U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Reports No. 50-254/88013(DRSS); 50-265/88013(DRSS)

Docket Nos. 50-254; 50-265 Licenses No. DPR-29; DPR-30

Licensee: Commonwealth Edison Company
Post Office Box 767
Chicago, IL 60690

Facility Name: Quad Cities Nuclear Power Station, Units 1 and 2

Inspection At: Quad Cities Site, Cordova, Illinois

Inspection Conducted: May 10-20, 1988

Inspector: W. J. Slawinski for 6-15-88
Date

Approved By: L. Robert Greger, Chief 6-15-88
Facilities Radiation Protection Section Date

Inspection Summary

Inspection on May 10-20, 1988 (Reports No. 50-254/88013(DRSS); No. 50-265/88013(DRSS))

Areas Inspected: Routine, unannounced inspection of the licensee's radwaste management and radiation protection programs during a refueling and maintenance outage including: organization and management controls (IP 83722); changes in organization, personnel, facilities, equipment, and procedures (IP 83729); planning and preparation (IP 83729); training and qualifications of contractor personnel (IP 83729); internal and external exposure controls (IP 83724, 83725, and 83729); control of radioactive materials and contamination (IP 83726, 83729); audits and appraisals (IP 83729); the ALARA program (IP 83728, 83729); solid radwaste (IP 84722); and liquid and gaseous effluents (IP 84723 and 84724). Also reviewed were previous open items (IP 92701), spent fuel pool liner leakage, an LER (IP 92700), and underwater camera equipment handling events (IP 83729).

Results: One procedural violation (two-part) was identified (failure to adhere to RWP protective clothing requirements while handling material removed from the spent fuel pool and reactor cavity, and failure to inform or consult the Rad/Chem Department prior to uncovering and disassembling contaminated material removed from the fuel pool - Section 12). Although one violation was identified, the licensee's radiation protection and ALARA programs continue to be generally effective in protecting the health and safety of occupational workers and reducing personnel exposures. Overall, radiological controls for the Unit 2 refueling/maintenance outage were good. The licensee's programs for controlling solid radwaste and liquid and gaseous effluents appear effective.

DETAILS

1. Persons Contacted

*+R. Bax, Station Manager
P. Behrens, Lead Chemist
*+R. Carson, Lead Health Physicist
*E. Huerta-Pavia, Technical Services Health Physicist
A. Lewis, Health Physicist
*M. Miller, QA Inspector
*G. Myrick, Technical Services Health Physicist
G. Powell, Health Physicist
*J. Sirovy, Rad/Chem Supervisor
R. Wiebenga, Chemist
M. Zinnen, ALARA Coordinator

*R. Higgins, NRC Senior Resident Inspector

The inspector also contacted other members of the rad/chem staff and members of the electrical maintenance and technical staffs.

*Denotes those present at the exit meeting on May 20, 1988.

+Denotes those contacted by telephone on May 27, 1988.

2. General

This inspection was conducted to review aspects of the licensee's radwaste management program and examine the radiation protection program during a refueling and maintenance outage, including organization and management controls, planning and preparation, qualifications and training, internal and external exposure controls, control of radioactive materials and contamination, audits and appraisals, the ALARA program, solid radwaste, and liquid and gaseous effluents. Also reviewed were past open items, spent fuel pool liner leakage, an LER, and fuel pool and reactor cavity camera equipment handling events.

Both units were shutdown during the inspection. A scheduled ten-week Unit 2 refueling/maintenance outage commenced April 10, followed on May 7 by a limited Unit 1 maintenance outage (diesel generator repair). During plant tours, no significant access control, posting, or procedure adherence problems were identified; housekeeping was generally good. A personal frisking procedure adherence problem was identified by the licensee during the inspection and is described in Section 13.

3. Licensee Action on Previous Inspection Findings (IP 92701, 92702)

(Open) Open Items (254/85025-01; 265/85028-01): Disposal/disposition of underground piping and associated contaminated soil resulting from a rupture in a pipe used to transfer processed water from the liquid radwaste treatment facility to the condensate storage tank. The licensee

plans to submit a 10 CFR 20.302(a) submittal for in-place disposal of the contaminated material; however, the submittal has been delayed due to problems related to foundation and piping schematics and locations.

(Open) Open Items (254/87026-01; 265/87026-01): Improve laundering and laundry monitoring program. The licensee plans to modify their existing laundry facility and lease an automated laundry monitor. This item remains open pending implementation of the proposed improvements. The laundry program is further discussed in Section 11(b).

(Closed) Open Items (254/87026-02; 265/87026-02): Formalize the establishment and testing of communications between fuel handlers and the drywell control point prior to core fuel manipulations. The licensee revised Master Refueling Procedure QFP 100-1 to require verification of the necessary communications link(s).

4. Organization and Management Controls (IP 83722)

The inspector reviewed the licensee's organization and management controls for the radiation protection program, including changes in the organizational structure and staffing, oversight of contractor outage activities, effectiveness of procedures and other management techniques used to implement these programs, and experience concerning self-identification and correction of program implementation weaknesses.

Since previously reported (Inspection Reports No. 254/87026; 265/87026), several organizational changes have occurred or are about to occur within the Radiation/Chemistry Department, as follows:

- A new ALARA Coordinator was appointed; the former returning to emergency planning activities.
- A new TLD Coordinator was appointed; the former accepting the ALARA Coordinator position.
- The station's Lead Health Physicist/RPM has accepted the GSEP Coordinator position at the licensee's Mazon facility; transfer effective approximately late June 1988.
- A new hire with a B.S. degree in health physics is scheduled to join the health physics staff in June 1988.
- Ten individuals from various station departments have been accepted into the rad/chem technician (RCT) trainee program and are currently undergoing training.

