



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**

REGION III
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November 26, 2010

EA-09-259

Mr. Michael J. Pacilio
Senior Vice President, Exelon Generation Company, LLC
President and Chief Nuclear Officer (CNO), Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

**SUBJECT: BRAIDWOOD STATION, UNIT 1, SUPPLEMENTAL INSPECTION
REPORT 05000456/2010009**

Dear Mr. Pacilio:

On November 1, 2010, the U. S. Nuclear Regulatory Commission (NRC) completed an inspection at your Braidwood Station, Unit 1. The enclosed report documents the inspection results, which were discussed during a Regulatory Performance Meeting on November 1, 2010, with Mr. A. Shahkarami, and other 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 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 finding having low-to-moderate safety significance (i.e., White) at the Braidwood Station. The finding involved a June 24, 2009, failure of Unit 1 Containment Sump Suction Isolation Valve 1SI8811B to open during surveillance testing. The inspectors determined that measures were not established to ensure the appropriate selection and suitability of application of equipment essential to the safety-related function of the 1SI8811B valve. Specifically, the design of the 1SI8811B motor-operated valve actuator and associated conduit were not suitable to the application, because the design allowed water to enter and collect inside the actuator. This resulted in the failure of the 1SI8811B valve to open during surveillance testing on June 24, 2009, due to corrosion of the torque switch. This issue was documented in NRC Inspection Report 05000456/2009007. The NRC staff was informed on July 22, 2010, of your staff's readiness for this inspection.

This supplemental inspection was conducted to provide assurance that the root causes and contributing causes of the event resulting in the White finding were understood, the extent of condition and extent of cause were identified, and that the corrective actions were sufficient to address the root causes and contributing causes and 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 personnel.

The inspector determined that your root cause evaluation was conducted to a level of detail commensurate with the significance of the problem and reached reasonable conclusions as to the root and contributing causes of the event. The inspector also concluded that you identified the extent of condition and extent of cause of the issue, that you identified appropriate corrective actions for each root and contributing cause, and that you appropriately prioritized these actions.

Based on the results of this inspection, no findings of significance were identified.

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 Website at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

/RA by Kenneth G. O'Brien for/

Gary L. Shear, Acting Director
Division of Reactor Projects

Docket No. 50-456
License No. NPF-72

Enclosure: Inspection Report 05000456/2010009
w/Attachment: Supplemental Information

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U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No: 50-456
License No: NPF-72

Report No: 05000456/2010009

Licensee: Exelon Generation Company, LLC

Facility: Braidwood Station, Unit 1

Location: Braceville, Illinois

Dates: October 18, 2010, through November 1, 2010

Inspector: C. Phillips, Senior Resident Inspector, Dresden Nuclear
Power Station

Approved by: E. Duncan, Chief
Branch 3
Division of Reactor Projects

Enclosure

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SUMMARY OF FINDINGS

IR 05000456/2010009; October 18, 2010 – November 1, 2010; Braidwood Station, Unit 1 Supplemental Inspection – Inspection Procedure 95001.

This supplemental inspection was performed by the Dresden Nuclear Power Station Senior Resident Inspector. The significance of most findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process" (SDP). Findings for which the SDP does not apply may be Green or be assigned a severity level after NRC management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

A. NRC-Identified and Self-Revealed Findings

Cornerstone: Mitigating Systems

This supplemental inspection was performed in accordance with Inspection Procedure 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area," to assess the licensee's root cause evaluation, extent of condition and extent of cause determination, and corrective actions for the failure on June 24, 2009, of Unit 1 Containment Sump Suction Isolation Valve 1SI8811B to fully open during surveillance testing. This finding was previously characterized as having low-to-moderate safety significance (i.e., White) in an NRC letter dated February 25, 2010, which finalized the preliminary assessment of the finding documented in NRC Inspection Report 05000456/2009007.

During this inspection, the inspector determined that the licensee's root cause evaluation was conducted to a level of detail commensurate with the significance of the problem and reached reasonable conclusions as to the root and contributing causes of the event. The inspector also concluded that the licensee identified appropriate corrective actions for each root and contributing cause and that these actions were appropriately prioritized.

