instrument air compressors with more reliable compressors which have self-contained air cooling by shaft driven fans

SAMA 177: Provide an alternate means of supplying the instrument air header: This SAMA involves procurement of an additional portable compressor to be aligned to the supply header to reduce the risk associated with loss of instrument air

Replacing the service and instrument air compressors could eliminate the instrument air system dependence on component cooling water. Providing an additional portable compressor to be aligned to the supply header would reduce the risk associated with loss of instrument air. A bounding analysis was performed by eliminating the failure of air supply from both divisions of the Noninterruptible Air Supply (NIAS), as well as failure of the station air compressors.

With the model changes discussed above, the averted cost risk relative to the base case is $99,460.

SAMA 074: Improve SRV and MSIV pneumatic components

This analysis was used to evaluate the change in plant risk from modifications to improve the reliability of SRVs and MSIVs. A bounding analysis was performed by eliminating the air dependency of MSIV components and the Division 1 SRVs (which includes all ADS valves).

With the model changes discussed above, the averted cost risk relative to the base case is $943.

SAMA 077: Cross-tie open cycle cooling system to enhance drywell spray system

This analysis was used to evaluate the change in plant risk from modifications to cross-tie the RHRSW system to increase the availability of containment heat removal. A bounding analysis was performed by eliminating the failure of both drywell spray loops.

With the model changes discussed above, the averted cost risk relative to the base case is $2,848.

SAMA 078: Enable flooding of the drywell head seal

Enabling flooding of the drywell head seal would reduce the probability of leakage through the seal. To evaluate the change in plant risk, it was assumed that flooding the drywell head seal would eliminate all Class II or Class IV accident sequences with large drywell failures.

With the model changes discussed above, the averted cost risk relative to the base case is $8,896.

SAMA 083: Enhance procedures to maintain ECCS suction on CST as long as possible

Maintaining ECCS suction on the CST as long as possible would reduce the chance of pump failure due to high suppression pool temperature. A bounding analysis was performed by assuming that the CST was always available for long term makeup for HPCI and RCIC.

With the model changes discussed above, the averted cost risk relative to the base case is $0.

SAMA 091: Improve vacuum breaker reliability by installing redundant valves in each line

Installing redundant valves in each line would improve vacuum breaker reliability and decrease the consequences of a vacuum breaker failure to reseat. To evaluate the change in plant risk, a bounding analysis was performed by eliminating random vacuum breaker failures, tailpipe vacuum breakers sticking open, as well as common cause failure of vacuum breakers.

With the model changes discussed above, the averted cost risk relative to the base case is $53,249.

SAMA 093: Provide post-accident containment inerting capability

SAMA 103: Install a passive hydrogen control system

Providing post-accident containment inerting capability, or installing a passive hydrogen control system would reduce the likelihood of hydrogen and carbon monoxide gas combustion. To evaluate the change in plant risk, a bounding analysis was performed by eliminating all hydrogen deflagrations which results in containment or drywell failure.

With the model changes discussed above, the averted cost risk relative to the base case is $95,942.

SAMA 100: Institute simulator training for severe accident scenarios

SAMA 145: Increase training and operating experience feedback to improve operator response

This analysis was used to evaluate the change in plant risk from increasing training to improve the success probability for important operator actions. The change in plant risk was evaluated by decreasing the likelihood of failure for important human actions by ten percent. The operator actions with a risk reduction worth of greater than 1.005 were improved by ten percent.

With the model changes discussed above, the averted cost risk relative to the base case is $309,765.

SAMA 107: Increase leak testing of valves in ISLOCA paths

SAMA 112: Revise EOPs to improve ISLOCA identification

SAMA 113: Improve operator training on ISLOCA coping

This analysis was used to evaluate the change in plant risk from reducing the frequency of ISLOCA events, and improving operators ability to cope with ISLOCAs. To assess this potential benefit, the frequency of all ISLOCA initiating events was decreased by twenty five percent.

With the model changes discussed above, the averted cost risk relative to the base case is $118,829.

SAMA 108: Improve MSIV design

Improving the MSIV design would decrease the likelihood of containment bypass scenarios. To assess this potential benefit, failure of the inboard and outboard MSIV to close (including common cause) was eliminated. Additionally, hardware failures associated with the MSIV failing to remain open, MSIV pneumatics support failures, and random MSIV closures were all eliminated from the model.

With the model changes discussed above, the averted cost risk relative to the base case is $11,762.

SAMA 115: Revise procedures to control vessel injection to prevent boron loss or dilution following SLC injection

This analysis was used to evaluate the change in plant risk from controlling vessel injection to ensure adequate boron concentration is maintained in the core following an ATWS. To determine the benefit from revising procedures to improve control of vessel injection, the failure probability of the human actions control level early during an ATWS sequence and to control level late during an ATWS sequence were each improved by ten percent.

With the model changes discussed above, the averted cost risk relative to the base case is $121,586.

SAMA 117: Increase boron concentration in the SLC system

This analysis was used to evaluate the change in plant risk from increasing the boron concentration in the SLC system which would reduce the time required to achieve shutdown concentration. To assess the benefit, the failure probability of the human actions to initiate the SLC system, both early and late, were each improved by twenty-five percent.

With the model changes discussed above, the averted cost risk relative to the base case is $43,214.

SAMA 121: Increase safety relief valve (SRV) reseat reliability

Increasing the reseat reliability of SRVs will reduce the risk of boron dilution due to SRV failure to reseat after standby liquid control (SLC) injection. A bounding analysis was performed by eliminating all stuck open relief valve (SORV) and inadvertent open relief valve (IORV) events.

With the model changes discussed above, the averted cost risk relative to the base case is $35,454.

SAMA 123: Install an ATWS sized filtered containment vent to remove decay heat

To evaluate the change in plant risk from installing an ATWS sized filtered containment vent, an analysis was performed decreasing the concentration of all radionuclides, excluding noble gases, by fifty percent. Since no modifications were made to the Level 1 or Level 2 PRA model, there was no change in core damage frequency or release category frequency. The averted cost risk was calculated by comparing the base modified MACR to the modified MACR using a fifty percent reduction in radionuclide concentrations.

With the model changes discussed above, the averted cost risk relative to the base case is $1,102,769.

SAMA 141: Install a digital large break LOCA protection system

This analysis was used to evaluate the change in plant risk from installing digital large break LOCA (leak before break) protection system. The analysis was performed by eliminating all large LOCA initiating events.

With the model changes discussed above, the averted cost risk relative to the base case is $67,613.

SAMA 149: Provide a portable EDG fuel oil transfer pump

This analysis was used to evaluate the change in plant risk from eliminating the dependency of the Emergency Diesel Generators (EDGs) on diesel fuel oil. A bounding analysis was performed by eliminating all failures of the fuel oil support system for each EDG.

With the model changes discussed above, the averted cost risk relative to the base case is $340.

SAMA 151: Provide a diverse swing diesel generator air start compressor

This analysis was used to evaluate the change in plant risk from installing a diverse swing diesel generator air start compressor. A bounding analysis was performed by eliminating all fails to start events, including common cause, from each diesel generator.

With the model changes discussed above, the averted cost risk relative to the base case is $20,500.

