U.S. NUCLEAR REGULATORY COMMISSION

REGION II

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Licensee:	Virginia Electric and Power Company (VEPCO)
Facility:	North Anna Power Station, Units 1 & 2
Location:	1022 Haley Drive Mineral, Virginia 23117
Dates:	August 29 through October 9, 1999
Inspectors:	M. Morgan, Senior Resident Inspector K. Coyne, Project Engineer (Sections M1.1 and E8.1) L. Garner, Project Engineer (Section M1.3) W. Kleinsorge, Reactor Safety Inspector (Section M2.1) G. McCoy, Resident Inspector, Surry Power Station (Section O1.3) M. Scott, Reactor Safety Inspector (Section M2.1) F. Wright, Senior Radiation Specialist (Sections R1.2, R1.3, R1.4 and R1.5)
Approved by:	R. Haag, Chief, Reactor Projects Branch 5 Division of Reactor Projects

Enclosure

EXECUTIVE SUMMARY

North Anna Power Station, Units 1 & 2
NRC Integrated Inspection Report Nos. 50-338/99-06, 50-339/99-06

This integrated inspection included aspects of licensee operations, engineering, maintenance, and plant support. The report covers a six-week period of resident inspection; in addition, it includes results of announced inspections by regional project engineers, safety inspectors, and a radiation specialist.

Operations

- On September 12, Unit 2 was shutdown for a scheduled refueling outage. The inspectors observed that shutdown activities were well-controlled. Operations personnel received special shutdown training and were well-prepared for the shutdown (Section O1.2).

- The inspectors observed that the Unit 2 reactor startup and the overall approach to criticality activities were carefully controlled. The licensee assigned extra operators to perform tasks such as pulling control rods, feeding steam generators, and performance of routine control room activities. Extra supervisors were also assigned to monitor such tasks (Section O1.3).

- Repair activities to increase the margin between breaker over-current setpoints, resolve reactor coolant pump seal standpipe alarms, and correct pressurizer power-operated relief valve leakage were properly performed and appropriately completed prior to the Unit 2 restart following a refueling outage (Section O2.1).

Maintenance

- Observed maintenance activities including reassembly of a Unit 2 low head safety injection suction valve, inspection/replacement of the number 2 seal for the 2B reactor coolant pump and replacement of the actuator diaphragm for a Unit 2 pressurizer power-operated relief valve were properly performed. Personnel performing the work were knowledgeable, properly trained and followed work package instructions (Section M1.1).

- Periodic surveillance tests on reactor protection logic were carefully performed by knowledgeable workers. Applicable technical specification requirements for each surveillance were satisfied. The use of a lead periodic test coordinator represented a good maintenance practice (Section M1.2).

- The Unit 2 integrated leakage rate test was performed in accordance with procedures and applicable regulations and demonstrated that the overall integrated containment leakage rate was within technical specification values. Procedure adherence and communications and coordination helped result in successful test performance with no significant problems (Section M1.3).

- Inservice examination procedures reviewed were concise and well written. Inservice examinations observed were generally conducted in accordance with approved procedures, by qualified and properly certified examiners using properly certified and calibrated equipment and materials (Section M2.1).

- A non-cited violation was identified for two examples of failure to follow inservice inspection procedures. Rust and scale had not been removed at the toe of a residual

heat removal system weld prior to liquid penetrant inspection and an examiner did not wait the required five minutes for his eyes to adjust to the darkened area prior to a fluorescent wet magnetic particle examination of a reactor pressure vessel stud (Section M2.1).

- Licensee actions taken following discovery of through-wall corrosion on the containment liner were well-planned and properly executed. The inspectors confirmed that actions taken conformed to regulatory requirements (Section M.2.2).

Engineering

- The emergency core cooling systems are not susceptible to the common mode failure discussed in Generic Letter 98-02, "Loss of Reactor Coolant Inventory and Associated Potential for Loss of Emergency Mitigation Functions While in a Shutdown Condition," (Section E8.1).

Plant Support

- Management of the ALARA program has been effective. Removal of radioactive material from the Unit 2 reactor coolant system prior to the refueling outage allowed the licensee to reduce their collective dose goals for the Unit 2 refueling outage and the 1999 calender year (Section R1.2).

- With the exception of a personnel contamination in the lower cavity resulting in a 14.4 rem extremity dose, contamination particles had not resulted in significant personnel exposures. On a number of occasions, byproduct particles were detected outside the radiological controlled area on worker's clothing and shoes. As a result, the last contamination barrier between licensee workers and the public (gamma detectors at the protected area exit portal) was being challenged (Section R1.3).

- A radiography contractor's failure to identify and control high radiation boundaries during radiography resulted in unplanned personnel exposure to licensee personnel. In this case, no significant personnel exposures of more than 6 mrem occurred. Health Physics personnel missed an opportunity to prevent the unplanned exposure (Section R1.5).

