UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
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July 17, 2013

Mr. Joseph Plona
Senior Vice President and
Chief Nuclear Officer
DTE Electric Company
Fermi 2 - 210 NOC
6400 North Dixie Highway
Newport, MI 48166

SUBJECT: FERMI POWER PLANT UNIT 2, NRC SUPPLEMENTAL INSPECTION REPORT 05000341/2013009 AND ASSESSMENT FOLLOW-UP LETTER

Dear Mr. Plona:

On June 14, 2013, the U.S. Nuclear Regulatory Commission (NRC) completed a supplemental inspection at your Fermi Power Plant Unit 2. The enclosed report documents the results of this inspection, which were discussed during an exit meeting and regulatory performance meeting on June 14, 2013, with you and members of your staff.

As required by the NRC Reactor Oversight Process (ROP) Action Matrix, this supplemental inspection was performed in accordance with Inspection Procedure (IP) 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area." The purpose of the inspection was to examine the causes for, and actions taken related to, a White Performance Indicator (PI) in the Initiating Events Cornerstone at Fermi Power Plant Unit 2. The PI was Unplanned Reactor Scrams per 7,000 Critical Hours PI and it exceeded the Green-to-White threshold as reported in your 4th Quarter 2012 PI submittal. By letter dated February 8, 2013, the NRC informed you that because of the change in the PI, the performance at your Fermi Power Plant Unit 2 was in the Regulatory Response Column of the ROP Action Matrix beginning in the 4th quarter of 2012; and also informed you of our intent to perform this supplemental inspection. The NRC staff was informed by your letter dated May 7, 2013, of your readiness for this inspection.

This supplemental inspection was conducted to provide assurance that the root causes and contributing causes of the events resulting in the White PI were understood, to independently assess the extent of condition and extent of cause, and to provide assurance that the corrective actions for the risk-significant performance issues were sufficient to address the root causes and contributing causes to prevent recurrence.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspector reviewed selected procedures and records and interviewed plant personnel.

The NRC determined that the root and apparent cause evaluations completed for each of the three individual unplanned reactor scrams that resulted in the White PI as well as the root cause evaluation you completed in preparation for this inspection were conducted to a level of detail commensurate with the significance of the problems and reached reasonable conclusions as to the root and contributing causes of the events. The NRC also concluded that you identified reasonable and appropriate corrective actions for each root and contributing cause and that the corrective actions appeared to be prioritized commensurate with the safety significance of the issues.

The Unplanned Scrams per 7,000 Critical Hours PI returned below the Green-to-White threshold on June 25, 2013. Therefore, given your acceptable performance in addressing the White PI that was the subject of this inspection, in accordance with the guidance in Inspection Manual Chapter 0305, “Operating Reactor Assessment Program,” the White PI will only be considered in assessing plant performance through the 2nd quarter of 2013. As a result, the NRC determined the performance at Fermi Power Plant Unit 2, to be in the Licensee Response Column of the ROP Action Matrix as of the date of this letter.

Based on the results of this inspection, one self-revealed finding of very low safety significance was identified. The finding did not involve a violation of NRC requirements.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any), will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records System (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/readingrm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA/

Michael Kunowski, Chief
Branch 5
Division of Reactor Projects

Docket No. 50-341
License No. NPF-43

Enclosure: Inspection Report 05000341/2013009
w/Attachment: Supplemental Information

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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No:	50-341
License No:	NPF-43
Report No:	05000341/2013009
Licensee:	DTE Electric Company
Facility:	Fermi Power Plant, Unit 2
Location:	Newport, MI
Dates:	June 10 through 14, 2013
Inspector:	B. Kemker, Senior Resident Inspector, Clinton
Approved by:	Michael Kunowski, Chief Branch 5 Division of Reactor Projects

Enclosure

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SUMMARY OF FINDINGS

Inspection Report 05000341/2013009; 06/10/2013 – 06/14/2013; Fermi Power Plant, Unit 2; Supplemental Inspection - Inspection Procedure (IP) 95001.

This report covers a 5-day period of onsite inspection by a senior resident inspector. One self-revealed Green finding was identified. The significance of inspection findings is indicated by their color (i.e., greater-than-Green, Green, White, Yellow, Red) and determined using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process," June 2, 2011. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4.

Cornerstone: Initiating Events

This inspection was conducted in accordance with IP 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area," to assess the licensee's evaluation of one White Performance Indicator (PI) in the Initiating Events Cornerstone. The PI was Unplanned Reactor Scrams per 7,000 Critical Hours and it exceeded the Green-to-White threshold as reported in the licensee's 4th Quarter 2012 PI submittal.

In preparation for the inspection, the licensee performed a root cause evaluation specifically to address the White PI. This was the primary root cause evaluation reviewed during the inspection to address the requirements of the inspection procedure. In addition, the inspector also reviewed the licensee's root or apparent cause evaluations conducted for each of the three individual unplanned reactor scrams. The inspector determined that the licensee's primary root cause evaluation was conducted to a level of detail commensurate with the significance of the problem and reached reasonable conclusions. The inspector also concluded that the licensee identified reasonable and appropriate corrective actions and that the corrective actions appeared to be prioritized commensurate with the safety significance of the issue.

The primary root cause evaluation reviewed the three unplanned reactor scrams that contributed to the White PI and an additional five reactor scrams over the previous three years (i.e., from 2009 to present). The evaluation discussed the conclusions that were drawn when those events were reviewed in aggregate. The conclusions from the root cause team included one contributing cause and one observation. The root, apparent, direct and contributing causes, and factors associated with the eight scrams reviewed were sufficiently diverse such that no commonality was identified that met the licensee's definition of a root cause. The evaluation did not reveal a root cause.

The Unplanned Scrams per 7,000 Critical Hours PI returned below the Green-to-White threshold on June 25, 2013. Therefore, given the licensee's acceptable performance in addressing the White PI that was the subject of this inspection, in accordance with the guidance in IMC 0305, "Operating Reactor Assessment Program," the White PI will only be considered in assessing plant performance through the 2nd quarter of 2013. As a result, the NRC determined the performance at Fermi Power Plant Unit 2 to be in the Licensee Response Column of the Reactor Oversight Process (ROP) Action Matrix as of the date of the cover letter for this inspection report.