Given the licensee's acceptable performance in addressing the failure of Unit 1 Containment Sump Suction Isolation Valve 1SI8811B to open during surveillance testing, the White finding associated with this issue will be closed at the end of 2010 in accordance with the guidance in Inspection Manual Chapter 0305, "Operating Reactor Assessment Program."

B. Licensee-Identified Violations

No findings of significance were identified.

REPORT DETAILS

4. OTHER ACTIVITIES

4OA4 Supplemental Inspection (Inspection Procedure 95001)

.01 Inspection Scope

This inspection was conducted in accordance with Inspection Procedure (IP) 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area," to assess the licensee's evaluation of one inspection finding of low-to-moderate safety significance (i.e., White) in the Mitigating Systems cornerstone. The inspection objectives were to:

- Provide assurance that the root causes and contributing causes of risk-significant performance issues were understood;
- Provide assurance that the extent of condition and extent of cause of risk-significant issues were identified; and
- Provide assurance that the licensee's corrective actions to address risk-significant performance issues were or will be sufficient to address the root causes and contributing causes, and to prevent recurrence.

By letter dated February 25, 2010, the NRC communicated to Braidwood Station the final significance determination for a finding having low-to-moderate safety significance (i.e., White), with one associated violation of NRC requirements. The specific finding was that the design of the Unit 1 Containment Sump Suction Isolation Valve 1SI8811B motor-operated valve (MOV) actuator and associated conduit were not suitable to the application, because the design allowed water to enter the conduit and collect inside the actuator. This resulted in the failure of valve 1SI8811B to stroke full open during surveillance testing on June 24, 2009.

The details of the performance issues and the preliminary results of the NRC's significance evaluation were documented in NRC Inspection Report 05000456/2009007. Braidwood Station, Unit 1, entered the Regulatory Response column of the NRC's Action Matrix in the fourth quarter of 2009 based on the White inspection finding. On July 22, 2010, the licensee notified the NRC that applicable corrective actions for the finding had been completed or initiated, and that the station was prepared for the NRC to conduct this supplemental inspection to review the licensee's evaluation of the causes and the actions taken to address the White finding.

The inspector reviewed root cause evaluation (RCE) 98732, "1SI8811B Valve Failure," Revision 0, dated November 23, 2009, in addition to other evaluations conducted in support and as a result of the root cause evaluation. 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 corrective actions taken or planned were appropriate to address the causes and prevent recurrence.

.02 Evaluation of the Inspection Requirements

02.01 Problem Identification

- a. *Determine that the evaluation documented who identified the issue (i.e., license-identified, self-revealed, or NRC-identified) and under what conditions the issue was identified.*

The inspector determined that the licensee's root cause evaluation adequately described who identified the issue and under what conditions the issue was identified.

During scheduled surveillance testing on June 24, 2009, operators attempted to open Containment Sump Suction Isolation Valve 1SI8811B. The control board displayed dual indication and never indicated full open. At the valve, observers identified an approximate 30-40 percent open condition. The licensee initiated Issue Report (IR) 934782, "1SI8811B Failed to Stroke Full Open During Surveillance," to document the failure. Upon investigation, the licensee identified water in the actuator limit switch (LS) compartment, and that the actuator torque switch and the internal LS were corroded. Rust marks indicated that water had potentially entered the LS compartment through an electrical conduit penetration. The licensee replaced the corroded torque switch and LS components, and the LS compartment and wiring were cleaned and dried. On June 26, 2009, the valve was satisfactorily tested and returned to service.

About 4 months later, on October 30, 2009, a system engineer performing a general walkdown of the Unit 1 curved wall area (CWA) identified water dripping from a leak in the removable roof plug and falling in the area of the 1SI8811B valve. Further inspection identified water in the stem nut area of the valve forming a puddle about 2 to 3 inches deep on top of the actuator. During the several hours immediately prior to this discovery, heavy rains had been experienced at Braidwood Station.

The licensee performed a borescope inspection in the actuator LS compartment of the 1SI8811B valve and found water. The licensee performed an as-found stroke test and the valve functioned properly. Troubleshooting identified a loose compression fitting in the electrical conduit connection on the actuator LS compartment. The licensee conducted further testing and concluded the loose conduit connection was the water entry point. The licensee repaired the conduit connector, and the compartment and components were cleaned and dried. Subsequently, the valve was re-tested and returned to service. As a result of the second event, the licensee initiated IR 987342, "Water in Actuator Limit Switch Compartment Valve 1SI8811B."

