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DTE Energy

10 CFR 54

June 26, 2015
NRC-15-0068

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

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

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

Subject: Fermi 2 License Renewal Application 2015 Annual Update

In Reference 2, DTE Electric Company (DTE) submitted the License Renewal Application (LRA) for Fermi 2. The purpose of this letter is to provide the NRC an update to the Fermi 2 LRA in accordance with 10 CFR 54.21(b). During NRC review of the Fermi 2 LRA, DTE is required by 10 CFR 54.21(b) to provide an amendment to the Fermi 2 LRA that identifies changes to the Fermi 2 current licensing basis (CLB) that materially affects the contents of the Fermi 2 LRA each year and at least three months before scheduled completion of the NRC review. DTE has completed the annual CLB review and is providing the changes to the LRA required by this review in Enclosure 1. In addition, Enclosure 1 of this letter includes additional LRA revisions that have been identified but are not related to changes to the Fermi 2 CLB.

No new commitments are being made in this submittal.

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

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

Executed on June 26, 2015

Vito A. Kaminskas
Site Vice President
Nuclear Generation

Enclosures: 1. Fermi 2 License Renewal Application Revisions for 2015 Annual Update

cc: NRC Project Manager
NRC License Renewal Project Manager
NRC Resident Office
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Regional Administrator, Region III
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Enclosure 1 to
NRC-15-0068

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

Fermi 2 License Renewal Application Revisions for 2015 Annual Update

Current Licensing Basis Changes

In accordance with 10 CFR 54.21(b), DTE has reviewed changes to the Fermi 2 current licensing basis (CLB) to determine if changes impact the Fermi 2 License Renewal Application (LRA). The results of this review that impact the LRA are discussed below.

A. Nonsafety-related flexible hoses in the reactor recirculation system (B31) were replaced. The material was previously stainless steel. The new material is nickel alloy. Nonsafety-related components in the B31 system were reviewed in LRA Table 3.1.2-4-2. There are existing line items in LRA Table 3.1.2-4-2 for stainless steel flex connections and these are retained since not all of the nonsafety-related flexible hoses in the reactor recirculation system were replaced. LRA Table 3.1.2-4-2 is revised to add line items for the new nickel alloy flex connections. In addition, LRA Section 3.1.2.1.4 is revised to add nickel alloy to the list of materials and LRA Table 3.3.1 (Item 3.3.1-95) is revised to include nickel alloy in the description of materials.

B. Strainers and strainer housings in the emergency equipment cooling water system (P44) were replaced. The strainer and strainer housing materials were previously copper alloy and carbon steel, respectively. The new strainer and strainer housing material is stainless steel. Although these components were part of the emergency equipment cooling water system, they were reviewed under the compressed air system in LRA Table 3.3.2-6. There are existing line items in LRA Table 3.3.2-6 for stainless steel strainer housings, so no new line items were needed for the housings. LRA Table 3.3.2-6 is revised to change line items for copper alloy strainers to stainless steel and to delete line items for carbon steel strainer housings.

C. Tubing in the emergency diesel generator system (R30) was replaced. The tubing material was previously copper alloy. The new material is stainless steel. The emergency diesel generator system is reviewed in LRA Table 3.3.2-10. There are existing line items in LRA Table 3.3.2-10 for copper alloy and these are retained since not all of the tubing was replaced. LRA Table 3.3.2-10 does contain existing line items for stainless steel tubing, but not for the internal environment of this new tubing. LRA Table 3.3.2-10 is revised to add a line item for stainless steel tubing in a treated water environment (not greater than 140°F).

D. Tubing in the fuel oil lines of the emergency diesel generator system (R30) was replaced. The tubing material was previously carbon steel. The new material is stainless steel. The fuel oil portion of the emergency diesel generator system is reviewed in LRA Table 3.3.2-15. There are existing line items in LRA Table 3.3.2-15 for stainless steel tubing, so no new line items were needed for the new material. However, there are no existing line items for carbon steel tubing (it previously was covered by line items for "piping"). Since not all of the carbon steel tubing was replaced and to ensure consistency throughout the LRA with respect to the use of "piping" vs. "tubing", LRA Table 3.3.2-15 is revised to add line items for carbon steel tubing.

E. Nonsafety-related valves in the heater drains system (N22) were modified to add nickel alloy (Inconel) cladding to the internal surfaces. The valves were previously carbon steel with no internal cladding. The nonsafety-related components in the N22 system were reviewed in LRA Table 3.4.2-3-4. There are existing line items in LRA Table 3.4.2-3-4 for carbon steel valve bodies. LRA Table 3.4.2-3-4 is revised to add line item for the new carbon steel valve bodies with nickel alloy internal cladding.

F. The nonsafety-related steam jet air ejectors (SJAEs) in the condenser and auxiliaries system (N61) were modified. The SJAEs were previously identified in the LRA as stainless steel ejectors. Review of the modification identified that the stainless steel components are internal to the ejector and that the material that performs the (a)(2) pressure boundary function is carbon steel. The nonsafety-related components in the N61 system were reviewed in LRA Table 3.4.2-3-6. The existing line items in LRA Table 3.4.2-3-6 for stainless steel SJAEs are deleted. LRA Table 3.4.2-3-6 is revised to add line items for the carbon steel SJAEs. In addition, a line item for an internal environment of steam was added since the SJAEs may be exposed to both steam and treated water.

G. Relief valves in the lube oil filters in the emergency diesel generator system (R30) were identified for replacement. The valve body material will be changed from carbon steel to aluminum but the change has not yet been implemented. However, from the review it was determined that the carbon steel material is exposed to both an internal and external lube oil environment. There is an existing line item in LRA Table 3.3.2-10 for carbon steel valve bodies with an internal lube oil environment. LRA Table 3.3.2-10 is revised to add a line item for carbon steel valve bodies with an external lube oil environment.

H. Metal fatigue calculations were revised and an environmentally assisted fatigue (EAF) screening was performed. LRA Sections 4.3, 4.6, 4.7, 4.8, and A.2.2 are revised to show the results of the fatigue calculations and reflect the EAF screening. More detailed calculations were performed for the locations where the projected cumulative usage factor did not meet acceptance criteria at the time of the LRA submittal, and the revised calculations show the criteria is met, excluding the impact of EAF. The EAF screening has identified some locations where additional action will be needed, e.g. more detailed analysis or stress based monitoring. LRA Sections 4.3 and A.2.2.3 are revised to indicate that the Fatigue Monitoring Program (LRA Section B.1.17) includes stress-based or cycle-based fatigue monitoring. Although the EAF screening has been performed, the commitment to develop EAF usage calculations (LRA Table A.4, Item 12.b) remains, since additional action is needed based on the EAF screening results.

I. Procedures associated with the Water Chemistry Control – BWR Program were revised to use the 2015 revision of BWRVIP-190 (EPRI Report 3002002623) rather than 2008 revision (EPRI Report 1016579). The Water Chemistry Control – BWR Program descriptions in LRA Sections A.1.43 and B.1.43 are revised to update the EPRI report number. NUREG-1801 Section XI.M2 also references the 2008 revision (EPRI Report

1016579) in the program description. The use of the 2015 revision of BWRVIP-190 can be considered an exception to NUREG-1801. LRA Section B.1.43 is revised to include discussion of this exception to NUREG-1801. LRA Table B-3 is also revised to indicate that the Water Chemistry Control – BWR Program has an exception.

In addition, the tables in LRA Section 3.0 include a "Notes" column. Generic notes A and B are identical except that note A is used for programs that are consistent with NUREG-1801 and note B is used for programs that have exceptions to NUREG-1801. The same is true for generic notes C and D. Due to the new exception discussed above, any line item in a table in LRA Section 3.0 that references the Water Chemistry Control – BWR Program and uses note A is revised to use note B. Similarly, LRA Section 3.0 table line items that reference the Water Chemistry Control – BWR Program and use note C are revised to use note D. Since this change affects multiple line items in multiples tables in LRA Section 3.0 and the change is administrative in nature, actual markups to the existing LRA tables are not provided in this letter.

