UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE RD. SUITE 210
LISLE, IL 60532-4352

December 5, 2016

EA–16–236

Mr. Bryan C. Hanson
Senior VP, Exelon Generation Company
LLC President and CNO, Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: DRESDEN NUCLEAR POWER STATION, UNIT 3—NRC INSPECTION REPORT 05000249/2016010 AND PRELIMINARY WHITE FINDING

Dear Mr. Hanson:

The enclosed inspection report documents a finding that has preliminarily been determined to be White, a finding with low to moderate safety significance, that may require additional U.S. Nuclear Regulatory Commission (NRC) inspections, regulatory actions, and oversight. This finding was assessed based on the best available information, using the Significance Determination Process (SDP). The NRC will inform you in writing when the final significance has been determined.

On October 28, 2016, the NRC met with Mr. J. Washko and other members of your staff to discuss an issue affecting the safety-related high pressure coolant injection (HPCI) system. On June 27, 2016, during the performance of DOS 2300–03, "HPCI System Operability and Quarterly IST [Inservice Testing] Verification Test," the Unit 3 HPCI auxiliary oil pump (AOP) motor failed and caught on fire. The root cause of the fire as documented in the licensee's root cause report (RCR) 2686163, "HPCI AOP Motor Failure," was that licensee personnel did not recognize or control critical parameters when installing a direct current (DC) shunt wound motor. Specifically, the licensee did not adjust the external variable shunt resistors while monitoring critical motor parameters such as armature current, field current, and pump speed when installing a new pump motor. In this instance, the variable shunt resistors were set to a maximum value in March of 2015, when the Unit 3 HPCI AOP motor was most recently replaced, which resulted in a field current that was too low for motor operation and an excessively high armature current which degraded the motor windings until failure. Because actions have been taken to replace the failed Unit 3 HPCI AOP and set the variable shunt resistors with consideration for critical motor parameters, this issue does not represent a continuing safety concern. The NRC assessed this finding using the best available information and Manual Chapter 0609, "Significance Determination Process." The basis for the NRC's preliminary significance determination is described in the enclosed report. The finding is also an apparent violation of NRC requirements and is being considered for escalated enforcement action in accordance with the Enforcement Policy, which can be found on the NRC's website at http://www.nrc.gov/about-nrc/regulatory/enforcement/enforce-pol.html.

We intend to issue our final significance determination and enforcement decision, in writing, within 90 days from the date of this letter. The NRC's significance determination process (SDP) is designed to encourage an open dialogue between your staff and the NRC; however, neither the dialogue nor the written information you provide should affect the timeliness of our final determination.

Before the NRC makes a final decision on this matter, we are providing you with an opportunity to (1) attend a Regulatory Conference where you can present your perspective on the facts and assumptions used to arrive at the finding and assess its significance, or (2) submit your position on the finding to the NRC in writing. If you request a Regulatory Conference, it should be held within 40 days of the date of this letter. We encourage you to submit supporting documentation at least one week prior to the conference in an effort to make the conference more efficient and effective. The focus of the Regulatory Conference is to discuss the significance of the finding and not necessarily the root cause or corrective actions associated with the finding. If you choose to attend a Regulatory Conference, it will be a Category 1 meeting open for public observance. The NRC will issue a public meeting notice and press release to announce the conference. If you decide to submit only a written response, it should be sent to the NRC within 40 days of the date of this letter. If you decline to request a Regulatory Conference or to submit a written response, you relinquish your right to appeal the NRC's final significance determination, in that by not choosing an option, you fail to meet the appeal requirements stated in the Prerequisites and Limitations sections of Attachment 2, "Process for Appealing NRC Characterization of Inspection Findings (SDP Appeal Process)," of NRC Inspection Manual Chapter 0609.

Please contact Mr. J. Cameron at 630–829–9833, and in writing, within 10 days from the date of this letter to notify us of your intentions. If we have not heard from you within 10 days, we will continue with our final significance determination and enforcement decision. The final resolution of this matter will be conveyed in separate correspondence.

Because the NRC has not made a final determination in this matter, no Notice of Violation is being issued for this inspection finding at this time. In addition, please be advised that the number and characterization of the apparent violation described in the enclosed inspection report may change based on further NRC review.