On November 23, 2009, the licensee completed its initial root cause evaluation to investigate the organizational and programmatic issues that led to this event.

- b. *Determine that the evaluation documented how long the issue existed and prior opportunities for identification.*

The inspector determined that the licensee's root cause evaluation provided a detailed chronology of the event, including the issues and actions leading up to and directly influencing the event.

The root cause evaluation detailed the findings from both the June and October 2009 events. The exact date and time of the 1SI8811B valve failure could not be determined, since the licensee stroked the valve on an 18-month frequency. The licensee last performed preventative maintenance on the 1SI8811B valve on May 17, 2006, when the valve actuator was overhauled and diagnostic testing was performed. The associated work package did not document the presence of water in the valve. The licensee concluded that the water entered the 1SI8811B valve sometime after May 17, 2006. The last successful valve stroke was performed on September 20, 2007.

In addition, the root cause evaluation discussed two other Braidwood motor-operated valves (MOVs) with similar failures. On August 12, 1990, Unit 1 Containment Sump Suction Isolation Valve 1SI8809A failed to stroke open after it was closed during surveillance testing. The licensee dispatched a non-licensed operator to the valve, and manually opened the valve. Later, upon opening the LS compartment of the valve, the licensee discovered that water intrusion had occurred causing corrosion of the torque switch. The corrosion caused binding and prevented the torque switch from freely moving. A potential cause of the water intrusion was determined to be draining operations of lines above the valve resulting in the inadvertent introduction of water on the valve. The licensee considered this an isolated event, and took no further action.

On May 14, 2002, while performing a surveillance test, the licensee successfully closed MOV 1CS001A, which failed to re-open with dual position indication. During troubleshooting, the licensee discovered about one quart of water in the LS compartment. The licensee determined that the LS compartment cover was mounted tightly to the actuator, and that the gasket was in good condition. The licensee determined that water entered the LS compartment through the flexible (flex) conduit, which did not fully extend under the sealing ring of the liquid-tight fitting. The licensee also discovered that the flex fitting at the MOV was very loose. The combination of the exposed inner metal jacket above the sealing ring and the loose flex fitting appeared to be the likely intrusion path into the LS enclosure. The likely source of water was from valve 1WO029 above 1CS001A that inadvertently had been left open during a local leak rate test on January 18, 2002.

These two occurrences were potential missed opportunities to discover the impact of water intrusion on valves in the CWA and to prevent the 1SI8811B valve stroke failures. The licensee's root cause report also stated that based on previous IRs for CWA leaks, roof leaks have been a known condition since 1998. The inspector concluded that this was also a missed opportunity to prevent the 1SI8811B valve stroke failures.

- c. *Determine that the evaluation documented the plant-specific risk consequences, as applicable, and compliance concerns associated with the issue.*

The inspector determined that the root cause evaluation adequately documented the plant-specific risk consequences associated with the event.

The licensee evaluated the safety significance of this issue using the NRC's Significance Determination Process (SDP) and Braidwood Probabilistic Risk Assessment (PRA) Application Notebook BW-SDP-003. The licensee estimated the incremental risk posed by the failure of 1SI8811B to fully open for the presumed length of time the valve was not fully capable of opening. Because the exact failure date was unknown, the licensee

applied the T/2 rules to calculate the PRA risk significance. In this case, 322 days was the time period assumed.

The licensee submitted additional information concerning the PRA risk insights to the NRC via correspondence BW100007 dated January 14, 2010, following a Regulatory Conference that was held on January 6, 2010. The information submitted did not change the initial position or conclusion presented during the Regulatory Conference or the root cause report.

The failure of the 1SI8811B valve to open resulted in the failure to satisfy electrical interlocks to open valves 1SI8804B and 1CS009B from the control room. The 1SI8804B valve was required to open to establish flow from the containment sump to the high and intermediate head emergency core cooling system (ECCS) pumps during the cold leg recirculation phase of ECCS. Valve 1CV8804A, the redundant valve for supplying water from the containment sump to the high and intermediate head ECCS pumps, was not affected by the failure of 1SI8811B to fully open. Containment Spray (CS) valve 1CS009B was required to open in order to establish flow from the ECCS sump to the 1B CS pump during the cold leg recirculation phase of ECCS.