Administrative Changes

In addition to the CLB changes, DTE has also identified some other non-material changes to the LRA. These changes are administrative changes to ensure consistency between the LRA and previously submitted RAI responses. These additional items that impact the LRA are discussed below.

J. In Enclosure 2 to DTE letter NRC-15-0030, dated March 19, 2015, DTE revised LRA Table 3.2.2-8-1 to add a line item for piping. The line item credits the Buried and Underground Piping aging management program. For consistency with that change, LRA Section 3.2.2.1.8 is revised to add Buried and Underground Piping to the list of aging management programs for the miscellaneous ESF systems in scope for 10 CFR 54.4(a)(2).

K. In the response to RAIs B.1.19-2a and B.1.19-8a in DTE letter NRC-15-0031, dated April 10, 2015, DTE added item "q" and modified item "p" in the Fire Water System Program in LRA Table A.4. However, the new item should have been labeled "r" and the item being modified should have been labeled "q". LRA Table A.4 is revised to clarify the item sequence. No changes to the text are being made, only to the sequence letters.

L. In the response to RAI B.1.17-2 in DTE letter NRC-15-0005, dated January 20, 2015, DTE added enhancements to the Fatigue Monitoring Program in LRA Section B.1.17. In that letter, the two new enhancements were shown as applicable to program elements 1 through 7. However, the first new enhancement was only applicable to program elements 1 through 6 and the second new enhancement was only applicable to program element 7 (i.e. the enhancements should have been separated by a table line). LRA Section B.1.17 is revised to clarify which program elements apply to the enhancements. No changes to the text are being made, only to the format of the table.

M. As discussed previously, the tables in LRA Section 3.0 include a "Notes" column and generic notes A and B are identical except that note A is used for programs that are consistent with NUREG-1801 and note B is used for programs that have exceptions to NUREG-1801. The same is true for generic notes C and D. In previous DTE letters, exceptions to NUREG-1801 were added or deleted from certain aging management programs. The line items in LRA Section 3.0 tables that reference these aging management programs and use a generic note A, B, C, or D are revised to use the appropriate note as indicated in the list below. Since these changes affect multiple line items in multiples tables in LRA Section 3.0 and the changes are administrative in nature, actual markups to the existing LRA tables are not provided in this letter.
   - DTE letter NRC-15-0056 dated May 19, 2015 revised the BWR Feedwater Nozzle Program (LRA Section B.1.6) to add an exception to NUREG-1801. For Section 3.0 table line items that reference this program, all use of generic note A associated with this program is revised to note B and all use of generic note C is revised to note D.
   - DTE letter NRC-15-0001 dated January 5, 2015 revised the BWR Stress Corrosion Cracking Program (LRA Section B.1.8) to add an exception to NUREG-1801. For Section 3.0 table line items that reference this program, all use of generic note A associated with this program is revised to note B and all use of generic note C is revised to note D.
   - DTE letter NRC-14-0051 dated July 30, 2014 revised the Fire Water System Program (LRA Section B.1.19) to add exceptions to NUREG-1801. For Section 3.0 table line items that reference this program, all use of generic note A associated with this program is revised to note B and all use of generic note C is revised to note D.
   - DTE letter NRC-15-0001 dated January 5, 2015 revised the Reactor Vessel Surveillance Program (LRA Section B.1.38) to delete the exception to NUREG-1801. For Section 3.0 table line items that reference this program, all use of generic note B associated with this program is revised to note A and all use of generic note D is revised to note C.
   - DTE letter NRC-15-0030 dated March 19, 2015 revised the Water Chemistry Control – Closed Treated Water Systems Program (LRA Section B.1.44) to add an exception to NUREG-1801. For Section 3.0 table line items that reference this program, all use of generic note A associated with this program is revised to note B and all use of generic note C is revised to note D.

N. LRA Section A.3 is a list of references for Appendix A of the LRA. In the original LRA submittal, the first reference (A.3-1) was a placeholder for the LRA submittal. LRA Section A.3 is revised to replace the placeholder reference for the LRA submittal with the actual reference.

LRA Revisions

The LRA revisions associated with the changes discussed above (both the CLB-related and administrative changes) are shown on the following pages. Additions are shown in underline and deletions are shown in strike-through. Note that previous changes made to these same LRA sections made in previous letters are not shown in underline or strike-through such that only the new changes due to the items below are shown as revisions. Since a single change may result in an impact to multiple locations in the LRA, the LRA revisions are labeled with a letter in the right margin that cross-references the change to the list above. The LRA revisions are provided in the order that they would appear in the LRA.

3.1.2.1.4 Miscellaneous RCS Systems in Scope for 10 CFR 54.4(a)(2)

Materials

Nonsafety-related components affecting safety-related systems are constructed of the following materials.

- Carbon steel
- Copper alloy
- Copper alloy >15% zinc or >8% aluminum
- Glass
- Nickel alloy | A
- Stainless steel

Table 3.1.2-4-2
Reactor Recirculation System
Nonsafety-Related Components Affecting Safety-Related Systems
Summary of Aging Management Evaluation

Table 3.1.2-4-2: Reactor Recirculation System, Nonsafety-Related Components Affecting Safety-Related Systems								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Program**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
Filter housing	Pressure boundary	Carbon steel	Lube oil (int)	Loss of material	Oil Analysis	V.D2.EP-77	3.2.1-49	C, 103
Flex connection	Pressure boundary	Nickel alloy	Air – indoor (ext)	None	None	IV.E.RP-03	3.1.1-106	A
Flex connection	Pressure boundary	Nickel alloy	Waste water (int)	Cracking – fatigue	TLAA – metal fatigue	--	--	H
Flex connection	Pressure boundary	Nickel alloy	Waste water (int)	Loss of material	Internal Surfaces in Miscellaneous Piping and Ducting Components	VII.E5.AP-279	3.3.1-95	C
Flex connection	Pressure boundary	Stainless steel	Air – indoor (ext)	None	None	IV.E.RP-04	3.1.1-107	A

A

3.2.2.1.8 Miscellaneous ESF Systems in Scope for 10 CFR 54.4(a)(2)

Aging Management Programs

The following aging management programs manage the effects of aging on nonsafety-related components affecting safety-related systems.

- Bolting Integrity
- Buried and Underground Piping | J
- External Surfaces Monitoring
- Flow-Accelerated Corrosion
- Internal Surfaces in Miscellaneous Piping and Ducting Components
- One-Time Inspection
- Periodic Surveillance and Preventive Maintenance
- Water Chemistry Control – BWR

Table 3.3.1
Summary of Aging Management Programs for the Auxiliary Systems Evaluated in Chapter VII of NUREG-1801

Table 3.3.1: Auxiliary Systems					
Item Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.3.1-95	Copper alloy, stainless steel, nickel alloy, steel piping, piping components, and piping elements, heat exchanger components, piping, piping components, and piping elements; tanks exposed to waste water, condensation (internal)	Loss of material due to pitting, crevice, and microbiologically influenced corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Loss of material for most copper alloy, nickel alloy, and stainless steel components exposed to waste water or condensation is managed by the Internal Surfaces in Miscellaneous Piping and Ducting Components Program. The Periodic Surveillance and Preventive Maintenance Program uses periodic visual inspections or other NDE techniques to manage loss of material for other components exposed to waste water. Steel components exposed to condensation are addressed in Item 3.3.1-89.

