U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket Nos:	50-456; 50-457
Licenses No:	NPF-72; NPF-77
Reports No:	50-456/97008(DRS); 50-457/97008(DRS)
Licensee:	Commonwealth Edison (ComEd)
Facility:	Braidwood Nuclear Power Station, Units 1 and 2
Location:	RR #1, Box 79 Braceville, IL 60407
Dates:	April 17-30, 1997
Inspectors:	S. Orth, Senior Radiation Specialist
Approved by:	T. Kozak, Chief, Plant Support Branch 2 Division of Reactor Safety

EXECUTIVE SUMMARY

Braidwood Nuclear Plant, Units 1 & 2
NRC Inspection Reports 50-456/97008; 50-457/97008

This announced inspection included aspects of licensee plant support performance and, specifically, an evaluation of effectiveness of the radiation protection program. This report covers a 2-week period of inspection performed by a regional radiation specialist. Two violations were identified concerning the failure to adequately implement procedures.

Plant Support

- The licensee effectively used past performance and work estimates to prepare dose estimates and goals for the 1997 Unit 1 refueling outage. Although the licensee's reviews of outage dose performance were generally thorough, the licensee did not trend the amount of dose attributable to re-work activities. (Section R1.1)

- Implementation of the ALARA program was a strength. ALARA planning and pre-job meetings were thorough; the radiation protection staff effectively communicated radiological work requirements and implemented dose reduction techniques. Planning problems were identified by the licensee concerning the installation of steam generator gallery steel. Other minor problems were identified concerning coordination of work groups and the use of low dose areas. (Section R1.2)

- The whole body counter (WBC) was properly calibrated, and the quality control program for the WBC was properly implemented. Problems were identified by the inspector concerning the calculation of radioactive material intakes. (Section R1.3)

- Two violations were identified concerning the failure to adequately implement procedures. A violation was identified for not properly locking the entrance to an area posted as a locked high radiation area. Another violation was identified for the failure to adequately follow procedures concerning control of vacuums within the radiologically protected area. Access to safety related equipment was relatively unencumbered by radiological impediments. (Section R2.1)

Report Details

IV. Plant Support

R1 Radiological Protection and Chemistry (RP&C) Controls

R1.1 Unit 1 Outage Dose Estimates and Dose Control

a. Inspection Scope (83750)

The inspector evaluated the licensee's process for developing outage dose goals for the Unit 1 re-fueling outage (A1R06). The inspector discussed the licensee's projected dose estimates with radiation protection (RP) staff, reviewed the licensee's historical data, and reviewed the licensee's current outage performance. In addition, the inspector discussed with the RP staff the oversight and control of outage dose.

b. Observations and Findings

The licensee maintained historical files for repetitive outage tasks and used the information as a basis for A1R06 estimates. The implementation of ALARA initiatives and lessons learned has resulted in an overall dose reduction for repetitive work activities during successive outages.

On March 29, 1997, the licensee began a 53-day refueling outage on Unit 1. The licensee estimated an outage dose goal of 215 person-rem which included the following outage work:

- Steam Generator (SG) Tube Inspections/Repairs (40.5 rem);
- Preparation Work for planned 1998 SG Replacements (29.2 rem);
- Valve No. RC8002C (Loop Stop Isolation Valve (LSIV)) Repair (15.8 rem);
- General Valve Work (10.2 rem);
- In-Service-Inspections (8.9 rem); and
- Reactor Head Work (8.5 rem).

Prior to A1R06, the plant staff submitted work duration estimates as part of the radiation work permit (RWP) requests. Based on the anticipated dose rates in the work area and the estimated work duration, the RP staff developed dose goals for non-routine outage evolutions. However, the RP staff indicated that the plant staff frequently overestimated the time required at the work site to perform the activity. The RP ALARA planners compensated for the overestimates and reduced the time estimates based on a historical fraction of time at the work area versus total work crew time (i.e. preparation, meetings, etc.). RP management acknowledged the inaccuracies in the plant staff's time estimates and indicated that the staff was making improvements in this area.

The inspector reviewed the licensee's outage work progress and the initial work projections. With the exception of SG gallery steel installation (Section R1.2), the

licensee's outage performance was consistent with dose and time estimates. At the time of the inspection, the accumulated dose for the LSIV repair, in-service inspection (ISI) activities, and reactor head work was consistent or better than initial outage estimates.