The licensee evaluated this event to determine past operability and to determine the ability of the valve to pass design flow at the as-found opening travel position for the valve. Based on the failure mode, the valve would have been capable of opening to the bypass LS setting of approximately 34 percent open and was capable of passing the required ECCS recirculation flow at this partial opening position.

One minor finding concerning the licensee's response to the violation associated with this event is discussed in Section 2.03.e of this report.

d. Findings

No findings of significance were identified.

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

a. *Determine that the problem was evaluated using a systematic methodology to identify the root and contributing causes.*

The licensee used several systematic processes to identify the root causes and the contributing causes for the event. Event and Causal Factor charting was used to provide a graphical display of the events leading up to the 1SI8811B valve stroke failure on June 24, 2009, and the identification of additional water in the valve on October 30, 2009.

The licensee used the Kepner-Tregoe® (K-T) Problem Analysis process to identify possible causes for the failure of the 1SI8811B valve to stroke open. The process identified that water from various sources, including non-watertight floor plugs, removable roof concrete slabs, and maintenance activities within the CWA, had leaked onto the actuator, which may not have been watertight. The K-T analysis for this event demonstrated that leaks from multiple sources could have caused all of the MOV failures.

The licensee used Barrier Analysis and Causal Factor charting to identify failures or challenged barriers. The licensee identified weaknesses in the corrective action process that could have previously identified equipment limitations and corrective actions that would have prevented the June 24, 2009, valve failure. Additionally, weaknesses in the corrective action, work control, and Maintenance Rule processes were identified that could have prevented or mitigated the event by prompt identification and repair of the improperly installed and leaking removable concrete roof slabs.

The licensee used Taproot Analysis to analyze and evaluate the identified causal factors and develop trend codes.

Following the October 30, 2009 event, Braidwood Station initiated a root cause evaluation to investigate the programmatic and organizational issues that led to the failure of the 1SI8811B valve.

The licensee identified the root cause to be that station personnel did not fully understand that the CWA design configuration did not incorporate watertight electrical components to prevent water intrusion. As a result, station personnel lacked sensitivity to the effects of water spills, sprays, or leaks in the CWA.

The licensee identified the following contributing causes in the root cause evaluation:

1. Station personnel did not identify and take action to correct the missing multi-ply insulated roof membrane as identified in design drawings to cover and seal the concrete removable slabs in the CWA roof.
2. The sealtight conduit connector for 1SI8811B was not properly installed. The fitting gasket was missing and was replaced during troubleshooting and repair of the actuator. While electrical conduits were not required to be watertight, proper installation of the conduit connector may have precluded water intrusion into the actuator compartment.

In addition to the root and contributing causes, the licensee identified causal factors in the root cause evaluation, including:

1. Long-standing material condition issues were left for a significant period of time without adequate resolution.
2. Station personnel did not consistently initiate IRs for the previously identified long-standing material condition issue with the CWA roof leaks. As a result, a degrading or changing condition potentially went unreported or existing work orders (WOs) were not reprioritized as might have been required.

- b. Determine that the root cause evaluation was conducted to a level of detail commensurate with the significance of the problem.*

The inspector determined that the licensee conducted the final root cause evaluation at an appropriate level. The licensee performed a thorough examination of the equipment, design, and organizational problems that led to the event.

The final root cause evaluation discussed weaknesses in the original Equipment Apparent Cause Evaluation (EACE) performed for the 1SI8811B valve stroke failure on June 24, 2009. The EACE identified the apparent cause to be corrosion of the torque switch due to water intrusion into the valve actuator LS compartment through conduit C1A1454. The licensee identified the open end of the conduit as the probable entry point for water. The EACE report evaluated multiple sources of water to determine the specific source. The licensee focused on the tritium identified in the water sample, which resulted in the discounting of roof leakage as a likely source. Therefore, the licensee took no further action to address the roof leaks that were a probable source of water during the June 24, 2009, water intrusion event. The EACE investigation narrowly focused on tritiated water sources and an open upward conduit opening as the likely water intrusion point. The EACE did not effectively evaluate other water sources such as CWA roof leakage that created a larger challenge to the valve and other leakage pathways that existed for water intrusion into the valve.