Technical Specification 6.1.D. requires that the Rad/Chem Supervisor or the Lead Health Physicist meet the requirements of radiation protection manager (RPM) of Regulatory Guide 1.8. The current Lead Health Physicist meets the requirements for radiation protection manager and is assigned as the RPM; it does not appear the the current Rad/Chem Supervisor meets the regulatory guide criteria for RPM. The licensee has not yet named the new Lead Health Physicist to fill the upcoming vacancy.

The ten RCT trainees all reportedly possess at least one year general plant experience and are currently undergoing the licensee's 12-week RCT training program. The station's 31 qualified RCTs all have greater than two years of applicable experience and meet the selection criteria in ANSI N18.1-1971 for technicians in responsible positions. The HP/RCT staff has remained fairly stable over the last two years. No regulatory requirements exist for other positions involved in the organizational changes delineated above.

The new ALARA Coordinator has about eight years applied radiation protection and ALARA experience and nearly 12 years overall station experience.

The impact of these staffing changes on the effectiveness of the radiation protection program will be reviewed during future inspections.

The station recently approved procedure QRP 1170-2, "Evaluation of Radiological Conditions and Work Practices," which formalizes plant tour observations and job evaluation oversight (Inspection Reports No. 254/87026; 265/87026). Pursuant to the procedure, the ALARA staff, health physicists, and the rad/chem foremen are required to conduct and document at least six radiological job evaluations per person annually and an additional 12 evaluations to consist of either tour observations or job evaluations. The inspector selectively reviewed records of completed job evaluations; no problems were noted. Most observed problems are immediately corrected.

In April 1988, the licensee contracted the services of a health physics consultant to review the station's personal contamination events and contamination control program. The consultant is scheduled to remain on-site for the duration of the Unit 2 outage and is currently supervising general plant decontamination activities.

The inspector discussed the intent of Generic Letter 82-12 requirements for limiting Rad/Chem staff (including RCTs) hours of work to assure that, to the extent practicable, personnel are not assigned to shift duties while in a fatigued condition that could reduce their mental alertness of decision making capability. During the inspection, a copy of an NRR guidance memorandum (dated April 1, 1988) concerning applicability of Generic Letter 82-12 to radiation protection staff was provided to the licensee. The guidance lists types of jobs performed by rad/chem technicians that should be considered applicable to the generic letter requirements for limiting hours worked. The licensee stated that they currently have no policy for limiting hours worked nor a system in place to track/project individual RCT duties to determine for whom working hour limits should apply because of applicable routine or emergency duties. This matter was discussed at the exit meeting and will be further reviewed during a future inspection (Open Items No. 254/88013-01; 265/88013-01).

No violations or deviations were identified.

5. Changes IP 83729

The inspector reviewed changes since the last inspection in the station's organization, personnel, facilities, equipment, programs, and procedures that may affect radiation protection. Changes in organization and personnel are discussed in Sections 4 and 6.

A major change for this outage was the use of contract RCTs to supplement the permanent station staff. According to the licensee, contract technicians have not been used since about 1984. During the outage, the station's health physicists are working at ut 10-hour days, six days per week; the ALARA ffice is continuously staffed except from 2:00 a.m. to 6:00 a.m. These working hours appear to be within Generic Letter 82-12 guidelines. According to the licensee, RCTs and rad/chem foreman provide continuous coverage during the outage and some appear likely to have exceeded 82-12 guidelines. As noted in Section 4 above, this matter will be reviewed further during a future inspection.

The station's laundry facility is being augmented by an off-site licensed commercial laundry service. The majority of laundry produced during outage activities is shipped to the laundry vendor for wet-washing, the remainder is laundered by the licensee. For the outage, the station devised a "bar-code" accountability program for respiratory protection equipment and electronic dosimetry. Bar-codes placed on security badges, respirators, and electronic dosimetry are computer scanned at a preliminary drywell access control point and are used to facilitate equipment traceability, assignment, and dose accountability. This drywell control point is also used for RWP review and sign-up.

The licensee also purchased and made operational a new fastscan whole-body counter. The counter and its calibration are further discussed in Section 9.

No violations or deviations were identified.

6. Planning and Preparation (IP 83729)

The inspector reviewed the outage planning and preparation performed by the licensee, including additional staffing, special training, increased equipment supplies, and job related health physics considerations.

The station's radiation protection group has been augmented with 23 contract health physics personnel consisting of 21 senior technicians, including three foreman, and two junior technicians. The inspector verified that those technicians not meeting ANSI N18.1-1971 selection criteria were not providing radiation protection duties without proper supervision. For the outage, contract technicians are providing most of the drywell radiation protection coverage. During the early stages of the outage, licensee oversight of drywell activities was limited and involved occasional drywell roving by rad/chem foreman, health physicists, and ALARA staff members; however, during this inspection, the licensee increased oversight by stationing rad/chem foreman at the control point just outside the drywell and instituted shiftly drywell roving.

Radiation protection participation in job planning and preparation includes pre-job briefings to station and contract workers, decontamination, installation of shielding, use of remote cutting and welding equipment and other ALARA measures, and ALARA and health physics participation in planning and daily outage meetings. The ALARA program is discussed in Section 18.

No violations or deviations were identified.

7. Training and Qualifications of New Personnel (IP 83729)

The inspector reviewed the licensee's selection criteria and the education and experience qualifications of contract radiation protection personnel. The training provided to the technicians by the licensee was also reviewed.