The licensee performed daily reviews of outage dose. An ALARA planner prepared a daily report containing accumulated dose as a function of department and by each RWP. In addition, the report contained a daily dose for each individual within a department. The ALARA planner indicated that he used the report to identify RWPs which were at or above 70 percent of the estimated dose and to identify any disparities between individual doses within departments. The inspector observed that the report provided a good comparison of current performance data and the licensee's goals. The inspector also noted that the licensee monitored re-work activities and determined the percentage of total work that was attributed to re-work. However, the inspector observed that the RP staff did not have a measure of dose attributable to re-work activities. The licensee acknowledged that they had not separately accounted for this dose but planned on evaluating a method to perform this type of analysis.

c. Conclusions

The licensee effectively used past performance and work estimates to prepare dose estimates and goals for the 1997 Unit 1 refueling outage. Although the licensee's reviews of outage dose performance were generally thorough, the licensee did not trend the amount of dose attributable to re-work activities.

R1.2 Unit 1 Outage Work Performance and ALARA Implementation

a. Inspection Scope (83750)

The inspector reviewed aspects of the licensee's RP planning, attended pre-job meetings, observed work in progress, and reviewed licensee post-job evaluations. The inspector also reviewed the licensee's implementation of the following procedures:

BwAP 700-1, "ALARA Policy Procedure", Revision 4, dated November 29, 1994, and
BwAP 700-2, "Guidelines for an ALARA Action Review", Revision 9, dated August 27, 1995.

b. Observations and Findings

The inspector observed some licensee initiatives in the ALARA program. During A1R06, the ALARA staff lowered the threshold for performing reviews. As required by Procedures BwAp 700-1 and BwAP 700-2, the licensee was required to perform ALARA Action Reviews if any the following conditions existed: (1) dose estimate for the work was greater than or equal to 1 rem total effective dose equivalent (TEDE); (2) working exposure rates were greater than or equal to

rem/hr; or (3) dispersable contamination in the work area was greater than or equal to 1,000,000 disintegrations per minute (dpm) over 100 square centimeters. In addition to the required ALARA Action Reviews, the licensee also performed less formal reviews of outage work activities which had total dose estimates between 0.1 and 1.0 rem TEDE. For these jobs, the licensee's objective was to better define the dose goals, to increase awareness of ALARA/dose reduction concerns, and to provide a better interface between the work group and the ALARA staff. The inspector observed that the licensee achieved positive results from these reviews. For example, the scope of the residual heat removal (RHR) drain valve repair was initially to replace the valve internals. However, the increased ALARA interface resulted in the complete valve replacement which eliminated a 1 rem per hour (rem/hr) hot spot within the plant. The inspector also noted that the several reviews resulted in more aggressive dose goals. In addition, the licensee identified that the requirements for determining when to conduct an ALARA pre-job meeting were not well defined. The licensee planned to determine if thresholds, similar to those used as requirements for ALARA Action Reviews, should be used as requirements for pre-job meetings.

During the outage, the licensee performed repairs on the loop C SG LSIV (1RC8002C). In accordance with Procedures BwAP 700-1 and BwAP 700-2, the licensee prepared an ALARA Action Review for the activity which contained a comprehensive description of the anticipated radiological conditions, lessons learned, dose reduction techniques, and contamination control practices. The licensee used cameras to reduce personnel exposures. In addition, the inspector noted that a mock-up of the valve provided excellent training for both the work crew and the radiation protection technicians (RPTs) involved in the evolution. The inspector observed personnel completing this repair and noted good radiation worker (radworker) practices and good oversight of personnel by RPTs. As of April 30, 1997, the licensee had accrued about 10.3 rem of exposure and anticipated about 1 rem in additional activities as compared to the original dose estimate of 15.7 rem.