The licensee's root cause evaluation documented that IR 1002754 also included the lessons learned from the shortcomings of the EACE performed for the June 24, 2009, event. One significant conclusion was that the decision-making process for the level of review should consider the risk significance of the components in the licensee's PRA analysis.

- c. *Determine that the root cause evaluation included a consideration of prior occurrences of the problem and knowledge of prior operating experience.*

The inspector determined that the root cause evaluation included a consideration of prior occurrences of the problem and knowledge of prior operating experience.

Through a review of Operating Experience (OPEX), the licensee identified the following events at other facilities that had a root or contributing cause that was similar to the 1SI8811B valve failure:

- Byron 1998 – Valve 1WO006B failed to close and tripped thermal overloads. The actuator motor was found seized due to water intrusion. Water was believed to have originated from condensation on the valve body.
- St. Lucie 2003 – An MOV failed to close on demand due to corrosion and binding of the actuator torque switch. The corrosion was due to water intrusion into the LS compartment due to a poor seal between the LS compartment cover and the actuator housing.
- North Anna 2003 – MOV 2-SW-MOV-217 failed to stroke due to tripping of the thermal overloads. An investigation determined that water had entered the LS compartment and shorted the torque switch. The water intrusion was traced to a threaded connection in the steel conduit.
- Farley 2007 – Containment Sump Suction Isolation Valve Q2E11MOV8811A failed to fully open during testing. This valve also failed to stroke open during an earlier stroke test in 2006. This failure was originally attributed to dirty contacts that were subsequently cleaned by stroking the valve numerous times. Following the second event, an investigation determined that the current and previous failures were due to corrosion and binding of the actuator torque switch. The

corrosion of the torque switch was due to the valve being inside an enclosure subject to a high humidity environment. The LS compartment was neither sealed nor otherwise protected from humidity. The root causes were (1) the equipment was not designed for the environment and (2) the torque switch was only bypassed for the first 25 percent of the stroke when it was only needed for the last portion of the stroke.

In addition, the licensee's root cause evaluation documented other Braidwood Station events relative to water intrusion into MOV actuators. Specifically highlighted in the root cause evaluation are the following events that occurred in 1990 and 2002, respectively:

- Valve 1SI8809A failed to stroke open due to corrosion of the torque switch causing it to bind and not move freely. Investigation into the cause of the water intrusion found that it was most likely due to draining operations of lines above the valve.
- Valve 1CS001A failed to reopen after being closed due to a failure of the torque switch bypass circuit. The apparent cause was that water entered the actuator LS compartment through the flex conduit. The flex portion of the conduit was too short and the outer jacket of the flex conduit was trimmed such that it did not fully extend under the sealing ring of the conduit connector. The conduit connector was also found to be very loose. Valve 1WO029, which was located directly above Junction Box 1JB617A and MOV 1CS001A, was identified as the likely source of water.

The OPEX review also addressed previous IRs related to roof leaks at Braidwood Station. The licensee did not recognize the significance of the previous OPEX prior to the failure of the 1SI8811B valve, but subsequently identified insights for the development of corrective actions to address the entry points for water intrusion as well as reducing the vulnerability of equipment that could be impacted from water intrusion.

- d. *Determine that the root cause evaluation addressed extent of condition and the 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 licensee developed a leakage/spill template for IRs associated with liquid leaks/spills as a corrective action to this event. The inspector reviewed several IRs associated with the use of the leakage template. The inspector also reviewed an identified vulnerability with licensee personnel and independently applied the leakage/spill template. The inspector concluded that the leakage/spill template adequately addressed the potential impact of water intrusion on electrical components. In addition, the inspector reviewed IR 1124189, "Degraded AOV [Air-Operated Valve] Assembly Identified During Rebuild," which identified water intrusion into an air-operated containment isolation valve actuator. The inspector determined that the application of the leakage/spill template to this IR was successful in identifying a potential problem due to plant leakage and adequately addressed that identified problem prior to any actual adverse consequences.

- e. *Determine that the root cause, extent of condition, and extent of cause evaluations appropriately considered the safety culture components as described in Inspection Manual Chapter (IMC) 0305.*

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 0305.