| A

Table 3.3.2-6
Compressed Air Systems
Summary of Aging Management Evaluation

Table 3.3.2-6: Compressed Air Systems								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Programs**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
Strainer	Filtration	~~Copper alloy~~ Stainless steel	Condensation (ext)	Loss of material	Compressed Air Monitoring	~~VII.D.AP-240~~ VII.D.AP-81	~~3.3.1-54~~ 3.3.1-56	B
Strainer	Filtration	~~Copper alloy~~ Stainless steel	Condensation (int)	Loss of material	Compressed Air Monitoring	~~VII.D.AP-240~~ VII.D.AP-81	~~3.3.1-54~~ 3.3.1-56	B
~~Strainer housing~~	~~Pressure boundary~~	~~Carbon steel~~	~~Air – indoor (ext)~~	~~Loss of material~~	~~External Surfaces Monitoring~~	~~VII.D.A-80~~	~~3.3.1-78~~	~~A~~
~~Strainer housing~~	~~Pressure boundary~~	~~Carbon steel~~	~~Condensation (int)~~	~~Loss of material~~	~~Compressed Air Monitoring~~	~~VII.D.A-26~~	~~3.3.1-55~~	~~B~~

B

Table 3.3.2-10
Emergency Diesel Generator System
Summary of Aging Management Evaluation

Table 3.3.2-10: Emergency Diesel Generator System								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Programs**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
Tubing	Pressure boundary	Stainless steel	Raw water (int)	Loss of Material	Service Water Integrity	VII.H2.AP-55	3.3.1-41	A
Tubing	Pressure boundary	Stainless steel	Treated water (int)	Loss of material	Water Chemistry Control – Closed Treated Water Systems	VII.C2.A-52	3.3.1-49	D
Tubing	Pressure boundary	Stainless steel	Treated water > 140°F (int)	Cracking	Water Chemistry Control – Closed Treated Water Systems	VII.C2.AP-186	3.3.1-43	C
Valve body	Pressure boundary	Carbon steel	Condensation (int)	Loss of material	Compressed Air Monitoring	VII.D.A-26	3.3.1-55	D
Valve body	Pressure boundary	Carbon steel	Lube oil (ext)	Loss of material	Oil Analysis	VII.H2.AP-127	3.3.1-97	A, 302
Valve body	Pressure boundary	Carbon steel	Lube oil (int)	Loss of material	Oil Analysis	VII.H2.AP-127	3.3.1-97	A, 302

C

G

Table 3.3.2-15
Fuel Oil Systems
Summary of Aging Management Evaluation

Table 3.3.2-15: Fuel Oil Systems								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Programs**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
Tank	Pressure boundary	Carbon steel	Soil (ext)	Loss of Material	Aboveground Metallic Tanks	VII.H1.A-402	3.3.1-129	A
Tubing	Pressure boundary	Carbon steel	Air – indoor (ext)	Loss of material	External Surfaces Monitoring	VII.I.A-77	3.3.1-78	A
Tubing	Pressure boundary	Carbon steel	Fuel oil (int)	Loss of material	Diesel Fuel Monitoring	VII.H1.AP-105	3.3.1-70	A, 303
Tubing	Pressure boundary	Stainless steel	Air – indoor (ext)	None	None	VII.J.AP-123	3.3.1-120	A

D

Table 3.4.2-3-4
Heater Drains System
Nonsafety-Related Components Affecting Safety-Related Systems
Summary of Aging Management Evaluation

Table 3.4.2-3-4: Heater Drains System, Nonsafety-Related Components Affecting Safety-Related Systems								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Programs**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
Valve body	Pressure boundary	Carbon steel	Waste water (int)	Loss of material	Periodic Surveillance and Preventive Maintenance	VII.E5.AP-281	3.3.1-91	E
Valve body	Pressure boundary	Carbon steel with nickel alloy clad	Air – indoor (ext)	Loss of material	External Surfaces Monitoring	--	--	F
Valve body	Pressure boundary	Carbon steel with nickel alloy clad	Treated water (int)	Cracking – fatigue	TLAA – metal fatigue	--	--	F
Valve body	Pressure boundary	Carbon steel with nickel alloy clad	Treated water (int)	Loss of material	Water Chemistry Control – BWR	--	--	F
Valve body	Pressure boundary	Copper alloy > 15% Zn or > 8% Al	Air – indoor (ext)	None	None	VIII.I.SP-6	3.4.1-54	A

E

Table 3.4.2-3-6
Condenser and Auxiliaries System
Nonsafety-Related Components Affecting Safety-Related Systems
Summary of Aging Management Evaluation

Table 3.4.2-3-6: Condenser and Auxiliaries System, Nonsafety-Related Components Affecting Safety-Related Systems

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Cooler housing	Pressure boundary	Carbon steel	Treated water (int)	Loss of material	Water Chemistry Control – BWR	VIII.E.SP-77	3.4.1-15	C, 401
Ejector	Pressure boundary	Carbon steel	Air – indoor (ext)	Loss of material	External Surfaces Monitoring	VIII.H.S-29	3.4.1-34	A
Ejector	Pressure boundary	Carbon steel	Steam (int)	Loss of material	Water Chemistry Control – BWR	VIII.A.SP-71	3.4.1-14	D, 401
Ejector	Pressure boundary	Carbon steel	Treated water (int)	Loss of material	Water Chemistry Control – BWR	VIII.E.SP-73	3.4.1-14	D, 401
~~Ejector~~	~~Pressure boundary~~	~~Stainless steel~~	~~Air – indoor (ext)~~	~~None~~	~~None~~	~~VIII.I.SP-12~~	~~3.4.1-58~~	~~A~~
~~Ejector~~	~~Pressure boundary~~	~~Stainless steel~~	~~Treated water (int)~~	~~Loss of material~~	~~Water Chemistry Control – BWR~~	~~VIII.E.SP-87~~	~~3.4.1-16~~	~~C, 401~~

F

4.3 METAL FATIGUE

4.3.1 Class 1 Fatigue Analyses

Fatigue evaluations were performed in the design of Class 1 components. Class 1 fatigue evaluations are contained in analyses and stress reports, and because they are based on a number of transient cycles assumed for a 40-year operating term, these evaluations are considered TLAA.

Based on the numbers of cycles accrued to date, the numbers of cycles at the end of 60 years of operation were projected as shown in Table 4.3-1. The projections are linear projections based of the rate of the occurrence from January 1, 2000, through December 31, 2012, except where identified by footnotes.

Fermi 2 recently reviewed the transient cycles that require counting and updated the cycle counts. These reviews provide the basis for the transient cycles that are listed in Table 4.3-1. The Fatigue Monitoring Program (Section B.1.17) tracks these transient cycles to manage the effects of fatigue for Class 1 components. The review included evaluation of transient cycle assumptions for locations that had been exempt from fatigue. ~~The review identified one location that did not meet the fatigue exemption criteria when considering the projected cycles for 60 years. This has been identified in the Corrective Action Program, and further evaluation will reassess the exemption and calculate the fatigue usage for that location, if necessary.~~ The locations that were previously exempt from fatigue evaluation meet the fatigue exemption criteria considering 60 years of operation. H

The Fatigue Monitoring Program tracks transient cycles and requires corrective actions if the numbers of cycles approach analyzed values. The Fatigue Monitoring Program ensures that the numbers of transient cycles experienced by the plant remain within the allowable numbers of cycles. It provides for use of cycle-based fatigue or stress-based fatigue monitoring methods if a component's cumulative usage factor based on cycle counting is projected to exceed 1.0 after the environmentally assisted fatigue (EAF) calculations are complete. Appendix B, Section B.1.17, provides further details on the Fatigue Monitoring Program. H

4.3.1.1 Reactor Pressure Vessel

As described in UFSAR Section 5.4.6.3.1 and shown in UFSAR Figure 5.4-1, the RPV is a vertical, cylindrical pressure vessel with hemispherical heads of welded construction. The vessel design data are listed in UFSAR Table 5.4-1. The RPV thermal cycles are listed in Table 4.3-1. The RPV is designed, fabricated, tested, inspected, and stamped in accordance with the ASME B&PV Code Section III, 1968, Class 1, up to and including summer 1969 Addenda.

Sections 4.3.1.2 and 4.3.1.3 provide additional details on the review of feedwater nozzle and underclad cracking. Table 4.3-2 lists the CUFs for the reactor vessel (Ref. 4-16). H

Fermi 2 will monitor transient cycles using the Fatigue Monitoring Program (Section B.1.17) and assure that action is taken if any of the actual cycles approach their analyzed numbers. As such, the Fatigue Monitoring Program will manage the effects of aging due to fatigue on the reactor pressure vessel in accordance with 10 CFR 54.21(c)(1)(iii).