Licensee selection of contractor radiation protection technicians includes a review of resumes to determine conformance to ANSI N18.1-1971 criteria. The licensee did not verify the experience/qualifications stated in resumes nor contact pervious employers for references; but did attempt to hire technicians with previous Commonwealth Edison station experience and/or those with BWR experience. According to the licensee, verification of resume authenticity is provided by the contractor. The inspector informed the licensee of the desirability for 100% verification of contract personnel experience and qualifications through contract vendor certification or equivalent and for a licensee spot-check program. Resumes of selected technicians currently working at the station were reviewed by the inspector. Senior technicians appear to meet ANSI N18.1-1971 criteria for responsible technicians; no problems were noted.

After the selected technicians arrive on-site, they are required to complete Nuclear-General Employee Training (NGET), and perform a proctored or self-study station procedure and RWP system review; plant tour and general program reviews follow. No formal training or testing program was provided. The inspector informed the licensee that it was desirable to institute a formal training and testing program for contract radiation protection technicians. The licensee stated that due to time constraints and other reasons, no formalized training program had been developed but agreed that such a program was desirable. These matters (formal training and qualification certification) were discussed at the exit meeting and will be reviewed during future inspections (Open Items 254/88013-02; 265/88013-02).

No violations or deviations were identified.

8. External Exposure Control and Personal Dosimetry (IP 83729, 83724)

The inspector reviewed the licensee's external exposure control and personal dosimetry programs, including: changes in the program to meet routine and outage needs; use of dosimetry; planning and preparation for maintenance and refueling tasks including ALARA considerations; and required records, reports and notifications.

There have been no significant changes in the licensee's routine external exposure measurement and control program since previously reported (Inspection Reports No. 254/87005; 265/87005). For the Unit 2 refueling/ maintenance outage, the licensee established a preliminary drywell and dosimetry control point at the Unit 2 trackway. Personnel needing access to the drywell are channeled through this station where drywell-related RWPs, associated survey maps and electronic dosimetry are normally maintained and issued. Station radiation protection technicians manning the control point question workers regarding their RWP work, the expected radiological conditions, and use of electronic dosimetry devices; this appears to be a good health physics practice. Minimum personnel monitoring requirements for drywell access include a TLD, direct reading dosimeter, and an electronic dosimeter. Radiation protection personnel manning the primary drywell access/egress control point check dosimetry placement and record the exposures received by drywell workers on dose cards.

For 1987, the station's total exposure was 719 person-rem, nearly meeting their goal of 700. In 1988, the station's exposure goal has been set at 600 person-rem; through May 11, 1988, about 350 person-rem has been expended. The ALARA program is discussed in Section 18.

No individual exposures approached regulatory limits in 1987 or thus far in 1988 through April 1988. Regulatory overexposures occurring in 1976 and 1980 were recently identified and reported by the licensee and are described in Section 17.

No violations or deviations were identified.

9. Internal Exposure Controls and Assessment (IP 83725, 83729)

The inspector reviewed selected aspects of the licensee's internal exposure control and assessment programs including: determination whether engineering controls, respiratory equipment, and assessment of intakes meet regulatory requirements, and planning and preparation for maintenance and refueling tasks including ALARA considerations.

The licensee's program for controlling internal exposures include the use of protective clothing, respirators and equipment, and control of surface and airborne radioactivity. A selected review of RWPs, air activity surveys, and MPC-hour determinations for 1983 to date was made; no significant problems were noted. RWPs appeared to adequately reflect the respiratory protection requirements for the job.

In 1988, the station purchased and made operational a new "Fastscan" whole-body counter and associated hardware/software. The unit is located in the service building and is operated by station RCTs. According to the licensee, the new system has operated satisfactorily and has significantly reduced the backlog associated with their older lay-down counter. The older unit is being maintained as a backup to the new system and for it's locational, organ specific, detection capabilities. On March 28, 1988, the fastscan counter was performance tested by the manufacturer after installation; the original factory calibration was

performed by the manufacturer in December 1987. The inspector reviewed the performance test records and noted that according to the manufacturer, the verification test confirmed that the efficiency file (comprised of mixed gamma standards of various activities) created during the factory calibration was valid and appropriate for routine whole-body counting.

Whole-body count data was reviewed for counts performed during the period December 18, 1987 through March 16, 1988, on company and contractor personnel. Followup counts were performed on persons who showed elevated initial counts and were adequate to verify that the 40 MPC-hour control measure was not exceeded.

No violations or deviations were identified.

10. Radiation Occurrence Reports (RORs)

The inspector selectively reviewed Radiation Occurrence Reports (RORs) generated from October 1987 through May 11, 1988. There were 33 RORs written during this period which coincided with refueling/maintenance outages for both units. A total of 38 RORs were written in 1987. RORs are normally assigned to the licensee's health physics staff for followup and assembly of a package of pertinent data concerning the incident. Each investigation goal is to establish root cause(s) and affect appropriate corrective actions to prevent recurrence. RORs are routed to licensee management for review.

The RORs were selectively reviewed for significance and adequacy and timeliness of corrective actions. The investigations appear good and generally meet the intended goals. Problems identified in closed RORs appear to be adequately addressed, documented, and corrected. Several RORs were written for personal contamination events and identification of hot particles in non-radiologically controlled plant areas; certain of these events are discussed in Section 11 Two RORs were written for personal contamination events resulting from handling camera equipment from the spent fuel pool or reactor cavity; these two incidents are detailed in Section 12.

No violations or deviations were identified.