Leakage from the CWA roof had been identified prior to the October 30, 2009, event. Based on interviews conducted by the licensee with operators, radiation protection (RP) technicians, and engineers, the licensee had identified rainwater leaking from the removable concrete roof slabs on both Unit 1 and Unit 2 on other occasions dating back to 1998. The licensee's interviews revealed a general awareness of CWA roof leaks on Unit 1 and Unit 2 during periods of heavy rains. However, no IRs related to roof leaks were generated between December 2007 and the October 30, 2009 event. The licensee's interviews revealed that this occurred because licensee personnel generally believed that IRs were written and work orders were already in the corrective action and work control processes. This demonstrated that when long-standing material condition issues, such as roof leaks, were not resolved over time, it created a condition in which individuals were less likely to generate additional IRs for the same issue. This resulted in a situation where degrading or changing conditions went unreported and existing work orders were not re-prioritized.

The licensee's root cause report documented that based on discussions with maintenance personnel in November 2009, the backlog of power-block non-outage facilities work orders was 1,816. The roof leak IRs described in the root cause evaluation were among this backlog and resulted in the degradation of the 1SI8811B valve.

The licensee determined that based on the results of an Institute for Nuclear Power Operations (INPO) Safety Culture Assessment conducted in January 2010, no additional corrective actions in this area were required. The inspector conducted interviews with two non-licensed operators concerning long-standing material conditions. The concerns expressed by the non-licensed operators echoed the licensee's original interview responses. The examples provided by the operators of long-standing material condition problems were neither safety-related nor safety significant. The inspector discussed these interview results with licensee management. The inspector communicated the concern that a seemingly minor material condition issue may not manifest itself as a safety issue for a very long time. The licensee described actions taken by the station to prioritize and reduce the backlog.

- f. Findings

No findings of significance were identified.

02.03 Corrective Actions

- a. *Determine that appropriate corrective actions are specified for each root and contributing cause or that the licensee has an adequate evaluation for why no corrective actions are necessary.*

The inspector reviewed applicable corrective actions and corrective actions to prevent recurrence and determined that the licensee specified appropriate corrective actions for each root and contributing cause. The inspectors also reviewed implementation of the corrective actions to verify completion.

As part of the corrective actions for this event, the licensee sealed the susceptible conduit. To address extent of condition concerns, the licensee subsequently performed successful valve strokes of the 1SI8811A, 2SI8811A, and 2SI8811B valves as part of previously scheduled maintenance activities. Additionally, the licensee performed a walkdown of the 1SI8811A, 2SI8811A, and 2SI8811B valves on both units. Open conduit terminations were identified on all three of these valves. The 2SI8811B valve was identified to have the same susceptible conduit and cable tray configuration, while the 1SI8811A and 2SI8811A valves had horizontal conduit terminations that were less susceptible to water intrusion. As a result, the licensee sealed the 2SI8811B valve open conduit termination.

In addition, the licensee developed a list of MOVs and other electrical components to be inspected, based on their contribution to risk. This list included actions to be performed, such as conduit inspections, and a schedule for performing the work. For susceptible MOVs, the licensee sealed the associated conduit and/or installed a T-drain into the bottom of the LS compartment to prevent water accumulation and/or increased the torque switch bypass setting to 100 percent.

The licensee identified the root cause to be that station personnel did not fully understand that the CWA design configuration did not incorporate watertight electrical components to prevent water intrusion. As a result, station personnel lacked sensitivity to the effects of water spills, sprays, or leaks in the CWA.

Corrective actions to address this concern included (1) training of all site personnel on the MOV actuator design requirements and the need to ensure proper control of water in areas of the plant not designed for water spray or spills, and (2) implementing processes and controls to evaluate electrical components affected by potential water intrusion.

In addition, the licensee identified that the CWA roof structure did not conform to the existing design drawings and was the probable source of water intrusion into the 1SI8811B valve. The licensee performed inspections and developed work orders and schedules to return the CWA roofs to the existing design requirements. The licensee inspected other safety-related structures with removable hatches for proper installation. The licensee had completed the work on the CWA roofs and were in the process of performing repairs to the main steam isolation valve room roofs, which were also identified as needing repair, during the inspection.