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

Sincerely,

/RA/

Julio F. Lara, Deputy Director
Division of Reactor Projects

Docket No. 50–249
License No. DPR–25

Enclosure:
Inspection Report 05000249/2016010

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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No:	50–249
License No:	DPR–25
Report No:	05000249/2016010
Licensee:	Exelon Generation Company, LLC
Facility:	Dresden Nuclear Power Station, Unit 3
Location:	Morris, IL
Dates:	September 26 through October 28, 2016
Inspectors:	G. Roach, Senior Resident Inspector R. Elliott, Resident Inspector J. Corujo-Sandin, Reactor Engineer I. Hafeez, Reactor Engineer
Approved by:	J. Cameron, Chief Branch 4 Division of Reactor Projects

Enclosure

SUMMARY

Inspection Report 05000249/2016010; Dresden Nuclear Power Station; Follow-Up of Events and Notices of Enforcement Discretion.

The enclosed inspection report documents a finding that has preliminarily been determined to be White, a finding with low to moderate safety significance, that may require additional NRC inspections, regulatory actions, and oversight. The significance of inspection findings is indicated by their color (i.e., greater than Green, or Green, White, Yellow, Red) and determined using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process," dated April 29, 2015. Cross-cutting aspects are determined using IMC 0310, "Aspects Within the Cross-Cutting Areas," dated December 4, 2014. All violations of NRC requirements are dispositioned in accordance with the NRC's Enforcement Policy, dated February 4, 2015. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG–1649, "Reactor Oversight Process," dated July 2016.

Cornerstone: Mitigating Systems

- Preliminary White. A self-revealing finding preliminarily determined to be of low to moderate safety significance, and an apparent violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," was associated with the licensee's failure to ensure that the applicable design basis for applicable structures, systems, and components was maintained by the performance of design reviews, through the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Specifically, the licensee failed to verify the adequacy of design for the Unit 3 high pressure coolant injection (HPCI) auxiliary oil pump (AOP) motor shunt resistor setting during motor replacement in March of 2002, and then again in March of 2015, eventually resulting in pump failure in June of 2016, and inoperability of the HPCI system. The licensee documented this issue in its corrective action program (CAP) as IR 2686163.

  The inspectors determined that the licensee's failure to verify the adequacy of design for the Unit 3 HPCI AOP motor shunt resistor setting was a performance deficiency, the cause was reasonably within the licensee's ability to foresee and correct due to previous events and licensee generated causal determinations regarding the significance of adjusting the shunt field resistors on motor and pump operations, and should have been prevented. The inspectors determined the issue was more than minor because it adversely impacted the Mitigating Systems Cornerstone attribute of Design Control and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences (i.e. core damage). Specifically, the failure to control the design of the Unit 3 HPCI AOP motor resulted in the degradation and ultimate failure of the pump motor windings, which is a required component for HPCI operation. The inspectors applied IMC 0609, Attachment 4, and IMC 0609, Appendix A, Exhibit 2, Section A, for "Mitigating Systems" to screen this finding and determined that a detailed risk evaluation was required because the finding represented a loss of system and/or function. Therefore, a coordinated effort between inspection staff and regional Senior Reactor Analyst (SRA) was required to perform an appropriate risk evaluation for the degraded condition that resulted from the finding. The SRA used the Dresden Standardized Plant Analysis Risk (SPAR) model, version 8.24 for the detailed risk evaluation. This evaluation concluded that the exposure time for the HPCI system was 1 year. The total delta core damage frequency (CDF) for the 1 year exposure period was 6.9E–6/year,

which is a finding of low to moderate safety significance (White). HPCI is an important high pressure injection system that is used to mitigate internal events, internal flooding, and internal fire events at Dresden. The inspectors determined the contributing cause that provided the most insight into the performance deficiency was associated with the cross–cutting area of Human Performance, Design Margins because the licensee failed to operate and maintain equipment within design margins, in that margins are carefully guarded and changed only through a systematic and rigorous process with special attention placed on maintaining fission product barriers, defense-in-depth, and safety-related equipment [H.6]. Specifically, the licensee failed to verify the adequacy of design for the Unit 3 HPCI AOP motor shunt resistor setting during motor replacement in March of 2002 and then again in March of 2015. (Section 4OA3)