The licensee also removed, inspected, and replaced the Unit 1 lower internals (core barrel) to perform the 10 year ISI inspections of the reactor vessel welds. The inspector reviewed the planning and ALARA Action Review for the evolution and found it to be comprehensive. Based on 1996 data from the licensee's sister plant (Byron Station), the RP staff identified the potential for dose rates exceeding 15 rad per hour (rad/hr) near the internals and general area dose rates exceeding 1 rad/hr on the 426' elevation of containment. With the exception of the two necessary crane operators, all other personnel monitored the evolution via cameras and robotics. As documented in the ALARA review, the RP staff emphasized the use of cameras, the required posting and control of effected plant areas, the control of reactor cavity water level, and the communications with and monitoring of the two crane operators. Within the ALARA Action Review, the staff also identified contingency actions. Prior to the removal, the licensee conducted practice manipulations of the crane to ensure the work crew was well prepared.

On April 18, 1997, the inspector attended a prejob meeting for the replacement of the core barrel and noted that there were excellent discussions among the workers about the evolution. The staff was well prepared for the meeting, discussed radiological conditions and concerns, and discussed contingency actions. In addition, the staff reviewed the lessons learned from the original core barrel removal. For example, during the removal, the licensee identified problems concerning the control of personnel access to containment. Prior to the evolution, the RP staff projected the potential dose rates in the containment and required that no personnel were to be allowed above the 401' elevation of containment. Once the 401' elevation and upper containment elevations were evacuated, RP staff was to restrict access to containment. During the evacuation verifications, the radiation protection manager (RPM) identified personnel preparing to enter containment. Consequently, he evacuated all areas within the containment building to ensure that no further problems were encountered. The licensee determined that a misunderstanding at the RP desk contributed to the problem. During the April 18, 1997, meeting, the RP staff described the issue and clearly communicated management's expectations to the plant staff. In addition, the licensee identified the need for additional lead for the crane operator, which resulted in a reduction in worker doses. The removal of the core barrel was accomplished for about 132 millirem (mrem) of dose. As a result of the lessons learned, the core barrel was re-installed for about 26 mrem of dose.

The inspector also reviewed the licensee's installation of reactor head o-rings. The pre-job meeting was well conducted. The RP and maintenance representatives were well prepared for the meeting. The maintenance supervisor discussed the scope of the evolution, emphasizing that the area under the reactor head was of greatest dose concern. The RP representative provided a thorough discussion of the RP concerns and RWP requirements, including dosimetry alarms, protective clothing requirements, high radiation area control considerations, and dose reduction techniques. The inspector observed good job performance and radworker practices, with some minor problems. For example, the inspector observed some coordination problems between work groups. As the maintenance crew was preparing to enter containment, the staff was informed that reactor head inspections had not been completed as scheduled. Since the reactor head inspections impacted the reactor head o-ring installation, the maintenance crew left the area and postponed the evolution. In addition, the inspector observed personnel donning an additional level of protective clothing at the job site instead of moving to a lower dose area. The health physics and chemistry supervisor indicated that the observations revealed areas that could be improved.

The licensee identified problems concerning the planning of SG gallery steel work associated with the anticipated 1998 SG replacement. Approximately 2 weeks into the evolution, the RP staff's initial dose estimate of 3.5 rem was increased to about 12.5 rem. In an April 13, 1997, ALARA Job-In-Progress Review, the licensee reviewed the work activity and identified some planing weaknesses. During the planning of the evolution, the licensee did not recognize that the early reduction of SG secondary side water level to support other critical work activities would result in an increase in general area dose rates for the SG gallery steel installation. In

addition, the licensee underestimated the time in the radiologically posted area (RPA) required for the installation. The inspector noted that the licensee identified the problems early in the process and re-emphasized exposure reduction techniques within the ALARA Job-In-Progress Review.

c. Conclusions

Implementation of the ALARA program was a strength. ALARA planning and pre-job meetings were thorough; the RP staff effectively communicated radiological work requirements and implemented dose reduction techniques. Planning problems were identified by the licensee concerning the installation of SG gallery steel. Other minor problems were identified concerning coordination of work groups and the use of low dose areas.

R1.3 Internal Dosimetry Program

a. Inspection Scope (83750)

The inspector reviewed the licensee's internal dosimetry program. The inspector reviewed the calibration and quality control of the whole body counter (WBC), including the implementation of the following procedures:

BwRP 5410-7 "Quality Control Operations for Whole Body Count Systems", Revision 0, dated April 22, 1997; and
BwRP 5410-8 "Canberra Fastscan Whole Body Counter Calibration", Revision 0, dated December 15, 1993.