SAMA 152: Proceduralize all potential 4 kV AC bus cross-tie actions

Proceduralizing all potential 4 kV AC bus cross-tie actions would improve the availability of the 4 kV power system. An analysis was performed by assuming a fifty percent improvement for operator actions to align 4kV AC cross-ties.

With the model changes discussed above, the averted cost risk relative to the base case is $25,338.

SAMA 154: Modify procedures to allow switching of the combustion turbines to buses while running

This analysis was used to evaluate the change in plant risk from increasing the availability of on-site AC power by allowing switching of the combustion turbines to buses while running. A bounding analysis was performed by eliminating all failures during operation of the combustion turbine generators (CTG), including the startup diesel generator. Additionally, failures of the CTG transformers during operation were also eliminated.

With the model changes discussed above, the averted cost risk relative to the base case is $6,884.

SAMA 155: Protect transformers from failure

This analysis was used to evaluate the change in plant risk from reducing the loss of off-site power (LOOP) frequency by protecting transformers from failure. The analysis was performed by decreasing LOOP initiating event frequencies by two orders of magnitude.

With the model changes discussed above, the averted cost risk relative to the base case is $146,349.

SAMA 165: Modify procedures to defeat the low reactor pressure interlock circuitry that inhibits opening the low pressure coolant injection (LPCI) or core spray injection valves following sensor or logic failures that prevent all low pressure injection valves from opening

SAMA 166: Install a bypass switch to allow operators to bypass the low reactor pressure interlock circuitry that inhibits opening the LPCI or core spray injection valves following sensor or logic failures that prevent all low pressure injection valves from opening

This analysis was used to evaluate the change in plant risk from eliminating the probability of ECCS low pressure permissives failing. An analysis was performed by improving the operator action to bypass low pressure permissives by an order of magnitude.

With the model changes discussed above, the averted cost risk relative to the base case is $25,796.

SAMA 169: Revise procedures to allow the ability to cross-connect the circulating water pumps and the SW going to the turbine equipment cooling system heat exchangers, allowing continued use of the power conversion system after SW is lost

This analysis was used to evaluate the change in plant risk from continued use of the power conversion system after service water is lost. The analysis was performed by eliminating failures of the Turbine Building Closed Cooling water (TBCCW), which includes failure of service water, the TBCCW heat exchangers and loss of off-site power.

With the model changes discussed above, the averted cost risk relative to the base case is $22,429.

SAMA 175: Operator procedure revisions to provide additional space cooling to the EDG room via the use of portable equipment

SAMA 176: Develop procedure to open the door to the EDG buildings upon the high temperature alarm

This analysis was used to evaluate the change in plant risk from revising procedures to provide additional cooling/ventilation to the EDG rooms via opening doors or through the use of portable equipment. The analysis was performed by adding an operator action to provide temporary ventilation to the EDGs.

With the model changes discussed above, the averted cost risk relative to the base case is $61,477.

SAMA 183: Improve alternate shutdown panel

SAMA 187: Upgrade ASDS panel to include additional system controls for opposite division

Installing additional transfer and isolation switches would reduce the number of spurious actuations during a fire. Upgrading the alternate shutdown panel would increase the ability to shutdown the plant from outside the main control room. This SAMA was evaluated by assuming that the additional train will reduce the CCDP of operation from the alternate shutdown panel by a factor of 10.

With the model changes discussed above, the averted cost risk relative to the base case is $30,330.

SAMA 188: Increase fire pump house building integrity to withstand higher winds so that the fire system would be capable of withstanding a severe weather event

This analysis was used to evaluate the change in plant risk from increasing the ability of the building containing the electric and diesel driven fire pump to withstand higher winds. A bounding analysis was performed by eliminating all failures of both the electric and diesel driven fire pumps to perform their functions (CST makeup and RPV injection).

With the model changes discussed above, the averted cost risk relative to the base case is $7,368.

SAMA 190: Implement GRA (trip and shutdown risk modeling) into plant activities, decreasing the probability of a plant trip

This analysis was used to evaluate the change in plant risk from decreasing the probability of trip/shutdown risk. The analysis was performed by decreasing manual shutdown, loss of condenser vacuum and turbine trip with bypass initiating event frequencies by twenty percent.

With the model changes discussed above, the averted cost risk relative to the base case is $188,514.

SAMA 194: Provide ability to maintain suppression pool temperature lower (especially during summer months)

This analysis was used to evaluate the change in plant risk from improving the ability to maintain the suppression pool temperature lower. To estimate the change in plant risk, the events representing insufficient flow from RHR heat exchangers, inadequate flow from check valve to RHR complex, heat exchanger unavailable due to maintenance, and misalignment of RHRSW Division 1 were eliminated. Lowering the initial temperature of the suppression pool may give operators enough extra time to restore RHRSW before the limits are reached, especially if the system is down for maintenance or is misaligned.

With the model changes discussed above, the averted cost risk relative to the base case is $28,874.

SAMA 195: Improve reliability of control rod drive mechanical components

This analysis was used to evaluate the change in plant risk from reducing ATWS frequency by improving the reliability of control rod drive mechanical components. The analysis was performed by decreasing the failure probability of the control rod drive hydraulic components by ten percent.

With the model changes discussed above, the averted cost risk relative to the base case is $77,294.

SAMA 196: Provide redundant HPCI auxiliary oil pump or backup motive force for HPCI turbine valves

This analysis was used to evaluate the change in plant risk from reducing the failure risk of the auxiliary oil pump used to provide the hydraulic force to operate the HPCI turbine valves. The analysis was performed by excluding the failure to start of the HPCI auxiliary oil pump.

With the model changes discussed above, the averted cost risk relative to the base case is $4,775.

SAMA 197: Upgrade flood barrier between DC switchgear room and Division 2 AC switchgear room

This analysis was used to evaluate the change in plant risk from physical upgrades to the doors between the DC switchgear room and the Division 2 AC switchgear room to prevent flooding in one room from propagating to the other room. The analysis was performed by assuming that flooding in one room could not propagate to the other.

With the model changes discussed above, the averted cost risk relative to the base case is $89,655.

SAMA 198: Provide automatic method of refilling the CST

This analysis was used to evaluate the change in plant risk from physical upgrades to provide an automatic method of refilling the CST. The analysis was performed by excluding the CST failures caused by an initial low level or an operator failure to refill the CST.

With the model changes discussed above, the averted cost risk relative to the base case is $71,719.

SAMA 199: Increase surveillance of SBLOCA initiators

This analysis was used to evaluate the change in plant risk from additional monitoring of piping and components which could cause a small break loss of coolant (SBLOCA) if failed. The analysis was performed by assuming that increased surveillance would result in a twenty five percent decrease in SBLOCA initiating events.

With the model changes discussed above, the averted cost risk relative to the base case is $15,403.

SAMA 200: Improve capability of GSW pumps to operate during summer months

This analysis was used to evaluate the change in plant risk from increasing successful operation of General Service Water pumps during summer months. A bounding analysis was performed by assuming that the GSW pumps never failed during summer months.

With the model changes discussed above, the averted cost risk relative to the base case is $65,045.

SAMA 201: Install redundant high water level trip for RCIC

This analysis was used to evaluate the change in plant risk from adding a redundant Level 8 trip device for RCIC. The analysis was performed by eliminating the failure of the RCIC Level 8 Trip.