NRC-Identified and Self-Revealed Findings

Green. A finding of very low safety significance was self-revealed from an event that resulted in a reactor scram. The licensee failed to correctly implement its foreign material

exclusion procedure following a reactor scram on September 30, 2009. The scram was caused by a turbine trip which was caused by the presence of a very small metallic particle (foreign material) that had bored into a main generator stator bar over time and created a hole that allowed hydrogen cooling gas to leak into the stator cooling water system. The ineffective corrective actions resulted in a second reactor scram for the same cause on November 7, 2012. Because the main turbine generator is not safety-related, no violation of regulatory requirements was identified. The licensee implemented appropriate mitigation actions until a permanent corrective action involving replacement of the generator or a modification to the existing stator design can be implemented.

The finding was of more than minor significance because this issue was associated with the Equipment Performance attribute of the Initiating Events Cornerstone and adversely affected the cornerstone objective of limiting the likelihood of events that upset plant stability and challenge critical safety functions during power operations. Specifically, inadequate foreign material exclusion controls coupled with a stator design that allows magnetized particles to be trapped in between the stator bars resulted in a reactor scram following development of a hydrogen leak through a stator bar. The finding was of very low safety significance because the issue: (1) did not involve a loss-of-coolant accident initiator; (2) did not cause a reactor trip AND the loss of mitigation equipment; (3) did not involve the complete or partial loss of a support system that contributes to the likelihood of, or cause, an initiating event AND affect mitigation equipment; and (4) did not increase the frequency of a fire or internal flooding initiating event. The inspector did not identify a cross-cutting aspect related to this finding. (Section 4OA4.2.01.d)

REPORT DETAILS

4. OTHER ACTIVITIES

4OA3 Follow-Up of Events and Notices of Enforcement Discretion (71153)

.1 (Closed) Licensee Event Report (LER) 05000341/2012-006-00, "Manual Reactor Scram Due to Hydrogen Leakage into the Stator Water Cooling System"

On November 7, 2012, operators manually scrammed the reactor and tripped the main turbine generator in response to excessive hydrogen gas leakage into the stator cooling water system from the main turbine generator. The direct cause was the presence of a very small metallic particle (foreign material) that bored into a generator stator bar over time and created a hole that allowed hydrogen cooling gas to leak into the stator cooling water system. Two control rods did not respond as expected; however, both rods exhibited normal scram times up to position 02, and the scram was uncomplicated. No other anomalies occurred during the transient. The licensee reported this event as a condition that resulted in the manual actuation of the reactor protection system in accordance with 10 CFR 50.73(a)(2)(iv)(A).

The performance issues related to this event are discussed in Section 4OA4.2.01.d of this inspection report. LER 05000341/2012-006-00 is closed.

4OA4 Supplemental Inspection (95001)

.1 Inspection Scope

This inspection was conducted in accordance with IP 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area," to assess the licensee's evaluation of one White PI in the Initiating Events Cornerstone. The PI was Unplanned Reactor Scrams per 7,000 Critical Hours and it exceeded the Green-to-White threshold as reported in the licensee's 4th Quarter 2012 PI submittal.

The inspection objectives were to:

- provide assurance that the root causes and contributing causes of risk-significant performance issues are understood;
- provide assurance that the extent of condition and extent of cause of risk-significant issues are identified; and
- provide assurance that licensee corrective actions to risk significant performance issues are sufficient to address the root causes and contributing causes, and to prevent recurrence.

The three unplanned reactor scrams that caused the PI to exceed the Green-to-White threshold are briefly described below:

- Reactor Scram Due to Loss of Condenser Vacuum

  On June 25, 2012, operators manually scrammed the reactor during a plant startup in response to a loss of the south reactor feed water pump and resultant degrading

main condenser vacuum. The south reactor feed water pump catastrophically failed due to inadequate maintenance and testing during the refueling outage. Manual operation of the north reactor feed water pump was used initially to recover reactor vessel water level. The plant was in Mode 1 and at 26 percent reactor power at the time of the scram. This event resulted in the loss of 747.9 hours (31.2 days) of reactor criticality.

- Reactor Scram Due to Loss of Feed Water and Apparent Loss of 120-kV Bus 101

  On September 14, 2012, the reactor automatically scrammed due to the loss of the Division 1 120-kilovolt (kV) switchyard, resulting in the loss of the feed water and condensate systems. The cause of the loss of power was determined to be an animal (bird) intrusion that caused a phase-to-ground fault at the Z-phase surge arrestor on Transformer 1 in the 120-kV switchyard. The bird apparently penetrated the insulated cap on the surge arrestor, creating a path to ground. The plant was in Mode 1 and at 68 percent reactor power at the time of the scram. This event resulted in the loss of 103.6 hours (4.3 days) of reactor criticality.

- Reactor Scram Due to Hydrogen In-Leakage to Stator Cooling Water

  On November 7, 2012, operators manually scrammed the reactor and tripped the main turbine generator in response to excessive hydrogen gas leakage into the stator cooling water system from the main turbine generator. The direct cause was the presence of a very small metallic particle (foreign material) that bored into a generator stator bar over time and created a hole that allowed hydrogen cooling gas to leak into the stator cooling water system. The plant was in Mode 1 and at 68 percent reactor power at the time of the scram. This event resulted in the loss of 1290.5 hours (53.8 days) of reactor criticality.

By letter dated May 7, 2013, the licensee notified the NRC that applicable corrective actions to address the White PI had either been completed or initiated, and that it was ready for the NRC to conduct this supplemental inspection to review the actions taken to address it. In preparation for the inspection, the licensee performed a root cause evaluation (Condition Assessment Resolution Document (CARD) 12-29127, "NRC Performance Indicator IE01 Exceeds White Threshold," Revision 1) to address the White PI. This was the primary root cause evaluation reviewed during the inspection to address the specific requirements of the inspection procedure. In addition, the licensee completed a self-assessment (NANL-13-0023, "Quick Hit Self-Assessment: Supplemental Inspection Readiness Review," dated March 25, 2013) to validate its readiness for this inspection.

