U.S. NUCLEAR REGULATORY COMMISSION

REGION III

REPORT NO. 50-456/96005; 50-457/96005

FACILITY

Braidwood Nuclear Plant, Unit 1 and 2
License Nos. NPF-72; NPF-77

LICENSEE

Commonwealth Edison Company
Opus West III
1400 Opus Place
Downers Grove, IL 60515

DATES

January 23 through March 21, 1996

INSPECTORS

C. Phillips, Senior Resident Inspector
E. Duncan, Resident Inspector
M. Kunowski, Resident Inspector

APPROVED BY

R Jones for

Lewis F. Miller, Jr., Chief
Reactor Projects Branch 4

4/4/96
Date

AREAS INSPECTED

A special reactive inspection of the mispositioning of the Unit 2 hydrogen monitor valves on January 23, 1996, the start of work on the Unit 2 safety injection system outside the established out-of-service boundary on March 5, 1996, and the configuration control and out-of-service trend problems in 1995 and 1996.

RESULTS

Five apparent violations were identified involving the failure to verify that the out-of-service boundaries enveloped the work on a Unit 2 safety injection system flange, 2) the failure to provide the operations department with marked up system drawings on the Unit 2 safety injection system, 3) the failure to take corrective actions to prevent recurrence of a 1994 hydrogen monitor valve mispositioning event, 4) the failure to have appropriate

documented procedures or instructions to ensure that the valve positions of the Unit 2 hydrogen monitors were satisfactorily controlled on January 23, 1996, and 5) the failure to identify and correct adverse trends which you identified in configuration control and the out-of-service program.

INSPECTION DETAILS

1.0 Summary of Events

The licensee identified numerous problems with configuration control and the out-of-service (OOS) program in 1995 that continued into 1996. In March 1996, the inspectors identified that work was performed on a flange in the 2B safety injection train that was outside the OOS boundary. This work opened a flow path from the other train of safety injection to the atmosphere, and had the potential to make both trains inoperable. In January 1996, an operator manipulated valves inside the Unit 2 hydrogen monitor cabinets without understanding the function or correct position of the valves. This action rendered both hydrogen monitors inoperable.

1.1 Unit 2 Safety Injection (SI) Pump Maintenance

On March 5, the inspectors observed water flowing from a flow orifice flange on the discharge line of the 2B SI pump, which was OOS for maintenance, at about 9:00 a.m.. The flange was scheduled to be cleaned and repaired as part of on-line maintenance of the 2B SI pump. The inspectors questioned a maintenance supervisor of a different job, who was also in the pump room, about the leak. The supervisor stated that the bolts on the flange had been loosened on a previous shift. The supervisor subsequently discussed the leak with control room personnel who determined that the flange was not included within the OOS boundary for the 2B SI pump work. In addition, the loosened flange opened a flow path from the Unit 2 refueling water storage tank through the 2A SI pump. The licensee initially concluded that the existence of the flow path rendered the 2A SI pump inoperable. The licensee subsequently restored the operability of the 2A pump (at 9:48 a.m.) by closing a train crosstie valve, 2SI8821B, the 2B SI pump to cold legs isolation valve.

On March 22, after a detailed engineering analysis, the licensee concluded that the 2A SI pump was not rendered inoperable by the leaking flange. The licensee also performed calculations that stated the 10 CFR 100 limits would not have been exceeded due to leakage into the auxiliary building during the recirculation phase of a loss of coolant accident.

The inspectors interviewed the maintenance supervisor whose work crew had begun work on the flange. The supervisor stated that water leakage was expected because of a vertical section of pipe connected to the flange. The supervisor indicated that his work crew worked another job while the water was draining and that water was still draining at the shift change. Licensee personnel later determined that the flange bolts were loosened about 11:45 p.m., on March 4.

