March 7, 2007

EA-06-081

Mr. Christopher M. Crane
President and Chief Nuclear Officer
Exelon Nuclear
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: BRAIDWOOD STATION, UNITS 1 AND 2 NRC SUPPLEMENTAL INSPECTION REPORT 05000456/2007008; 05000457/2007008

Dear Mr. Crane:

On February 2, 2007, the U.S. Nuclear Regulatory Commission (NRC) completed a supplemental inspection at your Braidwood Station, Units 1 and 2. The enclosed report documents the inspection results which were discussed on February 2, 2007, with Mr. Coutu and other members of your staff.

The NRC performed this supplemental inspection consistent with the NRC Action Matrix due to a White performance issue in the Public Radiation Safety Cornerstone. Specifically, on June 29, 2006, the NRC issued its Final Significance Determination and a Notice of Violation (NRC Inspection Report 05000456/2006012(DRS); 05000457/2006012(DRS)) for a White finding that involved multiple failures by your staff to adequately evaluate the radiological hazards associated with the leaks from the circulating water blowdown line vacuum breaker valves and to assess the environmental impact of the resultant onsite and offsite tritium contamination.

This supplemental inspection utilized NRC inspection procedure 95001, “Inspection for One or Two White Inputs in a Strategic Performance Area,” and was conducted to provide assurance that: (1) the root and contributing causes of the White performance issue were understood; (2) the extent of condition and extent of cause were identified; and (3) your corrective actions were sufficient to address the root causes and contributing causes and to prevent recurrence.

The inspection was an examination of activities conducted under your license as they relate to safety and to compliance with the Commission’s Rules and Regulations and with the conditions of your license. Within these areas, the inspection focused on your staff’s evaluation of the White performance issue and consisted of a selective review of procedures, documents and representative records, observation of activities, and interviews of personnel.

Based on the results of this inspection, no findings or significant weaknesses associated with your staff’s evaluation of the performance issue were identified. The inspectors determined that

your root cause evaluation and associated self-assessment for the White finding were conducted using systematic techniques and adequately identified the root and contributory causes for the specific performance issue. We also concluded that your corrective actions were adequate to address the causes that were identified in your evaluation so as to prevent recurrence. Therefore, consistent with NRC Manual Chapter 0305, "Operating Reactor Assessment Program," this issue will be removed from consideration of future agency actions after four quarters has elapsed following our input of the original finding in the assessment program (i.e., the end of the first quarter 2007).

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA by Anne T. Boland Acting for/

Cynthia D. Pederson, Director
Division of Reactor Safety

Docket Nos. 50-456; 50-457
License Nos. NPF-72; NPF-77

Enclosure: Inspection Report 05000456/2007008; 05000457/2007008
w/Attachments: Supplemental Information

cc w/encl: Site Vice President - Braidwood Station
Plant Manager - Braidwood Station
Regulatory Assurance Manager - Braidwood Station
Chief Operating Officer
Senior Vice President - Nuclear Services
Vice President - Operations Support
Director Licensing
Manager Licensing - Braidwood and Byron
Senior Counsel, Nuclear, Mid-West Regional
Operating Group
Document Control Desk - Licensing
Assistant Attorney General
Illinois Emergency Management Agency
State Liaison Officer
Chairman, Illinois Commerce Commission

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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Dockets:	50-456; 50-457
Licenses Nos.:	NPF-72; NPF-77
Reports Nos.:	05000456/2007008; 05000457/2007008
Licensee:	Exelon Generation Company, LLC
Facility:	Braidwood Station, Units 1 and 2
Location:	Braceville, IL
Dates:	January 29 through February 2, 2007
Inspectors:	J. G. Cassidy, Health Physicist S. K. Orth, Health Physics Program Manager
Technical Specialists:	R. E. Cady, PhD, Sr. Performance Assessment Analyst T. J. Nicholson, Senior Technical Advisor for Radionuclide Transport
Approved By:	C. D. Pederson, Director Division of Reactor Safety

SUMMARY OF FINDINGS

IR 05000456/2007008;05000457/2007008; 01/29/07 - 02/02/07; Braidwood Station. Inspection Procedure 95001 Supplemental Inspection.