In addition, the inspector reviewed the licensee's April 12, 1997, evaluation of internal exposures of three SG workers and reviewed the licensee's implementation of procedure BwRP 5400-1 "Guidelines for a Comprehensive Bioassay Program", Revision 1, dated December 27, 1994.

b. Observations and Findings

The licensee determined personnel internal exposures via a monitoring program consisting of WBC results and alarming portal contamination monitors. As required by procedure BwRP 5410-8, the licensee performed the WBC calibrations at an 18-month frequency. The current calibrations for the two WBCs were performed on January 1996 and March 1997. In performing the calibrations, the licensee used a tissue equivalent phantom and calibration sources traceable to the National Institute of Standards and Technology (NIST). The inspector noted that the licensee performed verifications to ensure that the new calibrations were acceptable. With the exception of some minor documentation problems, the inspector found the calibrations to the properly performed.

The licensee effectively implemented the WBC quality control (QC) program as defined in procedure BwRP 5410-7. The licensee maintained statistical control checks of instrument performance. Prior to each use and after every four hours of

use, the licensee performed a QC background test and a QC efficiency test. The WBC software verified that the results of the tests were within the licensee's statistically derived acceptance criteria. A health physicist (HP) reviewed monthly and quarterly QC data trends to identify performance biases and to identify and reject invalid points (e.g. source not in counter or source drops during count). The inspector reviewed the monthly reports for December 1996 and January through March 1997 and did not observe any notable statistical biases. However, the inspector identified that the licensee's justification for rejecting QC points was not well documented.

The inspector reviewed the licensee's evaluation of internal contaminations associated with SG work. On April 12, 1997, three individuals alarmed portal contamination monitors when exiting the area. The RP staff decontaminated the individuals and performed bioassay measurements via the WBC. The individuals' initial results indicated intakes of about 5-25 nanocuries (nCi) of cobalt-58, 3-6 nCi of cobalt-60, and 10-20 nCi of iodine-131. Subsequently, the licensee identified and corrected problems with the SG shield doors and with the high efficiency particulate air (HEPA) filtration unit which contributed to the unplanned contaminations. In accordance with procedure BwRP 5400-1, an HP evaluated the intakes to determine if the intakes met or exceeded the licensee's derived investigation level (DIL), which was one percent of an annual limit of intake. If the DIL was met or exceeded, the licensee was required to perform additional investigations and to determine and record the internal dose. The inspector identified some errors in the licensee's calculations: (1) the licensee used the incorrect intake retention fractions in determining the DIL for the ingestion pathway and (2) the licensee used the incorrect time of intake. The licensee performed additional calculations which verified that the errors had only a minor effect on the results and that the DILs were not exceeded. Although the intakes were below the DIL, the calculational errors indicated a lack of attention to detail. The licensee discussed the matter with the HP and planned to provide additional reviews.

c. Conclusions

The calibration of the whole body counter and the quality control program were properly implemented. Problems were identified concerning the calculation of radioactive material intakes.

R2 Status of RP&C Facilities and Equipment

R2.1 Control and Posting of Radiologically Posted Areas (RPAs)

a. Inspection Scope (83750)

The inspector reviewed the radiological conditions in the Auxiliary Building (AB), Containment Building (CB), and the Turbine Building (TB). The inspector reviewed the identification, posting, and control of radiological hazards as required by the following procedures:

BwRP 5010-1 "Radiological Posting and Labelling Requirements", Revision 5, dated November 12, 1996; and
BwRP 5310-2 "Control and Access to High Radiation Areas and Very High Radiation Areas", Revision 1, dated February 27, 1996.

In addition, the inspector reviewed the control of radiological vacuum cleaners within the RPAs which is required by procedure BwRP 6210-17 "Use of Vacuum Cleaners and Fans in Radiologically Posted Areas", Revision 2, dated September 16, 1996.

b. Observations and Findings

The inspector observed that the licensee maintained good access to safety related equipment with minimal radiological impediments. Based on licensee survey data and independent measurements, the inspector verified that the licensee properly posted areas within the AB, CB, and TB as required by procedure BwRP 5010-1. In addition, the licensee posted surveys on each floor of the AB to ensure that workers were aware of the radiological conditions. The inspector observed that individuals working in those areas were knowledgeable of radiological conditions and RWP requirements.