The failure to verify the proper isolation points for the work on the SI flange was contrary to BwAP 330-1, "Station Equipment OOS Procedure," and was an apparent violation of Technical Specification (TS) 6.8.1,

that required written procedures be established, implemented, and maintained covering the activities referenced in Appendix A, of Regulatory Guide 1.33, Revision 2, February 1978 (Violation 50-456/96005-01). Appendix A, of Regulatory Guide 1.33, references administrative procedures such as equipment control (e.g. tagging).

In addition to inadequate review by the operators, the licensee identified that the maintenance department had not provided a set of marked-up system drawings or a separate list identifying the isolation points to the operations department in support of the OOS preparation. This was required by BwAP 330-1 and, as such, the failure to provide that information was also an apparent violation of TS 6.8.1 (Violation 50-457/96005-02).

1.2 Unit 2 Hydrogen Monitor Surveillance Testing

The following information was based on a licensee root cause investigation into the mispositioning of valves on the Unit 2 hydrogen monitors. On January 23, 1996, at about 5:30 a.m. the licensee conducted Unit 2 operating surveillance BwOS 6.3.3-8, "Process Sampling Containment Isolation Valve Stroke Quarterly Surveillance," to verify, in part, that the 2A and 2B hydrogen monitoring system discharge check valves 2PS231A and B stroked open. During the surveillance on the 2A hydrogen monitor, a system flow rate of 5.0 standard cubic feet per hour (scfh) was obtained which met the minimum acceptance criteria of 2.5 scfh. Because the purpose of the surveillance was to verify that the check valve opened there was no maximum flow acceptance criteria. However, a note in the surveillance stated that a flow rate greater than 3.5 scfh indicated flow control problems in the instrument and that the instrument maintenance (IM) supervisor should be contacted. Control room operators did notify an IM supervisor of the problem.

The operator performing the surveillance noted that there was a difference between the flow rates of the 2A and 2B monitors which was 3.2 scfh. The operator also noticed there was a difference between the positions of the V-5 valves on the monitors. The V-5 valve throttles return flow from the monitor to containment to control response time. The V-4 valve throttles actual sample flow through the monitor. The correct positions of these valves are slightly throttled open (about 1/8 turn). The V-5 valve on the 2A monitor appeared fully open and the V-5 valve on the 2B valve appeared to be shut. The operator, without knowing the function or correct position of the valve, checked the V-5 and V-4 valves shut on the 2B monitor which isolated flow through the monitor, rendering it inoperable. The control room received a low flow alarm at the same time the operator in the field was closing the panel door to the monitor. The initial response by the control room operators was to assume that the flow alarm was due to closing the panel door. The control room operators turned the 2B monitor off and then turned it back on for less than four minutes. No low flow alarm was received. However, the control room operators did not know the hydrogen monitor low flow alarm had a four minute lock out feature to allow time for span gas to be purged from the system and for the thermal conductivity cell

to stabilize to the sample gas. BwAP 1250-2, "Problem Identification and Investigation Procedure," step E.2.a.1) stated in part, "If you see a problem, however minor write a PIF." The inspectors observed that no problem identification form (PIF) was written to identify that the flows and valve positions were different on the two monitors and that an alarm had been received.

During the following shift, the 2B hydrogen monitor failed the shiftly channel check due to low flow through the V-5 valve. The control room operators wrote a PIF to identify the problem with the 2B monitor. Operators and instrument maintenance technicians were dispatched and determined that both of the 2B monitor flow throttle valves were mispositioned closed which caused the low flow condition. These throttle valves were readjusted, proper flow was restored, and a channel check was completed satisfactorily.

On January 24, about 3:13 a.m., the shift engineer questioned the line-up of the Unit 2 hydrogen monitors. Although the problem with the 2B monitor had been fixed by instrument maintenance, instrument maintenance personnel did not relay the correct valve positions to operating personnel. The shift engineer and an auxiliary operator performed a walkdown of the 2A monitor without a documented valve lineup or procedure. During the walkdown, an operator checked the position of flow throttle valves V-4 and V-5. The V-5 valve was found open and left in that position. The V-4 valve was mistakenly thought to be shut when it was in fact cracked open. The operator checked shut the valve, closing it. Shutting the V-4 valve made the monitor inoperable because sample flow was isolated.

