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DTE Energy

10 CFR 50.90

October 13, 2014
NRC-14-0068

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 the NRC, "License Amendment Request to Revise Technical Specification Surveillance Requirements for Direct Current Batteries," NRC-14-0010, dated April 23, 2014 (ML14113A445)

3) NRC Email to DTE Electric Company, "FERMI 2 - Request for Additional Information regarding the License Amendment Request to Revise Technical Specification Surveillance Requirements for Direct Current Batteries (MF4002)," dated September 3, 2014 (ML14251A071)

Subject: Response to Request for Additional Information (RAI) Regarding the License Amendment Request to Revise Technical Specification Surveillance Requirements for Direct Current Batteries

In Reference 2, DTE Electric Company (DTE) submitted a license amendment request for Fermi 2 to revise Technical Specification Surveillance Requirements for Direct Current Batteries. In Reference 3 the NRC staff requested additional information to complete the review of Reference 2. The enclosure of this letter provides DTE's response to the NRC staff request.

This letter contains no new regulatory commitments.

Should you have any questions or require additional information, please contact Mr. Alan I. Hassoun of my staff at (734) 586-4287.

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

Executed on October 13, 2014

Vito A. Kaminskas
Site Vice President

Enclosure: Response to Request for Additional Information (RAI) Regarding the License Amendment Request to Revise Technical Specification Surveillance Requirements for Direct Current Batteries

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

Enclosure to
NRC-14-0068

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

Response to Request for Additional Information (RAI) Regarding the License Amendment Request to Revise Technical Specification Surveillance Requirements for Direct Current Batteries

RAI-1

Page 7 in Enclosure 1 of the LAR dated April 23, 2014, states the following:

> *Screening design bases accident (DBA) scenarios as stipulated in the Fermi 2 UFSAR and selecting those scenarios that potentially give rise to limiting DC [direct current] loadings. The selection is then used to review the loads and determine the bounding loading scenarios to be used in the computer modeling.*

Describe the loading scenarios chosen in the computer modeling, including the calculated minimum required battery terminal voltage and the bounding volt per cell value for each scenario. Also, please identify the most limiting voltage required at the component level and the corresponding voltage at the battery to meet the worst-case design basis loading requirements.

RAI-1 Response

The loading scenarios chosen in the computer modeling are LOOP/LOCA (Loss of Offsite Power / Loss of Coolant Accident), LOOP/LOCA with HPCI / RCIC test mode operation (High Pressure Coolant Injection / Reactor Core Isolation Cooling), and SBO (Station Blackout) scenarios. These scenarios were chosen as described in Reference R2, Enclosure 1, Section 3.2.2. Each scenario is described further below.

<u>LOOP/LOCA</u>

The LOOP/LOCA scenario assumes a concurrent Loss of Offsite Power and a Loss of Coolant Accident. A bounding loading scenario was created by modeling RCIC and HPCI operating for the entire duration of the event. These systems can cycle based on reactor water level and the size of the line break but modeling these two systems as continuously running results in a worst case DC system steady state loading. To ensure these two systems can successfully cycle on and off during the event, the HPCI and RCIC systems were each shut down and restarted in the last minute of the LOOP/LOCA duty cycle. The last minute of the LOOP/LOCA duty cycle was chosen to coincide with the maximum amp hours removed from the battery. The RCIC system is sized to prevent ADS (Automatic Depressurization System) actuation, thus it is not expected that ADS would actuate concurrent with RCIC. However, the scenario conservatively models an ADS automatic actuation as part of the worst case bounding duty cycle. This ensures that the analysis demonstrates that ADS can function when fed from the batteries during a bounding design basis event. Also HPCI and RCIC Systems are conservatively modeled as being started earlier in the battery duty cycle to coincide with the Emergency Diesel Generator (EDG) start and load sequencing. Since there was no clear method to determine whether a small, intermediate or large break LOCA results in the worst case LOOP/LOCA load profile, the HPCI and RCIC system actuations and cycle frequency due to the combination of all three scenarios (large, intermediate and small break LOCA) are taken into consideration in developing a bounding LOOP/LOCA DC load profile for each battery.

<u>LOOP/LOCA, HPIC/RCIC Test Mode</u>

The LOOP/LOCA scenario described above was modelled and run to account for HPCI and RCIC test modes. The test mode for HPCI provides for full flow functional testing of the HPCI system. If an actuation signal is received during a test, HPCI automatically stops the test mode and starts water injection to the feedwater line. Similarly, the test mode for RCIC provides for RCIC to be tested to design flow during normal plant operation; RCIC returns to operating mode from the full flow test if system initiation is required.