11. Control of Radioactive Materials and Contamination (IP 83726, 83729)

The inspector reviewed the licensee's program for control of radioactive materials and contamination, including: changes in instrumentation, equipment, and procedures; effectiveness of survey methods, practices, equipment, and procedures; effectiveness of methods of control of radioactive and contaminated materials; management techniques used to implement the program; and experience concerning self-identification and correction of program implementation weaknesses.

a. Whole-Body Friskers and Portal Monitor Usage

The licensee currently employs eight IPM-7 whole-body contamination monitors for use prior to leaving the radiologically controlled area (RCA). For the outage, four are located in the turbine building at

the Unit 2 trackway and three at the Unit 1 trackway; one located at the fifth floor of the Unit 1 reactor building is out-of-service. An RCT is normally stationed at or near the trackway monitors to observe their use and respond to alarms. The licensee plans to purchase three IPM-8s in 1988 for installation in the radwaste building, service building mechanical maintenance shop, and at the half-track.

The inspector reviewed calibration records for the existing seven operational IPM-7 units. Calibrations are performed every six-months using 100 cm^2 Cs-137 plate sources. Monitor detector efficiencies range from 14-22%; monitor alarms are set at about 2.25 nCi (5000 dpm). The units were last calibrated in February 1988 in accordance with procedure QRP 1240-18; no problems were noted.

IRT portal monitors located in the guard house must be passed through prior to leaving the site. Sign's posted at the gatehouse instruct individuals to contact radiation protection should the monitor alarm after a second pass through. However, no written policy or procedures exist concerning the actions that security guards or workers should take when monitors alarm, nor specific steps that radiation protection personnel responding to alarms should follow. The licensee indicated that personnel alarming portal monitors would be frisked using a hand-held frisker and required to clear an IPM-7 prior to leaving the site; however, the inspector noted at least one recent instance when an IPM-7 was not used after a hand-held frisk of a contaminated worker. The inspector informed the licensee that permitting workers to leave the site after alarming the gatehouse portal monitor if contamination is not detected on a subsequent personal frisk could result in not detecting persons with internal contamination or hidden hot particles unless a whole-body count is also performed. The licensee agreed that a policy/procedure should be developed for the security force and rad/chem personnel responding to portal monitor alarms. These matters were discussed at the exit meeting and will be reviewed further at a future inspection (Open Items 254/88013-03; 265/88013-03).

b. Laundry Facilities

For the outage, protective clothing is laundered at the licensee's facility using four dry-cleaning and two wet-washing units and/or sent to a commercial licensed laundry for wet-washing. The majority of outage related laundry is sent to the vendor which is located off-site but near the station; vendor turnaround time is about two days. The vendor monitors laundered items using automated gas flow proportional monitoring systems set to the licensee's specifications. The licensee randomly spot-checks (monitors about 10%) clothing returned from the vendor using their station constructed G-M detector laundry monitor.

In 1988, the licensee plans to lease an automated laundry monitor and modify their laundry facility to segregate the washing machines from the proposed location for the monitor. The licensee is also considering relocating the laundry issue area to the Unit 1 trackway. The inspector discussed the plans for the new monitor including it's calibration, alarm setpoint and revisions to monitoring procedures. The licensee plans to set-up and use the monitor in accordance with recently issued corporate guidance. The licensee's laundry monitoring program will continue to be reviewed during future inspections.

c. Personnel Contamination/Hot Particle Incidents

The inspector reviewed personal contamination event (PCE) tracking/trending data for 1987 and 1988 and selectively reviewed contamination incident reports generated from September 1987 through May 11, 1988. There were 528 PCEs reported in 1987, exceeding the station goal of 300; 321 events occurred during the last four months of 1987 concurrent with a Unit 1 refueling/maintenance outage. Nearly 400 PCEs were reported for 1986. In 1988 through May 12, 232 PCEs occurred including 100 in April; the Unit 2 refueling outage commenced April 20, 1988. This exceeds the station's 1988 goal of 200 events. Since September 1987, about 35% of all reported PCEs were attributed by the licensee to "clean areas" and did not involve RWP work or otherwise crossing into posted contaminated areas. Also, several PCEs were attributed to contamination in clean areas of the service building, a non-radiologically controlled area. The number of events attributed to clean areas appears high and may indicate a need for improvement in this area.

The licensee is readily aware of the plant-wide PCE problem and has proposed and partially implemented corrective actions aimed at reducing these events, particularly those occurring in clean areas. These actions include an intensified survey and cleanup program in general high plant traffic areas and an expanded NGET program stressing practical factors including PC removal and frisking. The consultant health physicist hired by the licensee to review PCE/contamination control is currently supervising a 12-person laborer force devoted to general plant cleanup. Intensified cleaning and surveying efforts began the week of May 9 and were frequently observed by the inspector throughout the inspection. In addition to these efforts, worker adherence to frisking procedures may need further strengthening as described in Section 13. These matters were discussed at the exit meeting and the licensee's progress will be monitored during future inspections (Open Items 254/88013-04; 265/88013-04).

The licensee continues to experience numerous incidents where hot-particles are detected on the skin and/or personal clothing of workers. Eighty-six hot-particle personal contamination incidents were reported from September 1987 through March 1988. Particle isotopic analysis shows cobalt-60 to be the predominant isotope;

activities range up to as much as 1.0 microcurie. Licensee calculated skin doses showed that no 10 CFR 20.101 limits were exceeded. The particles are mostly detected at SOP frisking stations or by IPM-7s prior to workers leaving the RCA; however, since November 1987, an additional seven hot particles were discovered in areas of the Service Building during routine mopping and surveying. This apparent problem is discussed further in subsection (d) below.

d. Service Building Contamination Controls

As noted in Section (c) above, about 35% of all PCEs reported since September 1987 were attributed to clean areas, including several in the service building. The licensee determined that service building events are primarily attributed to use and storage of contaminated materials in the laundry facility, mask storage area, and mechan maintenance decontamination facility, all located in the service building. Specifically, the licensee identified four practices as the most likely modes of contamination transfer into the service building:

1) Transfer of contaminated materials into and out of the mechanical maintenance shop and work in the designated area.

