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DTE Energy

10 CFR 50.73

July 26, 2006
NRC-06-0051

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

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

Subject: Licensee Event Report No. 2006-002, "Automatic Reactor Shutdown Due To Main Unit Transformer Failure"

Pursuant to 10 CFR 50.73(a)(2)(iv)(A), Detroit Edison is hereby submitting the enclosed Licensee Event Report (LER) No. 2006-002. This LER documents an automatic reactor shutdown as a result of a main turbine / generator trip in response to an internal fault to the Z-phase of main unit transformer 2B.

No commitments are made in this LER.

Should you have any questions or require additional information, please contact Mr. Ronald W. Gaston of my staff at (734) 586-5197.

Sincerely,

K. J. Hlavaty
for Don Cobb

cc: D. H. Jaffe
C. A. Lipa
NRC Resident Office
Regional Administrator, Region III
Supervisor, Electric Operators,
Michigan Public Service Commission

IE22

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: No. 3150-0104 Expires 6/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
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4. TITLE

Automatic Reactor Shutdown Due To Main Unit Transformer Failure

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
06	15	2006	2006	- 002	- 00	07	26	2006	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE

1

10. POWER LEVEL

100%

11. THIS REPORT SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THS LER

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
Robert J. Salmon – Principal Licensing Engineer	(734) 586-4273

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
D	EL	XFMR	P145	Y					

14. SUPPLEMENTAL REPORT EXPECTED	15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO				

ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

On June 15, 2006, at 1053 hours EDT, a reactor scram occurred from 100% power as a result of a main turbine / generator trip due to an internal fault on main unit transformer 2B. A reactor scram occurred as designed from the turbine control valve fast closure signal. The reactor protection system performed as expected, and all rods were fully inserted into the core. Reactor water level reached a low of approximately 134 inches above top of active fuel and recovered to normal automatically without operator intervention. Subsequent to the event, the main steam isolation valves remained open and reactor water level was maintained in the normal band of 173 to 214 inches. Reactor water was supplied by the condensate and reactor feedwater systems, and the resultant reactor steam was sent to the condenser via the main turbine bypass lines. Pressure control was maintained by the turbine bypass valves. Reactor dome pressure peaked at about 1077 psig, and none of the safety relief valves lifted. Reactor water Level 3 isolations occurred as expected. An internal fault to ground of the Z-phase of the high voltage transformer winding caused the transformer failure. The most probable cause of the internal fault is that two adjacent transformer oil coolers were taken out of service together and washed with cold water which caused the internal fault. Transformer 2B was isolated from the generator and the electrical system, and the plant was restarted at reduced power on June 18, 2006. The plant was subsequently shut down on July 8, 2006 for replacement of failed main unit transformer 2B and returned to 100% power on July 22, 2006.

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17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

Initial Plant Conditions:

Mode	1
Reactor Power	100 percent

Description of the Event

On June 15, 2006, at 1053 hours EDT, a reactor scram occurred from 100% power as a result of a main turbine [TA] / generator [TB] trip. A generator differential relay trip string operated in response to an internal fault to ground of the high voltage Z-phase of main unit transformer 2B [EL]. This resulted in a main turbine trip. A reactor scram occurred as designed from the turbine control valve fast closure signal. The reactor protection system (RPS) [JD] performed as expected, and all rods were fully inserted into the core. Reactor water level reached a low of approximately 134 inches above top of active fuel and recovered to normal automatically without operator intervention. Subsequent to the event, the main steam isolation valves (MSIVs) remained open and reactor water level was maintained in the normal band of 173 to 214 inches. Reactor water was supplied by the condensate [SD] and reactor feedwater systems [SJ], and the resultant reactor steam was sent to the condenser [SG] via the main turbine bypass lines. Pressure control was maintained by the main turbine bypass valves. Reactor dome pressure peaked at about 1077 psig. With reactor pressure maintained below the Safety Relief Valve (SRV) setpoints, none of the SRVs lifted. Reactor water Level 3 isolations [JM] occurred as expected. These included isolation Group 4 (Residual Heat Removal Shutdown Cooling and Head Spray), Group 13 (Drywell Sumps), and Group 15 (Traversing In-core Probe System) isolations.

At the time of the scram, main transformer 2B cleaning was taking place. At 1053 hours EDT, a Main Transformer 2B Oil Temperature High alarm was received, immediately followed by the generator differential relaying and turbine trip alarms. The transformer pressure relief valves opened in response to the pressure surge. Oil emitted from the relief valves and from piping adjacent to transformer oil pump No. 3, and the transformer shell was observed to be bowed. The transformer deluge initiated in response to the operation of a transformer external heat sensor and deenergization of the transformer. There was no external fire as a result of the event.