The report covers a supplemental inspection performed by regional health physics inspectors and with hydrogeology assistance from NRC Headquarters. No violations were identified. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 3, dated July 2000.

Cornerstone: Public Radiation Safety

The NRC performed this supplemental inspection to assess the licensee's evaluation of a White performance issue in the Public Radiation Safety Cornerstone. Specifically, the supplemental inspection assessed the adequacy of the licensee's evaluation, extent of condition/cause review and corrective actions associated with one White input in the public radiation safety cornerstone. Inspection Report No. 05000456/2006008(DRS); 05000457/2006008(DRS) provided the details of the failure to perform adequate radiological evaluations of the leaks that occurred on the blowdown line necessary to properly quantify and assess the radiological impact of the leaks and to report and document the associated releases. This problem was characterized as a White finding and was determined to involve violations of NRC regulations, as documented in the NRC's final significance determination report (Inspection Report No. 05000456/2006012(DRS); 05000457/2006012(DRS)) dated June 29, 2006.

During this "Inspection for One or Two White Inputs in a Strategic Performance Area," performed in accordance with Inspection Procedure (IP) 95001, the inspectors determined that the licensee performed an adequate evaluation of the specific performance issue and that comprehensive corrective actions addressed each of the root and contributing causes. The licensee identified four root causes:

- Inadequate preventative maintenance programs and inadequate design configuration of the circulating water blowdown vacuum breaker valves.
- Failure to implement a near zero leakage standard, due to a lack of technical rigor/questioning attitude.
- Lack of integrated procedural guidance to ensure proper recognition, evaluation, and timely mitigation of the radiological spill events.
- Weak management review and oversight of spill response activities.

Corrective actions included:

- Implementing a preventative maintenance program for the circulating water/blow down system vacuum breaker valves.
- Developing a leakage standard and monitoring program for radioactive liquid releases.

- Instituting procedures to improve technical rigor, questioning attitude, and attention to detail.

- Revising station procedures to strengthen reporting requirements to senior station management and to define senior management responsibilities for oversight of events through final disposition.

Based on the licensee's progress in evaluating and correcting the problems with the radioactive liquid waste program that resulted in the White finding, this public radiation safety cornerstone performance issue will not be held open beyond the normal four quarters provided in NRC Manual Chapter 0305, "Operating Reactor Assessment Program."

REPORT DETAILS

01 INSPECTION SCOPE

The inspection objectives were to provide assurance that the root and contributing causes were understood for a White performance issue, to provide assurance that the extent of condition and extent of cause were adequately assessed, and to provide assurance that the corrective actions were sufficient to address the causes and to prevent recurrence.

02 EVALUATION OF INSPECTION REQUIREMENTS

02.01 Problem Identification

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

This issue was identified in several records within the licensee's corrective action program. This self-revealed event was identified based upon questioning from the State of Illinois Environmental Protection Agency.

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

During the conduct of the root cause evaluation, the licensee reviewed its corrective action and work control databases for approximately the decade that preceded the identification of tritium in the groundwater wells. This search identified 17 leaks of various sizes from November 1996 through January 2006 where the corrective actions focused on repairing the leak, without addressing the potential radiological impact of the leak. The root cause assessment identified prior opportunities to identify the adverse work control practices. Specifically, a large leak in 2000 resulted in the development of a draft procedure "General Action Plan for Response to Unmonitored Releases and Very Low Level Radioactivity Spills". However, that procedure was not implemented.

c. *Determine that the evaluation documents the plant specific risk consequences (as applicable) and compliance concerns associated with the issue.*

A plant specific probabilistic risk-assessment is not applicable to this issue. However, the licensee evaluated the radiation dose risk to the public. That assessment concluded that doses from the contamination were a very small fraction of the NRC's limit for doses to members of the public and insignificant relative to normal background radiation dose. The inspectors performed an independent assessment of the offsite dose and the underlying hydrogeological evaluation that was used to develop the dose assessment. Based on that review, the inspectors questioned some of the assumptions utilized by the licensee. Although the dose-assessment adequately defined the bounding dose to any assumed individual, the inspectors noted that for certain scenarios the assessment did not fully account for the various parameters that impact groundwater flow such as seasonal variations and localized flooding. Nonetheless, the inspectors concluded that these variations would not exceed the maximum exposure determined by the licensee.