2) Transfer of contaminated protective clothing into the laundry area and handling of the clothing in the laundry.

3) Transfer of contaminated respirators into the respirator maintenance and storage area and handling of these respirators.

4) Persons exiting the RCA through exit points that are not equipped with whole-body frisking monitors.

The licensee has corrected Item No. 4 above and no longer allows access from the two areas formerly equipped only with conventional hand-held friskers and is actively pursuing and has partially implemented remedies for items 1-3. In addition to the four items described above and the licensee's proposed corrective actions, the inspector identified and discussed other possible contamination control problems which appear to be prevalent in the service building. These include the following:

1) The mechanical maintenance (MM) decontamination shop in the service building is not fully enclosed or equipped with a dedicated ventilation system. (The shop is segregated from the rest of the service building only by 8 to 10 foot high walls.)

2) The lathe used to work on radioactive materials or equipment in the mechanical maintenance shop is not enclosed to prevent possible migration of contamination. The licensee did indicate they implement strict radiological controls over the usage.

3) MM shop air patterns are very unstable especially when the large garage-type door, located next to the decontamination shop entrance, is left open. This is generally the practice during warm summer months.

4) The general location(s) and physical design and concept of station facilities that are used to handle, process, or store radioactive materials (located in non-radiologically controlled general plant access areas) is a poor health physics practice.

These issues and corrective action options available to the licensee were specifically discussed during the inspection and summarized at the exit meeting. Licensee actions to improve service building contamination controls will be reviewed during future inspections (Open Items 254/88013-05; 265/88013-05).

e. State of Illinois Effluent Monitoring System Controls

The inspector reviewed selected aspects of the stack sampling skid used by the State of Illinois, and which is housed in a recently constructed building adjacent to the station's crib house. An area radiation monitor is installed inside the building near the skid with a meter and warning beacon mounted outside near the doors to the building. The skid is an automated gaseous effluent sampling and monitoring system that samples exhaust from the station's main chimney, downstream of the station's own chimney sampling and monitoring system. After passing through the skid, the exhaust sample is returned to the chimney through heat-traced lines. The facility is not fully operational and is about to undergo preoperational testing by the state. The licensee and a state representative working in the facility during the inspection were informed by the inspector that facility radiological controls should be the same as those imposed on other workers performing work on effluent monitoring systems and should comply with licensee procedures. In order to accomplish this the state needs to inform the licensee prior to any maintenance on the systems, opening of process lines, or removal of equipment or samples off-site. This matter was discussed at the exit meeting.

No violations or deviations were identified.

12. Underwater Camera Equipment Handling Events

Overview

Since October 1987, two unrelated personnel contamination events occurred involving handling of equipment previously removed from the spent fuel pool or reactor cavity. In both instances, the workers involved apparently failed to wear proper protective clothing as required by the RWPs governing the job. Additional problems were noted in the initial event which also resulted in internal contamination of one individual (presumably via ingestion). In the second event, one individual was externally contaminated. These events are described below.

A. Initial Event Description

On October 25, 1987, two licensee electrical maintenance (EM) workers handled underwater cameras and associated equipment removed from the Unit 1 spent fuel pool on October 23 and 24, 1987. Camera surveys performed by the licensee on October 23 and 24 showed contact radiation fields ranging up to 10 mR/hr gamma and 400 mrad/hr beta. Smearable levels on the camera and its cable were 200,000 dpm. On the morning of October 25 prior to commencing work activities, the EM workers reviewed and signed the applicable RWP (No. 70206A) and were informed by a rad/chem foreman they were required to wear full face masks and rubber gear for items coming out of the fuel pool or reactor cavity and to contact radiation protection prior to removing such items from the pool. When the workers arrived at the work area, they discovered that the cameras and related equipment had already been removed from the pool, bagged, and were stored on the refuel bridge and in an adjacent work area. According to the licensee, the bags are purchased pre-labeled with "Caution Radioactive Materials" but did not indicate any specific radiological information (direct radiation or smearable levels) or other information or instructions even though it is normal licensee practice to do so. In this particular case the bag appears to have been exempt from these labeling requirements because of the limited amount of radioactive material present. Protective clothing worn by the workers included coveralls, canvas and rubber gloves, shoe covers and rubbers, and a hood. The RWP also required full face mask and a waterproof outer layer; there were no notations, footnotes, or special instructions on the RWP to indicate otherwise. According to one of the EM workers involved, a waterproof outer layer and respiratory protection equipment was not worn because they did not remove any materials from the pool and the equipment to be worked on was already bagged and presumably decontaminated. This presumption was unfounded and proved to be incorrect since post incident surveys of the equipment on October 25 and 26 showed camera and cabling smearable levels similar to those that existed on October 23 and 24 when the materials were initially removed from the pool. Reportedly, both workers had previous experience handling materials removed from the pool and cavity.

The workers performed various work on the cameras and related equipment (cables, cable reels) including hydrolazing the camera and connecting cable using a closed system; wiping the camera down and visually inspecting it; and disassembling a camera cable reel, inspecting its brushes, and reassembling it. Afterwards, one of the workers identified contamination on his wrist while performing an SOP area frisk and subsequently alarmed the IPM-7 whole-body frisker. The other EM worker did not handle the same equipment and was not contaminated. The licensee initiated an ROR (No. 4-87-25) and an investigation to determine the cause of the event.

Radiological Consequences

One EM worker was discovered to be contaminated both externally and internally; the latter resulting apparently from ingestion. External skin contamination was detected on numerous areas of the body including the facial area, stomach, hands, knees, groin, shoulder and lower back; contamination levels ranged from 2000-15,000 dpm. Whole-body counts performed the day of the incident and for several days thereafter showed Co-60 internal deposition equating to about 8 MPC-hours. Subsequent counts showed the material to be totally cleared from the body four days after the event.