In addition to the primary root cause evaluation for the White PI mentioned above, the inspector also reviewed the licensee's root or apparent cause evaluations conducted for each of the three individual unplanned reactor scrams. The following root or apparent cause evaluations were also the subject of this inspection:

- CARD 12-29077, "Reactor Scram Due to H2 [Hydrogen] In-Leakage to Stator Water," Revision 1

- CARD 12-27639, "Reactor Scram Due to Loss of Feedwater and Apparent Loss of 120-kV Bus 101," Revision 0

- CARD 12-25544, “Reactor Scram Due to Loss of Condenser Vacuum,” Revision 1

The inspector reviewed corrective actions that were taken or planned to address the identified causes. The inspector also held discussions with licensee personnel to ensure that the root and contributing causes and the contribution of safety culture components were understood and that corrective actions taken or planned were appropriate to address the causes and preclude repetition.

The following inspection results are organized by the specific inspection requirements of IP 95001, which are noted in italics in each section.

.2 Evaluation of Inspection Requirements

2.01 Problem Identification

a. *Determine whether the evaluation identified who (i.e., licensee, self-revealing, or NRC), and under what conditions the issue was identified.*

The inspector determined that the licensee’s root cause evaluation adequately identified when the Unplanned Reactor Scrams per 7,000 Critical Hours PI crossed the Green-to-White threshold. Each of the three unplanned scrams described above that contributed to the PI was the result of self-revealed events. The licensee and NRC resident inspectors both correctly recognized after the third reactor scram occurred that the PI would cross the Green-to-White threshold, primarily due to a relatively high loss of reactor critical hours (i.e., 3055 hours or 127.3 days) in 2012 as a result of the three unplanned reactor scrams and a refueling outage. The unplanned reactor scram on November 7th, caused by an increase of hydrogen in-leakage to the generator stator cooling water system, was the third unplanned reactor scram in 2012 and resulted in exceeding the White PI threshold.

b. *Determine whether the evaluation documented how long the issue existed and, whether there were any prior opportunities for identification.*

The Unplanned Reactor Scrams per 7,000 Critical Hours PI exceeded the Green-to-White threshold as reported in the licensee’s 4th Quarter 2012 PI submittal. The licensee’s evaluation correctly documented that this occurred with the third unplanned reactor scram on November 7th. As discussed in the licensee’s evaluation, each of the three reactor scrams was sufficiently unique, such that there was no prior opportunity for identification and actions to preclude the PI exceeding the White threshold. The last two reactor scrams were separated in time by only two months.

c. *Determine whether the licensee’s root cause evaluation documented the plant specific risk consequences and compliance concerns associated with the issue.*

As noted in the licensee’s evaluation, the White PI represents performance outside an excepted range of nominal utility performance, thus indicating an increase in the frequency of those events with the potential to upset plant stability and challenge critical safety functions during power operation. The inspector determined that nuclear safety significance and risk was appropriately discussed in the licensee’s evaluation for the White PI and also adequately evaluated by the licensee in the separate root or apparent cause evaluations performed for each of the three unplanned reactor scrams.

In response to each of the three unplanned reactor scrams, the resident inspectors evaluated plant parameters, operator actions, and overall plant status including the availability of mitigating systems. For each of the scrams, the inspectors determined that all safety systems responded as designed, the scrams were not complicated by material condition deficiencies, and no human performance errors complicated the event response.

The inspector noted that the licensee did not include quantitative risk consequence information in its root and apparent cause evaluations of the three unplanned reactor scrams. Inasmuch as each of the events would screen as very low safety significance using the Significance Determination Process (SDP), the inspector concluded that there would be little value in the licensee completing quantitative risk evaluations for the individual events. Similarly, because each of the scrams was uncomplicated and safety systems responded as designed, evaluating the cumulative risk significance of the three events to determine whether a change in initiating event frequency for scrams would cause an appreciable increase in core damage frequency would also be of little value.

The resident inspectors reviewed the licensee's root and apparent cause evaluations and closed the LERs associated with the first two unplanned reactor scrams in NRC Inspection Report 05000341/2012005. The inspectors documented a Non-Cited Violation of Technical Specification 5.4.1.a associated with the June 25th reactor scram for the licensee's failure to establish and implement adequate procedures for performing maintenance and testing on the south reactor feed water pump, which resulted in the pump catastrophically failing during a plant startup. The licensee's root cause evaluations (both CARD 12-29127 and CARD 12-25544) adequately described the regulatory compliance concerns related to the event. The inspectors did not identify any regulatory compliance concerns associated with the September 14th reactor scram.

The licensee's root cause evaluation for the third unplanned reactor scram on November 7th (CARD 12-29077) was just recently completed. The inspector's review of the root cause evaluation and regulatory compliance concerns associated with this event is discussed below in Section 4OA4.2.01.d. The licensee's root cause evaluations (both CARD 12-29127 and CARD 12-29077) adequately described the regulatory compliance concerns related to the event.

d. Findings

(1) Failure to Implement Foreign Material Exclusion Procedure Requirements Adversely Affected the Reliability of the Main Turbine Generator and Caused a Reactor Scram

Introduction

A finding of very low safety significance was self-revealed from an event that resulted in a reactor scram. The licensee failed to properly implement its foreign material exclusion procedure requirements for the main turbine generator following a reactor scram on September 30, 2009. The reactor had scrammed following a turbine trip due to the presence of a very small metallic particle (foreign material) that had bored into a generator stator bar over time and created a hole that allowed hydrogen cooling gas to leak into the stator cooling water system. The ineffective corrective actions resulted in a second reactor scram for the same cause on November 7, 2012. Because the main turbine generator is not safety-related, no violation of regulatory requirements was identified.