With the model changes discussed above, the averted cost risk relative to the base case is $10,668.

SAMA 202: Replace or upgrade RBCCW pressure control valve

This analysis was used to evaluate the change in plant risk from improving the reliability of the reactor building closed cooling water (RBCCW) system by replacing or upgrading the RBCCW pressure control valve. The analysis was performed by decreasing the loss of RBCCW initiating event frequency by two orders of magnitude.

With the model changes discussed above, the averted cost risk relative to the base case is $36,791.

SAMA 203: Improve EDG maintenance procedures to decrease unavailability time

This analysis was used to evaluate the change in plant risk from improving EDG maintenance procedures to decrease the time in which they are unavailable due to maintenance. The analysis was performed by assuming that improved procedures would decrease the unavailability due to maintenance for all EDGs by fifty percent, including times when multiple EDGs are unavailable.

With the model changes discussed above, the averted cost risk relative to the base case is $16,474.

SAMA 204: Improve test and maintenance procedures on SBFW pumps to decrease their unavailability time

This analysis was used to evaluate the change in plant risk from improving SBFW pump test and maintenance procedures to decrease the time in which SBFW is unavailable due to maintenance. The analysis was performed by assuming that improved procedures would decrease the unavailability due to test and maintenance for the SBFW pump by fifty percent.

With the model changes discussed above, the averted cost risk relative to the base case is $8,442.

SAMA 205: Improve test and maintenance procedures on HPCI pump/turbine to decrease unavailability time

This analysis was used to evaluate the change in plant risk from improving HPCI pump/turbine test and maintenance procedures to decrease the time in which HPCI is unavailable due to maintenance. The analysis was performed by assuming that improved procedures would decrease the unavailability due to test and maintenance for HPCI by fifty percent.

With the model changes discussed above, the averted cost risk relative to the base case is $9,173.

SAMA 206: Improve the ability of operators to manually close a damper to isolate the third floor of Reactor Building from hardened vent path

During the IPEEE, it was determined that the human action to manually close a damper to isolate the third floor of the reactor building from the hardened vent path when the non-interruptible air supply had failed was not feasible. Even though the failure is not associated with fire, it accounts for 1.55E-06/yr of the Control Room and 6.09E-07/yr of the northeast quadrant of the Reactor Building fire CDF in the modified Fermi fire assessment results. A backup air bottle supply and local control for this damper would allow this action to be performed. The SAMA is assessed by assuming the all of the fire CDF associated with the damper for the two fire areas above is removed from the results. This results in a reduction of 2.15E-06/yr in the Fire CDF. This reduction in CDF was applied proportionately to each release category.

With the model changes discussed above, the averted cost risk relative to the base case is $437,922.

SAMA 207: Add incipient fire detection and suppression to selected cabinets in the Division 1 Switchgear Room

Four components in the Division 1 Switchgear Room (04ABN) account for approximately 66% of the fire CDF in the room. These components are the 480V 72C Bus/Transformer, 480V 72B Bus/Transformer, 4160V 64C Bus and the 4160V 64B Bus. The addition of incipient fire detection and automatic actuation systems for these components will reduce the CDF of these fires significantly. To determine the impact of this modification, the assumption is made that the detection/auto suppression system has a failure probability of 0.05. It is also assumed that the CCDP for a fire with successful suppression is equal to the CCDP associated with a non-severe fire. Non-severe fires will not propagate to other equipment in the room, while severe fires will result in failure of all equipment in the room. Therefore, the severe fire scenarios for these components are revised from one scenario to two scenarios; one with successful suppression and one with failed suppression. With this modification, the Fire CDF is reduced by 1.36E-06/yr. This reduction in Fire CDF was applied proportionately to each release category.

With the model changes discussed above, the averted cost risk relative to the base case is $269,737.

SAMA 208: Add incipient fire detection and suppression to selected cabinets in the Relay Room

Three panels in the Relay Room (03AB) account for approximately 70% of the fire CDF in the room. These components are P620, P613 and P622. The addition of incipient fire detection and automatic actuation systems for these components will reduce the CDF of these fires significantly. To determine the impact of this modification, the assumption is made that the detection/auto suppression system has a failure probability of 0.05. It is also assumed that the CCDP for a fire with successful suppression is reduced by an order of magnitude compared to the original CCDP. Therefore, the original fire scenarios for these components are revised from one scenario to two scenarios; one with successful suppression and one with failed suppression. With this modification, the Fire CDF is reduced by 8.3E-07/yr. This reduction in Fire CDF was applied proportionately to each release category.

With the model changes discussed above, the averted cost risk relative to the base case is $168,621.

SAMA 209: Add incipient fire detection and suppression to selected cabinets in the Division 2 Switchgear Room

Five components in the Division 2 Switchgear Room (12AB) account for approximately 76% of the fire CDF in the room. These components are the 480V 72F Bus/Transformer, 480V 72E Bus/Transformer, 4160V 65F Bus, 4160V 65E Bus and the 4160V 65G Bus. The addition of incipient fire detection and auto actuation systems for these components will reduce the CDF of these fires significantly. To determine the impact of this modification, the assumption is made that the detection/auto suppression system has a failure probability of 0.05. It is also assumed that the CCDP for a fire with successful suppression is equal to the CCDP associated with a non-severe fire. Non-severe fires will not propagate to other equipment in the room, while severe fires will result in failure of all equipment in the room. Therefore, the severe fire scenarios for these components are revised from one scenario to two scenarios; one with successful suppression and one with failed suppression. With this modification, the Fire CDF is reduced by 8.74E-07/yr. This reduction in Fire CDF was applied proportionately to each release category.

With the model changes discussed above, the averted cost risk relative to the base case is $178,695.

SAMA 210: Add incipient fire detection and suppression to selected cabinets in Division 1 portion of the Miscellaneous Room

Three cabinets in the Division 1 portion of the Miscellaneous Room (11ABE) account for approximately 60% of the fire CDF in the room. These cabinets are MCC 2PA-1, MCC 2PB-1 and Cabinet 2PA-2. The addition of incipient fire detection and automatic actuation systems for these cabinets will reduce the CDF of these fires significantly. To determine the impact of this modification, the assumption is made that the detection/auto suppression system has a failure probability of 0.05. It is also assumed that the CCDP for a fire with successful suppression is reduced by an order of magnitude compared to the original CCDP. Therefore, the original fire scenarios for these components are revised from one scenario to two scenarios; one with successful suppression and one with failed suppression. With this modification, the Fire CDF is reduced by 4.85E-07/yr. This reduction in Fire CDF was applied proportionately to each release category.

With the model changes discussed above, the averted cost risk relative to the base case is $97,937.

SAMA 211: Add incipient fire detection and suppression to selected cabinets on the second floor of the Reactor Building

Three cabinets on the second floor of the Reactor Building (RB06) account for approximately 50% of the fire CDF in the room. These cabinets are R1600S003J, H2100P627 & R1600S003D. The addition of incipient fire detection and auto actuation systems for these cabinets will reduce the CDF of these fires significantly. To determine the impact of this modification, the assumption is made that the detection/auto suppression system has a failure probability of 0.05. It is also assumed that the CCDP for a fire with successful suppression is reduced by an order of magnitude compared to the original CCDP. Therefore, the original fire scenarios for these components are revised from one scenario to two scenarios; one with successful suppression and one with failed suppression. With this modification, the Fire CDF is reduced by 2.09E-07/yr. This reduction in Fire CDF was applied proportionately to each release category.