Report Details

Summary of Plant Status

Unit 1 operated at or near 100 percent power for the entire inspection period.

Unit 2 began the inspection period in a coastdown condition at 92 percent power. On September 12, the unit was shutdown for a scheduled refueling outage (RFO). Planned outage activities were completed and unit criticality was achieved on October 9. The inspection period ended with Unit 2 physics testing in progress.

I. Operations

O1 Conduct of Operations

O1.1 Daily Plant Status Reviews (71707, 40500)

The inspectors conducted frequent control room tours to verify proper staffing, operator attentiveness, and adherence to procedures. The inspectors also observed many Unit 2 control room RFO activities. The inspectors attended plant status meetings to maintain awareness of facility operations and reviewed operator logs to verify operational safety and compliance with Technical Specifications (TSs). Instrumentation and safety system line-ups were periodically reviewed to assess operability. Frequent facility tours were conducted to observe equipment status and housekeeping conditions. Licensee plant issues (PIs) were reviewed to ensure that potential safety concerns were properly reported and resolved. The inspectors witnessed that daily plant operations were appropriately conducted in accordance with regulatory requirements.

O1.2 Unit 2 Shutdown for Refueling (71707)

On September 12, Unit 2 was shutdown for a scheduled RFO. The inspectors observed numerous operations activities during the reduction from 35% to less than 10% power, the opening of the main generator output breakers, and operation of the steam dumps. These activities were performed in accordance with plant procedures. All observed shutdown activities were well-controlled. The inspectors also noted that operations personnel had received special shutdown training and were well-prepared for the unit shutdown.

O1.3 Unit 2 Reactor Startup Observations

a. Inspection Scope (71707)

The inspectors observed numerous activities associated with the Unit 2 startup from the scheduled RFO.

b. Observation and Findings

On October 9, the inspectors observed approach to criticality (ATC) activities. The licensee dedicated operators for specific startup activity tasks. They included a senior reactor operator (SRO) whose only duty was to supervise the reactor operator (RO) who pulled the control rods. A second SRO supervised other unit startup activities. The RO properly monitored the source range and startup rate instruments. A second operator and a shift technical advisor also monitored associated unit nuclear instrumentation.

Effective reactivity management practices were used that resulted in a carefully controlled ATC and startup. Criticality was achieved on October 9 at 3:38 p.m. and the inspectors observed that criticality was achieved well within the established range of rod steps for the estimated critical position (ECP).

Well before the ATC, the inspectors discussed with the operators the diverse indications of unit power and elements of the ECP. The inspectors found that the operators knew the various power indications and the ECP, and the operators understood their significance.

c. Conclusions

The inspectors observed that the Unit 2 reactor startup and the overall approach to criticality activities were carefully controlled. The licensee assigned extra operators to perform tasks such as pulling control rods, feeding steam generators, and performance of routine control room activities. Extra supervisors were also assigned to monitor such tasks.

O2 Operational Status of Facilities and Equipment

O2.1 Readiness to Restart Following the Unit 2 RFO

a. Inspection Scope (71707, 60710)

The inspectors reviewed several repair activities completed during the outage to correct plant problems experienced during the previous operating cycle.

b. Observations and Findings

Each of the following items were reviewed by the inspectors:

- 2J and 2H 480V Load Center Coordination Setpoint Changes - On November 24, 1997, an electrical fault occurred in an auxiliary building ventilation fan. This fault unexpectedly de-energized the fan's associated motor control center (NRC Inspection Report No. 50-339/97-11, Section M1.2). The fan was powered from a breaker that should have opened before the motor control center (MCC) supply breaker opened. Since this did not occur, the MCC was de-energized. Engineering determined that the over-current protection margin between the fan breaker and the MCC supply breaker was insufficient. This margin was re-calculated prior to the RFO. During the RFO the MCC supply breaker overload settings were readjusted to the newly calculated margin. Testing following this readjustment was satisfactory.

- 2B Reactor Coolant Pump (RCP) Seal Repair/Replacement - From May 1998 to the Unit 2 RFO, high RCP seal standpipe level alarms occurred four to five times per shift. In accordance with guidance contained in work orders (WOs) and the RCP seal technical manual, the seal internals were replaced. During the repair, maintenance personnel noted fraying of the number 2 seal, "roll-up" of the shaft sleeve O-ring, and wearing of the number 3 seal ring. Engineering determined that this contributed to the seal problem and receipt of the high standpipe level

alarms. Similar high standpipe level alarms have not occurred since repair of the 2B RCP seal.