Table 4.3-2
Reactor Pressure Vessel Cumulative Usage Factors

General Location	Location/Node	CUF
CRD return nozzle	Nozzle-vessel intersection	0.683
	Cap	Bounded by the nozzle
Recirculation outlet nozzles	Nozzle-vessel intersection	0.258
	Safe end	0.103
	Nozzle	0.116
Recirculation inlet nozzles	Nozzle-vessel intersection	0.054
	Safe end	0.002
	Liner, Cut 2, inside surface	0.220
Core ΔP nozzle	Cut II, outside surface	0.637
CRD nozzles	Cut 6	0.645
Basin seal skirt		0.162
Shroud support	Cut 3a	0.111
4" Vent nozzle bolts		0.318
6" Instrument/head spray nozzle bolts		0.382
CRD assembly	Main flange	0.146

H

4.3.1.4 Reactor Pressure Vessel Internals

As described in UFSAR Section 4.1.2, the major Fermi 2 reactor internal components are the core (fuel, channels, control rods, and instrumentation), the core support structure (including the core shroud, shroud head separators, top guide, and core support plate), the steam dryer assembly, and the jet pumps. Table 4.3-3 identifies the usage factors that were calculated for the RVI locations that are subject to aging management review (Ref. 4-16). H

Table 4.3-3
RPV Internals Cumulative Usage Factors

General Location	Location/Node	CUF
Core spray lines		0.287
Jet pump riser braces		0.266
Access hole covers	Ring to cover	0.380
	Ring to adaptor ring	0.163
	Adaptor ring to shroud support plate	0.876
Jet pump auxiliary spring wedges	Spring half	0.000
	Right half	0.000
Feedwater sparger	Sparger pipe to spray nozzle	0.598
	Thermal sleeve to reducer tee	0.497
	Sparger pipe to end plate	0.400

H

4.3.1.5 Reactor Pressure Vessel Internals

NPVC 1 (NPVC - 1, 2, 3 Draft ASME Code for Pumps and Valves for Nuclear Power, Class I, II, III). As identified in Note z of UFSAR Table 3.2-1 and UFSAR Table 3.2-4 Note j, the reactor recirculation pumps were upgraded to the 4th generation design, and the modified components were designed and manufactured to ASME III, 1989. Representative analyses of recirculation pumps are summarized in UFSAR Table 3.9-20. The transients that require tracking are included in Table 4.3-1. Table 4.3-4 provides the CUFs for the reactor recirculation pumps (Ref. 4-16). H

4.3.1.6 Class 1 Piping

Detailed fatigue analyses were generated to analyze multiple locations on each system within the Class 1 boundary. The transients that require tracking are included in Table 4.3-1. Table 4.3-6 provides the highest piping cumulative usage factors (Ref. 4-16), and Table 4.3-7 provides the associated valve cumulative usage factors (Ref. 4-16). H

Table 4.3-6
Piping Cumulative Usage Factors

General Location	Location/Node	CUF	
Div. 2 core spray piping inside containment (CS-01)	Node 95	0.035	
Div. 1 core spray piping inside containment (CS-02)	Node 90	0.032	
Div. 2 core spray piping outside containment (CS-03)	Node 7	0.007	
Div. 1 core spray piping outside containment (CS-05)	Node 6	0.011	
Main steam piping outside containment (MS-05)	Node 960	0.003	
RWCU supply piping inside drywell	Node 030B	0.043	
RWCU supply piping outside drywell	Node 387	0.036	
Div. 1 & 2 RHR return piping outside drywell (RHR-02)	Node 5	0.136	
Div. 1 & 2 RHR supply piping outside drywell (RHR-07)	Node 9	0.055	
Feedwater Loop B piping inside drywell (FW-01)	Node 40	0.071	
Feedwater Loop A piping inside drywell (FW-02)	Node 40	0.101	
Feedwater Loop B piping outside drywell (FW-04)	Node 16	0.003 ~~0.246~~	H
Feedwater Loop A piping outside drywell (FW-05)	Node 305	0.010 ~~0.128~~	
RCIC steam supply piping outside drywell (RCIC-01)	Node 6	0.001	
HPCI steam supply piping outside drywell (HPCI-02)	Nodes 6 & 8	0.002	
SLC piping inside containment	Node 55 ~~N/A~~	0.097 ~~Note 1~~	H
SLC piping outside containment	Node 95	0.056	
Main steam drain piping inside drywell	Node 50	0.047	
Main steam drain piping outside drywell	Node 50	0.022	

Table 4.3-6
Piping Cumulative Usage Factors

General Location	Location/Node	CUF
RPV vent line from RPV to bulkhead piping	Node 17	0.181 ~~0.375~~
RPV vent line from bulkhead to drain manifold piping	Node 33W/412	0.026 ~~0.077~~
RPV vent line from bulkhead to main steam A piping	Node 43W/397	0.228 ~~0.501~~
Main steam line A and HPCI steam piping	Node 102	0.085
Main steam line B and RCIC steam piping	Node 200	0.174
Main steam line C piping	Node 200	0.147
Main steam line D piping	Node 200	0.054
Recirculation A and Div. 1 RHRR piping	Node 250	0.012
Recirculation B, RHRS and Div. 2 RHRR piping	Node 516	0.011
Condensing chambers	B2102D006A & C	0.410

~~Note 1: The projected 40-year CUF for this location is 0.893. The projected 60-year CUF for this location is greater than 1.0, and this has been identified in the Corrective Action Program. Potential solutions include repair of the component, replacement of the component, a more rigorous analysis of the component, or monitoring and tracking cycles to ensure fatigue limits are not exceeded.~~

4.3.3 Effects of Reactor Water Environment on Fatigue Life

Industry test data indicate that certain environmental factors (such as temperature and dissolved oxygen content) in the primary systems of light water reactors could result in greater susceptibility to fatigue than would be predicted by fatigue analyses based on the ASME Section III design fatigue curves. The ASME design fatigue curves were based on laboratory tests in air at low temperatures. Although the fatigue curves derived from laboratory tests were adjusted to account for effects such as data scatter, size, and surface finish, these adjustments may not be sufficient to account for actual reactor water operating environments.

As reported in SECY-95-245, the NRC believes that no immediate staff or licensee action is necessary to deal with the environmentally assisted fatigue issue. In addition, the staff concluded that it could not justify requiring a backfit of the environmental fatigue data to operating plants. However, the NRC concluded that environmentally assisted fatigue should be evaluated for any proposed extended period of operation for license renewal because metal fatigue effects increase with service life.

NUREG/CR-6260 addresses the application of environmental correction factors to fatigue analyses (CUFs) and identifies locations of interest for consideration of environmental effects (Ref. 4-13). NUREG/CR-6260 identified the following component locations to be the most sensitive to environmental effects for General Electric plants.