The inspectors concluded that the evaluations were performed with adequate detail and rigor to calculate a bounding dose to the public.

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

a. *Determine that the problem was evaluated using a systematic method(s) to identify root cause(s) and contributing cause(s).*

The licensee conducted a root cause analysis of the performance issue which was later supplemented with an extent of cause review during the licensee's Focused Area Self-Assessment. The licensee used Procedure LS-AA-125-1001, "Root Cause Analysis Manual", Revision 6, to evaluate these issues. This procedure included such analysis tools as "TapRooT®," Task Analysis, Change Analysis, Barrier Analysis, and Failure Modes, and Effects Analysis. The inspectors evaluated the root cause evaluation report against the requirements of the licensee's procedures and determined that the evaluations performed followed the administrative procedure requirements.

The inspectors concluded that systematic methods were used to identify the root cause and contributing cause.

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

The inspectors concluded that the root cause evaluation was thorough and had identified and assessed the potential contributors to the decrease in performance in sufficient detail to identify appropriate corrective actions.

The licensee identified four root causes and three contributing causes for the events that resulted in the identification of tritium in onsite and offsite groundwater monitoring wells:

Root Causes

- Inadequate preventative maintenance programs and inadequate design configuration of the Circulating Water (CW) Blowdown (B/D) Vacuum Breaker (VB) Valves.

- Failure to implement a near zero leakage standard, due to a lack of technical rigor/questioning attitude.

- Lack of integrated procedural guidance to ensure proper recognition, evaluation, and timely mitigation of the radiological spill events.

- Weak management review and oversight of spill response activities.

Contributing Causes

- Processes and procedures for communication were not well defined.
- General training did not instruct personnel to report environmental spills for assessment of radiological conditions.
- Inadequate consideration of prior occurrences of the problem and knowledge of prior operating experience.

The inspectors concluded that the evaluations were performed with adequate detail and rigor to provide assurance that a similar event would not recur.

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

The Root Cause Evaluation included an historical review which identified 17 previous leaks of various sizes over the previous decade. In November 2000, an estimated 3 million gallon leak from Vacuum Breaker No. 2 released water with radioactive material to the groundwater pathway. A similar leak occurred in 1998, but the water from the leak was not collected or sampled for radioactive material. The Root Cause Evaluation conducted a review of previous industry events. This review did not identify any directly related industry events.

The inspectors concluded that, in general, the licensee's root cause evaluation appropriately considered both internal and external operating experience. The evaluation assessed the licensee's previous lack of recognition, evaluation, and timely mitigation of the radiological spill events.

d. *Determine that the root cause evaluation addresses the extent of condition and extent of cause of the problem*.

The licensee's evaluations considered the potential for common cause and extent of condition for each of the identified root causes. Additionally, the licensee formed a panel to identify other systems that may contain tritium contamination. That team identified 20 additional systems and evaluated the individual system components to determine the potential for any release of radioactively contaminated liquid to environment.

The inspectors concluded that the extent of condition and extent of cause reviews performed by the licensee were adequate.

02.03 Corrective Actions

a. *Determine that appropriate corrective action(s) are specified for each root/contributing cause or that there is an evaluation that no actions are necessary.*

Comprehensive corrective actions were developed to address the identified causes and the contributors so as to prevent recurrence of the performance issue. These corrective actions included:

- Implementing a preventative maintenance program for the circulating water/blowdown system vacuum breaker valves.

- Developing a leakage standard and monitoring program for radioactive liquid releases.