A 4-hour notification of this event was made to the NRC in accordance with 10 CFR 50.72(b)(2)(iv)(B) at 1338 hours ET on June 15, 2006 (EN 42643).

Main unit transformer 2B is a three phase, 800 MVA, 21.1 kV (delta connected) to 345kV (grounded Y connected) power generator step-up transformer. It is one of two, approximately 50% capacity, three-phase transformers used to convert the power produced in the main generator to 345 kV for transmission purposes.

It was determined that it would take some time to prepare a spare transformer to replace main transformer 2B. Therefore, the damaged transformer 2B was isolated from main transformer 2A in preparation for near term plant operation using only the 2A transformer. The plant was restarted and the unit was synchronized on June 18, 2006. The plant was subsequently shut down on July 8, 2006 for replacement of main unit transformer 2B.

Cause of the Event

The event was caused by an internal fault to ground of the high voltage Z-phase winding of main unit transformer 2B. The most probable cause of the internal fault is that two adjacent transformer oil coolers were taken out of service together and washed with cold water which caused an arc on the Z-phase 345 kV winding to ground. The investigation is continuing to rule out several additional potential causes, and the team performing the investigation has indicated that an inspection of the internals of the failed transformer and possibly some failure analysis of internal transformer components may be needed before making final conclusions regarding the cause of the fault itself.

Analysis of the Event

The main transformers have no safety-related function. The generator and turbine trips functioned as designed. The reactor scrammed as designed from the turbine control valve fast closure signal. The plant response to the turbine trip was as expected and was enveloped by the more severe turbine trip without bypass transient described in the UFSAR. There was no challenge to the integrity of the reactor coolant system or the main steam system. The lowest reactor water level during the transient was measured to be approximately 134 inches above top of active fuel which is below the reactor water Level 3 isolation trip setpoint. Reactor water Level 3 isolations occurred as expected. These included isolation Group 4 (Residual Heat Removal Shutdown Cooling and Head Spray), Group 13 (Drywell Sumps), and Group 15 (Traversing In-core Probe System) isolations. The highest reactor pressure received was about 1077 psig which is below the safety relief valve setpoints; 5 each at 1135, 1145, and 1155 psig. Subsequent to the unit trip, reactor pressure was adequately controlled using the main turbine bypass valves, and reactor water level was controlled using the condensate and feedwater systems.

Therefore, since the generator, turbine and reactor protection systems performed as designed, and since plant response was enveloped by the UFSAR transient analyses, there was no undue risk to the health and safety of the public as a result of this event.

Corrective Actions

Electrical testing was performed on the failed transformer that more specifically identified the location of the internal fault to be between the high voltage transformer bushing and the Z-phase high voltage winding of the transformer or on the first few turns of the Z-phase high voltage winding.

As an interim measure, the plant was restarted on June 18, 2006 and run at a reduced power level using only transformer 2A to deliver power to the 345 kV electrical system. The plant was subsequently shutdown on July 8, 2006 to replace main unit transformer 2B and returned to 100% power on July 22, 2006.

Recommended action to address the probable cause includes ensuring that when multiple coolers are simultaneously removed from service for cleaning or maintenance that there is no adverse impact on oil flows in the transformer. However this is preliminary, and a final set of corrective actions will be developed within the corrective action process when the probable cause has been validated and the final cause analysis has been completed.

This event has been documented in the Fermi 2 corrective action program, CARD 06-24046. The event was caused by an internal fault to ground of the high voltage Z-phase winding. An investigation is continuing to validate the probable cause for the internal ground fault and to rule out other possible causes. This could result in the identification of additional corrective actions to minimize future occurrences of this type. Any further corrective actions identified as a result of these evaluations will be tracked and implemented commensurate with the established processes and priorities of the corrective action program.

Additional Information

A. Failed Components: Main Unit Transformer
Component: 800 MVA, 65°C rise, Three Phase Power Generator Step Up Transformer, 345-21.1 kV
Function: Generator Voltage Step-up Transformer
Manufacturer: Cooper Power Systems (now Pennsylvania Transformer Technology)
Model Number: None
Failure Cause: Internal Fault

B. Previous LERs on Similar Problems:

None. There have been no main unit transformer failures in the last decade at Fermi 2.