Discussion

On November 7, 2012, control room operators manually scrammed the reactor and manually tripped the main turbine generator in response to excessive hydrogen cooling gas leakage into the stator cooling water system from the main turbine generator. The leak was caused by a very small metallic particle that was magnetized and oscillated with the four-pole generator rotor field. The oscillating particle, in conjunction with a magnetic attraction towards the stator bar, damaged end-winding insulation laminates over time, eventually reaching the copper stator water bar and continuing until a hole was bored through the stator bar allowing hydrogen gas to leak into the generator stator cooling water. The actual piece of foreign material was not recovered.

The Fermi Unit 2 main turbine generator has had two instances (September 2009 and November 2012) of excessive leakage of hydrogen cooling gas into stator cooling water as a consequence of foreign material (often referred to as “magnetic termites”) drilling holes through stator bars in the stator end-winding area. In September 2009, maintenance craftsmen repaired the stator bar leak and cleaned the stator end-winding area; however, cruciforms (cross-shaped braces located between stator bars) were only removed in the repair area slip-ring end. No additional cruciforms were removed for more thorough cleaning of the end-winding areas at the time due to a lack of expertise, materials, tools, and time. This less than thorough cleaning was inconsistent with plant procedure MMA-17, Foreign Material Exclusion (FME), dated September 28, 2006.

During the recent forced outage following the November 2012 event, maintenance craftsmen cleaned the stator using magnetic sweeps, vacuuming, and wiping down the stator bars. Additionally, maintenance craftsmen more thoroughly cleaned the generator stator end-winding areas (slip-ring and turbine ends) by removing the cruciforms from the bottom one-third of the end-winding area at both ends of the generator, thereby allowing better access for cleaning activities. Additionally, a flooding varnish was applied at the turbine and slip-ring ends of the stator to stabilize any remaining magnetic termites. The licensee expects that the application of flooding varnish and the implementation of more robust and thorough cleaning of the generator should mitigate the future risk of foreign material to damage the stator bars. However, the generator is still vulnerable to damage from the foreign material that was not found, was not covered by the flooding varnish, or metallic particles that have already burrowed through the conforming material/insulation.

The inspector thoroughly examined the licensee’s root cause evaluation for the reactor scram and concluded that the licensee had not neglected any likely factors. The licensee identified one root cause and one contributing cause:

Root Cause: *The English Electric/Alstom turbine generator has a design that allows magnetized particles (foreign material) to be trapped in between the stator bars. Once the magnetized particles are trapped, they can rotate in the magnetic field and bore into the stator bars that then leak hydrogen into the stator cooling water system.*

Contributing Cause: *Foreign material in the turbine generator can cause damage to stator bars; this damage is the source of excessive leaks of hydrogen cooling gas to the stator cooling water system.*

The design of the generator makes keeping foreign material out of the unit a challenge. Any small magnetic particle that becomes trapped in-between stator bars can possibly

create a leak. Operating experience with English Electric /Alstom generators, of the same design and vintage of the Fermi Unit 2 main turbine generator, has identified the same stator bar leak issues. Sites whose generators have failed in the same fashion as the Fermi Unit 2 generator are San Onofre Unit 3 in 1991, Kori Unit 3 in 1996, Kori Unit 3 in 1999, and Kori Unit 3 in 2007. The conforming material and insulation around the stator bars allows foreign material to be more easily trapped and makes it difficult to remove. Most other generator designs have spacers that do not trap foreign material in between stator bars. The English Electric/Alstom generator 76-inch baffle arrangement has upstream openings where particles can enter the end-winding area and become trapped in the windings.

While the licensee attempted to remove as much foreign material as possible following the November 2012 event and has taken some additional mitigation actions, there is no guarantee that all of the foreign material has been removed. To that end, it is possible that the licensee will be forced to shut down and repair another stator bar leak sometime in the future before a permanent corrective action can be completed.

To address the root cause and correct the generator stator design problem, the licensee is considering a long-term project (with a current end date of December 2017) to either: (1) replace the entire generator with a different design, (2) rewind the existing stator covering it with a protective layer of woven glass cloth (commonly referred to as "wallpapering") to prevent the migration of magnetic termites from causing damage, or (3) replace the stator with a new Alstom design (also with wallpapering applied).

Additional corrective actions identified by the licensee in the root cause evaluation included:

- Revisions to plant procedures and training of plant staff to implement more rigorous foreign material exclusion controls, specifically for the main turbine generator.

- When the main turbine generator is next scheduled to be disassembled during the 2015 refueling outage, thoroughly inspect the back of the core, hydrogen lines, carbon dioxide lines, and the back of the gas sparger, and remove any foreign material found.

The inspector agreed with the licensee's conclusion that corrective actions taken for the September 2009 reactor scram also caused by a hydrogen leak into the stator cooling water system due to the same direct cause (i.e., a stator bar leak due to a magnetic termite) were ineffective. The licensee implemented appropriate mitigation actions until a permanent corrective action involving replacement of the generator or modification to the existing stator design can be implemented.

Refer to Section 4OA3.1 of this inspection report for a review and closure of the LER associated with the reactor scram.

Analysis

The inspector determined that the failure to correct a significant condition adversely affecting the reliability of the main turbine generator that resulted in a second reactor scram for the same cause was a licensee performance deficiency warranting a significance evaluation. The inspector reviewed the examples of minor issues in IMC 0612, "Power Reactor Inspection Reports," Appendix E, "Examples of Minor

Issues," dated August 11, 2009, and found several examples wherein licensees failed to adequately correct adverse conditions and consequences had some safety impact were considered to be of more than minor safety significance. Consistent with the guidance in IMC 0612, Appendix B, "Issue Screening," dated September 7, 2012, the inspector determined that the finding was of more than minor safety significance because it was associated with the Equipment Performance attribute and adversely affected the Initiating Events Cornerstone objective to limit the likelihood of events that upset plant stability and challenge critical safety functions during shutdown as well as power operations. Specifically, inadequate foreign material exclusion controls, coupled with a stator design that allows magnetized particles to be trapped in between the stator bars, resulted in a reactor scram following the development of hydrogen leak through a stator bar. The inspector performed a significance screening of this finding using the guidance provided in IMC 0609, "Significance Determination Process," Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," dated June 19, 2012. In accordance with Exhibit 1, "Initiating Events Screening Questions," the inspector determined that that this finding was a licensee performance deficiency of very low safety significance (Green) because the finding: (1) did not involve a loss-of-coolant accident initiator; (2) did not cause a reactor trip AND the loss of mitigation equipment; (3) did not involve the complete or partial loss of a support system that contributes to the likelihood of, or cause, an initiating event AND affect mitigation equipment; and (4) did not increase the frequency of a fire or internal flooding initiating event.