- Instituting procedures to improve technical rigor, questioning attitude, and attention to detail.

- Implementing integrated procedures to provide detailed spill and leak response requirements.

- Revising station procedures to strengthen reporting requirements to senior station management and to define senior management responsibilities for oversight of events through final disposition.

The inspectors determined that the corrective actions specified in the root cause evaluation were appropriate for the associated causes.

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

All radioactive liquid releases were suspended after tritium was identified in offsite ground water wells. Releases were resumed only after the licensee demonstrated the integrity of the circulating water blowdown piping, installed a leak detection and annunciation system, and installed an impermeable membrane in each of the vacuum breaker valve vaults. Initial releases were conducted with visual observation of 100 percent of the vacuum breaker valve vaults during each release. This practice continued until the effectiveness of the leak detection and annunciation system was demonstrated.

The licensee completed interim corrective actions, and subsequent corrective actions were on track for completion as scheduled. The licensee suspended liquid releases until the root causes were identified and corrective actions were taken. The inspectors considered the prioritization of the established corrective actions to be appropriate.

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

The licensee established adequate schedules for the completion of the specified corrective actions. The majority of the corrective actions had been completed, and the remaining corrective actions were on schedule for completion. The inspectors reviewed the completed corrective actions and concluded that they had been generally implemented in a timely and effective manner. The inspectors did not identify any concerns with the scheduling or completion of corrective 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 licensee developed a means to validate the effectiveness of its corrective actions for the performance deficiency. However, the inspectors questioned the adequacy of certain performance measures. Although the performance measures represented a high standard of performance, the inspectors noted that the measures did not appear to provide an adequate indication of a performance trend over the elapsed time between the implementation of the corrective actions and the intended review. For example, the measures included: (1) zero major valve failures of the blowdown line that result in large spills, and; (2) zero issues regarding poor or improper response to spills and leaks. Based on the specified measures, the inspectors estimated that the corrective actions would not likely be challenged within the time period in a manner evaluated by the performance measure. Additionally, another measure did not appear to directly measure the specified corrective taken. The inspectors reviewed licensee procedure LS-AA-125-1004 (Revision 2), that provided guidance for conducting effectiveness reviews. That procedure required an evaluation that the performance measure was sufficiently challenged before conducting the effectiveness review. The inspectors concluded that the defined process/procedure provided adequate assurance that the performance measures would be re-evaluated.

e. Determine that the root cause evaluation, extent of condition, and extent of cause appropriately considered the safety culture components as described in IMC 0305.

The Focused Area Self-Assessment reviewed the Root Cause Evaluation report and used its results to analyze the safety culture. The analysis determined that the causal factors of:

- a lack of resources (integrated procedures);
- a lack of training;
- a lack of technical rigor/questioning attitude; and
- weak management review and oversight were associated with safety culture components and identified actions that are in place to address each of these items.

The inspectors concluded that the licensee adequately considered the safety culture components associated with the root cause extent of condition and extent of cause reviews performed by the licensee were adequate.

03 OTHER ISSUES

03.01 (Closed) Violation (VIO) 050000454/2006008-01;050000455/2006008-01: Failure to Survey

The licensee did not make surveys to assure compliance with 10 CFR 20.1301, which limits radiation exposure to 0.1 rem. As examples, in November 1996 and December 1998, failed vacuum breaker valves in the licensee's radioactive waste discharge line resulted in large volumes of liquid contaminated with radioactive material to leak in an uncontrolled manner to the unrestricted areas, which were not evaluated by the

licensee. The inspectors reviewed the corrective actions to address the violation as documented in this report. Specifically, the licensee installed over 300 groundwater monitoring wells to characterize the concentration and quantities of radioactive material released to the environment. Additional sample locations included surface water and private drinking water wells. No new issues or additional findings of significance were identified during the review. This violation is closed.