(1) Reactor vessel shell and lower head
(2) Reactor vessel feedwater nozzle
(3) Reactor recirculation piping (including inlet and outlet nozzles)
(4) Core spray line reactor vessel nozzles and associated Class 1 piping
(5) Residual heat removal nozzles and associated Class 1 piping
(6) Feedwater line Class 1 piping

~~Fermi 2 evaluated these six locations as a screening evaluation in Table 4.3-8 using the guidance provided in NUREG-1801, Revision 2. NUREG-1801, Revision 2 calls for using the guidance (formulas) provided in NUREG/CR-6909 (Ref. 4-15) to calculate environmentally assisted fatigue correction factors (F_{en}) for nickel alloy components but specifies that NUREG/CR-6583 (Ref. 4-14) may be used for carbon and low alloy steel, and NUREG/CR-5704 (Ref. 4-12) may be used for austenitic stainless steel.~~

Environmentally assisted fatigue (EAF) screening was performed (Ref. 4-17) for these NUREG/CR-6260 locations and the remaining ASME Class 1 reactor pressure vessel and piping locations for which fatigue had been assessed that are (1) wetted (in contact with liquid reactor coolant) and (2) form part of the reactor coolant pressure boundary. All wetted reactor coolant pressure boundary locations with CUF calculations were addressed, so determination of thermal zones was not required. The components with the highest calculated CUF in each system were evaluated for the effects of EAF. H

The evaluation of environmentally assisted fatigue included an evaluation of the water chemistry history to determine the cumulative environment for the components when determining the dissolved oxygen (DO). Values were determined for six zones in the primary system, using data from the three chemistry regimes used historically (Normal Water Chemistry, Hydrogen Water Chemistry, and On-line Noble Metal Chemistry). ~~Using the availability data, there was the equivalent of over 12 full years of hydrogen water chemistry (HWC) from 1997 to the end of 2012. A 95 percent availability in 2013 through March 2045 would result in over 30 more years of HWC. This screening analysis will therefore use 42 years as a best estimate of the time for HWC (42 years with HWC and 18 [60-42] years without HWC).~~

~~Based on water samples taken prior to HWC control, 140 ppb dissolved oxygen is considered a representative value for the water chemistry in the reactor vessel and attached piping (other than feedwater) for the period of operation prior to HWC. Prior to the implementation of HWC, a representative value for feedwater dissolved oxygen based on sampling is 20 ppb. Following implementation of HWC, the oxygen concentrations in the vessel and attached piping (other than feedwater) are less than 5 ppb. A representative value for feedwater following HWC is 35 ppb.~~

The screening evaluation used guidance in NUREG/CR-6909 (Ref. 4-15), as allowed by NUREG-1801, Revision 2. The fatigue curves in NUREG/CR-6909 were applied for all materials. The methodology discussed in EPRI 1024995, "Environmentally Assisted Fatigue Screening: Process and Technical Basis for Identifying EAF Limiting Locations" was used as guidance to determine which locations are bounding. These locations are referred to as Sentinel locations. The Sentinel locations are monitored to manage the effects of aging including EAF in the period of extended operation. H

The environmental correction factor (F_{en}) calculation followed the formulas in NUREG/CR-6909. The historical dissolved oxygen chemistry input from the plant was used to account for the various chemistry zones and regimes that existed in the plant operating history and future projections when calculating the correction factor (F_{en}) for 60 years. Fatigue calculations for 60 years used the projected cycles from Table 4.3-1.

The results of the EAF screening calculation were used to determine the bounding components based on fatigue, including EAF effects.

To summarize the approach taken in the EAF screening evaluation, the following steps were followed for each one of the components that have calculated CUFs:

- Pre-screening to establish the eligibility of the component for further EAF evaluation (e.g. wetted or not).
- Determine the bounding location in terms of fatigue for the component.
- Apply NUREG/CR-6909 fatigue curves.
- Obtain alternating stresses from design information.

- Calculate the environmental correction factor, F_{en}, using the formulas in NUREG/CR-6909 and the least favorable conditions for sulfur content in metal, strain rate and temperature in thermal transient along with the zone-specific DO values.
- Apply time weighted average F_{en} factor to increase the fatigue usage.
- Compare against EAF criterion of 1.0 and the Sentinel location screening threshold value of 0.8.

~~The following equations were utilized in determining environmental fatigue correction factors.~~

~~*Carbon Steel*~~

~~The environmentally assisted fatigue correction factor (F_{en}) for carbon steel is calculated using NUREG/CR-6583, Equation 6.5a.~~

~~*Low Alloy Steel*~~

~~The environmentally assisted fatigue correction factor (F_{en}) for low alloy steel is calculated using NUREG/CR-6583, Eq. 6.5b.~~

~~*Wrought and Cast Austenitic Stainless Steels*~~ H

~~The environmentally assisted fatigue correction factor (F_{en}) for wrought and cast austenitic stainless steels is calculated using NUREG/CR-5704, Eq. 13.~~

~~*Nickel-Chromium-Iron (Ni-Cr-Fe) Alloys*~~

~~The environmentally assisted fatigue correction factor (F_{en}) for Ni-Cr-Fe alloys is calculated using NUREG/CR-6909, Eq. A.14. To recalculate F_{en} using NUREG-6909 requires the use of updated fatigue tables. This will be addressed by the commitment identified in this section to complete a reanalysis prior to the period of extended operation.~~

The screening calculations determined that some components have a calculated CUF_{en} greater than 1.0. Where this occurred, the locations were re-evaluated with reduced F_{en} multipliers using average transient temperatures (based on NUREG/CR-6909 guidance) or average load pair temperatures where available. The results of the EAF screening are shown in Table 4.3-8. Sentinel locations are noted in Table 4.3-8.

As shown in Table 4.3-8, this screening has determined that there are locations that, when accounting for environmental effects, have projected usage factors greater than 1.0. Additional action will be needed, e.g. more detailed analysis or stress-based or cycle-based fatigue monitoring, as part of the Fatigue Monitoring Program (Section B.1.17) for these locations. DTE H
will update the fatigue usage calculations using refined fatigue analyses to determine ~~valid~~ CUFs less than 1.0 when accounting for the effects of reactor water environment prior to the period of extended operation or institute stress-based fatigue (SBF) or cycle-based fatigue

(CBF) monitoring to demonstrate CUFs remain less than 1.0. ~~This includes applying the appropriate F_{en} factors to valid CUFs determined using an NRC-approved version of the ASME code or NRC-approved alternative (e.g., NRC-approved code case). DTE will review design basis ASME Class 1 component fatigue evaluations to ensure the Fermi 2 locations evaluated for the effects of the reactor coolant environment on fatigue include the most limiting components within the reactor coolant pressure boundary. Environmental effects on fatigue for these critical components will be evaluated using one of the following sets of formulae.~~

~~*Carbon and low alloy steels*~~

- ~~Those provided in NUREG/CR-6583, using the applicable ASME Section III fatigue design curve.~~
- ~~Those provided in Appendix A of NUREG/CR-6909, using either the applicable ASME Section III fatigue design curve or the fatigue design curve for carbon and low alloy steel provided in NUREG/CR-6909 (Figures A.1 and A.2, respectively, and Table A.1).~~
- ~~An NRC-approved alternative.~~

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~~*Austenitic stainless steels*~~

- ~~Those provided in NUREG/CR-5704, using the applicable ASME Section III fatigue design curve.~~
- ~~Those provided in NUREG/CR-6909, using the fatigue design curve for austenitic stainless steel provided in NUREG/CR-6909 (Figure A.3 and Table A.2).~~
- ~~An NRC-approved alternative.~~

~~*Nickel alloys*~~

- ~~Those provided in NUREG/CR-6909, using the fatigue design curve for austenitic stainless steel provided in NUREG/CR-6909 (Figure A.3 and Table A.2).~~
- ~~An NRC-approved alternative.~~

Fermi 2 manages the effects of fatigue, including environmentally assisted fatigue, under the Fatigue Monitoring Program (Section B.1.17) for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