Cross-Cutting Aspects

The inspector concluded that because the licensee's missed opportunity to correct the condition was following a reactor scram in September 2009 and no other more recent opportunities reasonably existed to identify and correct the problem, this issue would not be reflective of current licensee performance and no cross-cutting aspect was identified.

Enforcement

No violation of regulatory requirements was identified. This issue is considered to be a finding (FIN 05000341/2013009-01, Failure to Implement Foreign Material Exclusion Procedure Requirements Adversely Affected the Reliability of the Main Turbine Generator and Caused a Reactor Scram). The licensee entered this finding into its corrective action program as CARD 12-29077.

2.02 Root Cause, Extent of Condition, and Extent of Cause Evaluation

a. Determine whether the licensee's root cause evaluation applied systematic methods in evaluating the issue in order to identify root causes and contributing causes.

The inspector determined that the primary root cause evaluation adequately applied systematic methods in evaluating the issue. In its root cause analysis, the licensee used an Event and Causal Factors Chart, Pareto Analysis, an Organizational and Programmatic Diagnostic Chart, and an Organizational and Programmatic Issue Screen.

b. Determine whether the licensee's root cause evaluation was conducted to a level of detail commensurate with the significance of the problem.

The inspector determined that the primary root cause evaluation was conducted to a level of detail commensurate with the significance of the problem.

The licensee's evaluation reviewed the three unplanned reactor scrams that contributed to the White PI and an additional five reactor scrams over the previous three years (i.e., from 2009 to present). The evaluation discussed the conclusions that were drawn when those events were reviewed in aggregate. The conclusions from the root cause team included one contributing cause and one observation. The root, apparent, direct and contributing causes, and factors associated with the eight scrams reviewed were considered by the licensee to be sufficiently diverse such that no commonality was identified that met its definition of a root cause. The evaluation did not reveal a root cause.

Contributing Cause

Inadequate performance of Critical to Production Asset (CPA) refurbishment activities has resulted in failed CPAs impacting critical hours and scrams during the period of evaluation.

Supporting Information:

- Foreign material was introduced into the main generator as a result of less than adequate foreign material controls during main generator refurbishments. The foreign material led to hydrogen-to-stator cooling water leaks on two separate occasions, resulting in reactor scrams. The first event occurred in September 2009 and the second event occurred in November 2012. The most recent event is considered a repeat due to the same nature of the failure, and without this repeat event, the White PI for Unplanned Scrams per 7000 Critical Hours would not have occurred.

- The south reactor feed water pump turbine was overhauled and reassembled with tighter than design clearances between the diaphragm seals and rotor shaft and, without a diaphragm alignment. Operation of the turbine following reassembly led to the development of an undetected hard rub and subsequently contributed to failure of the pump turbine and a reactor scram. The licensee recently completed a self-assessment on forced generation losses due to large asset (i.e., CPA) refurbishment, which aligned with the Pareto data used to determine primary contributors to lost critical hours.

- It was also found during the evaluation that resources outside of the licensee's Nuclear Generation organization, but within the company, were not leveraged to the fullest extent to enhance maintenance and care of similar CPAs at the plant. In two of the eight events there were decisions made on equipment, that if resources outside Fermi Plant but within the company were utilized, the outcome for the equipment may have been different.

Observation

Weaknesses existed in incorporating relevant operating experience into site processes to prevent and/or minimize events.

Supporting Information:

The root cause team found that four of the eight events that were investigated had an element of ineffective use of operating experience. The four events were amongst the

additional five pre-2012 unplanned reactor scrams that were included in the licensee's evaluation. It should be noted that the evaluations of two of these events concluded that misuse of operating experience caused the event and corrective actions from those evaluations to address use of operating experience were completed. The evaluations for the other two events discussed the use of operating experience, but did not identify misuse of operating experience to be actual causes. The licensee's evaluation also determined that there were missed opportunities with the interpretation of "low level" operating experience.

Outlined below are the issues with operating experience for each event.

- CARD 10-29450, "Reactor Scram Due to Loss of Vacuum"

  The root cause of the scram (October 24, 2010) was steam jet air ejector degradation was not determined through preventive maintenance. The licensee concluded that had industry operating experience on nozzle degradation been incorporated into the preventive maintenance activity, it is possible that inspection of the steam jet air ejector during the refueling outage would have identified the degradation. For example, the nozzle degradation that occurred in the steam jet air ejectors (CARD 10-29450) was previously experienced at Browns Ferry and mentioned in a Boiling Water Reactor Owners Group technical paper.

- CARD 09-21910, "Main Turbine High Vibrations"

  In this investigation, industry operating experience was available that discussed heat-up rates of main turbines during plant start-ups and the consequence of vibration resulting from too fast of a heat-up rate. The licensee did not consider this operating experience and apply it for cool-down rates during plant shutdowns although the same phenomena would apply. The rate of cool down was what caused the high turbine vibrations that resulted in the unplanned reactor scram (March 28, 2009).

- CARD 10-22632, "Automatic Reactor Scram Due to Main Turbine Trip"

  The root cause of this event (March 25, 2010) was multiple plant processes and programs failed to incorporate industry operating experience to ensure that inspection and maintenance practices identified and corrected the current transformer wiring deficiency prior to failure. Also, a contributing cause identified a specific issue with the review of an industry report that reviewed main generator failures, with specific details on failure modes similar to this event.