Following the improper verification of the 2A hydrogen monitor lineup as described above, operators performed throttle valve position verifications for the 2B hydrogen monitor and improperly shut the V-4 and V-5 valves. In both cases, the operator was unaware of the function and required positions of these valves. No documented instructions or procedures for this activity were used, nor were any existing procedures clearly required by the licensee to be invoked. Following the walkdown and valve position verifications a channel check was performed which the 2B monitor failed. The 2B hydrogen monitor was then declared inoperable.

Later that day the inspectors questioned the effect of the high flow rate (5.0 scfh) on the operability of the 2A monitor. Licensee personnel called the vendor, Teledyne Analytical Instruments, who stated that the monitors had only been tested for a maximum flow rate of 4.0 scfh. The licensee then declared the 2A monitor inoperable, but later performed calculations to demonstrate that a flow rate as high as 5.2 scfh through V-5 would not make the monitor inoperable.

However, due to improper closures of V4 and V5, both hydrogen monitors were inadvertently rendered inoperable. This error was subsequently discovered and corrected prior to exceeding the Technical Specification 3.6.4.1 allowable outage time of 72 hours.

10 CFR 50, Appendix B, Criterion V, requires that activities affecting quality shall be prescribed by documented instructions or procedures of a type appropriate to the circumstances, and these instructions or procedures shall have sufficient acceptance criteria to determine that important activities have been correctly performed. These activities are further required to be conducted in accordance with these procedures or instructions. The failure to ensure that the lineup checks on the 2A and 2B hydrogen monitors on January 23 and 24 were properly conducted in accordance with documented instructions or procedures is an apparent violation of this criterion (Violation 50-457/96005-04).

The licensee had a previous opportunity to prevent this event from occurring. On December 30, 1994, instrument maintenance personnel performed BwIS 6.4.1-200, "Analog Operational Test/Surveillance Calibration Of Containment Hydrogen Monitoring Analyzer Indicating Loop." On December 31, operating personnel started the hydrogen monitor to perform BwOS 6.3.3-8, "Process Sampling Containment Isolation Valve Stroke Quarterly Surveillance," and a trouble alarm was received. The trouble alarm was subsequently cleared after the licensee determined that flow throttle valve V-5 had been inadvertently closed. As a result, an engineering request was written to evaluate replacing V-5 with a valve with a finer throttle control. However, no action had been taken to address the engineering request prior to the event which occurred on January 23 and 24, 1996, as described above. In addition, no actions were taken administratively, such as training operators, putting up signs, or changing the surveillance procedure to prevent recurrence of the problem.

10 CFR 50, Appendix B, Criterion XVI, requires that measures be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to preclude repetition.

The failure to take corrective actions to prevent recurrence of the December 1994 event was an apparent violation of 10 CFR 50, Appendix B, Criterion XVI (Violation 50-457/96005-03).

1.4 Licensee Configuration Control And OOS Trend Problems

Errors in configuration control had been identified as a problem by the licensee's Site Quality Verification (SQV) department in the October, November, and December 1995 monthly reports. SQV generated a Problem Identification Form (PIF) to trend problems with configuration control in October 1995. The licensee elevated the configuration control problem to a level requiring a root cause investigation, in mid-November. Prior to the January 23, 1996 problem with the hydrogen monitors no root cause investigation into the problems with configuration control had begun. Consequently, no corrective actions had been identified. In January 1996, the licensee identified that in

1995 there were about 90 identified configuration controls errors, about 50 of which involved component positioning errors.