Table 4.3-8
EAF Screening of Fermi 2 Locations

NUREG/CR-6260 Generic Location		Fermi 2 Location	Material[1]~~[(a)]~~	CUF	F_{en}	EAF CUF
1	Reactor vessel shell and lower head	Reactor vessel shell[2]	LAS	0.021 ~~0.054~~	7.21 ~~5.72~~	0.153 ~~0.309~~
1	Reactor vessel shell and lower head	CRD nozzle[2]	NBA~~[(b)]~~	0.630 ~~0.645~~	1 - 3.45[3] ~~3.18~~	1.28[4] ~~>1~~
2	Reactor vessel feedwater nozzle	FW nozzle safe end (CS portion)[2]	CS	0.087 ~~0.267~~	1.88 ~~1.74~~	0.164 plus 0.0014 rapid cycling = 0.165 ~~0.465~~
2	Reactor vessel feedwater nozzle	FW nozzle safe end (SS portion)[2]	SS	0.664 ~~0.585~~	6.6 - 9.8[3] ~~15.35~~	6.364 plus 0.0014 rapid cycling = 6.37[4] ~~>1~~
2	Reactor vessel feedwater nozzle	Nozzle-vessel intersection[2]	LAS	0.0154 ~~0.037~~	6.10 ~~5.72~~	0.0942 ~~0.212~~ plus 0.0206 ~~0.021~~ rapid cycling = 0.115 ~~0.233~~
3	Reactor recirculation piping (including inlet and outlet nozzles)	RR inlet nozzle liner	SS	~~0.220~~	~~13.25~~	Note 5 ~~>1~~
3	Reactor recirculation piping (including inlet and outlet nozzles)	RR inlet nozzle safe end[2]	SS	0.006 ~~0.002~~	11.20 ~~13.25~~	0.071 ~~0.027~~
3	Reactor recirculation piping (including inlet and outlet nozzles)	RR inlet nozzle nozzle-vessel intersection[2]	LAS	0.023 ~~0.054~~	4.06 ~~5.72~~	0.095 ~~0.309~~
3	Reactor recirculation piping (including inlet and outlet nozzles)	RR outlet nozzle nozzle-vessel intersection[2]	LAS	0.112 ~~0.258~~	4.06 ~~5.72~~	0.453 ~~>1~~

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Table 4.3-8
EAF Screening of Fermi 2 Locations

NUREG/CR-6260 Generic Location		Fermi 2 Location	Material[1]~~[(a)]~~	CUF	F_{en}	EAF CUF
3	Reactor recirculation piping (including inlet and outlet nozzles)	RR outlet nozzle safe end[2]	SS	0.021 ~~0.103~~	11.2 ~~13.25~~	0.240 ~~>1~~
		RR outlet nozzle	LAS	~~0.116~~	~~5.72~~	Bounded by nozzle-vessel intersection ~~0.664~~
3	Reactor recirculation piping (including inlet and outlet nozzles)	RR piping[2]	SS	0.018 ~~0.012~~	11.2 ~~13.25~~	0.199 ~~0.159~~
3	Reactor recirculation piping (including inlet and outlet nozzles)	RR valve	SS	~~0.215~~	~~13.25~~	Bounded by adjacent piping ~~>1~~
4	Core spray line reactor vessel nozzle and associated Class 1 piping	Core spray nozzle –vessel intersection[2]	LAS	0.048 ~~0.114~~	5.31 ~~5.72~~	0.254 ~~0.652~~
4	Core spray line reactor vessel nozzle and associated Class 1 piping	Core spray nozzle safe end[2]	NBA~~[(b)]~~	0.075 ~~0.079~~	3.65 ~~3.18~~	0.273 ~~0.251~~
4	Core spray line reactor vessel nozzle and associated Class 1 piping	Core spray valve	CS	0.0152 ~~0.048~~	4.95 ~~1.74~~	0.075 ~~0.084~~
4	Core spray line reactor vessel nozzle and associated Class 1 piping	Core spray piping[2]	CS	0.0091 ~~0.035~~	4.95 ~~1.74~~	0.045 ~~0.061~~
5	Residual heat removal (RHR) nozzles and associated Class 1 piping	RHR valve	CS	0.063 ~~0.140~~	3.78 ~~4.07~~	0.239 ~~0.570~~

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Table 4.3-8
EAF Screening of Fermi 2 Locations

NUREG/CR-6260 Generic Location		Fermi 2 Location	Material[1]~~(a)~~	CUF	F_{en}	EAF CUF
5	Residual heat removal (RHR) nozzles and associated Class 1 piping	RHR piping[2]	CS	0.048 ~~0.136~~	3.78 ~~4.07~~	0.180 ~~0.554~~
6	Feedwater line Class 1 piping	FW valve	CS	0.063 ~~0.140~~	3.78 ~~1.74~~	0.239 ~~0.244~~
6	Feedwater line Class 1 piping	FW piping[2]	CS	0.0003 ~~0.246~~	3.78 ~~1.74~~	0.0012 ~~0.428~~
--	--	RWCU piping	CS	0.014	3.78	0.052
--	--	RWCU valve	CS	0.018	3.78	0.069
--	--	HPCI valve	CS	0.053	1.88	0.099
--	--	SLCS piping	SS	0.108	2.42 - 9.73[3]	0.503
--	--	Containment penetrations:				
		X-13A/B, RHR return weld[2]	CS	0.086	3.78	0.326
		Highest non-Sentinel: X-12 body, RHR supply	CS	0.181	3.78	0.685
--	--	Condensing chamber[2]	SS	0.385	9.73	3.75[4]
--	--	Core ΔP nozzle[2]	NBA	0.580	2.55	1.48[4]
--	--	CRD assembly, main flange	SS	0.134	2.45	0.329

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Table 4.3-8
EAF Screening of Fermi 2 Locations

NUREG/CR-6260 Generic Location		Fermi 2 Location	Material[1(a)]	CUF	F_{en}	EAF CUF
--	--	RR pump cooler[2]	SS	0.150	3.86	0.581

1. CS: carbon steel. LAS: low alloy steel. NBA: nickel-based alloy. SS: stainless steel.
2. This component is a sentinel location.
3. F_{en} was calculated for each transient or load pair based on average temperature.
4. CUF_{en} is above 1, so additional action will be needed, e.g. more detailed analysis or stress based monitoring.
5. Not part of reactor coolant pressure boundary, so no EAF evaluation is needed.

a. CS: carbon steel. LAS: low alloy steel. NBA: nickel-based alloy. SS: stainless steel.
b. This is a nickel alloy location that will require reanalysis of usage factor with new fatigue curves in accordance with NUREG/CR 6909.

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4.6 CONTAINMENT LINER PLATE, METAL CONTAINMENT, AND PENETRATIONS FATIGUE ANALYSES

4.6.1 Primary Containment

The usage factors are identified in Table 4.6-1 (Ref. 4-16). The SRV actuations and seismic cycles are tracked and will be maintained below the cycle value used in the fatigue evaluation, or reanalysis will be completed. Fermi 2 will manage the aging effects due to fatigue using the Fatigue Monitoring Program (Section B.1.17) in accordance with 10 CFR 54.21(c)(1)(iii). | H

4.6.5 Containment Penetrations

As described in UFSAR Section 3.8.2.1.3.1, sleeved penetration assemblies with bellows consist of the process pipe, guard pipe, penetration sleeve bellows, and flued head. For Class 1 piping (Fermi 2 Group A), the design of the flued head meets ASME Section III Class 1 requirements, which specify a fatigue analysis that determines the cumulative usage factor for the flued head. UFSAR Figure 3.8-9 provides a cross-sectional drawing of the penetration assemblies and a listing of the penetrations that utilize this design (designated as Type I). The usage factors are shown in Table 4.6-2 for these flued head penetrations (Ref. 4-16) based on the number of cycles shown in the analysis input value column in Table 4.3-1. | H

Table 4.6-2
Cumulative Usage Factors for Flued Head Penetrations

Location/Node	CUF
Penetrations X-9A / B (Feedwater A, B)	~~0.464~~ 0.471
Penetration X-10 (RCIC steam supply)	0.046
Penetration X-12 (RHR supply)	0.416
Penetrations X-16A / B (Core spray A, B)	0.405
Penetrations X-7A-D (Main steam lines A through D)	0.271
Penetration X-8 (Main steam line drains)	0.094
Penetration X-11 (HPCI steam supply)	0.020
Penetrations X-13A / B (RHR return A, B)	0.371
Penetration X-43 (Reactor water clean up)	~~0.267~~ 0.144
Penetration X-42 (Standby liquid control)	0.002

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4.7 OTHER PLANT-SPECIFIC TLAAS

4.7.2 Determination of High-Energy Line Break Locations

UFSAR Sections 3.6.1 and 3.6.2 state that the method used to determine the intermediate locations of pipe breaks in high-energy lines includes an evaluation based on CUFs being less than 0.1 if other stress criteria are also met.