03.02 (Closed) Violation (VIO) 050000454/2006008-02;050000455/2006008-02: Failure to assess dose from liquid effluents

The licensee did not determine the cumulative dose contributions from liquid effluents inadvertently leaked to onsite and offsite locations resulting from failed vacuum breaker valves along the radioactive waste discharge line in 1996, 1998, and 2000. The inspectors reviewed the corrective actions to address the violation as documented in ths report. Specifically, the licensee performed an assessment of the offsite dose from inadvertent releases of water from the Circulating Water blowdown line. No new issues or additional findings of significance were identified during the review. This violation is closed.

03.03 (Closed) Violation (VIO) 050000454/2006008-03;050000455/2006008-03: Failure to monitor radioactive materials in the environment

The licensee did not establish an appropriate surveillance and monitoring program to evaluate the relationship between quantities of radioactive material released in effluents and resultant doses to individuals from principal pathways of exposure for the radioactive material released in the 1996, 1998, and 2000 vacuum breaker valve leaks. The inspectors reviewed the corrective actions to address the violation as documented in ths report. Specifically, the licensee completed a groundwater investigation program to identify the extent and concentration of radioactive contamination near vacuum breaker valves and the Radiological Effluent Monitoring Program (REMP) was revised to include new monitoring locations. No new issues or additional findings of significance were identified during the review. This violation is closed.

04 MANAGEMENT MEETINGS

Exit Meeting Summary

On February 2, 2007, the inspectors presented the inspection results to Mr. T. Coutu, Site Vice President, and other members of the staff who acknowledged the findings. The inspectors confirmed that proprietary information was not provided or examined during this inspection.

ATTACHMENT: SUPPLEMENTAL INFORMATION

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee
M. Cichon, Regulatory Affairs
C. Dunn, Training
J. Eggart, Chemistry
J. Gosnell, Engineering
A. Haeger, Tritium Team Leader
P. Harvey, Hydrologist Contractor
J. Moser, Radiation Protection
J. Petty, Regulatory Affairs
D. Skoza, Engineering
J. Vanos, Engineering

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened and Discussed

None

Closed

050000456/2006008-01; 050000457/2006008-01	VIO	Braidwood Tritium White Finding - failure to survey
050000456/2006008-02; 050000457/2006008-02	VIO	Braidwood Tritium White Finding - failure to assess dose
050000456/2006008-03; 050000457/2006008-03	VIO	Braidwood Tritium White Finding - failure to monitor radioactive materials in the environment

LIST OF DOCUMENTS REVIEWED

Procedures:

LS-AA-125-1001; Root Cause Analysis Manual; Revision 6

EN-AA-407; Response to Unplanned Discharges; Spills and Venting of Licensed Radionuclides to Groundwater; Surface Water or Soil; Revision 0

CY-AA-170-400; Radiological Groundwater Protection; Revision 1

CY-AA-17-415; Controlled RGPP Sample Point Data and Standard Control Limits; Revision 2

CY-AA-170-4000; RGPP Reporting Requirements; Revision 2

CY-AA-170-4100; Radiological Groundwater Protection Program Environmental Sample Collection Implementation; Revision 0

CY-BR-170-4160; Radioactive Ground Water Protection Program Scheduling and Notification; Revision 0

CY-AA-170-4200; RGPP Data Analysis and Report Preparation; Revision 0

CY-AA-170-4400; Groundwater Well and Surface Sample Point Selection Criteria; Revision 0

LS-AA-125-1004; Effectiveness Review Manual; Revision 2

Evaluations

Root Cause Report 428868; "Inadequate response to unplanned environmental tritium releases from Braidwood Station due to weak managerial oversight and the lack of integrated procedure guidance," to determine the root cause(s) and appropriate corrective actions for the unplanned tritium releases from Braidwood; Report Date February 14, 2006.

Focused Area Self-Assessment Report 552340-04

Tritium Investigation, Exelon Generation - Braidwood Station; Conestoga-Rovers and Associates; dated March 2006

TR-01-2006 DMA-TR-27; "Assessment of Offsite Doses from Inadvertent Releases of Water from the Blowdown Line at Braidwood Station;" dated March 28, 2006