- Pressurizer Power-Operated Relief Valve (PORV) PCV-2455C Repair - On May 14, high pressurizer tailpipe temperature alarms were received in the control room and it was determined that PORV PCV-2455C was leaking past its seat. Per guidance contained in WOs and the PORV technical manual, the PORV actuator diaphragm was replaced and the PORV internals were repaired. During repair activities, personnel noted that the pilot valve seat and plug were "steam cut," and that a tight seal did not exist between the seat and plug. Engineering attributed the overall leakage problem to this cutting of the pilot valve seat and plug. Since the repair of the PORV, no further leakage has been noted.

c. Conclusions

Repair activities to increase the margin between breaker over-current setpoints, resolve reactor coolant pump seal standpipe alarms, and correct pressurizer power-operated relief valve leakage were properly performed and appropriately completed prior to Unit 2 restart from a refueling outage.

II. Maintenance

M1 Conduct of Maintenance

M1.1 Observation of Preplanned Maintenance Activities

a. Inspection Scope (62707)

The inspectors observed portions of the work performed under the following WOs:

- 397381-01 Rebuild Low Head Safety Injection Valve (02-SI-MOV-2862A)
- 390125-01 Inspect/Clean/Replace 2-RC-P-1B Seal
- 402640-01 Actuator Diaphragm Replacement (02-RC-PCV-2455C)

b. Observations and Findings

All observed work was properly approved by the operations department and included on the plan of the day (POD). The inspectors found that work performed under these activities was professional and thorough. Work was performed with the work package present and in use. Accompanying documents such as supplemental work instructions, work order guidance, and technical manual information were properly followed by craft personnel. Documentation of work activities was complete and contained adequate details. Personnel were experienced, properly trained, and knowledgeable of their assignments. The inspectors noted that supervisors periodically monitored the job.

c. Conclusions

Observed maintenance activities including reassembly of a Unit 2 low head safety injection suction valve, inspection/replacement of the number 2 seal for the 2B reactor coolant pump and replacement of the actuator diaphragm for a Unit 2 pressurizer power-

operated relief valve were properly performed. Personnel performing the work were knowledgeable, properly trained and followed work package instructions.

M1.2 Periodic Testing (PT) Observations

a. Inspection Scope (61726)

The inspectors observed portions of the following PTs:

- 2-PT-36.1A, "Train A Reactor Protection and ESF Logic Channel Functional Test," Revision 24
- 2-PT-31.1.2, "Delta-T/Tave Protection Channel Functional Test," Revision 33

b. Observations and Findings

The inspectors verified that the tests were properly approved by station management and documented on the POD prior to performance. Workers had procedures in-hand and followed the test procedures carefully. A lead periodic test coordinator was assigned to oversee the tests. Test instruments were verified to be in calibration. The inspectors verified that applicable technical specification requirements for each surveillance were satisfied.

c. Conclusions

Periodic surveillance tests on reactor protection logic were carefully performed by knowledgeable workers. Applicable technical specification requirements for each surveillance were satisfied. The use of a lead periodic test coordinator represented a good maintenance practice.

M1.3 Unit 2 Containment Integrated Leak Rate Testing (ILRT) Observations

a. Inspection Scope (61726)

The inspectors observed performance of selected activities associated with the Unit 2 ILRT.

b. Observations and Findings

The ILRT pre-test briefings of the day and night shifts were thorough. The briefings included discussions of the plant configuration, actions to be taken by operators to maintain the plant in a safe condition, precautions to be observed, criteria for terminating the test, points of contact and individual job assignments, industry and licensee operating experiences, and managements' expectations for conducting the test. The active solicitations of questions, i.e., asking each individual for comments, concerns and questions, during the night shift briefing was especially effective in promoting feedback and back-and-forth dialogue.

The inspectors observed that the ILRT was successfully performed without significant problems. The test method and acceptance criteria in 2-PT-61.1, "Reactor Containment Integrated Leak Rate Test," Revision 10-P1, met the requirements of TS 4.6.1.2 and its

referenced documents. Procedural adherence was verified by observing activities in progress, independently verifying selected penetrations were properly aligned, review of completed procedures and discussions with test personnel. During the ILRT test, the inspectors observed that managements' expectations, and communications and coordination as discussed in the pre-test briefings were implemented.

The inspectors performed a pre-test and a post-test inspection of portions of the containment liner and various other components inside containment and reviewed the licensee's post-test containment inspection results. Based on these containment inspections, the inspectors concluded that the ILRT test had no observable detrimental effect on containment structures or on equipment inside containment. Review of the test data revealed that the overall containment leakage rate was less than the limit specified in TS 3.6.1.2.a.

c. Conclusions

The Unit 2 integrated leakage rate test was performed in accordance with procedures and applicable regulations and demonstrated that the overall integrated containment leakage rate was within technical specification values. Procedure adherence and communications and coordination helped result in successful test performance with no significant problems.

M2 Maintenance and Material Condition of Facilities and Equipment

M2.1 Unit 2 Inservice Inspection (ISI) Review

a. Inspection Scope (73753)

The inspectors evaluated the licensee's Inservice Inspection (ISI) program and the program's implementation.