With the model changes discussed above, the averted cost risk relative to the base case is $44,089.

SAMA 212: Diversify SLC explosive valve operation

This analysis was used to evaluate the change in plant risk from diversifying SLC explosive valve operation to decrease the probability of common cause failures. A bounding analysis was performed by eliminating all common cause failures of SLC squib valves.

With the model changes discussed above, the averted cost risk relative to the base case is $75,586.

SAMA 213: Provide leak detection and automatic isolation valves on EECW piping in the DC Switchgear room

This analysis was used to evaluate the change in plant risk from providing the capability to detect and isolate floods from EECW piping in the DC Switchgear room. The analysis was performed by assuming that a flood from this piping would not result in the failure of any electrical equipment in the DC Switchgear room.

With the model changes discussed above, the averted cost risk relative to the base case is $98,645.

SAMA 214: Provide leak detection and automatic isolation valves on EECW piping in the Division 2 Switchgear room

This analysis was used to evaluate the change in plant risk from providing the capability to detect and isolate floods from EECW piping in the Division 2 Switchgear room (Area A3G10). The analysis was performed by assuming that a flood from this piping would not result in the failure of any electrical equipment in the Division 2 Switchgear room.

With the model changes discussed above, the averted cost risk relative to the base case is $44,438.

D.2.4 Sensitivity Analyses

Two sensitivity analyses were conducted to gauge the impact of key assumptions upon the analysis. The benefits (averted cost-risk) of each SAMA analysis with these sensitivities are presented in Table D.2-2.

The sensitivities performed are as follows:

Sensitivity Case 1: Conservative Discount Rate

The purpose of this sensitivity case was to investigate the sensitivity of each analysis case to the discount rate. A discount rate of 7.0% was used in the base case analyses. A lower discount rate of 3.0% was assumed in this sensitivity case to investigate the impact on each analysis case as per NEI 05-01.

Sensitivity Case 1: 95^{th} Percentile Uncertainty

The purpose of this sensitivity case was to investigate the sensitivity of the PRA model underestimating averted plant risk. If the best estimate failure probability values were consistently lower than the "actual" failure probabilities, the PRA model would underestimate plant risk and yield lower than "actual" averted cost-risk values for potential SAMAs. Re-assessing the cost benefit calculations using the high end of the failure probability distributions is a means of identifying the impact of having consistently underestimated failure probabilities for plant equipment and operator actions included in the PRA model. This sensitivity uses a multiplier of 2.5, which is conservative with respect to the CDF 95th percentile results (2.36), to examine the impact of uncertainty in the PRA model.

D.2.5 References

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D.2-2 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding James A. FitzPatrick Nuclear Power Plant – Final Report (NUREG-1437, Supplement 31)," January 2008.

D.2-3 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Columbia Generating Station – Draft Report for Comment (NUREG-1437, Supplement 47)," August 2011.

D.2-4 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Cooper Nuclear Station, Unit 1 – Final Report (NUREG-1437, Supplement 41)," July 2010.

D.2-5 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Oyster Creek Nuclear Generating Station – Final Report, (NUREG-1437, Supplement 28)," January 2007.

D.2-6 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Monticello Nuclear Generating Plant – Final Report (NUREG-1437, Supplement 36)," August 2006.

D.2-7 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Brunswick Steam Electric Plant, Units 1 and 2 (NUREG-1437, Supplement 25)," April 2006.

D.2-8 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Pilgrim Nuclear Power Station – Final Report (NUREG-1437, Supplement 29)," July 2007.

D.2-9 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Susquehanna Steam Electric Station, Units 1 and 2 (NUREG-1437, Supplement 35)," March 2009.

D.2-10 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Vermont Yankee Nuclear Power Station – Final Report (NUREG-1437, Supplement 30)," August 2007.

D.2-11 NUREG/CR-6928, "Industry-Average Performance for Components and Initiating Events at U.S. Commercial Nuclear Power Plants," February 2007.

D.2-12 NUREG-1742, "Perspectives Gained From the Individual Plant Examination of External Events (IPEEE) Program – Final Report," April, 2002.

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D.2-14 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Duane Arnold Energy Center – Final Report (NUREG-1437, Supplement 42)," October 2010.

D.2-15 Grand Gulf Nuclear Station License Renewal Application Environmental Report, Attachment E, ML11308A493.

D.2-16 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Donald C. Cook Nuclear Plant, Units No. 1 and 2 – Final Report (NUREG-1437, Supplement 20)," May 2005.

D.2-17 Sequoyah Nuclear Station License Renewal Application Environmental Report, Attachment E, ML13024A010.

D.2-18 Columbia Generating Station, Docket No. 50-397 Response to Request for Additional Information for the Review of the Columbia Generating Station, License Renewal Application, January 28, 2011, ML110330395.

Table D.2-1 – Summary of Phase II SAMA Candidates							
SAMA	Source	CDF Reduction (%)	Population Dose Reduction (%)	Off-Site Economic Cost Reduction (%)	Internal and External Benefit ($)	Fermi Cost Estimate ($)	Conclusion
009 -Reduce DC dependence between high-pressure injection systems and ADS	Minimum Hardware Cost	1.33%	0.24%	-0.11%	$5,597	$100,000	Not Cost-Beneficial
012 - Improve 4.16-kV bus cross-tie ability	Implementation Cost from Grand Gulf	4.72%	1.97%	2.12%	$79,294	$656,000	Not Cost-Beneficial
014 - Install an additional, buried off-site power source	Fermi Estimate	5.06%	7.80%	12.82%	$345,255	> $1,000,000	Not Cost-Beneficial
016 - Install tornado protection on gas turbine generator	Implementation Cost from Columbia	2.86%	5.46%	9.28%	$244,796	$2,100,000	Not Cost-Beneficial
018 - Improve uninterruptible power supplies	Minimum Hardware Cost	0.00%	0.30%	0.27%	$8,447	$100,000	Not Cost-Beneficial
021 - Use fire water system as a backup source for diesel cooling	Implementation Cost from Brunswick	4.19%	5.79%	9.47%	$256,946	$2,000,000	Not Cost-Beneficial
023 - Develop procedures to repair or replace failed 4 kV breakers	Minimum Procedure Cost	0.00%	0.18%	0.33%	$8,155	$50,000	Not Cost-Beneficial
024 - In training, emphasize steps in recovery of off-site power after an SBO	Minimum Procedure Cost	0.93%	0.07%	0.11%	$6,268	$50,000	Not Cost-Beneficial