- b. *Determine that corrective actions have been prioritized with consideration of the risk significance and regulatory compliance.*

The inspector concluded that the licensee adequately prioritized the corrective actions with consideration of the risk significance and regulatory compliance.

- c. *Determine that a schedule has been established for implementing and completing the corrective actions.*

The inspector determined that the licensee established a schedule for implementing and completing the corrective actions.

The licensee assigned completion due dates that were commensurate with the significance of the issues being addressed as well as the level of effort required to complete the actions.

- d. *Determine that quantitative or qualitative measures of success have been developed for determining the 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. The period identified for review by the licensee to determine corrective action effectiveness had not yet ended at the end of this supplemental inspection.

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

The inspector concluded that the corrective actions planned or taken adequately addressed the Notice of Violation. However, the inspector identified that the licensee's response to violation 05000456/2009007-001, "Failure of Containment Sump Suction Valve 1SI8811B to Stroke Open," did not address all regulatory concerns.

In particular, the Notice of Violation, as documented in the Final Significance Determination dated February 25, 2010, stated the following:

"Title 10 CFR Part 50, Appendix B, Criterion III, Design Control, requires, in part, that measures be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the structures, systems, and components.

Contrary to the above, from initial design, measures were not established to ensure the selection and suitability of application of equipment essential to the safety-related function of the residual heat removal system. Specifically, the design of the 1SI8811B motor operated valve actuator and associated conduit were not suitable to the application, because the design allowed water to enter the conduit and collect inside the actuator. This resulted in the failure of valve 1SI8811B to stroke full open during

surveillance testing on June 24, 2009, due to corrosion of the torque switch.”

The inspector identified that although the licensee’s corrective actions sealed the flex conduit, the design change process was not utilized to ensure that the seal would not be removed in the future; which was a performance deficiency. However, due to the comprehensive nature of the licensee’s corrective actions, the inspector determined that this issue was minor since the performance deficiency did not impact the Mitigating System cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences, or satisfy any of the other criteria to be considered when assessing the significance of a performance deficiency.

Based on the inspector’s concerns, the licensee generated IR 1128767, “Update Design Drawings, Generate DCR [Document Change Request],” and completed DCR 381928 to update drawings 20E-1-3312, 20E-1-3314, 20E-2-3312, and 20E-2-3314 to ensure the seal would not be removed from the conduit in the future.

f. Findings

No findings of significance were identified.

4OA5 Other

.1 (Closed) Violation 05000456/2009007-01, “Failure of Containment Sump Suction Valve 1SI8811B to Stroke Open”

The inspector determined that the licensee’s root cause evaluation was conducted to a level of detail commensurate with the significance of the problem and reached reasonable conclusions as to the root and contributing causes of the event.

The inspectors also concluded that the licensee identified appropriate corrective actions for each root and contributing cause and that the corrective actions were prioritized commensurate with the safety significance of the issues. No other instance of the violation was identified. This violation is closed.

4OA6 Meetings, Including Exit

.1 Exit Meeting Summary

The inspectors presented the inspection results to Mr. A. Shahkarami and other members of licensee management on November 1, 2010. The inspector asked the licensee if any of the material examined during the inspection should be considered proprietary. The licensee did not identify any proprietary information.

.2 Regulatory Performance Meeting

On November 1, 2010, 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 finding that resulted in Braidwood Nuclear Power Station, Unit 1 being placed in the Regulatory Response column of the Reactor Oversight Process (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

A. Shahkarami, Site Vice President
L. Coyle, Plant Manager
C. Bedford, Program Engineering
P. Boyle, Maintenance Director
R. Gaston, Regulatory Assurance Manager
M. Marchionda, Operations Director
R. Radulovich, Nuclear Oversight Manager
M. Smith, Engineering Director

NRC

K. O'Brien, Acting Deputy Director, Division of Reactor Projects
E. Duncan, Branch Chief, Division of Reactor Projects, Branch 3
J. Benjamin, Senior Resident Inspector
D. Bentancourt, Resident Inspector

LIST OF ITEMS OPENED, CLOSED AND DISCUSSED

Opened

None

Closed

05000456/2009007-01 VIO Failure of Containment Sump Suction Valve 1SI8811B to Stroke Open (Section 4OA5)