Root Cause(s)

It is not readily apparent what caused numerous areas of the worker's body to be contaminated, but the contamination appears to be attributed to several factors, including improper protective clothing, extent and nature of the work performed, possible leeching and migration of contamination through the PCs, and perhaps careless radiological work practices.

The RWP required a full face mask and waterproof outer layer in addition to the usual full set of PCs; there were no footnotes or special instructions in the RWP to indicate otherwise or require their use only during certain evolutions. According to the licensee, the workers were informed by a Rad/Chem Supervisor to wear a full face mask and rubber gear for items coming out of the fuel pool or cavity and to call radiation protection prior to removing any items from the pool. The workers did contact radiation protection prior to commencing work activities but not after discovering that the equipment had already been removed from the pool and bagged nor prior to disassembling a cable reel; communications should have been better. The RWP could also have been more explicit. Station Procedure QRP 1000-1, Page 6, "Personnel Conduct in a Controlled Area," states that Rad/Chem shall be informed and/or consulted so that a radiological evaluation can be made before raising radioactive materials in the fuel pools above established limits, uncovering contaminated materials, or disassembling potentially contaminated equipment where dose rates or airborne activity may be expected to increase significantly. Contrary to this procedure, Rad/Chem was not informed or consulted prior to uncovering (unbagging) the contaminated camera equipment or disassembling the camera cable reel. This is a violation of Procedure QRP 1000-1 (Violation 254/88013-06(b); 265/88013-06(b)). In addition, page 15 of QRP 1000-1 states "each individual shall comply with the requirements of the RWP in all respects." Contrary to this portion of the procedure, the EM workers did not wear full face masks as required by the RWP (No. 70206A) governing the work activities. This is also a violation of Procedure QRP 1000-1 (Violation 254/88013-06(a); 265/88013-06(a)).

B. Second Event

On May 17, 1988, a second underwater camera equipment handling (contamination) event occurred, again involving two EM workers. Similar to the October 25, 1987 event, the workers did not wear RWP required respiratory protection equipment (full-face mask) because they misinterpreted the applicability of the RWP to their work activities. This appears to be a violation of Procedure QRT 1000-1 which requires each individual to comply with the requirements of the RWP in all respects (Violation 254/88013-06(a); 265/88013-06(a)). The workers incorrectly assumed that the RWP only applied to removal and subsequent repair of equipment and not to work on equipment previously removed (and bagged) from the reactor cavity. As a result, one EM worker was determined to have a .011 microcurie (24,000 dpm) Co-60 hot-particle on his face near the lower lip; no internal contamination was identified by subsequent licensee whole-body counting. No significant skin dose was received from the hot-particle.

C. Corrective Actions

Corrective actions for the initial event included issuance of a station manager policy letter regarding refuel floor work in fuel pools or cavities, counselling of those involved and modification to the RWPs governing such activities. These corrective actions initially may not have been adequate and/or properly conveyed to the plant staff. After the second event, additional corrective actions were taken to make the RWPs governing such activities more explicit. The licensee is also considering other broader scope corrective actions to encompass this problem and related issues and strengthen the overall program area. These proposed corrective actions will be reviewed during a future inspection.

13. Audits and Appraisals (IP 83729)

The inspector reviewed records of onsite audits/surveillances of radiation protection program activities conducted since September 1987. Extent of audits/surveillances and adequacy and timeliness of corrective actions were reviewed.

No audits of radiation protection activities have been performed during the review period; however, numerous surveillances were conducted by the licensee's QA Department. The surveillance included review of personal contamination and hot-particle events and controls, RWPs, radiation area access controls, whole-body counting, TLD program records, RORs, and radwaste shipments. Approximately 30 surveillances of such activities were performed from September 1987 to May 1988. No significant problems were identified; minor problems were adequately corrected and surveillances subsequently closed. One QA surveillance performed during this inspection identified examples of workers performing inadequate frisks at the drywell frisking station; this observation was elevated to an audit finding. To correct this problem, the licensee plans to post

an RCT at the frisking station during peak drywell egress periods and to revise the station frisking procedure to specify the minimum duration for an adequate torso frisk. This matter was discussed at the exit meeting. QA surveillances appear to be thorough and well documented.

No violations or deviations were identified.

14. Solid Radioactive Wastes (IP 84722)

The inspector selectively reviewed the licensee's solid radioactive waste management program, including: overall performance of the process control and quality assurance programs; adequacy of required records, reports, and notifications; and experience concerning identification and correction of programmatic weaknesses.

The licensee continues to segregate potentially clean from potentially contaminated refuse within radiologically controlled areas. Color coded trash containers located throughout controlled areas of the plant are used for initial segregation of non-radioactive and radioactive wastes. Potentially non-radioactive wastes are then hand sorted and surveyed by the licensee and repackaged prior to disposal as normal "cold" trash. The station's dry active waste (DAW) is compacted in 52-gallon drums, or "Muncher" compacted into approximately 1000-pound bails which are loaded in steel bins having a capacity of about 8000-pounds and shipped to Scientific Ecology Group, Inc., in Oak Ridge, Tennessee for further segregation, repackaging, super compaction and subsequent burial. DAW in 52-gallon drums is either sent to the same contractor for super compaction or sent directly to the burial site.

A vendor continues to cement-solidify bead resins in 55-gallon drums and dewater other resins in high integrity containers. The inspector selectively reviewed records of packaged waste shipments made during 1988 through May 16; no problems were noted. For this period, a total volume of about 8000 cubic feet was shipped to burial sites after compaction/ supercompaction.

No violations or deviations were identified.