REPORT DETAILS

4. OTHER ACTIVITIES

Cornerstones: Mitigating Systems

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

.1 (Closed) Licensee Event Report 05000249/2016–001–00, "Alert Declared from Unit 3 HPCI Auxiliary Oil Pump Motor Fire"

a. Inspection Scope

The inspectors reviewed the licensee's response to and assessment of a failure of the Unit 3 HPCI AOP during surveillance testing. Specifically, on June 27, 2016, during the performance of DOS 2300–03, "HPCI System Operability and Quarterly IST [Inservice Testing] Verification Test," the Unit 3 HPCI AOP motor failed and caught on fire. The licensee declared an Alert under emergency action level MA5 due to a fire which results in damage to at least one train of a safety system, in this case HPCI. Follow-up investigation identified that the licensee did not appropriately adjust the external variable shunt resistors while monitoring critical motor parameters such as armature current, field current, and pump speed during motor installation. Improper setting of the variable shunt resistor resulted in a field current that was too low for motor operation and an excessively high armature current, which degraded the motor windings until failure.

The licensee reported this event in accordance with 10 CFR 50.73(a)(2)(v)(D), any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to mitigate the consequences of an accident. Documents reviewed are listed in the Attachment to this report. This subject licensee event report (LER) is closed.

This event follow-up review constituted one sample as defined in IP 71153.05.

b. Findings

Introduction: A self-revealed finding of low to moderate safety significance (White) and an apparent violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," was associated with the licensee's failure to ensure that the applicable design basis for applicable structures, systems, and components was maintained by the performance of design reviews, through the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Specifically, the licensee failed to verify the adequacy of design for the Unit 3 HPCI AOP motor shunt resistor setting during motor replacement in March of 2002, and then again in March of 2015.

Description: On June 27, 2016, during the performance of DOS 2300–03, "HPCI System Operability and Quarterly IST Verification Test," the Unit 3 HPCI AOP motor failed and caught on fire. The root cause of the fire as documented in the licensee's root cause report (RCR) 2686163, "HPCI AOP Motor Failure," was that licensee personnel did not recognize or control critical parameters when installing a direct current (DC) shunt wound motor. Specifically, the licensee did not adjust the external variable shunt resistors while monitoring critical motor parameters such as armature current, field current, and pump speed when installing a new pump motor. In this instance, the

variable shunt resistors were set to a maximum value (69 ohms) originally in October of 2002, and then again in March of 2015, when the Unit 3 HPCI AOP motor was most recently replaced, which resulted in a field current that was too low for motor operation and an excessively high armature current that degraded the motor windings until failure.

In 1967, the vendor (General Electric) informed the licensee via letter that the set point for the variable shunt resistors (two series-wired 33 ohm resistors external to the pump motor) were to be set at a total of 56.8 ohms. This value was indicated on the original plant electrical drawings 12E–2819E (Unit 2) and 12E–3819E (Unit 3). The original Unit 2 HPCI AOP motor was operated until June of 1992 when it experienced an internal ground and was replaced. The original GE pump motor part number 5CD326E765 was considered obsolete and was replaced with GE pump motor part number 5CD173XD817A800. In a letter dated July 21, 1992, the vendor approved the licensee's setting of the variable shunt resistor at 66 ohms with the new pump motor as it resulted in an acceptable motor speed and acceptable pump discharge pressure and HPCI operation. On August 14, 1992, just two months following installation, the Unit 2 HPCI AOP motor electrically failed and caught fire. The cause of the fire was a catastrophic failure of the armature windings due to excessive armature current. Licensee Deviation Report 12–2–92–158, "HPCI AOP Motor Failure Due to an Internal Fault on the Armature," identified a corrective action to determine whether the shunt field resistance bank should be modified. To address this concern, the licensee requested that an architect/engineering firm confirm that the correct shunt resistor setpoint was being used. The engineering firm determined that the new motor possessed adequate performance characteristics for the application, but that performance could be improved if the setpoint were adjusted to 58.8 ohms. The licensee did not implement this change, the reason for which is unknown and is not indicated in Attachment 'E' of licensee calculation DRE96–0189, "Voltages on Loads Fed from the Safety Related 250V Batteries," which is devoted specifically to the HPCI AOP and contains the correspondence in 1992 and 1993 between the licensee and the vendor as well as the licensee and the engineering firm.