Design criteria for piping between the primary containment and outboard isolation valves provide for maximum stresses considering all normal and upset conditions as calculated by the equations in Paragraph NB-3653 of ASME B&PV Code Section III. UFSAR Section 3.6.2.1.2.2 states that pipe breaks were not postulated in the high energy piping between the containment penetration and outboard isolation valves since the piping was conservatively designed and restrained. The calculated CUFs for containment penetration piping were also limited to values less than 0.1 if equation 10 of NB-3653 exceeds 2.4 S_m.

The CUFs, as calculated in the design fatigue analyses, are based on the design transients assumed for the original 40-year life of the plant; therefore, the CUF analyses used in the selection of postulated high-energy line break locations are considered TLAAs.

The Fatigue Monitoring Program (Section B.1.17) identifies when the transients affecting high-energy piping systems are approaching their analyzed numbers of cycles. ~~The modification of the Fermi 2 fatigue calculations to account for the projected cycles for 60 years resulted in locations with CUFs above the 0.1 criteria for HELB exclusion. These have been entered into the Fermi 2 Corrective Action Program and reanalysis or other corrective actions will be completed as necessary.~~ Re-analyses of the limiting locations where a break is not already assumed for 60 years of projected cycles resulted in CUFs meeting the 0.1 criterion for high-energy line break exclusion (Ref. 4-16). H

DTE Electric will manage the effects of aging associated with the fatigue analyses used in the selection of postulated high-energy line break locations using the Fatigue Monitoring Program (Section B.1.17) in accordance with 10 CFR 54.21(c)(1)(iii).

4.8 REFERENCES

4-12 ~~NUREG/CR-5704 (ANL-98/31), *Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels*, April 1999.~~ Deleted H

4-13 NUREG/CR-6260, (INEL 95/0045) *Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components*, February 1995.

4-14 ~~NUREG/CR-6583 (ANL-97/18), *Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low-Alloy Steels*, February 1998.~~ Deleted H

4-15 NUREG/CR-6909 (ANL-06/08), *Effect of LWR Coolant Environments on the Fatigue Life of Reactor Materials*, February 2007.

4-16 Design Calculation DC-6222, "ASME Operating Plant Fatigue Assessment for License Renewal – RCPB Components", Revision A, March 2015.

4-17 Structural Integrity Associates Calculation 1400966.301, "Fermi 2 Environmental Assisted Fatigue (EAF) Screening", Revision 2, May 2015. H

A.1.43 Water Chemistry Control – BWR

The Water Chemistry Control – BWR Program manages loss of material, cracking, and fouling in components exposed to a treated water environment through periodic monitoring and control of water chemistry. The Water Chemistry Control – BWR Program monitors and controls water chemistry parameters such as pH, chloride, conductivity, and sulfate. EPRI Report ~~1016579~~ 3002002623 is used to provide guidance. I

The One-Time Inspection Program utilizes inspections or non-destructive evaluations of representative samples to verify that the Water Chemistry Control – BWR Program has been effective at managing aging effects. The representative sample includes low flow and stagnant areas.

A.2.2 Metal Fatigue

A.2.2.1 Class 1 Metal Fatigue Analyses

Fatigue evaluations were performed in the design of the Fermi 2 Class 1 components. Class 1 fatigue evaluations are contained in analyses and stress reports, and because they are based on a number of transient cycles assumed for a 40-year operating term, these evaluations are considered time-limited aging analyses.

The Fatigue Monitoring Program (Section A.1.17) tracks transient cycles and requires corrective actions if the numbers of cycles approach analyzed values. It provides for use of cycle-based fatigue or stress-based fatigue monitoring methods if a component's cumulative usage factor based on cycle counting is projected to exceed 1.0 after the environmentally assisted fatigue (EAF) calculations are complete. The Fatigue Monitoring Program will manage the effects of aging due to fatigue in accordance with 10 CFR 54.21(c)(1)(iii). H

The following provides additional information for specific Class 1 components.

A.2.2.3 Effects of Reactor Water Environment on Fatigue Life

NUREG/CR-6260 addresses the application of environmental correction factors to fatigue analyses (cumulative usage factors [CUFs]) and identifies locations of interest for consideration of environmental effects. NUREG/CR-6260 identified the following component locations to be the most sensitive to environmental effects for General Electric plants.

(1) Reactor vessel shell and lower head
(2) Reactor vessel feedwater nozzle
(3) Reactor recirculation piping (including inlet and outlet nozzles)
(4) Core spray line reactor vessel nozzles and associated Class 1 piping
(5) Residual heat removal nozzles and associated Class 1 piping
(6) Feedwater line Class 1 piping

Environmentally assisted fatigue (EAF) screening was performed for these NUREG/CR-6260 locations and the remaining ASME Class 1 reactor pressure vessel and piping locations for which fatigue had been assessed that are (1) wetted (in contact with liquid reactor coolant) and (2) form part of the reactor coolant pressure boundary. The components with the highest calculated CUF in each system were evaluated for the effects of EAF. The screening evaluation used guidance in NUREG/CR-6909, as allowed by NUREG-1801, Revision 2. The fatigue curves in NUREG/CR-6909 were applied for all materials. The methodology discussed in EPRI 1024995, "Environmentally Assisted Fatigue Screening: Process and Technical Basis for Identifying EAF Limiting Locations" was used as guidance to determine which locations are bounding. These locations are referred to as Sentinel locations. The Sentinel locations are H monitored to manage the effects of aging including EAF in the period of extended operation. Fermi 2 performed a screening evaluation of these six locations using the guidance provided in NUREG-1801, Revision 2. This screening has determined there are locations that, when accounting for environmental effects, have projected usage factors greater than 1.0. Additional action will be needed, e.g. more detailed analysis or stress-based or cycle-based fatigue monitoring, as part of the Fatigue Monitoring Program (Section A.1.17) for these locations. Fermi 2 will update the fatigue usage calculations using refined fatigue analyses to determine valid CUFs less than 1.0 when accounting for the effects of reactor water environment prior to the period of extended operation. This includes applying the appropriate F_{en} factors to valid CUFs determined using an NRC-approved version of the ASME code or NRC-approved alternative (e.g., NRC-approved code case). Fermi 2 will review design basis ASME Class 1 component fatigue evaluations to ensure the Fermi 2 locations evaluated for the effects of the reactor coolant environment on fatigue include the most limiting components within the reactor coolant pressure boundary. Environmental effects on fatigue for these critical components will be evaluated using one of the following sets of formulae:

- Carbon and low alloy steels
  - Those provided in NUREG/CR-6583, using the applicable ASME Section III fatigue design curve.
  - Those provided in Appendix A of NUREG/CR-6909, using either the applicable ASME Section III fatigue design curve or the fatigue design curve for carbon and low alloy steel provided in NUREG/CR-6909 (Figures A.1 and A.2, respectively, and Table A.1).
  - An NRC-approved alternative.
- Austenitic stainless steels
  - Those provided in NUREG/CR-5704, using the applicable ASME Section III fatigue design curve.
  - Those provided in NUREG/CR-6909, using the fatigue design curve for austenitic stainless steel provided in NUREG/CR-6909 (Figure A.3 and Table A.2).
  - An NRC-approved alternative.
- Nickel alloys
  - Those provided in NUREG/CR-6909, using the fatigue design curve for austenitic stainless steel provided in NUREG/CR-6909 (Figure A.3 and Table A.2).
  - An NRC-approved alternative.

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Fermi 2 will manage the effects of fatigue, including environmentally assisted fatigue, under the Fatigue Monitoring Program (Section A.1.17) for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

A.3 REFERENCES

A.3-1 [Fermi 2 License Renewal Application—later] DTE Electric Company to NRC, "Fermi 2 License Renewal Application," NRC-14-0028, letter dated April 24, 2014 (ML14121A554). N

A.3-2 [NRC Safety Evaluation Report for Fermi 2 License Renewal—later]

A.3-3 DTE Electric Company to NRC, "License Amendment Request for Measurement Uncertainty Recapture (MUR) Power Uprate," NRC-13-0004, letter dated February 7, 2013 (ML13043A659).