Table D.2-1 – Summary of Phase II SAMA Candidates							
SAMA	Source	CDF Reduction (%)	Population Dose Reduction (%)	Off-Site Economic Cost Reduction (%)	Internal and External Benefit ($)	Fermi Cost Estimate ($)	Conclusion
026 - Bury off-site power lines	Fermi Estimate	5.06%	7.80%	12.82%	$345,255	> $1,000,000	Not Cost-Beneficial
028 - Provide an additional high pressure injection pump with independent diesel	Implementation Cost from Cooper	27.94%	5.86%	6.36%	$287,507	$1,000,000	Not Cost-Beneficial
029 - Raise HPCI/RCIC backpressure trip set points	Minimum Procedure Cost	2.06%	0.08%	0.08%	$9,854	$50,000	Not Cost-Beneficial
031 - Revise procedure to allow intermittent operations of HPCI and RCIC	Minimum Procedure Cost	3.13%	0.14%	0.14%	$15,700	$50,000	Not Cost-Beneficial
034 - Modify automatic depressurization system components to improve reliability	Minimum Hardware Cost	0.00%	0.00%	0.00%	$0	$100,000	Not Cost-Beneficial
041 - Provide capability for alternate injection via reactor water cleanup (RWCU)	Minimum Procedure Cost	0.27%	0.17%	0.16%	$5,904	$50,000	Not Cost-Beneficial
046 - Improve ECCS suction strainers	Fermi Estimate	2.20%	2.08%	2.22%	$73,034	>$2,000,000	Not Cost-Beneficial
050 - Change procedures to allow cross connection of motor cooling for RHRSW pumps	Minimum Procedure Cost	0.33%	0.38%	0.41%	$13,154	$50,000	Not Cost-Beneficial

Table D.2-1 – Summary of Phase II SAMA Candidates							
SAMA	**Source**	**CDF Reduction (%)**	**Population Dose Reduction (%)**	**Off-Site Economic Cost Reduction (%)**	**Internal and External Benefit ($)**	**Fermi Cost Estimate ($)**	**Conclusion**
051 - Add redundant DC control power for SW pumps	Minimum Hardware Cost	0.00%	0.04%	0.05%	$1,399	$100,000	Not Cost-Beneficial
053 - Provide self-cooled ECCS seals	Implementation Cost from Columbia	2.79%	6.02%	10.00%	$264,424	$675,000	Not Cost-Beneficial
054 - Enhance procedural guidance for use of cross-tied component cooling or service water pumps	Minimum Procedure Cost	0.27%	0.05%	0.09%	$3,237	$50,000	Not Cost-Beneficial
055 - Implement modifications to allow manual alignment of the fire water system to RHR heat exchangers	Minimum Hardware Cost	0.13%	0.06%	0.04%	$1,858	$100,000	Not Cost-Beneficial
067 - Enhance procedure to trip unneeded RHR or CS pumps on loss of room ventilation	Minimum Procedure Cost	0.13%	0.03%	0.02%	$1,185	$50,000	Not Cost-Beneficial
068 - Stage backup fans in switchgear rooms	Minimum Procedure Cost	0.00%	0.00%	0.00%	$10	$50,000	Not Cost-Beneficial
071 - Modify procedure to provide ability to align diesel power to more air compressors	Minimum Procedure Cost	0.00%	0.03%	0.03%	$895	$50,000	Not Cost-Beneficial

Table D.2-1 – Summary of Phase II SAMA Candidates							
SAMA	**Source**	**CDF Reduction (%)**	**Population Dose Reduction (%)**	**Off-Site Economic Cost Reduction (%)**	**Internal and External Benefit ($)**	**Fermi Cost Estimate ($)**	**Conclusion**
072 - Replace service and instrument air compressors with more reliable compressors which have self-contained air cooling by shaft driven fans	Implementation Cost from Sequoyah	2.20%	2.95%	3.10%	$99,460	$433,100	Not Cost-Beneficial
074 - Improve SRV and MSIV pneumatic components	Minimum Hardware Cost	0.07%	0.02%	0.02%	$943	$100,000	Not Cost-Beneficial
077 - Cross-tie open cycle cooling system to enhance drywell spray system	Minimum Hardware Cost	0.00%	0.08%	0.10%	$2,848	$100,000	Not Cost-Beneficial
078 - Enable flooding of the drywell head seal	Minimum Hardware Cost	0.00%	0.28%	0.31%	$8,896	$100,000	Not Cost-Beneficial
083 - Enhance procedure to maintain ECCS suction on CST as long as possible	Minimum Procedure Cost	0.00%	0.00%	0.00%	$0	$50,000	Not Cost-Beneficial
091 - Improve vacuum breaker reliability by installing redundant valves in each line.	Implementation Cost from Cooper	0.67%	1.60%	1.75%	$53,249	$500,000	Not Cost-Beneficial
093 – Provide post-accident containment inerting capability	Fermi Estimate	0.0%	3.00%	3.32%	$95,942	$1,600,000	Not Cost-Beneficial

Table D.2-1 – Summary of Phase II SAMA Candidates							
SAMA	**Source**	**CDF Reduction (%)**	**Population Dose Reduction (%)**	**Off-Site Economic Cost Reduction (%)**	**Internal and External Benefit ($)**	**Fermi Cost Estimate ($)**	**Conclusion**
100- Institute simulator training for severe accident scenarios	Implementation Cost from Sequoyah	9.45%	8.21%	9.76%	$309,765	$8,000,000	Not Cost-Beneficial
103 - Install a passive hydrogen control system	Implementation Cost from Monticello	0.00%	3.00%	3.32%	$95,942	$760,000	Not Cost-Beneficial
107 - Increase leak testing of valves in ISLOCA paths.	Implementation Cost from Duane Arnold	0.86%	5.87%	2.58%	$118,829	$2,300,000	Not Cost-Beneficial
108 - Improve MSIV design.	Minimum Hardware Cost	0.33%	0.33%	0.36%	$11,762	$100,000	Not Cost-Beneficial
112 - Revise EOPs to improve ISLOCA identification.	Procedure Change with Engineering and Training	0.86%	5.87%	2.58%	$118,829	$200,000	Not Cost-Beneficial
113 - Improve operator training on ISLOCA coping	Procedure Change with Engineering and Training	0.86%	5.87%	2.58%	$118,829	$200,000	Not Cost-Beneficial
115 - Revise procedures to control vessel injection to prevent boron loss or dilution following SLC injection.	Procedure Change with Engineering and Training	1.73%	3.63%	3.97%	$121,586	$200,000	Not Cost-Beneficial

Table D.2-1 – Summary of Phase II SAMA Candidates							
SAMA	Source	CDF Reduction (%)	Population Dose Reduction (%)	Off-Site Economic Cost Reduction (%)	Internal and External Benefit ($)	Fermi Cost Estimate ($)	Conclusion
117 - Increase boron concentration in the SLC system	Implementation Cost from Duane Arnold	1.13%	1.23%	1.35%	$43,214	$400,000	Not Cost-Beneficial
121 - Increase safety relief valve (SRV) reseat reliability.	Minimum Hardware Cost	0.73%	1.03%	1.13%	$35,454	$100,000	Not Cost-Beneficial
123 – Install an ATWS sized filtered containment vent to remove decay heat	Fermi Estimate	0.00%	34.84%	37.89%	$1,102,769	$40,000,000	Not Cost-Beneficial
141 - Install digital large break LOCA protection system.	Implementation Cost from Sequoyah	1.06%	2.00%	2.20%	$67,613	> $2,000,000	Not Cost-Beneficial
145 - Increase training and operating experience feedback to improve operator response.	Fermi Estimate	9.45%	8.21%	9.76%	$309,765	$1,000,000	Not Cost-Beneficial
149 - Provide a portable EDG fuel oil transfer pump: This SAMA provides additional means of supplying the EDG day tank in the event a common cause failure prevents operation of the existing pumps.	Minimum Procedure Cost	0.00%	0.01%	0.01%	$340	$50,000	Not Cost-Beneficial
151 - Provide a diverse swing diesel generator air start compressor.	Minimum Hardware Cost	1.06%	0.41%	0.64%	$20,500	$100,000	Not Cost-Beneficial