In March of 2002, the licensee experienced low insulation resistance on the Unit 3 HPCI AOP and determined through engineering Procurement Evaluation (PE) 16258, that the same part number motor used on Unit 2 in 1992 would be used to replace the original design motor. With the new motor installed on the Unit 3 HPCI AOP, the licensee immediately began to experience higher vibrations and poor pump characteristics (flow rate and pump discharge pressure). The licensee began troubleshooting and performed Equipment Apparent Cause Evaluation (EACE) 128822, "HPCI AOP High Vibrations and Low RPM on New Motor," through which it determined that the apparent cause of this issue was the improper setting of the adjustable shunt resistors in the control circuit. Specifically, when a DC motor with shunt resistors is replaced, field adjustments to the shunt resistors may be required to obtain optimal performance of the pump and motor. In addition, the EACE noted that work order (WO) 422001 that was used to install the new motor in March of 2002 had an unused contingency work instruction, if the old motor had to be reinstalled, to set the variable shunt resistors to 46 ohms which was the as found value for the old motor. The actual work instruction used to install the new motor did not include a step to adjust the shunt resistors and as such they remained at 46 ohms with the new motor installed. PE 16258 did not address the need to make adjustments to the shunt resistors when assessing the acceptability of installing the new motor in the Unit 3 application. It is unknown why the Unit 3 shunt resistors were set to 46 ohms as the control drawing at the time (12E–3819E) indicated that the resistors for

the original design motor should be 56.8 ohms. Troubleshooting under WO 00501804, "Trouble Shoot Low RPM [revolutions per minute] Reading on HPCI Oil Pump Motor," reported that the variable shunt resistor banks were adjusted "to get required speed." Based on future as-found data, this as-left value is believed to have been between 66–69 ohms. In addition, corrective action 128822–09 from EACE 128822 required the licensee to add clarifying notes in the licensee's Passport database system under the equipment part number of all affected DC shunt motors on site that "during installation, shunt resistors may require adjustments and because motors cannot be run uncoupled, in-field balancing may be required."

During routine operations of placing the Unit 2 HPCI turbine on the turning gear in 2004, the licensee started the Unit 2 HPCI AOP and immediately experienced a significant drop in 250 volt direct current (VDC) battery charger voltage and a control room alarm that was entered into the licensee's CAP under IR 274991, "Battery Charger Trouble Rec'd During U2 HPCI AOP Start". Follow-on troubleshooting indicated that the AOP motor was drawing excessive armature current (800 amps) when starting. According to licensee design calculation DRE96–0189, the HPCI AOP armature current is limited to less than 139 amps. The inspectors were not able to ascertain how this issue was further resolved.

In March of 2015, during a post maintenance run, the Unit 3 HPCI AOP motor began sparking, this time resulting in significant damage to the motor's commutator and brushes. Licensee EACE 2498875, "Unit 3 HPCI AOP Motor Failure Mechanism," determined the apparent cause of the failure to be a short circuit event between adjacent commutator segments resulting from trapped carbon dust from the motor's brushes. The EACE noted that maintenance procedures needed to be enhanced to direct air blasting or vacuuming of the brush box and commutator to remove carbon dust during cleaning and inspection preventative maintenance. WO 1825228 was used to replace the damaged Unit 3 HPCI AOP motor with a like-for-like motor. During installation, the variable shunt resistors were briefly set to 58 ohms but were changed to the original as-found value of 69 ohms due to vibrations experienced during maintenance testing.

In March of 2016, the licensee adjusted balancing rings mechanically to help reduce motor vibrations and performed its 4 year preventative maintenance on the motor, which included measuring field resistance in accordance with procedure DES 8300–04, "Inspection of DC Motors and Brushes." The surveillance noted that total field resistance for the shunt resistors and the motor's internal field windings was approximately 1 05 ohms. This would correspond to a shunt resistor setting of approximately 66 ohms as verified by the licensee's 250 VDC calculation.

On June 27, 2016, during surveillance testing, the Unit 3 HPCI AOP again failed and caught on fire. During motor replacement subsequent to this event under WO 01934807 the licensee noted that power cables to the pump glowed red when the pump was briefly started for testing. Following this event and in conjunction with the execution of RCR 2686163, the licensee consulted with outside DC motor experts who identified that the licensee needed to monitor field current, armature current, and motor speed in addition to pump flow characteristics and vibrations when evaluating a newly installed DC shunt motor. Following this recommendation, the licensee was able to generate work instructions that adequately established pump characteristics while ensuring armature and field current values as well as motor speed were acceptable by adjusting the shunt resistors to an as-left setting of 60.07 ohms for the Unit 3 HPCI AOP motor.