In addition, in March 1996, the licensee identified that about 54 errors in the OOS program had been identified between January 1, 1995 and March 13, 1996. About 21 of those errors involved improperly isolating, draining/depressurizing, or improperly returning equipment to service. This trend had not been identified prior to the problem with the SI system OOS on March 5.

The trend in inadequate configuration controls continued. For example, on March 12, 1996, both auxiliary building ventilation supply fans were approved for operation following maintenance, although one of the fans was still being worked on. On March 13, one of the Unit 1 containment chilled water pumps was uncoupled from the motor without proper authorization. On March 18, with Unit 2 in Mode 5, while de-energizing panels 2PA01J and 2PA03J to hang out-of-service cards, a low pressurizer level signal was mistakenly generated. As a result, all pressurizer heaters tripped and reactor coolant system (RCS) pressure slowly decreased. Operations department personnel immediately re-energized 2PA01J to clear the false low pressurizer level signal, re-energized pressurizer heaters, and restored RCS pressure to normal.

10 CFR 50, Appendix B, Criterion XVI, requires that measures be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to preclude repetition.

The failure to take action to perform corrective actions regarding the identified trend in configuration control and to identify and correct the trend with the OOS program was an apparent violation of 10 CFR 50, Appendix B, Criterion XVI (Violation 50-457/96005-05).

2.0 Licensee Root Cause Investigation Results

Safety Injection System Root Cause The licensee's investigation determined that the reactor operator who prepared the OOS paperwork for the job erroneously excluded the flange from within the OOS boundary. The OOS request from the maintenance department described the job as "clean and repair" the flange. The operator stated to the inspectors that he did not interpret this as requiring loosening of the bolts. The licensee determined that another reactor operator and a senior reactor operator also failed to verify that the proper isolation points were included in the OOS to assure opposite train operability.

Hydrogen Monitor Root Cause The licensee root cause investigation determined:

- operators manipulated valves without knowing their required positions;
- operators did not reference the hydrogen monitor startup procedure, BwOP PS-9, "Post LOCA Containment Hydrogen Monitoring System Operation," after the 2B hydrogen monitor alarmed on low flow on January 23, when the monitor was shutdown and restarted; and
- operating personnel lacked knowledge of the hydrogen monitoring system.

Configuration Control Root Cause The licensee root cause investigation into the configuration control problems was not completed by the end of the inspection period. The licensee also initiated a separate root cause investigation into the stations OOS problems but it was not completed prior to the end of the inspection period.

3.0 Licensee Corrective Actions

SI System Corrective Actions As part of the corrective action for the event, the licensee initiated a root cause investigation headed by a senior manager. Other actions taken by the licensee included:

- the SI work was stopped until the OOS was corrected;
- all current OOS paperwork was checked to verify that proper isolation points were included;
- selected outage OOSs were rechecked;
- the SQV department reviewed OOS practices and procedures;
- the OOSs for recently completed work on both trains of the Unit 2 residual heat removal system were reviewed;
- an SRO reviewed all OOSs with the non-licensed operators, before the OOSs were hung, for one week after the event;
- the electronic work control system was modified to allow reactor operators access to the work package instructions;
- all operations shift personnel were briefed on the event and required to read a four-page memo that described the event, department expectations on OOSs, and initial corrective actions; and
- senior licensee management began a root cause investigation to review the long term adverse trend in OOSs.

Hydrogen Monitor Corrective Actions The licensee briefed all operations personnel on the expectation that prior to any valve manipulation the required position of that valve should be known. The licensee planned to revise initial and requalification training to include all phases of hydrogen monitor operation. The training for initial qualification was scheduled for the Fall classes and requalification training was scheduled to start in August 1996. The licensee revised the hydrogen monitor trouble alarm annunciator procedure to identify the four minute lock-out time on the alarm.