Table D.2-1 – Summary of Phase II SAMA Candidates							
SAMA	**Source**	**CDF Reduction (%)**	**Population Dose Reduction (%)**	**Off-Site Economic Cost Reduction (%)**	**Internal and External Benefit ($)**	**Fermi Cost Estimate ($)**	**Conclusion**
152 - Proceduralize all potential 4-kV AC bus cross-tie actions.	Procedure Change with Engineering	0.60%	0.74%	0.79%	$25,338	$100,000	Not Cost-Beneficial
154 - Modify procedures to allow switching of the combustion turbines to buses while running.	Minimum Procedure Cost	0.27%	0.15%	0.23%	$6,884	$50,000	Not Cost-Beneficial
155 - Protect transformers from failure.	Implementation Cost from Cooper	3.86%	3.54%	4.95%	$146,349	$780,000	Not Cost-Beneficial
165 - Modify procedures to defeat the low reactor pressure interlock circuitry that inhibits opening the low pressure coolant injection (LPCI) or core spray injection valves following sensor or logic failures that prevent all low pressure injection valves from opening.	Procedure Change with Engineering	3.13%	0.44%	0.50%	$25,796	$100,000	Not Cost-Beneficial
166 - Install a bypass switch to allow operators to bypass the low reactor pressure interlock circuitry that inhibits opening the LPCI or core spray injection valves following sensor or logic failures that prevent all low pressure injection valves from opening.	Minimum Hardware Cost	3.13%	0.44%	0.50%	$25,796	$100,000	Not Cost-Beneficial

Table D.2-1 – Summary of Phase II SAMA Candidates							
SAMA	**Source**	**CDF Reduction (%)**	**Population Dose Reduction (%)**	**Off-Site Economic Cost Reduction (%)**	**Internal and External Benefit ($)**	**Fermi Cost Estimate ($)**	**Conclusion**
167 - Improve training on alternate injection via the fire water system, increasing the availability of alternate injection.	Minimum Procedure Cost	0.27%	0.17%	0.16%	$5,904	$50,000	Not Cost-Beneficial
169 - Revise procedures to allow the ability to cross-connect the circulating water pumps and the SW going to the turbine equipment cooling system heat exchangers, allowing continued use of the power conversion system after SW is lost.	Procedure Change with Engineering	0.73%	0.71%	0.63%	$22,429	$100,000	Not Cost-Beneficial
175 - Operator procedure revisions to provide additional space cooling to the EDG room via the use of portable equipment.	Implementation Cost from Sequoyah	2.53%	1.26%	2.04%	$61,477	$200,000	Not Cost-Beneficial
176 - Develop a procedure to open the door to the EDG buildings upon the high temperature alarm.	Implementation Cost from Sequoyah	2.53%	1.26%	2.04%	$61,477	$200,000	Not Cost-Beneficial

Table D.2-1 – Summary of Phase II SAMA Candidates							
SAMA	Source	CDF Reduction (%)	Population Dose Reduction (%)	Off-Site Economic Cost Reduction (%)	Internal and External Benefit ($)	Fermi Cost Estimate ($)	Conclusion
177 - Provide an alternate means of supplying the instrument air header: This SAMA involves procurement of an additional portable compressor to be aligned to the supply header to reduce the risk associated with loss of instrument air.	Implementation Cost from Brunswick	2.20%	2.95%	3.10%	$99,460	$489,300	Not Cost-Beneficial
183 - Improve alternate shutdown panel.	Implementation Cost from Cooper	0.93%	0.90%	0.90%	$30,330	$790,000	Not Cost-Beneficial
187 - Upgrade the ASDS panel to include additional system controls for opposite division.	Implementation Cost from Cooper	0.93%	0.90%	0.90%	$30,330	$790,000	Not Cost-Beneficial
188 - Increase fire pump house building integrity to withstand higher winds so that the fire system would be capable of withstanding a severe weather event	Minimum Hardware Cost	0.27%	0.21%	0.22%	$7,368	$100,000	Not Cost-Beneficial
190 - Implement GRA (trip and shutdown risk modeling) into plant activities, decreasing the probability of trips/shutdown.	Implementation Cost from Cooper	3.93%	5.49%	5.99%	$188,514	$500,000	Not Cost-Beneficial

Table D.2-1 – Summary of Phase II SAMA Candidates

SAMA	Source	CDF Reduction (%)	Population Dose Reduction (%)	Off-Site Economic Cost Reduction (%)	Internal and External Benefit ($)	Fermi Cost Estimate ($)	Conclusion
194 - Provide ability to maintain suppression pool temperature lower (especially during summer months)	Minimum Hardware Cost	1.20%	0.81%	0.82%	$28,874	$100,000	Not Cost-Beneficial
195 - Improve reliability of control rod drive mechanical components	Fermi Estimate	1.33%	2.28%	2.49%	$77,294	> $1,000,000	Not Cost-Beneficial
196 - Provide redundant HPCI auxiliary oil pump or backup motive force for HPCI valves.	Minimum Hardware Cost	1.00%	0.04%	0.04%	$4,775	$100,000	Not Cost-Beneficial
197 - Upgrade flood barrier between DC switchgear room and Division 2 AC switchgear room	Fermi Estimate	1.40%	2.71%	2.88%	$89,655	$418,720	Not Cost-Beneficial
198 - Provide automatic method of refilling the CST	Procedure Change with Engineering and Training	3.39%	1.95%	1.99%	$71,719	$200,000	Not Cost-Beneficial
199 - Increase surveillance of SBLOCA initiators.	Minimum Procedure Cost	0.60%	0.41%	0.46%	$15,403	$50,000	Not Cost-Beneficial
200 - Improve capability of GSW pumps to operate during summer months	Implementation Cost from Cooper	1.60%	1.51%	2.26%	$65,045	$1,000,000	Not Cost-Beneficial

Table D.2-1 – Summary of Phase II SAMA Candidates

SAMA	Source	CDF Reduction (%)	Population Dose Reduction (%)	Off-Site Economic Cost Reduction (%)	Internal and External Benefit ($)	Fermi Cost Estimate ($)	Conclusion
201 - Install redundant high water level trip for RCIC	Minimum Hardware Cost	2.40%	0.05%	0.07%	$10,668	$100,000	Not Cost-Beneficial
202 - Replace or upgrade RBCCW pressure control valve	Minimum Hardware Cost	1.20%	1.02%	1.11%	$36,791	$100,000	Not Cost-Beneficial
203 - Improve EDG maintenance procedures to decrease unavailability time	Minimum Procedure Cost	1.26%	0.37%	0.41%	$16,474	$50,000	Not Cost-Beneficial
204 - Improve test and maintenance procedures on SBFW pumps to decrease their unavailability time	Minimum Procedure Cost	0.40%	0.23%	0.24%	$8,442	$50,000	Not Cost-Beneficial
205 - Improve test and maintenance procedures on HPCI pump/turbine to decrease unavailability time	Minimum Procedure Cost	1.73%	0.09%	0.10%	$9,173	$50,000	Not Cost-Beneficial
206 - Improve the ability of operators to manually close a damper to isolate the third floor of Reactor Building from hardened vent path	Minimum Hardware Cost	12.97%	13.00%	13.00%	$437,922	$100,000	Potentially Cost-Beneficial