Analysis: The inspectors determined the licensee's failure to verify the adequacy of design for the Unit 3 HPCI AOP motor shunt resistor setting was a performance deficiency, the cause was reasonably within the licensee's ability to foresee and correct due to previous events and licensee generated causal determinations. Specifically, PE 16258 was performed in 2002 when the licensee first replaced the Unit 3 HPCI AOP motor with the current motor part number. The evaluation considered the new motor electrically the same as the previous motor and noted that the same part number motor had been previously installed on the Unit 2 HPCI AOP. However the licensee's evaluation made no attempt to determine either through calculation or testing what the appropriate setting was for the shunt field resistance with the new motor installed. The prior motor failure for the Unit 2 HPCI AOP and engineering firm determination that a lower resistor setting was more appropriate for the application was documented in the licensee calculation of record at the time, but apparently was not considered. The Unit 3 HPCI AOP motor was again replaced in March of 2015 for corrective reasons, and again the licensee did not consider shunt motor resistance even though licensee EACE 128822 noted that regarding DC shunt motors, during installation, shunt resistors may require adjustments. However, since the licensee did not seek vendor guidance or attempt to determine the appropriate settings for the variable shunt resistors through calculation or testing, in both instances the licensee inappropriately applied the Unit 2 HPCI AOP motor shunt resistor settings to the Unit 3 HPCI AOP motor without performing a detailed design review to verify the adequacy of design and evaluate any potential impacts to the Unit 3 components. This was contrary to the requirements of 10 CFR Part 50, Appendix B, Criterion III, "Design Control".

This performance deficiency was determined to be more than minor, and thus a finding, in accordance with IMC 0612, Appendix B, "Issue Screening," dated September 7, 2012, because it was associated with the Mitigating Systems Cornerstone attribute of Design Control and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences (i.e. core damage). Specifically, the failure to control the design of the Unit 3 HPCI AOP motor resulted in degradation and ultimate failure of the pump motor, which is a required component for HPCI operation.

The inspectors determined the finding could be evaluated using the SDP in accordance with IMC 0609, Attachment 4, "Initial Characterization of Findings", and IMC 0609, Appendix A, "The Significance Determination Process for Findings At–Power," Exhibit 2, "Mitigating Systems Screening Questions," both issued June 19, 2012. The inspectors determined the finding represented a loss of system function and answered "yes" to question A.2 of Exhibit 2. As a result, a detailed risk evaluation was required.

The SRAs used the Dresden Standardized Plant Analysis Risk (SPAR) model, version 8.24 for the detailed risk evaluation.

The following assumptions were made in the evaluation:

1. The AOP motor failure prevented HPCI from being able to re-start.

2. Operators would likely trip HPCI given a fire in the AOP motor, as operators took this action when the actual fire occurred.

3. A 24 hour HPCI probabilistic risk assessment (PRA) mission is likely to require multiple HPCI starts/stops.

4. The AOP is a component included within the turbine-driven pump component boundary as it is a necessary support system for the HPCI turbine-driven pump to operate. Therefore, any AOP failure is mapped to the HPCI turbine-driven pump basic events in the SPAR model.

5. The HPCI system failure to re-start was modeled as a HPCI failure to run by setting the basic event for failure to run to "True".

6. The AOP ran for a total of approximately 14 hours during periodic surveillance tests since the pump motor was installed in March 2015, before it failed and caught on fire on June 27, 2016. Since the AOP normally runs while the HPCI system is operating, the AOP motor was susceptible to failure anytime during a HPCI 24 hour PRA mission since it was installed. An AOP failure during the HPCI mission would prevent HPCI's ability to restart and complete its mission.

7. The exposure time was determined in accordance with the NRC's Risk Assessment of Operational Events (RASP) manual for Component Run Failures. The exposure time starts when the component no longer has the capability to operate for the PRA mission time (i.e. 24 hours). The exposure time for the degraded condition is one year, which is the maximum time used in the SDP process.

8. HPCI could not be manually operated with a failure of the AOP and successful operation of HPCI could not be recovered.

