



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**  
REGION III  
2443 WARRENVILLE ROAD, SUITE 210  
LISLE, IL 60532-4352  
February 25, 2010

EA-09-259

Mr. Charles G. Pardee  
Senior Vice President, Exelon Generation Company, LLC  
President and Chief Nuclear Officer (CNO), Exelon Nuclear  
4300 Winfield Road  
Warrenville, IL 60555

**SUBJECT: FINAL SIGNIFICANCE DETERMINATION FOR A WHITE FINDING;  
NOTIFICATION OF FOLLOW-UP ASSESSMENT; AND NOTICE  
OF VIOLATION; NRC INSPECTION REPORT NO. 05000456/2010008;  
BRAIDWOOD NUCLEAR POWER STATION, UNIT 1**

Dear Mr. Pardee:

The purpose of this letter is to provide you the final results of our significance determination of the preliminary Yellow finding identified in Inspection Report 05000456/2009007. The inspection finding was assessed using the Significance Determination Process and was preliminarily characterized as Yellow, a finding with substantial importance to safety that will require additional U.S. Nuclear Regulatory Commission (NRC) inspections. The finding is associated with the failure to design the containment sump suction valve, 1SI8811B, and its associated electrical conduit in a manner that protected the safety-related function to open and provide the 1B emergency core cooling system (ECCS) train with a suction source from the containment sump for ECCS recirculation. This resulted in the failure of the valve to stroke full open during testing on June 24, 2009.

At your request, a Regulatory Conference was held on January 6, 2010, to discuss your views on this issue. During the meeting, your staff described your assessment of the significance of the finding and the corrective actions taken to resolve it, including the root cause evaluation of the finding. Your staff attributed the root cause of the failure to a lack of sensitivity to effects of water spills, sprays, or leaks in the curved wall area where the valve was located. Corrective actions taken, besides immediate repair of the valve, included in part: (1) repairing long-term leaks on the roof removable concrete slabs in the curved wall areas; (2) inspecting safety-related structures with removable hatches to ensure proper installation; and (3) inspecting risk significant motor operated valves for water intrusion and evaluating the need to add drains or to bypass the torque switch logic.

At the conference, your staff acknowledged that the violation had occurred, but provided additional information concerning your staff's view on the risk significance of the finding. Further, your staff provided information to convey your view that recovery credit was appropriate and that your risk assessment contained additional conservatism. Based on that information, your staff concluded that the June 24, 2009, 1SI8811B valve failure did not represent an event of substantial safety significance, as was concluded by the NRC's preliminary assessment, but

instead represented an event of very low risk significance. After the conference, your staff provided us with additional information in a letter dated January 14, 2010, to support your position and to respond to NRC questions raised during the Regulatory Conference (ML100150069).

After reviewing the information developed during the inspection and provided during and after the conference, the NRC has concluded that the inspection finding is appropriately characterized as White, a finding with low to moderate safety significance that may require additional NRC inspections. Specifically, the NRC acknowledged that some recovery credit was warranted, which resulted in a reduction in the NRC's risk assessment for the finding. The recovery credit reduced the risk for a small break loss of coolant accident scenario. However, the NRC identified that not all your staff's assumptions concerning available recovery time were appropriate (Enclosure 1), which resulted in no recovery credit for the medium break loss of coolant accident scenario. Additionally, the NRC concluded that the conservatisms identified in your analysis would not impact the final risk significance. After considering these scenarios, the NRC's assessment resulted in a finding with low to moderate safety significance (White).

The NRC has also determined that the finding had an associated violation, as cited in the enclosed Notice of Violation (Notice) (Enclosure 2). The circumstances surrounding the violation were described in detail in the subject inspection report. In accordance with the NRC Enforcement Policy, the Notice is considered escalated enforcement action because it is associated with a White finding.

The NRC has concluded that the information regarding the reason for the violation, the corrective actions taken, and the date when full compliance was achieved is already adequately addressed on the docket in the subject inspection report and during the January 6, 2010, Regulatory Conference. Therefore, you are not required to respond to this letter unless the description therein does not accurately reflect your corrective actions or your position.

As a result of our review of Braidwood Nuclear Power Station Unit 1's performance, including this White finding, we have assessed you to be in the Regulatory Response column of the NRC's Action Matrix. Therefore, we plan to conduct a supplemental inspection using Inspection Procedure 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area," when your staff has notified us of your readiness for this inspection. This inspection procedure is conducted to provide assurance that the root cause and contributing causes of risk significant performance issues are understood, the extent of condition is identified, and the corrective actions are sufficient to prevent recurrence.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response, if you choose to provide one, will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's

C. Pardee

-3-

Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. To the extent possible, your response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction.

Sincerely,

*/RA/*

Mark A. Satorius  
Regional Administrator

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

Enclosures:

1. Risk Assessment and Considerations
2. Notice of Violation

cc w/encls: Distribution via Listserv

Letter to Charles G. Pardee from Mark A. Satorius dated February 25, 2010

SUBJECT: FINAL SIGNIFICANCE DETERMINATION FOR A WHITE FINDING;  
NOTIFICATION OF FOLLOW-UP ASSESSMENT; AND NOTICE OF  
VIOLATION; NRC INSPECTION REPORT NO. 05000456/2010008;  
BRAIDWOOD NUCLEAR POWER STATION, UNIT 1

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## RISK ASSESSMENT AND CONSIDERATIONS

### Licensee Risk Considerations:

1. Credit for local operator action (recovery) to open valve 1SI8811B was appropriate and consistent with the Braidwood design and operation, since the valve was accessible under postulated conditions, sufficient time was available to open the valve and procedures and training reinforced actions to locally open the valve.
2. The risk assessment contained several conservatisms, including no credit for restarting residual heat removal (RH) pumps if the 1SI8811A/B valves could not be opened further; the most limiting break size was used within a given loss of coolant accident (LOCA) category; all LOCAs were assumed to be hot leg breaks to minimize the time for operator response; no credit was taken for the use of the RH system in the shutdown cooling mode; and no credit was taken for reactor water storage tank (RWST) refill or the use of the volume control tank as a source of water for injection into the reactor coolant system (RCS).