SBO

The SBO scenario is modelled as follows. The batteries are sized for a 1 hour SBO to support operation of the alternate AC source (AAC). RCIC and HPCI systems are available and can be used for inventory control during this event. Load shedding will occur due to a LOOP followed by an unsuccessful EDG load start sequence. Both RCIC and HPCI systems are conservatively assumed to start immediately and run continuously during the SBO duty cycle with these two systems also cycled at the end of the duty cycle similar to the LOOP/LOCA scenario. The additional DC control circuit closures of the safety related breakers necessary to connect Combustion Turbine Generator (CTG) 11-1 to Buses 64B and 64C were modeled in the last minute of the SBO duty cycle.

The calculated minimum required battery terminal voltage and the bounding volt per cell value for each scenario are described in the tables below (Reference R1).

LOOP/LOCA Scenario

Battery	Battery 130VDC Section	Calculated Minimum Required Battery Terminal Voltage	Volt per Cell for Sizing (bounding volt per cell value)	Equivalent Battery Terminal Voltage (volt/cell x 58 cells)
Div. 1 (2PA)	2A-1	110.77	1.92	111.36
	2A-2	111.35	1.93	111.94
Div. 2 (2PB)	2B-1	107.08	1.85	107.30
	2B-2	106.37	1.84	106.72

LOOP/LOCA, HPIC/RCIC Test Mode Scenario

Battery	Battery 130VDC Section	Calculated Minimum Required Battery Terminal Voltage	Volt per Cell for Sizing (bounding volt per cell value)	Equivalent Battery Terminal Voltage (volt/cell x 58 cells)
Div. 1 (2PA)	2A-1	110.79	1.92	111.36
	2A-2	111.36	1.93	111.94
Div. 2 (2PB)	2B-1	107.09	1.85	107.30
	2B-2	106.38	1.84	106.72

SBO Scenario

Battery	Battery 130VDC Section	Calculated Minimum Required Battery Terminal Voltage	Volt per Cell for Sizing (bounding volt per cell value)	Equivalent Battery Terminal Voltage (volt/cell x 58 cells)
Div. 1 (2PA)	2A-1	110.61	1.91	110.78
	2A-2	110.64	1.92	111.36
Div. 2 (2PB)	2B-1	107.18	1.85	107.30
	2B-2	106.22	1.84	106.72

The most limiting voltage required at the component level and the corresponding voltage at the battery to meet the worst-case design basis loading requirements are described in the following table (Reference R1).

Battery	Battery 130VDC Section	Most Limiting Voltage Required at Component	Component	Minimum Required Battery Terminal Voltage
LOOP/LOCA Scenario				
Div. 1 (2PA)	2A-1	105.0	Inverter E21K601A	110.77
	2A-2	105.0	Inverter R31K001	111.35
Div. 2 (2PB)	2B-1	102.9	H11P612	107.08
	2B-2	81.0	Relay ED3AX	106.37
LOOP/LOCA, HPCI/RCIC Test Mode Scenario				
Div. 1 (2PA)	2A-1	105.0	Inverter E21K601A	110.79
	2A-2	105.0	Inverter R31K001	111.36
Div. 2 (2PB)	2B-1	102.9	2PB2-6 Ckt 7	107.09
	2B-2	81.0	Relay ED3AX	106.38
SBO Scenario				
Div. 1 (2PA)	2A-1	105.0	Inverter R1700S011A	110.61
	2A-2	105.0	Inverter R31K001	110.64
Div. 2 (2PB)	2B-1	102.9	H11P612	107.18
	2B-2	100.0	Relay 6PL69	106.22

RAI-2

Page 8 in Enclosure 1 of the LAR dated April 23, 2014, states the following:

> *Design Basis Calculation (Reference 6.2) demonstrates acceptable results using a 70 degree Fahrenheit electrolyte temperature.*

Please provide a summary of the calculations including the assumptions and supportive documentation to show that the safety related batteries at 70 degree Fahrenheit continue to support operability of all safety related equipment.

RAI-2 Response

As discussed in the LAR (Reference R2), the electrolyte temperature is an input to the design basis calculation (Reference R1). Historic surveillance data and room temperature data were reviewed to verify that electrolyte temperature is consistently maintained above 70°F. The change of the TS SR 3.8.6.3 electrolyte temperature from > 60°F to > 70°F is consistent with Fermi 2 normal operational conditions. As discussed in Reference R2, Fermi 2 plant operation is currently administratively controlled to verify average electrolyte temperature of representative cells is > 70°F.