Table D.2-1 – Summary of Phase II SAMA Candidates

SAMA	Source	CDF Reduction (%)	Population Dose Reduction (%)	Off-Site Economic Cost Reduction (%)	Internal and External Benefit ($)	Fermi Cost Estimate ($)	Conclusion
207 - Add incipient fire detection and suppression to selected cabinets in the Division 1 Switchgear Room	Fermi Estimate	7.98%	8.01%	8.01%	$269,737	$1,144,000	Not Cost-Beneficial
208 - Add incipient fire detection and suppression to selected cabinets in the Relay Room	Fermi Estimate	4.99%	5.00%	5.01%	$168,621	$790,000	Not Cost-Beneficial
209 - Add incipient fire detection and suppression to selected cabinets in the Division 2 Switchgear Room	Fermi Estimate	5.32%	5.30%	5.30%	$178,695	$1,144,000	Not Cost-Beneficial
210 - Add incipient fire detection and suppression to selected cabinets in the Division 1 portion of the Miscellaneous Room	Implementation Cost from Cooper	2.93%	2.90%	2.90%	$97,937	$375,000	Not Cost-Beneficial
211 - Add incipient fire detection and suppression to selected cabinets on the second floor of the Reactor Building	Implementation Cost from Cooper	1.33%	1.30%	1.31%	$44,089	$375,000	Not Cost-Beneficial
212 - Diversify SLC explosive valve operation	Implementation Cost from Columbia	2.46%	6.27%	6.84%	$75,586	$370,000	Not Cost-Beneficial

Table D.2-1 – Summary of Phase II SAMA Candidates							
SAMA	**Source**	**CDF Reduction (%)**	**Population Dose Reduction (%)**	**Off-Site Economic Cost Reduction (%)**	**Internal and External Benefit ($)**	**Fermi Cost Estimate ($)**	**Conclusion**
213 - Provide leak detection and automatic isolation valves on EECW piping in the DC Switchgear room	Implementation Cost from Columbia RAI	2.20%	2.90%	3.09%	$98,645	$377,000	Not-Cost Beneficial
214 - Provide leak detection and automatic isolation valves on EECW piping in the Division 2 Switchgear room	Implementation Cost from Columbia RAI	0.86%	1.32%	1.41%	$44,438	$377,000	Not-Cost Beneficial

Table D.2-2 – Sensitivity Analyses				
SAMA Number and Title	**Internal and External Benefit Original**	**Sensitivity Case 1, 3% Discount Rate**	**Sensitivity Case 2, 95th Percentile Uncertainty**	**Fermi Cost Estimate**
009 - Reduce DC dependence between high-pressure injection systems and ADS	$5,597	$7,003	$13,992	$100,000
012 - Improve 4.16-kV bus cross-tie ability	$79,294	$107,898	$198,235	$656,000
014 - Install an additional, buried off-site power source	$345,255	$479,335	$863,137	> $1,000,000
016 - Install tornado protection on gas turbine generator	$244,796	$340,309	$611,991	$2,100,000
018 - Improve uninterruptible power supplies	$8,447	$11,803	$21,117	$100,000
021 - Use fire water system as a backup source for diesel cooling	$256,946	$356,468	$642,365	$2,000,000
023 - Develop procedures to repair or replace failed 4 KV breakers	$8,155	$11,396	$20,389	$50,000
024 - In training, emphasize steps in recovery of off-site power after an SBO	$6,268	$8,186	$15,670	$50,000
026 - Bury off-site power lines	$345,255	$479,335	$863,137	> $1,000,000
028 - Provide an additional high pressure injection pump with independent diesel	$287,507	$384,570	$718,767	$1,000,000
029 - Raise HPCI/RCIC backpressure trip set points	$9,854	$12,501	$24,634	$50,000
031 - Revise procedure to allow intermittent operations of HPCI and RCIC	$15,700	$20,016	$39,249	$50,000
034 - Modify automatic depressurization system components to improve reliability	$0	$0	$0	$100,000

Table D.2-2 – Sensitivity Analyses

SAMA Number and Title	Internal and External Benefit Original	Sensitivity Case 1, 3% Discount Rate	Sensitivity Case 2, 95th Percentile Uncertainty	Fermi Cost Estimate
041 - Provide capability for alternate injection via reactor water cleanup (RWCU)	$5,904	$8,086	$14,760	$50,000
046 - Improve ECCS suction strainers	$73,034	$100,704	$182,584	> $2,000,000
050 - Change procedures to allow cross connection of motor cooling for RHRSW pumps	$13,154	$18,176	$32,884	$50,000
051 - Add redundant DC control power for SW pumps	$1,399	$1,955	$3,497	$100,000
053 - Provide self-cooled ECCS seals	$264,424	$367,777	$661,060	$675,000
054 - Enhance procedural guidance for use of cross-tied component cooling or service water pumps	$3,237	$4,360	$8,093	$50,000
055 - Implement modifications to allow manual alignment of the fire water system to RHR heat exchangers	$1,858	$2,515	$4,646	$100,000
067 - Enhance procedure to trip unneeded RHR or CS pumps on loss of room ventilation	$1,185	$1,574	$2,963	$50,000
068 - Stage backup fans in switchgear rooms	$10	$13	$24	$50,000
071 - Modify procedure to provide ability to align diesel power to more air compressors	$895	$1,251	$2,237	$50,000
072 - Replace service and instrument air compressors with more reliable compressors which have self-contained air cooling by shaft driven fans	$99,460	$137,631	$248,649	$433,100
074 - Improve SRV and MSIV pneumatic components	$943	$1,277	$2,358	$100,000

Table D.2-2 – Sensitivity Analyses				
SAMA Number and Title	**Internal and External Benefit Original**	**Sensitivity Case 1, 3% Discount Rate**	**Sensitivity Case 2, 95th Percentile Uncertainty**	**Fermi Cost Estimate**
077 - Cross-tie open cycle cooling system to enhance drywell spray system	$2,848	$3,980	$7,120	$100,000
078 - Enable flooding of the drywell head seal	$8,896	$12,431	$22,240	$100,000
083 - Enhance procedure to maintain ECCS suction on CST as long as possible	$0	$0	$0	$50,000
091 - Improve vacuum breaker reliability by installing redundant valves in each line.	$53,249	$73,999	$133,123	$500,000
093 – Provide post-accident containment inerting capability	$95,942	$134,065	$239,855	$1,600,000
100- Institute simulator training for severe accident scenarios	$309,765	$427,045	$774,413	$8,000,000
103 - Install a passive hydrogen control system	$95,942	$134,065	$239,855	$760,000
107 - Increase leak testing of valves in ISLOCA paths.	$118,829	$165,515	$297,073	$2,300,000
108 - Improve MSIV design.	$11,762	$16,231	$29,405	$100,000
112 - Revise EOPs to improve ISLOCA identification.	$118,829	$165,515	$297,073	$200,000
113 - Improve operator training on ISLOCA coping	$118,829	$165,515	$297,073	$200,000
115 - Revise procedures to control vessel injection to prevent boron loss or dilution following SLC injection.	$121,586	$168,836	$303,966	$200,000
117 - Increase boron concentration in the SLC system	$43,214	$59,689	$108,034	$400,000
121 - Increase safety relief valve (SRV) reseat reliability.	$35,454	$49,093	$88,636	$100,000