15. Liquid Radioactive Wastes (IP 84723)

The inspector reviewed the licensee's liquid radwaste effluent program, including: determination whether liquid radioactive waste effluents were in accordance with regulatory requirements; adequacy of required records, reports, and notifications; and experience concerning identification and correction of programmatic weaknesses.

The licensee's liquid radwaste system, instrumentation, controls and release pathways remain essentially as previously described (Inspection Reports No. 254/85021; 265/85024). Since the previous inspection, no unmonitored releases or significant radwaste monitor operability problems were reported. The Unit 2 service water monitor is currently inoperable due to flow meter problems; a maintenance work request has been initiated to affect repairs.

Liquid effluents are normally released on a batch basis from a single tank (following sampling and analysis) to a single monitored (with alarm and isolation function) radwaste release line. The line directs effluent to one of two diffuser lines to provide dilution with station circulating water prior to reaching the river. Most plant liquids are processed and reclaimed by use of filters and resin beds. As a result, batch releases consist mainly of laundry water or a batch of liquid which has been processed but either does not meet chemical criteria for reuse or is released during the early stages of an outage due to lack of storage space. Batch release records were reviewed for 1988 to date; seven (each 38,350 gallon) batch releases were made during this period. No problems were noted. Eighteen batch releases were made during the last four months of 1987.

As previously reported (Inspection Reports No. 254/87026; 265/87026), pure beta emitter concentrations recorded on liquid release forms had been estimated from generic scaling factors, rather than using actual composite analysis results. Since that time, the licensee altered their method of quantifying beta emitters (H-3, Fe-55 and Sr-89/90) and uses actual sample results from previously analyzed quarterly composites. No problems were identified.

No violations or deviations were identified.

16. Gaseous Radioactive Waste (IP 84724)

The inspector reviewed the licensee's gaseous radwaste effluent program, including: gaseous radioactive waste effluents for compliance with regulatory requirements; adequacy of required records, reports, and notifications; and experience concerning identification and correction of programmatic weaknesses.

Gaseous release pathways, monitoring capabilities, and collection and analysis methods remain essentially as previously described (Inspection Reports No. 254/87026; 265/87026 and 254/85021; 265/85024). To address concerns identified in Inspection Reports No. 254/86012; 265/86012), procedure QCP 1300-1, "Drywell and Suppression Chamber Venting and Purging," has been revised and implemented to require collection and analysis of noble gas grab samples in addition to iodine and particulate samples, before each drywell vent/purge release to the reactor vent stack.

Vent/purge releases are allowed if the noble gas grab sample concentration is less than 1E-4 uCi/ml, the Technical Specification lower limit of detection for reactor building vent stack noble gas releases. The inspector reviewed Unit 1 drywell noble gas grab sample results collected in 1988 prior to venting/purging; no problems were noted.

The inspector reviewed semiannual effluent reports for 1987 and selectively reviewed gaseous release records for 1988 to date. No instances of a release exceeding Technical Specification limits were noted. Technical Specification gaseous effluent collection and analysis requirements appear to be met. Annual reports over the last several years show a significant reduction in the total noble gas releases since 1984.

Releases were quantified at about 6000 curies annually (both units) in 1984, 3000 curies in 1985, 1480 curies in 1986, and less than 400 curies in 1987. Over the last few years, the station has not experienced any significant fuel leakage problems. Unit 2 leakage problems identified in the 1970's and early 1980's have been gradually rectified by phasing in new "barrier" fuel. Currently, Unit 2 has a full "barrier" core and Unit 1 is progressing. No fuel sipping was performed on reload fuel assemblies at the end of Unit 1's ninth cycle (March 1988). This decision was based on chemical and radiochemical data collected during the cycle which reportedly showed no indication of leakage or fuel failure. For Unit 1 cycle ten, 200 new "barrier" clad assemblies were 100% visually inspected and loaded into the core. In 1988, the licensee conducted a limited study to evaluate noble gas grab sample data generated over the last several years. (Gaseous releases are typically quantified for noble gases based on daily grab samples from the reactor building vent duct and plant chimney.) In this study, the licensee compared noble gas data for 1981 through January 1988 collected from each units recombiner (primary noble gas sources) grab sample to main chimney grab sample results for the same period. The study showed a significant decrease in recombiner off-gas concentrations and a corresponding decrease in main chimney sample concentrations. Trends were similar to those reported in annual reports. The licensee attributes the reduction in noble gas releases primarily to the introduction of the "barrier" fuel.

No violations or deviations were identified.

17. Licensee Event Reports (LER) Followup (IP 92700)

Through discussions with licensee personnel and review of records, the following event report was reviewed to determine that reportability requirements were fulfilled and that corrective action including measures to prevent recurrence had been accomplished. The LER listed below is considered closed:

LER No. 254/88-001-01, "Three Personnel Over-Exposures in the Past Due to Dosimeter Inaccuracy," dated March 3, 1988. Using a newly developed computer program, the CECo Corporate Health Physics Department identified three past instances where workers apparently received doses in excess of the applicable 10 CFR 20 quarterly whole-body limits. One 18-year old station employee received 1350 mrem during the second quarter of 1975 (1250 mrem limit) and two contract workers received 3190 and 3180 mrem, respectively, for the fourth quarter of 1980 (3000 mrem limit). The cause of the apparent overexposures was inaccurate secondary and/or primary (film) dosimetry and exposure accounting and tracking process procedural deficiencies. Since these events, the licensee has upgraded primary and secondary dosimetry systems, improved administrative dose tracking capabilities, limited quarterly whole-body dose limits for 18-year olds to 1000 mrem, and provided for immediate recognition of individuals approaching dose limits. The exposure incidents are considered licensee identified and corrected.