A.3-4 NRC to DTE Electric, "Fermi 2—Issuance of Amendment re: Measurement Uncertainty Recapture Power Uprate (TAC NO. MF0650)," letter dated February 10, 2014 (ML13364A131).

A.4 LICENSE RENEWAL COMMITMENT LIST

No.	Program or Activity	Commitment	Implementation Schedule	Source
14	Fire Water System	Enhance Structures Monitoring Program as follows: ~~p~~ q. If the decreasing trend in fire water system flow tests is not resolved through the Corrective Action Program prior to the period of extended operation, revise Fire Water System Program procedures to continue performing annual fire water system flow tests during the period of extended operation until such a time as trend data from fire water system flow tests indicates that the system will be capable of performing its intended function throughout the period of extended operation and therefore TRM frequency may be resumed. ~~q~~ r. Revise Fire Water System Program procedures to include formal documentation of the CCHVAC makeup and recirculation fire water supply drain down inspection for indications of flow blockage.	Prior to September 20, 2024, or the end of the last refueling outage prior to March 20, 2025, whichever is later, with the exception that the activities described in this commitment for piping segments designed to be dry but determined to be collecting water shall be conducted within five years prior to March 20, 2025.	A.1.19

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Table B-3

Fermi 2 Program Consistency with NUREG-1801

Program Name	NUREG-1801 Comparison			Plant-Specific
	Consistent with NUREG-1801	Programs with Enhancement	Programs with Exception to NUREG-1801	
Water Chemistry Control – BWR	~~X~~		X	

B.1.17 FATIGUE MONITORING

Enhancements

Element Affected	Enhancement
1. Scope of Program 2. Preventive Actions 3. Parameters Monitored or Inspected 4. Detection of Aging Effects 5. Monitoring and Trending 6. Acceptance Criteria ~~7. Corrective Actions~~	Revise Fatigue Monitoring Program procedures so that the scope of the program includes monitoring the operating hours for the main steam bypass operation at the 30%-45% valve open position and perform trending to ensure that the operating time for the main steam bypass operation remains below the design limit during the period of extended operation. ~~Revise Fatigue Monitoring Program procedures to provide for corrective actions to prevent the operating time for the main steam bypass from exceeding the analysis during the period of extended operation. Acceptable corrective actions include repair of the component, replacement of the component, or a more rigorous analysis of the component to demonstrate that the service life will not be exceeded during the period of extended operation.~~
7. Corrective Actions	Revise Fatigue Monitoring Program procedures to provide for corrective actions to prevent the operating time for the main steam bypass from exceeding the analysis during the period of extended operation. Acceptable corrective actions include repair of the component, replacement of the component, or a more rigorous analysis of the component to demonstrate that the service life will not be exceeded during the period of extended operation.

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B.1.43 WATER CHEMISTRY CONTROL – BWR

Program Description

The Water Chemistry Control – BWR Program manages loss of material, cracking, and fouling in components exposed to a treated water environment through periodic monitoring and control of water chemistry. The Water Chemistry Control – BWR Program monitors and controls water chemistry parameters such as pH, chloride, conductivity, and sulfate. EPRI Report ~~1016579~~ 3002002623 is used to provide guidance

The One-Time Inspection Program utilizes inspections or nondestructive evaluations of representative samples to verify that the Water Chemistry Control – BWR Program has been effective at managing aging effects. The representative sample includes low flow and stagnant areas.

NUREG-1801 Consistency

The Water Chemistry Control – BWR Program is consistent with the program described in NUREG-1801, Section XI.M2, Water Chemistry, with one exception.

Exceptions to NUREG-1801

~~None~~
The Water Chemistry Control – BWR Program has the following exception.

Element Affected	Exception
N/A (Program Description)	NUREG-1801, Section XI.M2, Water Chemistry, references the guidelines in BWRVIP-190, EPRI 1016579 as the basis of the water chemistry program for boiling water reactors under Program Description. Fermi 2 has adopted Rev. 1 of BWRVIP-190, BWR Water Chemistry Guidelines, EPRI 3002002623.[1]

Exception Note

1. The BWR Water Chemistry Guidelines were updated in 2014 to provide an enhanced methodology for establishing site-specific BWR water chemistry control programs. The focus is on mitigating environmentally assisted cracking, maintaining fuel performance, controlling flow accelerated corrosion and controlling radiation fields. The guidelines were separated into two volumes – the first on implementation guidance and the second on the technical basis and background information. EPRI reports such as "BWR Water Chemistry Guidelines" are industry reports, which are reviewed and revised by industry experts to incorporate recent industry operating experience

and best practices. Adoption of the revised guidelines is required.

Through use of the updated BWR Water Chemistry Guidelines, which are based on operating experience with the goal to improve performance, the Fermi 2 Water Chemistry Control – BWR Program will better manage the effects of aging on materials exposed to the BWR treated water environment.

Key non-editorial changes in the guidelines include the following:

- A new section on water chemistry guidance for fuel reliability was added.
- Guidance on monitoring and eliminating transient sources of ionic impurities in reactor water to minimize impacts on accelerated Intergranular Stress Corrosion Cracking (IGSCC) and potential adverse effects on fuel was included.
- Guidance was refined for feedwater iron, feedwater copper and feedwater zinc action levels and needed values for fuel performance.
- Good practice recommendations for chemistry control in auxiliary systems, with emphasis on minimizing impurities that can potentially enter the reactor coolant were added.
- A new chapter on startup good practices and conditions to avoid based on operating experience was added. I
- Recommendations were enhanced on shutdown good practices and conditions to avoid based on experience, including mid-cycle outages in addition to refueling outages.
- Tables on data monitoring and evaluation, including good practice sampling frequencies, were updated, and half-lives for activated corrosion products and fission products were included.
- The technical basis for water chemistry control in BWRs was consolidated and updated, including addition of information on zinc oxide and depleted zinc oxide.
- The bases for environmentally assisted fatigue of structural materials, low-alloy steel cracking, the effects of impurities on crack growth rates, stress corrosion cracking of carbon steel, and IGSCC mitigation methods were updated.
- Latest research results were added on controlling dissolved oxygen to minimize flow accelerated corrosion and the effects of noble metal chemistry and on-line noble metal chemistry.
- Water chemistry impacts on fuel integrity were updated with experience, including an additional table of chemistry trigger values for fuel risk assessment.
- Latest industry experience was used to update the chapter on water chemistry effects on radiation fields, including effects of moderate hydrogen water chemistry, noble metal chemistry addition, on-line noble chemistry, zinc injection and operating with low iron.
- A section was added on good practices and conditions to avoid for the

design and operation of condensate polishing systems in order to optimize feedwater quality, with emphasis on minimizing the potential for impurities that may impact fuel performance.

- Sampling practices and monitoring techniques were updated, including background information, experience and good practices for electrochemical corrosion potential monitoring and on monitoring moisture carryover.
- The guidance on developing a BWR strategic water chemistry plan was updated.
- The tables of BWR transients have been updated and the latest results of higher conductivity crack growth rate studies have been incorporated. The correction in measured conductivity for presence of ionic species that are benign towards system integrity and to bound concentrations of potential ionic impurities that are not directly measured were updated.
- Improvements in selecting the power profile, gamma and fast neutron dose rates and chemical reaction rate constants and radiolysis G-values were added.
- A new appendix was added requiring all plants that inject hydrogen for IGSCC mitigation to have a mitigation performance indicator and providing good practices.
- Information on ultrasonic fuel cleaning was removed from this document and placed in a different EPRI guideline on fuel reliability.
- Another appendix was added on use of new technologies, such as methanol and titanium dioxide.
- Appendices were added for conversion to SI units.

All changes were conservative, or provided additional information.

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Enhancements

None