- CARD 09-27607, "Hydrogen In-Leakage Into Stator Water"

  A contributing cause to the event (September 30, 2009) was the failure to incorporate into site program controls external operating experience lessons-learned from other plants that had similar stator bar failures. The operating experience outlined in the root cause evaluation described failures to implement foreign material exclusion controls for main generator internal work sufficient to prevent contamination by small metallic particles.

Upon reviewing the licensee's root cause evaluation for the White PI, the inspector had the following observations:

1. The inspector noted that by including the additional five pre-2012 reactor scrams, the root cause team gained further insights and the licensee's evaluation benefited by additional data to input into the various root cause analysis methods employed.

2. The inspector noted that the Unplanned Scrams per 7,000 Critical Hours PI was close to crossing the Green-to-White threshold back in 2010 based on reactor scrams that occurred in September 2009; March 2010; June 2010; and October 2010. At that time, the licensee did not treat this as a "near-miss" opportunity to proactively and collectively evaluate the causes of the scrams for lessons learned that might have been beneficial.

3. In developing the observation related to operating experience, the root cause team found that weaknesses in incorporating operating experience were apparent in four of the eight reactor scrams. However, the inspector noted that while the team included the September 2009 reactor scram due to hydrogen leakage into the stator cooling water system as one of the four operating experience related scrams, it did not include the November 2012 reactor scram due to hydrogen leakage in its list. The inspector further noted that both scrams were due to the same cause and that operating experience was directly tied to the root cause for the November 2012 scram as discussed in the extent of condition review and operating experience review sections of the root cause evaluation.

4. The inspector noted that in the Organizational and Programmatic Issue Screen tool, many of the screening questions were marked as "yes." For example, questions such as: "Is there evidence that job standards were not adequately defined or communicated?" and "Is there evidence of inadequate job skills, work practices or decision making?" were marked as "yes." In all, 35 of the 73 screening questions were marked as "yes." However, the inspector noted that there was a limited review of the data, no documented explanations for the "yes" or "no" answers to any of the screening questions, and there did not appear to be any direct correlation with the corrective actions.

c. *Determine whether the licensee's root cause evaluation included consideration of prior occurrences of the problem and knowledge of prior operating experience.*

The inspector determined that the root cause evaluation included consideration of prior occurrences of the problem and knowledge of prior operating experience. However, the inspector also noted that the licensee missed some important considerations during its operating experience review.

In its root cause evaluation, the licensee identified both internal and external operating experience items that were related to several of the reactor scrams. However, the licensee concluded in the root cause evaluation that no new information was identified during its internal/external operating experience review that would apply to developing additional corrective actions for the root cause evaluation and no operating experience was identified that could have been used to predict/prevent the White PI.

As discussed above, the Unplanned Scrams per 7,000 Critical Hours PI was close to crossing the Green-to-White threshold back in 2010 based on reactor scrams that

occurred in September 2009, March 2010, June 2010, and October 2010. At that time, the licensee did not treat this as a "near-miss" opportunity to proactively and collectively evaluate the causes of the scrams for lessons-learned that might have been beneficial.

Also as discussed above, the licensee recognized that ineffective use of operating experience was a factor in four of the eight scrams it reviewed during the root cause evaluation. The inspector noted, however, that the November 2012 reactor scram due to hydrogen leakage was an additional fifth scram where the ineffective use of both internal and external operating experience was a factor.

d. *Determine whether the licensee's root cause evaluation addressed extent of condition and extent of cause of the problem.*

The inspector determined that the root cause evaluation adequately addressed the extent of condition and extent of cause of the problem. The evaluation adequately reviewed the extent of issues associated with the contributing cause identified. No corrective actions were tied to the extent of condition; however, appropriate corrective actions were identified for the extent of cause.

Each of the three unplanned reactor scrams were individually evaluated by either a root cause or apparent cause evaluation and each of those evaluations addressed the extent of condition and extent of cause of the problem that resulted in the scrams. Corresponding corrective actions appeared to be appropriate to address the problems.

In its root cause analysis, the licensee addressed the extent of condition by defining the condition as the change in the Unplanned Scrams per 7,000 Critical Hours PI from Green to White. The scope of the licensee's extent of condition evaluation included the impact of this change in PI status and evaluated whether a similar condition existed in other NRC PIs or NRC inspection findings.

The licensee addressed the extent of cause by looking at the extent of the contributing cause, which was that inadequate performance of CPA refurbishment activities has resulted in failed CPAs impacting critical hours and scrams during the period of evaluation. The extent of cause extends to CPAs, not specific to equipment or system type, and was bounded by nonsafety-related CPA plant refurbishments. The corrective actions offered to address the contributing cause address this extent of cause. The licensee concluded that there were already controls in place for similar work on safety-related equipment, which is governed by 10 CFR 50, Appendix B. The licensee also completed a self-assessment on large asset CPA refurbishments that would support this extent determination. Corrective actions are discussed below in Section 4OA4.2.03.

e. *Determine whether the licensee's root cause evaluation, extent of condition, and extent of cause appropriately considered the safety culture components as described in IMC 0310.*

The inspector determined that, in general, the root cause, extent of condition, and extent of cause evaluations appropriately considered the safety culture components as described in IMC 0310, Components Within the Cross-Cutting Areas, dated October 28, 2011.

The inspector reviewed the root cause evaluation and validated that the licensee had systematically considered the safety culture components. However, the inspector noted

that the licensee limited its consideration of the safety culture components to only the one contributing cause and did not also factor in the observation that involved weaknesses in incorporating operating experience. Clearly, weaknesses in incorporating operating experience was a factor in four (or five) of the eight unplanned reactors scrams that were reviewed by the licensee in the root cause evaluation.