On April 17, 1997, the inspector identified that a door posted as a locked high radiation area (LHRA) was not locked. The door provided access to the high integrity container (HIC) storage area in the Radwaste Building (RB) and was posted as "DANGER, LOCKED HIGH RADIATION AREA, >1000 MREM/HR". The licensee immediately secured the door and corrected a problem with the locking mechanism. On April 21, 1997, the licensee conducted a survey of the storage area and measured dose rates of 200-250 mrem/hr at contact with the only HIC in storage. Since dose rates in the area routinely exceeded 1000 mrem/hr when HICs were loaded, the licensee maintained the LHRA posting and control as a precautionary measure. Step G.2.c.1 of Procedure BwRP 5310-2 requires that radiation protection technicians post areas as "DANGER, LOCKED HIGH RADIATION AREA, >1000 mrem/hr", when dose rates exist or potentially exist which are in excess of 1000 mrem/hr and less than 15000 mrem/hr. Step G.2.a.1 of procedure BwRP 5310-2 requires that when a normally locked high radiation area or very high radiation area remains temporarily unlocked, additional positive controls shall be established to prevent unauthorized entry.

Technical Specification (TS) 6.12.2 requires, in part, that areas accessible to personnel with radiation levels greater than 1000 mR/h at 45 cm from the radiation source or from any surface which radiation penetrates shall be provided with locked doors to prevent unauthorized entry. Procedure BwRP 5310-2 provides controls for areas controlled as LHRAs. The failure to adequately implement procedure BwRP 5310-2 is a violation of TS 6.12.2. (50-456/97008-01 and 50-457/97008-01)

The licensee conducted a thorough investigation of the event and concluded that there were no unauthorized entries into the area. Based on the results of the investigation, the licensee (1) repaired the locking mechanism on the door to the

HIC storage area and inspected/repaired all other LHRA door locks, (2) added preventative maintenance tasks to inspect/repair LHRAs on a six month frequency, and (3) reviewed the event with RPTs to reinforce the need to inspect the LHRA doors after a door has been operated. The licensee also revised procedure BwRP 5310-2 to require an independent verification of locked doors after any access to an LHRA.

On April 23 - 29, 1997, the inspector identified problems concerning the control of vacuum cleaners within the RPA. RP procedure BwRP 6210-17, "Use of Vacuum Cleaners and Fans in Radiologically Posted Areas", Revision 2, contained the following requirements: (1) "If the vacuum cleaner will be needed beyond the end of the work shift, the responsible department shall be responsible for controlling the vacuum (i.e. locked)" and (2) "After each use, the openings on the suction line and hose ends SHALL be covered to prevent the spread of contamination." On April 23, 1997, the inspector and a licensee representative identified the following problems: (1) a vacuum cleaner stored for over one shift on the 401' elevation of the AB near the boric acid batch tanks was not locked and (2) the openings on vacuum hoses were not covered in the 401' elevation RP storage area. On April 25 and 29, 1997, the inspector identified additional problems: (1) vacuums stored for in excess of one shift in the 1A residual heat removal (RHR) and in the Unit 1 blowdown condenser rooms were not locked and (2) the openings on vacuum hoses were not covered on vacuum cleaners stored in the 401' elevation RP storage area and in the 401' elevation scaffolding storage area. The inspector reported these problems to RPTs who corrected each of the problems.

Technical Specification (TS) 6.8.1.a requires that procedures be implemented for activities covered in Appendix A of Regulatory Guide (RG) 1.33. Appendix A of RG 1.33 recommends that RP procedures be implemented for contamination control. Procedure BwRP 6210-17 provides controls for vacuums within RPAs to prevent the spread of contamination. The failure to adequately implement procedure BwRP 6210-17 is a violation of TS 6.8.1.a. (50-456/97008-02 and 50-457/97008-02).