Table D.2-2 – Sensitivity Analyses

SAMA Number and Title	Internal and External Benefit Original	Sensitivity Case 1, 3% Discount Rate	Sensitivity Case 2, 95th Percentile Uncertainty	Fermi Cost Estimate
123 – Install an ATWS sized filtered containment vent to remove decay heat	$1,102,769	$1,543,877	$2,756,923	$40,000,000
141 - Install digital large break LOCA protection system.	$67,613	$93,825	$169,033	> $2,000,000
145 - Increase training and operating experience feedback to improve operator response.	$309,765	$427,045	$774,413	$1,000,000
149 - Provide a portable EDG fuel oil transfer pump: This SAMA provides additional means of supplying the EDG day tank in the event a common cause failure prevents operation of the existing pumps.	$340	$475	$850	$50,000
151 - Provide a diverse swing diesel generator air start compressor.	$20,500	$27,991	$51,249	$100,000
152 - Proceduralize all potential 4-kV AC bus cross-tie actions.	$25,338	$35,038	$63,346	$100,000
154 - Modify procedures to allow switching of the combustion turbines to buses while running.	$6,884	$9,456	$17,210	$50,000
155 - Protect transformers from failure.	$146,349	$202,129	$365,872	$780,000
165 - Modify procedures to defeat the low reactor pressure interlock circuitry that inhibits opening the low pressure coolant injection (LPCI) or core spray injection valves following sensor or logic failures that prevent all low pressure injection valves from opening.	$25,796	$34,123	$64,489	$100,000

Table D.2-2 – Sensitivity Analyses

SAMA Number and Title	Internal and External Benefit Original	Sensitivity Case 1, 3% Discount Rate	Sensitivity Case 2, 95th Percentile Uncertainty	Fermi Cost Estimate
166 - Install a bypass switch to allow operators to bypass the low reactor pressure interlock circuitry that inhibits opening the LPCI or core spray injection valves following sensor or logic failures that prevent all low pressure injection valves from opening.	$25,796	$34,123	$64,489	$100,000
167 - Improve training on alternate injection via the fire water system, increasing the availability of alternate injection.	$5,904	$8,086	$14,760	$50,000
169 - Revise procedures to allow the ability to cross-connect the circulating water pumps and the SW going to the turbine equipment cooling system heat exchangers, allowing continued use of the power conversion system after SW is lost.	$22,429	$30,891	$56,072	$100,000
175 - Operator procedure revisions to provide additional space cooling to the EDG room via the use of portable equipment.	$61,477	$84,351	$153,692	$200,000
176 - Develop a procedure to open the door to the EDG buildings upon the high temperature alarm.	$61,477	$84,351	$153,692	$200,000
177 - Provide an alternate means of supplying the instrument air header: This SAMA involves procurement of an additional portable compressor to be aligned to the supply header to reduce the risk associated with loss of instrument air.	$99,460	$137,631	$248,649	$489,300
183 - Improve alternate shutdown panel.	$30,330	$41,809	$75,825	$790,000
187 - Upgrade the ASDS panel to include additional system controls for opposite division.	$30,330	$41,809	$75,825	$790,000

Table D.2-2 – Sensitivity Analyses

SAMA Number and Title	Internal and External Benefit Original	Sensitivity Case 1, 3% Discount Rate	Sensitivity Case 2, 95th Percentile Uncertainty	Fermi Cost Estimate
188 - Increase fire pump house building integrity to withstand higher winds so that the fire system would be capable of withstanding a severe weather event	$7,368	$10,132	$18,419	$100,000
190 - Implement GRA (trip and shutdown risk modeling) into plant activities, decreasing the probability of trips/shutdown.	$188,514	$261,008	$471,285	$500,000
194 - Provide ability to maintain suppression pool temperature lower (especially during summer months)	$28,874	$39,611	$72,186	$100,000
195 - Improve reliability of control rod drive mechanical components	$77,294	$107,189	$193,235	> $1,000,000
196 - Provide redundant HPCI auxiliary oil pump or backup motive force for HPCI valves.	$4,775	$6,059	$11,937	$100,000
197 - Upgrade flood barrier between DC switchgear room and Division 2 AC switchgear room	$89,655	$124,421	$224,138	$418,720
198 - Provide automatic method of refilling the CST	$71,719	$98,131	$179,298	$200,000
199 - Increase surveillance of SBLOCA initiators.	$15,403	$21,156	$38,508	$50,000
200 - Improve capability of GSW pumps to operate during summer months	$65,045	$89,910	$162,613	$1,000,000
201 - Install redundant high water level trip for RCIC	$10,668	$13,434	$26,669	$100,000
202 - Replace or upgrade RBCCW pressure control valve	$36,791	$50,674	$91,977	$100,000
203 - Improve EDG maintenance procedures to decrease unavailability time	$16,474	$22,243	$41,185	$50,000

Table D.2-2 – Sensitivity Analyses

SAMA Number and Title	Internal and External Benefit Original	Sensitivity Case 1, 3% Discount Rate	Sensitivity Case 2, 95th Percentile Uncertainty	Fermi Cost Estimate
204 - Improve test and maintenance procedures on SBFW pumps to decrease their unavailability time	$8,442	$11,552	$21,106	$50,000
205 - Improve test and maintenance procedures on HPCI pump/turbine to decrease unavailability time	$9,173	$11,755	$22,933	$50,000
206 - Improve the ability of operators to manually close a damper to isolate the third floor of Reactor Building from hardened vent path	$437,922	$603,957	$1,094,805	$100,000
207 - Add incipient fire detection and suppression to selected cabinets in the Division 1 Switchgear Room	$269,737	$372,011	$674,343	$1,144,000
208 - Add incipient fire detection and suppression to selected cabinets in the Relay Room	$168,621	$232,556	$421,552	$790,000
209 - Add incipient fire detection and suppression to selected cabinets in the Division 2 Switchgear Room	$178,695	$246,429	$446,738	$1,144,000
210 - Add incipient fire detection and suppression to selected cabinets in the Division 1 portion of the Miscellaneous Room	$97,937	$135,054	$244,843	$375,000
211 - Add incipient fire detection and suppression to selected cabinets on the second floor of the Reactor Building	$44,089	$60,790	$110,223	$375,000
212 - Diversify SLC explosive valve operation	$75,586	$105,070	$188,964	$370,000
213 - Provide leak detection and automatic isolation valves on EECW piping in the DC Switchgear room	$98,645	$136,493	$246,613	$377,000

Table D.2-2 – Sensitivity Analyses

SAMA Number and Title	Internal and External Benefit Original	Sensitivity Case 1, 3% Discount Rate	Sensitivity Case 2, 95th Percentile Uncertainty	Fermi Cost Estimate
214 - Provide leak detection and automatic isolation valves on EECW piping in the Division 2 Switchgear room	$44,438	$61,563	$111,094	$377,000