The licensee concluded that the contributing cause was found to relate to the cross-cutting area of Human Performance in the component of Work Control with the cross-cutting aspects of Planning and Coordination. Recommended actions to address the cross-cutting aspects identified in the licensee's safety culture screen for the contributing cause are summarized in the table below:

Cross-Cutting Aspect	**Root Cause Evaluation Assessment of Cross-Cutting Aspect**	**Root Cause Evaluation Recommendations That Address This Safety Culture Aspect**
Planning	The south reactor feed pump turbine was overhauled and reassembled with tighter than design clearances between the diaphragm seals and rotor shaft and, without a diaphragm alignment. Critical alignment and design tolerance requirements were not provided. Specific post-maintenance testing guidelines were less than adequate.	• Develop a conduct manual for CPA refurbishment. • Develop design specifications for CPA refurbishments. • Establish quality program requirements for CPAs. • Incorporate engineered controls in maintenance procedures for CPAs. • Revise MMA-11, "Post Maintenance Testing Guidelines," to include specific post-maintenance testing requirements for CPA refurbishments.
Coordination	Resources outside of Nuclear Generation but within the corporation are not leveraged to the fullest extent to enhance maintenance and care of CPAs at the Fermi Plant.	• Develop a conduct manual for CPA refurbishment. • Develop design specifications for CPA refurbishments. • Revise MDI-034, "Project Plans," to define the role for engineering involved in CPA refurbishments.

f. Findings

No findings were identified.

2.03 Corrective Actions

a. Determine whether the licensee specified appropriate corrective actions for each root/contributing cause or that the licensee evaluated why no actions were necessary.

The inspector reviewed each of the four root and apparent cause evaluations and the associated corrective actions. The corrective actions were clearly described and were entered into the licensee's corrective action program tracking system. The inspector determined that the corrective actions appropriately address the root causes and contributing causes of the events and if properly implemented would address the

problems identified within each of the root and apparent cause evaluations. No concerns were identified.

b. Determine whether the licensee prioritized the corrective actions with consideration of the risk significance and regulatory compliance.

The inspector determined that the licensee adequately prioritized the corrective actions with consideration of the risk significance and regulatory compliance. The inspector reviewed the prioritization of the corrective actions and verified that, within reason, actions of a generally higher priority were scheduled for completion ahead of those of a lower priority. While many of the corrective actions were completed, some have not yet been completed. Two concerns were noted.

1. The licensee's current plan to address the main turbine generator design issue that led to unplanned reactor scrams in September 2009 and November 2012 is not scheduled to be completed until December 2017. The licensee implemented appropriate mitigation actions until a permanent corrective action involving replacement of the generator or modification to the existing stator design can be implemented. While the licensee attempted to remove as much foreign material as possible following the November 2012 event and has taken some additional mitigation actions, there is no guarantee that all of the foreign material has been removed. To that end, it is possible that the licensee will be forced to shut down and repair another stator bar leak sometime in the future before a permanent corrective action can be completed.

2. Recognizing that a reactor scram is an initiating event precursor, a controlled plant shutdown would be preferable to a reactor scram whenever possible. With the benefit of hindsight from two scrams due to main generator hydrogen leaks, the inspector discussed with the Operations Manager and Engineering Director what actions may be taken differently going forward that might afford plant operators the opportunity to complete a controlled plant shutdown vice a reactor scram to protect the generator from damage. CARD 13-24210 was written to capture this concern.

c. Determine whether the licensee established a schedule for implementing and completing the corrective actions.

The inspector determined that the licensee adequately established a schedule for implementing and completing the corrective actions. The schedule is tracked in the licensee corrective action program data base. As discussed above, while many of the corrective actions were completed, some have not yet been completed. The remaining corrective actions have been scheduled along with effectiveness reviews. The inspector concluded the timeline for completion of corrective actions was appropriate.

d. Determine whether the licensee developed quantitative or qualitative measures of success for determining effectiveness of the corrective actions to prevent recurrence.

The inspector determined that the licensee adequately developed quantitative or qualitative measures of success for determining effectiveness of the corrective actions to prevent recurrence.

One effectiveness review was identified by the licensee for the contributing cause identified in the root cause evaluation for CARD 12-29127, "NRC Performance Indicator

IE01 Exceeds White Threshold." The effectiveness review involved performing a self-assessment of the CPA refurbishment process, reviewing new program procedures established by actions in the root cause evaluation, and assessing the performance of any CPA refurbishments that have been performed against program procedures. It is scheduled to be completed in October 2014.

The licensee also identified effectiveness reviews associated with each of the root and apparent causes for the three unplanned reactor scrams:

- CARD 12-29077, "Reactor Scram Due to H2 In-Leakage to Stator Water"

  If the main generator is replaced, then the licensee will verify no stator bar failures due to foreign material events for three years after replacement. If the main generator stator is replaced or rewound, then the licensee will verify no stator bar failures due to foreign material events for three years from replacement/rewinding.

- CARD 12-27639, "Reactor Scram Due to Loss of Feed Water and Apparent Loss of 120-kV Bus 101"

  The licensee will verify no phase to ground fault failures due to animal intrusion on 13.2 kV bus surge arresters until October 2015.

- CARD 12-25544, "Reactor Scram Due to Loss of Condenser Vacuum"

  The licensee will verify no power reductions or forced outages resulting from equipment degradation due to inadequate maintenance or operation of the reactor feed water pump turbines. The due dates are six months from restoration and installation of a newly rebuilt south reactor feed water pump turbine and six months from completion of the 10-year overhaul of the north reactor feed water pump turbine.

The inspector concluded the effectiveness reviews were appropriate.

e. Determine that the corrective actions planned or taken adequately address the Notice of Violation that was the basis for the supplemental inspection.

The NRC staff did not issue a Notice of Violation to the licensee; therefore, this inspection item was not applicable.

f. Findings

No findings were identified.

2.04 Evaluation of IMC 0305 Criteria For Treatment Of Old Design Issues

The licensee did not request credit for self-identification of an old design issue; therefore, this inspection item was not applicable.

4OA6 Management Meetings

.1 Exit Meeting Summary

The inspector presented the inspection results to Mr. J. Plona and members of licensee management on June 14, 2013. The inspector confirmed that proprietary information was not provided or examined during this inspection.