Discussed

None

LIST OF DOCUMENTS REVIEWED

The following is a list of documents reviewed during the inspection. Inclusion on this list does not imply that the NRC inspectors reviewed the documents in their entirety, but rather, that selected sections of 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, "Inspection for One or Two White Inputs in a Strategic Performance Area"

- Letter from M. Satorius, (U.S. NRC), to C. Pardee, (Exelon Generation Company, LLC),
Subject: Final Significance Determination for a White Finding and Notice of Violation;
NRC Inspection Report No. 05000456/2010008; Braidwood Station, Unit 1, February 25, 2010
- Letter from S. West, (U.S. NRC), to C. Pardee, (Exelon Generation Company, LLC),
Subject: Braidwood Station, Unit 1, NRC Follow-Up Inspection Report 05000456/2009007;
PRELIMINARY YELLOW FINDING; November 30, 2009
- Root Cause Evaluation 987342, "1SI8811B Valve Failure," Revision 0, November 23, 2009
- Focused Area Self Assessment 1059848-03, "1SI8811B 95001 Inspection Readiness,"
June 30, 2010
- LS-AA-115, "Operating Experience Program," Revision 15
- LS-AA-115, "Operating Experience Procedure," Revision 10
- ER-MW-450, "Structures Monitoring," Revision 5
- AR 01129344, "95001 Issue: IR Should Be Included in Root Cause"
- AR 01129348, "95001 Issue: ACIT Closure Needs Improvement"
- AR 01124189, "Degraded AOV Assembly Identified During Rebuild (1RE9159B)
- AR 01128767, "Update Design Drawings, Generate DCR"
- AR 01127332, "Boric Acid Leak At 1PS9355A"
- AR 01127480, "1SI087 Boric Acid LKG. (INTERIM FNM/RP Actions Requested)"
- CAPR-1, 987342-18, Corrective Action to Prevent Reoccurrence (Assignment 18)
- CAPR-2, 987342-19, Corrective Action to Prevent Reoccurrence (Assignment 19)
- CA 987342-1-7, Corrective Action (Assignments 41,41,20,21,22,23,& 44)
- ACIT 987342-xx, Action Item (Assignments 11, 12, 24, 25, 29, 30, 31, 33, 14-17, 45-51, 36,
54, 57, & 58)
- Work Order 723246-03, "Determ/Reterm In Support of MMD Actuator Overhaul"
- Braidwood Nuclear Station Nuclear Safety Culture Assessment, January 2010
- Braidwood Station Motor Operated Valve Program Status (4th Quarter 2007)

LIST OF ACRONYMS USED

ADAMS	Agencywide Documents Access and Management System
CS	Containment Spray
CWA	curved wall area
EACE	Equipment Apparent Cause Evaluation
ECCS	Emergency Core Cooling System
IMC	Inspection Manual Chapter
INPO	Institute for Nuclear Power Operations
IP	Inspection Procedure
IR	Issue Report
K-T	Kepner-Tregoe
LS	Limit Switch
MOV	Motor-Operated Valve
NRC	U.S. Nuclear Regulatory Commission
OPEX	Operating Experience
PRA	Probabilistic Risk Assessment
ROP	Reactor Oversight Process
SDP	Significance Determination Process
VIO	Violation

The inspector determined that your root cause evaluation was conducted to a level of detail commensurate with the significance of the problem and reached reasonable conclusions as to the root and contributing causes of the event. The inspector also concluded that you identified the extent of condition and extent of cause of the issue, that you identified appropriate corrective actions for each root and contributing cause, and that you appropriately prioritized these actions.

Based on the results of this inspection, no findings of significance were identified.

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 Website at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

/RA by Kenneth G. O'Brien for/

Gary L. Shear, Acting Director
Division of Reactor Projects

Docket No. 50-456
License No. DPR-72

Enclosure: Inspection Report 05000456/2010009
w/Attachment: Supplemental Information

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DATE	11/23/10		11/23/10		11/26/10			

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Letter to M. Pacillio from G. Shear dated November 26, 2010.

SUBJECT: BRAIDWOOD STATION, UNIT 1, SUPPLEMENTAL INSPECTION
REPORT 05000456/2010009

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