The risk contribution from internal events for an exposure period of one-year is estimated to be 5.9E–6/yr. The dominant accident sequence cut-sets for internal events involve a reference leg leak down (RLLD) initiating event with a failure of the main condenser, the isolation condenser, main feedwater, HPCI, and the failure of reactor cooling system depressurization.

A rough estimate of the fire risk contribution was obtained using information from the Dresden Individual Plant Examination of External Events (IPEEE), Revision 1, dated February 14, 2000. The SRAs used the fire frequencies provided in the IPEEE and calculated a change in conditional core damage probability with HPCI failed. Main feedwater was also assumed to be failed as an impact of the fire event. Combining the two terms gives an estimate of the delta CDF. The fire risk ΔCDF contribution was estimated to be 1.0E–6/yr. The following list of fire initiating events was considered in the IPEEE and were the dominant initiating events that contributed to fire risk for this issue.

%TP Multiple Spurious Automatic Depressurization System (ADS) Valve Opening
%TI Single Spurious ADS Valve Opening
%TC Loss of Main Condenser
%LOOP Single Unit Loss of Offsite Power

The SRAs concluded that risk contributions from other external initiating events was negligible. The analysts further concluded that the risk characterization of the issue

should be based on the ΔCDF results and that the change in large early release frequency (ΔLERF) would not increase the overall significance of the finding.

The licensee performed a risk evaluation, which was documented as DR–SDP–10, Revision 0, "Significance Determination Estimate for the Unit 3 HPCI Auxiliary Oil Pump Motor Fire," and provided it to the inspectors and SRAs for review on October 6, 2015. The licensee concluded the finding was of very low safety significance, or Green. The SRAs determined that the difference between the outcome of the NRC's preliminary risk estimate and the licensee's risk estimate was primarily due to the use of a different exposure time for the degraded condition of the HPCI system. The licensee used an exposure time of 61.5 days, which is half of the time from the last successful quarterly surveillance test of the HPCI system on March 16, 2016, until the HPCI AOP motor failed on June 27, 2016. The NRC determined that this method, defined as the "T/2" method, did not fully capture the period of time that the HPCI system was degraded. The "T/2" approach to exposure time is typically used when the degradation mechanism ultimately leading to failure is affecting the component while it is in a standby configuration. Based on the licensee's root cause evaluation, the HPCI AOP motor was degrading while it was operating, and not while it was in standby. The AOP degradation mechanism and the potential impact to the 24 hour PRA mission of the HPCI system since installation formed the basis for the NRC's determination of a 1 year exposure period.

The inspectors determined the contributing cause that provided the most insight into the performance deficiency was associated with the cross-cutting area of Human Performance, Design Margins because the licensee failed to operate and maintain equipment within design margins, in that margins are carefully guarded and changed only through a systematic and rigorous process with special attention placed on maintaining fission product barriers, defense–in–depth, and safety-related equipment [H.6]. Specifically, the licensee failed to verify the adequacy of design for the Unit 3 HPCI AOP motor shunt resistor setting during motor replacement in March of 2002, and then again in March of 2015.

Enforcement: Title 10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program.

From March of 2002, until June 27, 2016, the licensee failed to verify the adequacy of the design of the HPCI AOP motor, which was a component subject to the requirements of 10 CFR 50, Appendix B.

Specifically, PE16258 performed by the licensee failed to verify the Unit 3 HPCI AOP motor shunt field resistor bank setting was adequate for the design of the component and ensure it would be capable of performing its design basis function.

Licensee corrective actions included reducing the shunt field resistor value for the affected motor to 60.07 ohms and revising procedures used for the installation, inspection and testing of DC motors, including the procedures used to set the HPCI AOP motor shunt field resistor bank. The licensee has also identified all DC shunt motors noting those with variable shunt field resistors, determined an allowable shunt resistor range for all motors with field resistors, and validated all motors requiring a space heater had one that was functional. The licensee also planned to conduct case study training

on the event and planned to conduct additional training on DC motor operation for affected personnel.

This is an apparent violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," preliminarily determined to be of low to moderate safety significance (White). The licensee entered this issue into their CAP as IR 2686163 **(AV 05000249/2016010–01, Failure to Verify the Adequacy of Design for the Unit 3 HPCI AOP Motor Shunt Resistor Setting)**.