### NRC Evaluation:

1. With regard to local operator action (recovery) to open valve 1SI8811B:
  - a. During small break loss of coolant accident scenarios (SLOCAs), the NRC determined that your staff's timeline of 43.5 minutes was overly optimistic. Your staff's timeline was largely based on simulator scenarios and other walk-throughs performed after the discovery of the failed valve. It did not explicitly consider operator recognition of the failed valve and discussion of the valve's status given the dual position indication that would appear on the control board, potential operator attempts to open the valve from the control room, operator briefings with the shift manager or technical support center personnel. It also did not explicitly consider interactions with radiation protection (RP) staff and management for attempting local recovery of the valve in a high radiation area during an ongoing LOCA, RP survey time, and dress-out time. The NRC considered all of these factors in addition to the time to reach the proper step in the relevant emergency operating procedure, transit time to the valve, and valve manipulation time. The NRC developed a time estimate of 60 to 75 minutes to locally open 1SI8811B and establish recirculation flow. The NRC used the SPAR-H method to estimate the human error probability (HEP) at  $4.0 \times 10^{-2}$  for the failure of operators to locally recover the 1SI8811B valve.
  - b. During medium break loss of coolant accident scenarios (MLOCAs), the NRC determined that no recovery credit was warranted. The NRC considered your staff's estimate of seven minutes to close the SI8812 RWST outlet valves after reaching 46 percent RWST level as optimistic. In a set of simulator scenarios conducted after the valve failure occurred, in at least one case the second SI8812 valve was not closed until 10 minutes after the recirculation switchover setpoint of 46 percent RWST level was reached. The NRC further concluded that operators could easily be distracted by the dual position indication and other factors discussed above. Using information provided by your staff, the NRC calculated that the RWST could drain down to 9 percent of its total inventory in

approximately 13 minutes, if the SI8812 valves were not closed. Your staff also assumed plant operators would conduct a cool down and depressurization of the RCS beginning at 45 minutes into the event and continuing at the maximum rate allowed by the technical specifications (100 degrees Fahrenheit (°F) per hour). The NRC determined that this assumption was not consistent with the Braidwood Emergency Operating Procedures, since during a MLOCA, the RCS temperature would have decreased by greater than 100°F in the last hour at the time of switchover, and the cooldown would have been delayed until the limit of 100°F over the last hour was met. The NRC therefore determined that it was not appropriate to use the RCS cooldown timing for this case.

Your staff provided an evaluation of the time to top of active fuel (TAF) from 46 percent RWST level without active cool down. This revised estimate showed a reduction in the time available to TAF from two hours to 1.44 hours. It also showed that the time to reach TAF from when the RWST was at 9 percent was just 18.6 minutes. Therefore, the NRC determined that, unless operators closed the SI8812 valves well before the RWST drained to 9 percent, there would not be enough time to perform the local recovery of the 1SI8811 valve prior to RCS level reaching the top of active fuel. Given the sensitivity of successful recovery of 1SI8811B to the impact of RWST flow diversion and the uncertainty associated with the time to close the SI8812 valves, the NRC determined that the recovery credit should not be applied to the MLOCA sequences.

2. With regard to your staff's perspective that their risk evaluation contained several conservatisms, the NRC determined that these issues would not significantly impact the final risk result since they were either not allowed by plant procedures or would not significantly impact credit for recovery.

## NOTICE OF VIOLATION

Exelon Generation Company  
Braidwood Nuclear Power Station, Unit 1

Docket No. 50-456  
License No. NPF-72  
EA-09-259

During a U.S. Nuclear Regulatory Commission (NRC) inspection conducted from June 24 to November 3, 2009, a violation of NRC requirements was identified. In accordance with the NRC Enforcement Policy, the violation is listed below:

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.

This violation is associated with a White finding.

The NRC has concluded that information regarding the reason for the violation, the corrective actions taken and planned to be taken to correct the violation and to prevent recurrence, and the date when full compliance was achieved, is already adequately addressed on the docket in Inspection Report 05000456/2009007; dated November 30, 2009, and during a Regulatory Conference held January 6, 2010. However, you are required to submit a written statement or explanation pursuant to 10 CFR 2.201 if the description therein does not accurately reflect your corrective actions or your position. In that case, or if you choose to respond, clearly mark your response as a "Reply to a Notice of Violation EA-09-259," and send it to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001 with a copy to the Regional Administrator, Region III, 2443 Warrenville Road, Suite 210, Lisle, IL 60532, and a copy to the NRC Resident Inspector at the Braidwood facility, within 30 days of the date of the letter transmitting this Notice of Violation (Notice).

If you contest this enforcement action, you should also provide a copy of your response, with the basis for your denial, to the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

If you choose to respond, your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. Therefore, to the extent possible, the response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction.

In accordance with 10 CFR 19.11, you may be required to post this Notice within two working days.

Dated this 25<sup>th</sup> day of February 2010

ENCLOSURE 2

Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. To the extent possible, your response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction.

Sincerely,

*/RA/*

Mark A. Satorius  
Regional Administrator

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

Enclosures:

- 1. Risk Assessment and Considerations
- 2. Notice of Violation

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1. OE concurrence received via e-mail from G. Gulla on February 18, 2010.