The design basis calculation, utilizing an input of 70°F electrolyte temperature, verifies that the safety related batteries (at 70°F) continue to support operability of all safety related equipment. Reference R2, Enclosure 1, Section 3.2.2, provides a summary of the calculation and the steps taken to derive the volt per cell (Vpc) for battery sizing. The Vpc derivation first determines the minimum required battery terminal voltage for each device and then selects the highest minimum of these. The Vpc so derived, when applied to battery sizing, guarantees the adequacy of voltage support for components. In accordance with IEEE 485, battery sizing is performed at specified electrolyte temperature; the Fermi 2 calculation specifies 70°F. The results of the calculation confirm that the safety related batteries continue to support operability of all safety related equipment, consistent with IEEE 485.

Specifically related to the electrolyte temperature, the battery vendor qualification report for Fermi 2 (Reference R3), states that the 20 year qualified life is predicated on an annual average temperature of 77°F. The vendor qualification report (consistent with IEEE 485) explains:

> Operating temperatures above 77°F cause a lowering of electrolyte resistivity and an increase in electrochemical activity. This results in improved discharge performance, but reduced battery life. Operating temperatures below 77°F have directly the opposite effects, ie, reduced performance, but improved life.

The vendor qualification report confirms that the electrolyte temperature monitoring threshold of 70°F is well within the rated temperature of 77°F, and there is no impact on qualified life. Requiring the Fermi 2 TS SR 3.8.6.3 electrolyte temperature to be greater than70°F improves the discharge performance, increasing the battery capacity margin.

RAI-3

Page 9 in Enclosure 1 of the LAR dated April 23, 2014, states the following:

> *Based on the design age of the batteries, several years remain before any battery reaches its 85% of expected life.*
>
> *For all four 130 VDC [volts direct current] batteries, the surveillance results verified that battery capacity is >100% of the manufacturer's rating with no degradation.*

Please provide the battery capacity margin data based on the most recent TS surveillance test. What is the expected life of the four batteries and when will they reach 85% of expected life?

RAI-3 Response

The battery capacity margin data based on the most recent TS surveillance test is provided in the table below. The table also describes the expected life of the four batteries and when they will reach 85% of expected life.

Battery 130Vdc	Initial Installation	Month / Year to reach 85% of expected life	Most Recent Discharge Performance Test	
	Date	Date	Surveilance Date	Capacity % of Manufacturer Rating
2A-1	April 2000	April 2017	Nov 2010	105.0
2A-2	April 2000	April 2017	Nov 2010	103.5
2B-1	April 2009	April 2026	Oct 2010	105.0
2B-2	April 2009	April 2026	Nov 2010	106.6

All batteries are C&D lead acid storage battery LCR-21, rated at 20 year expected service life. Battery cells, cell plates, and racks are verified during surveillance performance. The most recent surveillance results show no visual indication of physical damage or abnormal deterioration that could degrade battery performance.

RAI-4

Page 9 and 10 of the LAR dated April 23, 2014, indicates that aging factor applied to 2B-2 battery is 1.18. The aging factor applied to the other batteries is 1.25. Explain why the proposed capacity and frequency specified for 2B-2 battery in TS SR 3.8.4.8 is conservative.

RAI-4 Response

As described further below, the aging factor applied to the 2B-2 battery has been updated to 1.25 (Reference R1). The aging factor is consistent with IEEE 485, and the proposed capacity and frequency specified in TS SR 3.8.4.8 is conservative. The capacity and frequency proposed in TS SR 3.8.4.8 is supported by IEEE 450 and IEEE 485 as discussed in the Technical Specification Bases (Enclosure 4 of Reference R2). The proposed capacity and frequency is also consistent with Standard Technical Specifications (NUREG-1433, Revision 4, ML12104A192).

The Design Basis Calculation (Reference R1) has been revised since the original submittal of this LAR (Reference R2). The revised calculation utilizes an aging factor of 1.25 for all batteries.

During the last refueling outage, DTE completed plant equipment modifications, replacing four Division 2 Inverters. These four Inverters had high demand voltages; they were replaced with upgraded equipment with lower demand voltages. The voltage requirements of the Division 2 Inverters were updated in the revision of the calculation; this allowed the 1.25 aging factor to be utilized as an input.

Consistent with IEEE 485, the 1.18 aging factor which was applied in the previous calculation revision, limited the battery life, effectively reducing the available service life of the 2B-2 battery. The increased margin, realized by replacing the high demand Inverters, allowed DTE to update the 2B-2 aging factor, while simultaneously increasing the calculated excess capacity reported in the table in Reference R2, Enclosure 1, Page 10.