The inspector noted that a number of problem identification forms (PIFs) concerning the implementation of the vacuum cleaner control program were initiated between March and August of 1996 and observed that the licensee had completed corrective actions for the PIFs. The inspector noted that the initial PIFs were immediately corrected and the work group supervisor was notified. However, the licensee identified that the initial corrective actions had not resolved the issue. During June and August of 1996, the licensee's corrective actions became more comprehensive. The licensee revised the program, including the governing procedure, the responsibilities of each department, and the system by which vacuum cleaners were issued. The licensee did not fully complete all of the corrective actions until late September 1996. However, the inspector's observations indicated that the licensee's corrective actions were not fully effective.

c. Conclusions

Two violations were identified concerning the failure to adequately implement procedures. A violation was identified for not properly locking the entrance to an area posted as a LHRA. Another violation was identified for the failure to adequately follow procedures concerning control of vacuums within the RPA. Access to safety related equipment was relatively unencumbered by radiological impediments.

R6 Quality Assurance in RP&C Activities

The inspector assessed the effectiveness of the licensee's identification and resolution of problems. The inspector reviewed PIFs generated by the licensee over the previous 12 month period to assess the licensee's evaluation of RP issues and to determine the effectiveness of the licensee's corrective actions. The inspector observed that the licensee's trending and analysis of personnel contamination events (PCEs) was thorough. The RP staff maintained a data base indicating the PCE and assigning a root cause. In addition, the licensee correlated the PCEs to significant plant events, i.e. refueling outages, SG work activities, etc. A licensee representative indicated that a number of recent PCEs had been attributed to contaminated protective clothing received from its laundry service. The inspector observed that the licensee was in the process of investigating the issue and developing corrective actions. The inspector noted that the actions taken by the licensee were appropriate. However, as described in Section R2.1, licensee's corrective actions for problems controlling vacuum cleaners within the RPA were not as effective.

V. Management Meetings

X1 Exit Meeting Summary

The inspector presented the inspection results to members of licensee management at the conclusion of the inspection on April 30, 1997. The licensee acknowledged the findings presented. No proprietary information was identified.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

M. Cassidy, NRC Coordinator
A. Creamean, Lead Radiation Protection Supervisor
M. Finney, Lead Health Physicist - Operations
A. Haeger, Health Physics and Chemistry Supervisor
T. Simpkin, Regulatory Assurance Supervisor - Technical
R. Thacker, Lead Health Physicist
T. Tulon, Station Manager

INSPECTION PROCEDURES USED

IP 83750 Occupational Radiation Exposure

ITEMS OPEN, CLOSED, AND DISCUSSED

Opened

50-456/457-97008-01	VIO	Failure to lock the entrance to an area posted as a locked high radiation area
50-456/457-97008-02	VIO	Failure to follow procedures concerning the control of vacuum cleaners within the radiologically protected area

Closed

None

Discussed

None

LIST OF ACRONYMS USED

AB	Auxiliary Building
DIL	Derived Investigation Limit
DPM	Disintegrations Per Minute
HEPA	High Efficiency Particulate Air
HIC	High Integrity Container
HRA	High Radiation Area
ISI	In-service Inspection
LHRA	Locked High Radiation Area
LSIV	Loop Stop Isolation Valve
MREM	Millirem
MREM/HR	Millirem per hour
NCI	nanocuries
NIST	National Institute of Standards and Technology
PCE	Personnel Contamination Event
PIF	Problem Identification Form
QC	Quality Control
Radwaste	Radioactive Waste
RB	Radwaste Building
RG	Regulatory Guide
RHR	Residual Heat Removal
RP	Radiation Protection
RPA	Radiologically Posted Area
RPT	Radiation Protection Technician
RP&C	Radiation Protection and Chemistry
RWP	Radiation Work Permit
SG	Steam Generator
TEDE	Total Effective Dose Equivalent
TS	Technical Specification
VIO	Violation
WBC	Whole Body Counter

PARTIAL LIST OF DOCUMENTS REVIEWED

ALARA Action Review Plans:

Installation of Unit 1 Lower Internals (Core Barrel),

Addendum to Installation of Unit 1 Lower Internals (Core Barrel), and

Disassemble/Inspect/Repair/Reassemble 1RC8002C.

ALARA Job-In-Progress Review for RWP 97-4032, dated April 14, 1997.

Problem Identification Forms (PIFs) Nos. 456-201-96-042900, 456-201-96-143400, 456-201-96-143401, 456-201-97-1120, 456-201-97-1184, and 456-201-97-1231.

Problem Investigation Report No. 456-200-040, "Required Locked High Radiation Area Door Found Unlocked"