In addition, the licensee changed surveillance requirements. Instrument maintenance personnel began checking hydrogen monitor flow rates weekly using BwIS 6.4.1-201, "Weekly Sample Flow Verification of Containment Hydrogen Monitoring Analyzer." Licensee personnel began to trend as found flow rates to identify a suitable frequency for this new surveillance.

Finally, the licensee posted signs on the outside of the monitor warning that permission was required from Operations before entering the cabinet and inside the monitor warning that the V-4 and V-5 valve affect operability and require shift engineers permission prior to operation.

Configuration Control Corrective Actions After the hydrogen monitor event on January 23 and before the safety injection event on March 5 the licensee performed 28 plant walkdowns and identified numerous errors in the mechanical and electrical lineup sheets. These problems included system modifications not incorporated into lineups, operating procedure return to service positions differing from lineup positions, and components inadvertently omitted from a lineup sheet. In addition, the licensee identified that lineups had not been performed for some systems in several years and that lineups had not been performed following revisions to the lineup sheet.

The licensee developed a plan to reperform electrical and mechanical lineups. The plan prioritized the sequence of lineups based on safety significance and opportunity to perform the lineups. The licensee planned to reconcile all lineups with plant procedures, plant drawings, and the electronic OOS system. The licensee planned to perform training with several departments on configuration control problems and the revised temporary modification procedure. However, there were no scheduled due dates as of the end of the inspection period for the completion of these items. As mentioned above, the licensee had not completed the configuration control problem root cause investigation.

Finally, the operations manager has conducted training with operators, reemphasizing that operators should understand the tasks which they are to perform before they attempt them (so-called self-check expectations).

Out-Of-Service Problems Corrective Actions The licensee initiated the following immediate corrective actions prior to the conclusion of the root cause investigation for this subset of configuration control errors:

- work analysts were instructed to provide more detail on the special instructions panel for OOSs in the electronic work control system;

- a job description and/or pre-job brief will be provided to non-licensed operator prior to hanging an OOS;

- vent and drain instructions are required on any new OOS;

- maintenance supervisors were trained, in that, more than one group of tags could be hung under a single OOS number. For example, an OOS may cover two separate pieces of equipment with a different tag checklist for each piece of equipment.

- the job supervisor will visually ensure proper isolation for individual equipment; and

- the person authorizing the clearance of the OOS is held accountable for a visual walkdown of the work prior to clearing the OOS.

4.0 Review of Updated Final Safety Analysis Report (UFSAR) Commitments

A recent discovery of a licensee operating their facility in a manner contrary to the UFSAR description highlighted the need for a special focused review that compares plant practices, procedures and/or parameters to the UFSAR descriptions. During a portion of the inspection (February 1-9, 1996) the inspectors reviewed the applicable sections of the UFSAR that related to the inspection areas discussed in this report. The inspectors verified that the UFSAR wording was consistent with the observed plant practices, procedures and/or parameters.

5.0 Management Debriefing and Persons Contacted

At the conclusion of the inspection on March 21, 1995, the inspectors met with the licensee representatives (denoted by *) and summarized the scope and findings of the inspection activities. The licensee did not identify that any of the documents or precesses reviewed by the inspectors as proprietary.

*K. Kaup, Site Vice President
*T. Tulon, Station Manager
*R. Flessner, Site Quality Verification Director
*R. Byers, Maintenance Superintendent
*D. Miller, Work Control Superintendent
*T. Simpkins, Regulatory Assurance Supervisor
*H. Cybul, System Engineer Supervisor
*H. Pontious, Jr., Nuclear Licensing Administrator
*J. Meister, Engineering Manager
*D. Cooper, Operations Manager
*D. Farrar, Regulatory Services

*J. Lewand, Regulatory Assurance - NRC Coordinator
*M. Pavey, RPA - Licensing
*S. Trubatch, Counselor
*L. Weber, SOS
*M. Olson, Root Cause
*E. Roche, Executive Assistant
*J. Allen, Maintenance Group Leader
*R. Lemke, Offsite Review