4OA6 Management Meeting

Exit Meeting Summary

On October 28, 2016, the inspectors presented the inspection results to Mr. J. Washko, and other members of the licensee staff. The licensee acknowledged the issues presented. The inspectors confirmed that none of the potential report input discussed was considered proprietary.

ATTACHMENT: SUPPLEMENTAL INFORMATION

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee

P. Karaba, Site Vice President
J. Washko, Station Plant Manager
C. Bachman, Plant Engineering
M. Budelier, Senior Engineering Manager
T. Dean, Director, Site Training
T. Ditchfield, Shift Operations Superintendent
B. Franzen, Regulatory Assurance Manager
F. Gogliotti, Director, Site Engineering
P. Hansett, Work Control Director
M. Jursich, Plant Engineering
G. Morrow, Operations Director
S. Matzke, Corrective Action Program Coordinator
P. O'Brien, Site Assessor
A. Rehn, Regulatory Engineer
D. Walker, Regulatory Assurance – NRC Coordinator
P. Wojtkiewicz, Engineering Manager

U.S. Nuclear Regulatory Commission

J. Cameron, Chief, Division of Reactor Projects, Branch 4
L. Kozak, Senior Reactor Analyst

IEMA

M. Porfirio, Resident Inspector, Illinois Emergency Management Agency

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

05000249/2016010–01	AV	Failure to Verify the Adequacy of Design for the Unit 3 HPCI AOP Motor Shunt Resistor Setting (Section 4OA3)

Closed

05000249/2016-001–00	LER	Alert Declared from Unit 3 HPCI Auxiliary Oil Pump Motor Fire

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.

Follow-Up of Events and Notices of Enforcement Discretion

- WO 01934807-04, “Adjust Shunt Field Resistor for U3 HPCI Aux Oil Pump Motor 3-2303-AOP”
- WO 1934807-26, “Damaged U3 HPCI Aux Oil Pump Motor”
- WO 01825228-01, “U3 HPCI Aux Oil Pump Elevated Vibration”
- WO 01825228-06, “TS [Technical Specification]/Repair (HPCI Auxiliary Oil Pump Motor 3-2303-AOP)”
- WO 1818352-04, “Adjust Shunt Field Resistor for U3 HPCI Aux Oil PP Motor”
- WO 0501804-01, “Trouble Shoot Low RPM Reading on HPCI Oil Pump Motor”
- WO 0422001-07, “Replace HPCI Aux Oil Pump Motor”
- IR 2716049, “Internal Inspection of MOV 3-3203 to Support FFWTR Project”
- IR 2686163-04, “RCR for HPCI AOP Motor Failure”
- IR 2686163-30, “RCR for HPCI AOP Motor Failure”
- IR 2686163-35, “RCR for HPCI AOP Motor Failure”
- IR 2476080, “U3 HPCI Aux Oil Pump Elevated Vibration”
- IR 1490301, “U3 HPCI Aux Oil Pump Motor Sparking”
- IR 0128822, “HPCI Aux Oil Pump High Vibration and Low RPM on New Motor”
- History for D2 4Y PM [planned maintenance] Insp DC Motor/Brush HPCI Turbine Aux Oil Pump 03/01/1996 through 03/24/2015
- Letter CHRON# 187593, to C.W. Schroeder from S. Gaconis, RE: “HPCI Auxiliary Oil Pump Motor Replacement Unit 2, Dresden Station,” dated June 19, 1992
- Letter GE# 190537 to B. Wong, Commonwealth Edison Company from M.W. Hansen, RE: “Dresden 3 HPCI Aux Oil Pump Motor Shunt Resistor,” dated August 10, 1992
- DVR[Deviation Report] D-12-2-92-158, “HPCI Auxiliary Oil Pump Motor Failure Due to an Internal Fault on the Armature”
- Apparent Cause Evaluation (ACE) for AR 122822, “HPCI Auxiliary Oil Pump Vibrations ond Low RPM on New Motor”
- EACE for CR 2498875-02, “Unit 3 HPCI Aux Oil Pump (AOP) Motor Failure Mechanism,” Revision 2
- Root Cause Report (RCR) for IR 2686163, “ U3 HPCI Aux Oil Pump on Fire,” dated 08/16/2016
- EC [Engineering Change] 00006421, “Revise the Setpoint for U-3 HPCI Turbine Oil Header Aux Pump”
- ECR [Engineering Change Request] 0000057672, “Provide Justification for HPCI Aux Oil Pump Shunt Readings,” dated 10/5/1999
- Procurement Evaluation 16258, “U3 AOP Install”
- PE Evaluation 21647 for AR 128822
- EC Evaluation 401652, “Evaluation of Elevated Vibration Readings on U3 HPCI Aux Oil Pump Motor,” Revision 000
- ICES 323383, “Alert Declaration Due to Fire in High Pressure Coolant Injection Auxiliary Oil Pump Motor,” dated 09/22/16
- SM-AA-300, “Procurement Engineering Support Activities,” Revision 0