.2 Regulatory Performance Meeting

On June 14, 2013, the NRC met with the licensee to discuss its performance in accordance with IMC 0305, Section 10.02.b.4. During this meeting, the NRC and licensee discussed the issues related to the White PI that resulted in Fermi Power Plant Unit 2 being placed in the Regulatory Response Column of the NRC's ROP Action Matrix. This discussion included the causes, corrective actions, extent of condition, extent of cause, and other planned licensee actions.

ATTACHMENT: SUPPLEMENTAL INFORMATION

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee

M. Caragher, Nuclear Engineering Director
T. Conner, Vice President, Nuclear Generation
J. Ford, Organization Effectiveness Director
J. Plona, Senior Vice President and Chief Nuclear Officer
Z. Rad, Nuclear Licensing Manager
K. Scott, Plant Manager
G. Strobel, Operations Manager

Nuclear Regulatory Commission

R. Morris, Senior Resident Inspector
R. Jones, Resident Inspector
M. Kunowski, Branch Chief

LIST OF ITEMS OPENED, CLOSED, DISCUSSED

Opened

05000341/2013009-01	FIN	Failure to Implement Foreign Material Exclusion Procedure Requirements Adversely Affected the Reliability of the Main Turbine Generator and Caused a Reactor Scram (Section 4OA4.2.01.d)

Closed

05000341/2012-006-00	LER	Manual Reactor Scram Due to Hydrogen Leakage into the Stator Water Cooling System (Section 4OA3.1)
05000341/2013009-01	FIN	Failure to Implement Foreign Material Exclusion Procedure Requirements Adversely Affected the Reliability of the Main Turbine Generator and Caused a Reactor Scram (Section 4OA4.2.01.d)

Discussed

None

LIST OF DOCUMENTS REVIEWED

The following is a partial list of documents reviewed during the inspection. Inclusion on this list does not imply that the NRC inspector reviewed the documents in their entirety, but rather that selected sections or portions of the documents were evaluated as part of the overall inspection effort. Inclusion of a document on this list does not imply NRC acceptance of the document or any part of it, unless this is stated in the body of the inspection report.

IP 95001

- Root Cause Evaluation (CARD 12-29127), "NRC Performance Indicator IE01 Exceeds White Threshold," Revision 1
- Root Cause Evaluation (CARD 12-29077), "Reactor Scram Due to H2 In-Leakage to Stator Water," Revision 1
- Apparent Cause Evaluation (CARD 12-27639), "Reactor Scram Due to Loss of Feed Water and Apparent Loss of 120-kV Bus 101," Revision 0
- Root Cause Evaluation (CARD 12-25544), "Reactor Scram Due to Loss of Condenser Vacuum," Revision 1
- NANL-13-0023, "Quick Hit Self-Assessment: Supplemental Inspection Readiness Review," March 25, 2013
- LER 05000341/2012-006-00, "Manual Reactor Scram Due to Hydrogen Leakage into the Stator Water Cooling System," December 21, 2012
- Operational Decision Making Issue (ODMI) 12-008, "Increased H2 Leakage Into Stator Winding Cooling System," Revision 0
- MMA-27, "Critical to Production Asset Refurbishment or Replacement," Revision 0
- CARD 12-29127, "NRC Performance Indicator IE01 Exceeds White Threshold"
- CARD 12-29077, "Reactor Scram Due to H2 In-Leakage to Stator Water"
- CARD 12-27639, "Reactor Scram Due to Loss of Feed Water and Apparent Loss of 120-kV Bus 101"
- CARD 12-25544, "Reactor Scram Due to Loss of Condenser Vacuum"
- CARD 13-24210, "NRC Observation – Main Generator ODMI"
- CARD 13-24240, "Improvement Opportunity – CAP [Corrective Action Program] Program"

LIST OF ACRONYMS USED

ADAMS	Agencywide Documents Access and Management System
CAP	Corrective Action Program
CARD	Condition Assessment Resolution Document
CFR	Code of Federal Regulations
CPA	Critical to Production Asset
FIN	Finding
H2	Hydrogen
IMC	Inspection Manual Chapter
IP	Inspection Procedure
kV	Kilovolt
LER	Licensee Event Report
NRC	U.S. Nuclear Regulatory Commission
ODMI	Operational Decision Making Issue
PARS	Publicly Available Records System
PI	Performance Indicator
ROP	Reactor Oversight Process
SDP	Significance Determination Process

The NRC determined that the root and apparent cause evaluations completed for each of the three individual unplanned reactor scrams that resulted in the White PI as well as the root cause evaluation you completed in preparation for this inspection were conducted to a level of detail commensurate with the significance of the problems and reached reasonable conclusions as to the root and contributing causes of the events. The NRC also concluded that you identified reasonable and appropriate corrective actions for each root and contributing cause and that the corrective actions appeared to be prioritized commensurate with the safety significance of the issues. Some observations regarding specific aspects of your root/apparent cause evaluations and corrective actions that warrant additional consideration by your staff were identified.

The Unplanned Scrams per 7,000 Critical Hours PI returned below the Green-to-White threshold on June 25, 2013. Therefore, given your acceptable performance in addressing the White PI that was the subject of this inspection, in accordance with the guidance in Inspection Manual Chapter 0305, "Operating Reactor Assessment Program," the White PI will only be considered in assessing plant performance through the 2nd quarter of 2013. As a result, the NRC determined the performance at Fermi Power Plant Unit 2 to be in the Licensee Response Column of the ROP Action Matrix as of the date of this letter.

Based on the results of this inspection, one self-revealed finding of very low safety significance was identified. The finding did not involve a violation of NRC requirements.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any), will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records System (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/readingrm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA/

Michael Kunowski
Division of Reactor Projects

Docket No. 50-341
License No. NPF-43

Enclosure: Inspection Report 05000341/2013009
w/Attachment: Supplemental Information

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Letter to J. Plona from M. Kunowski dated July 17, 2013

SUBJECT: FERMI POWER PLANT, UNIT 2
NRC SUPPLEMENTAL INSPECTION REPORT 05000341/2013009 AND
ASSESSMENT FOLLOW-UP LETTER

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