18. Maintaining Occupational Exposures ALARA (IP 83728, 83729)

The inspector reviewed the licensee's program for maintaining occupational exposures ALARA, including: changes in ALARA policy and procedures, ALARA considerations for the Unit 2 outage, worker awareness and involvement in the ALARA program, the establishment and realization of goals and objectives; and management techniques used to implement the program.

The inspector reviewed the ALARA organization and recent changes to it, the qualification and experience of its members, and the effectiveness of the organization in instituting dose saving programs during outages. As previously noted (Section 4), a new ALARA Coordinator with several years station radiation protection experience was appointed. The remainder of the ALARA staff remains as previously described (Inspection Reports No. 254/87026; 265/87026).

The licensee took major ALARA steps to reduce the exposures for the outage. For example, the licensee (as in the past) hydrolazed the drywell and performed a chemical decontamination of the recirculation loops; decontamination factors of about 10 were achieved in several areas of the recirculation system. In addition, the licensee utilized local filtered ventilation systems in the drywell, employed use of remote cutting and welding equipment, and constructed stem value containments for certain tasks. ALARA reviews are normally conducted for jobs projected to exceed 1 person-rem or 2 MPC-hrs. Approximately 33 ALARA job packages were generated during the current Unit 2 outage through May 11. These job packages were selectively reviewed by the inspector; no problems were noted. The packages appeared to be adequately documented and thorough.

Total station exposure for 1987 was 719 person-rems (both units), nearly meeting the ALARA goal of 700. This is a considerable reduction from 1986 exposure when a total of 950 person-rems was expended. The licensee has established ALARA goals for 1988 including overall station goals and individual working group goals for total dose. The station goal for total dose in 1988 is, according to the licensee, optimistically set at 600 person-rems. Through May 11, 1988, about 352 person-rem has been expended, somewhat over that projected for this point in the year. Thus far in 1988, most work groups have expended doses equivalent to that projected; however, because of increased emphasis, decontamination activities have produced higher than expected initial exposures. This included the chemical decontamination of the recirculation system and decontamination crews (laborers) and stationmen assigned to plant decontamination activities. The station has about 65 laborers dedicated to decontamination and cleanup tasks; about double the work force assigned during previous outages.

The licensee tracks percent of plant contaminated areas on a monthly basis including the general access areas of the reactor, turbine, and radwaste buildings. The station's non-outage goal is 25%. Since 1987, the station normally has about 30-35% contaminated areas during non-outages and approaches 50% during outages. A baseline of nearly 22% results from reactor and radwaste building basements.

No violations or deviations were identified.

19. Spent Fuel Pool Liner Leakage

Each of the station's two units is equipped with a spent fuel storage pool connected by a double gated transfer canal. The pools are constructed of reinforced-concrete, lined with seam-welded, stainless steel (liner) plate welded to reinforcing members embedded in the concrete. The liner plate leak detection system for the dryer-separator pools, transfer canals, and spent fuel pools consists of a series of interconnected channels behind the welded connections terminating in four sumps, one in each corner of each pool. According to the FSAR, the sumps are drained to the reactor building sump floor drain via the floor drain system and ultimately to the radwaste system. Each sump is connected independently to the floor drain system through a manually operated gate valve with a sight glass downstream of the valve. During this inspection, the inspector and a station technical staff representative unsuccessfully attempted to verify the sump drain flowpath including a partial system walkdown.

Station procedure QTS 170-8, initiated January 1987, requires surveillance of water leakage through the dryer-separator pool, spent fuel pool, and drywell liners at least once per operating cycle. The surveillance is performed by visual observation of sight glasses. Unit 1 surveillance was last performed in September 1987. No spent fuel pool liner leakage was noted; however, some dryer-separator pool liner leakage was identified and subsequently repaired by the licensee. The Unit 2 surveillance was last performed in April 1988; no leakage was identified.

No violations or deviations were identified.

20. Tours and Observations

During tours of the reactor buildings, including Unit 2 drywell, turbine radwaste, and service buildings, the inspector noted that radioactive material controls (other than those described in Section 11(d)), access controls, postings, and housekeeping were generally good. The inspector noted the increased emphasis on general plant cleanup. Observations of ingress and egress activities at the Unit 2 drywell indicated that workers appeared to be adhering to PC requirements and proper radiological work practices. As noted in Section 13, the licensee identified instances of workers failing to properly frisk at the drywell frisking station.

No violations or deviations were identified by the inspector.

21. Exit Meeting (IP 30703)

The inspector met with licensee representatives (denoted in Section 1) at the conclusion of the site inspection on May 20, 1988, and further discussed issues related to underwater camera equipment handling problems (Section 12) in a telecon with Mr. Bax and others on May 27, 1988.

The inspector discussed the scope and findings of the inspection and the likely information content of the inspection report with regard to documents or processes reviewed by the inspectors during the inspection. The licensee identified no such documents/processes as proprietary. In response to certain matters discussed, the licensee:

a. Acknowledged the apparent procedural violation (Section 12).

b. Acknowledged the inspector's comments concerning development of a policy for radiation protection personnel addressing Generic Letter 82-12 (Section 4).

c. Acknowledged the inspector's comments concerning development of a formalized training program for contract radiation protection technicians (Section 7).

d. Acknowledged the inspector's comments concerning the desirability to develop a policy/procedure for response to portal monitor alarms (Section 11(a)).

e. Acknowledged the inspector's comments on the apparent personnel contamination event problem (Section 11(c)).

f. Acknowledged the inspector's comments regarding service building contamination controls (Section 11(d)).

g. Acknowledged the inspector's comments concerning radiological controls exercised over the State of Illinois effluent monitoring system (Section 11(e)).