- DES 8300-04, “Inspection of DC Motors and Brushes,” Revision 18
- MA-AB-MM-4-00427, “HPCI Auxiliary Oil Pump Maintenance,” Revision 0
- DMP 2300-10, “HPCI Auxiliary Pump Maintenance,” Revision 03
- SMP-E-03, “Inspection and Maintenance of DC Motors,” Revision 0
- DOS 2300-03, “High Pressure Coolant Injection System Operability and Quarterly IST Verification Test,” Revision 110
- NES-EIC-40.02, Repair Requirements for Small Motors (Nuclear Safety-Related and Non Safety-Related) up to 600 VAC and 250 VDC,” Revision 5
- CC-AA-204, “Control of Vendor Equipment Manuals,” Revision 10
- DGA-03, “Loss of 250 VDC Battery Chargers With Simultaneous Loss of Auxiliary Electrical Power,” Revision 14
- DOP 2300-02, “HPCI System Turning Gear Operation,” Revision 10
- GEH-3967M, “Direct Current Motors and Generators Frames CD180AT-CD500AT”
- Nutherm International, Inc. Test Specification TPG-0002, No. 13016-01, GE Model 5CD173XD817A800
- IEEE Standard 334-2006, “IEEE Standard for Qualifying Continuous Duty Class 1E Motors for Nuclear Power Generating Stations”
- Analysis No. DRE96-0189, “Voltage on Loads Fed from the Safety Related 250V Batteries,” Revision 003
- Drawing: GEH-3967L, CD210AT-CD500AT Frames, Exploded View, no revision
- Drawing: 12E-3819E, Wiring Diagram HPCI Junction Boxes 3RB-50, 3RB-53, 3RB-64, 3TB-89 & 3TN-91 & Auxiliary Oil Pump Resistor Box, Revision O
- Drawing: 12E-3819E, Wiring Diagram HPCI Junction Boxes 3RB-50, 3RB-53, 3RB-64, 3TB-89 & 3TN-91 & Auxiliary Oil Pump Resistor Box, Revision S
- Drawing: 12E-3532, Schematic Diagram High Pressure Coolant Injection System Turbine Auxiliary Pumps, Revision AH
- Drawing: 12E-3532, Schematic Diagram High Pressure Coolant Injection System Turbine Auxiliary Pumps, no revision
- Drawing: 20600-005, HPCI Turbine Oil System, Revision 2
- DR-SDP-10, Revision 0, “Significance Determination Estimate for the Unit 3 HPCI Auxiliary Oil Pump Motor Fire”

LIST OF ACRONYMS USED

ADAMS	Agencywide Documents Access and Management System
ADS	Automatic Depressurization System
AOP	Auxiliary Oil Pump
AV	Apparent Violation
CAP	Corrective Action Program
CFR	Code of Federal Regulations
DC	Direct Current
EACE	Equipment Apparent Cause Evaluation
EC	Engineering Change
GE	General Electric
HPCI	High Pressure Coolant Injection
IMC	Inspection Manual Chapter
IPEEE	Individual Plant Examination of External Events
IST	Inservice Testing
LER	Licensee Event Report
LERF	Large Early Release Frequency
NRC	U.S. Nuclear Regulatory Commission
PARS	Publicly Available Records System
PE	Procurement Evaluation
PRA	Probabilistic Risk Assessment
RASP	Risk Assessment of Operational Events
RCR	Root Cause Report
RLLD	Reference Leg Leak Down
RPM	Revolutions Per Minute
SDP	Significance Determination Process
SPAR	Standardized Plant Analysis Risk
SRA	Senior Reactor Analyst
VDC	Volts Direct Current
WO	Work Order

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Sincerely,

/RA/

Julio F. Lara, Deputy Director
Division of Reactor Projects

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