The calculation revision (Reference R1) also applied design margin (as shown in the table below) within the computational model. The increased design margin applied in the calculation lowers the calculated excess capacity of the batteries, effectively transferring some of the calculated excess capacity to design margin. All other calculation assumptions discussed in Reference R2 and this submittal remain unchanged. The results of the revised calculation support all conclusions stated in Reference R2 and this submittal; i.e. the batteries will provide the minimum required voltages, with margin, to support safety related equipment in performing their intended safety functions. The table in Reference R2, Enclosure 1, Page 10 has been updated below to be consistent with the revised calculation.

The table below provides key design parameters of the safety related batteries at Fermi 2 (Reference R1):

Battery	Battery 130VDC Section	Minimum Battery Terminal Voltage (Volt) for Sizing	Volt per Cell for Sizing	Aging Factor Applied	% Excess Capacity[1] Over Design Requirement		Design Margin Applied
					LOOP / LOCA[2]	LOOP /LOCA HPCI / RCIC Test[3]	
Div. 1 (2PA)	2A-1	111.36	1.92	1.25	28.1	23.47	1.05
	2A-2	111.94	1.93	1.25	9.48	7.48	1.05
Div. 2 (2PB)	2B-1	107.30	1.85	1.25	6.64	6.30	1.02
	2B-2	106.72	1.84	1.25	7.74	7.49	1.02

Notes:

(1) % Excess capacity is defined in terms of percentage of the number of installed excess positive plates over design requirement, divided by the number of installed positive plates

(2) The LOOP/LOCA Design Basis Accident scenario assumes a concurrent Loss of Offsite Power and a Loss of Coolant Accident that require the initiation of the High Pressure Cooling Injection and Reactor Core Isolation Cooling systems

(3) The LOOP/LOCA HPCI / RCIC Test scenario assumes the LOOP / LOCA DBA during HPCI / RCIC testing.

RAI-5

Please provide a summary of the calculation including assumptions that determined the total connection resistance allowable value of 2700 micro ohm will provide the minimum required voltages with some margins to support safety related equipment in performing their intended safety functions.

RAI-5 Response

The total connection resistance allowable value of 2700μΩ is an input to the calculation that verifies the batteries support safety related equipment, with some margin, in performing their intended safety functions (Reference R1). As discussed in Reference R2, historic surveillance data, battery manufacturer's design and rating parameters, UFSAR voltage limits, and design cycle loads, support the 2700μΩ SR allowable value. The allowable value of 2700μΩ is consistent with Fermi 2 normal operational conditions, and Fermi 2 plant operation is currently administratively controlled to verify the total connection resistance allowable limit of 2700μΩ.

The design basis calculation (Reference R1), utilizing an input of 2700μΩ for battery cell-to-cell and terminal connection resistance, verifies that that the safety related batteries continue to support operability of all safety related equipment. Reference R2, Enclosure 1, Section 3.2.2, provides a summary of the calculation and the steps taken to derive the volt per cell (Vpc) for battery sizing. The Vpc derivation first determines the minimum required battery terminal voltage for each device and then selects the highest minimum of these. The Vpc so derived, when applied to battery sizing, guarantees the adequacy of voltage support for components. The results of the calculation confirms that the safety related batteries, with the total connection resistance allowable value of 2700μΩ, continue to support operability of all safety related equipment, consistent with IEEE 485.

Specifically related to the total battery connection resistance, 2700μΩ is chosen as the upper limit for the TS surveillance tests and an input to the calculation (Reference R1). The calculation utilized 2700μΩ in determining the amount of resistance not already accounted for within the battery curves to be added back to the ETAP model as external resistance before performing the model runs for load flow / voltage drops. Adding external resistance provides conservative model runs for the load flow / voltage drop calculations.

RAI Response References

R1. Fermi 2 Design Basis Calculation DC-6480, Vol. I, Rev. B, 130/260V DC System Analysis, dated October 2, 2014. (Note: this calculation supersedes Reference 6.2 of the LAR submittal [DTE Letter NRC-14-0010]. As discussed in response to RAI-4 above, all discussion of DC-6480, including the calculation descriptions, assumptions, results, and conclusions of the LAR and this submittal, are now supported by this revision.)

R2. DTE Electric Company Letter to the NRC, "License Amendment Request to Revise Technical Specification Surveillance Requirements for Direct Current Batteries," NRC-14-0010, dated April 23, 2014 (ML14113A445)

R3. C&D Qualification Report QR-284030-01, "Environmental and Seismic Qualification Report of 250 Volt DC Power Batteries and Racks, Battery System 2PB, Cell Type LCR-21 and Single Row Battery Racks, for Detroit Edison Fermi 2 Energy Center," Revision 0, May 1998