The inspectors reviewed procedures, observed in process ISI examinations and reviewed selected records. Observations were compared with applicable procedures, the Updated Final Safety Analysis Report (UFSAR) and American Society of Mechanical Engineers Boiler and Pressure Vessel (ASME B & PV) Code Sections V and XI, 1986 Edition, No Addenda (86NA).

Specific areas examined included observation of two liquid penetrant (PT) examinations of residual heat removal system (RHR) components, dry viable magnetic particle (MT) examination of feedwater system piping, fluorescent wet MT examination of a reactor pressure vessel (RPV) stud, ultrasonic (UT) examination of a RHR pipe weld, UT examination of a RPV stud, an augmented ISI UT examination of feedwater piping, visual and UT examinations of the containment liner plate, eddy current data acquisition of steam generator tubing, and review of selected records of completed ISI examinations.

The inspectors evaluated the licensee's program for monitoring microbiologically induced corrosion in stainless steel service water system (SWS) piping. Specific areas examined included program and procedure review, review of past inspection data including radiographs, and verification that examinations were completed as scheduled. A walkdown inspection of selected portions of the SWS piping was performed.

The inspectors reviewed records for nondestructive examination (NDE) personnel and equipment utilized to perform ISI examinations. The records included NDE equipment calibration and materials certification, and records attesting to NDE examiner qualification, certification and visual acuity.

b. Observations and Findings

During NDE observations the inspectors observed the following examination problems:

1. During the PT examination of weld 4B on drawing 12050-WMKW-RH-E-1A, a nozzle to shell weld on a RHR heat exchanger, the inspectors observed that the examiner failed to remove an area of rust/scale approximately 1/16" x 3/4" at the toe of the weld in the area of interest, immediately prior to the application of the penetrant dye. The inspectors questioned the adequacy of the pre-examination cleaning. The rust/scale material could obscure surface openings or otherwise interfere with the examination. The examiner concurred and subsequently re-cleaned the weld area and satisfactorily completed the PT examination.

   TS 4.0.5.a requires, in part, that ISI of ASME Code Class 1, 2, and 3 components shall be performed in accordance with Section XI of the ASME B & PV Code and applicable Addenda as required by 10 CFR 50.55a(g). For North Anna the applicable Code and Addenda are ASME B & PV Code Section XI 1986 Edition with no Addenda (86NA). ASME B & PV Code Section XI, Paragraph IWA-2220 implements ASME B & PV Code Section V 86NA as the applicable code for surface examinations. ASME B & PV Code Section V 86NA, Paragraph T-627, and Virginia Power NDE Procedure NDE-PT-501, "Liquid Penetrant Examination," Revision 2, Paragraph 1.5.3 states, in part, "Prior to liquid penetrant examination the surface to be examined and adjacent areas within at least one inch shall be...free of all... scale,..and other extraneous matter that could obscure surface openings or otherwise interfere with the examination." The failure to properly clean, e.g., free of extraneous matter, weld 4B is being treated as an non-cited violation (NCV) consistent with Appendix C of the NRC Enforcement Policy and is identified as NCV 50-339/99006-01.

2. During the fluorescent wet MT examination of a RPV stud, the inspectors observed that the examiner commenced the examination after only two minutes in the darkened area. The inspectors pointed out that both the code and the examination procedure required a minimum of a five minute wait in the darkened area to let the examiners eyes get accustomed to the darkened area. The examiner stopped the examination and waited for five minutes prior to re-commencing the examination. The examiners satisfactorily completed the examination.

   ASME B & PV Code Section V 86NA, Paragraph T-726 (c) (2), and Virginia Power NDE Procedure NDE-MT-502, "Magnetic Particle Examination of RPV Studs," Revision 3, Paragraph 1.5.6, referring to fluorescent magnetic particle examinations, states, in part, "The examiner shall remain in the darkened area for at least five minutes prior to the examination to enable his eyes to adapt to dark viewing..." Failure to wait 5 minutes before starting an examination is being treated as an NCV consistent with Appendix C of the NRC Enforcement Policy and is identified as the second example of NCV 50-339/99006-01. The licensee

entered these code/procedure violations into their corrective action program as Plant Issue Nos. N-1999-2234 and N-1999-2235.

c. Conclusions

Inservice examination procedures reviewed were concise and well written. Inservice examinations observed were generally conducted in accordance with approved procedures, by qualified and properly certified examiners using properly certified and calibrated equipment and materials.

A non-cited violation was identified for two examples of failure to follow inservice inspection procedures. Rust and scale had not been removed at the toe of an RHR weld prior to liquid penetrant inspection and an examiner did not wait the required five minutes for his eyes to adjust to the darkened area prior to a fluorescent wet magnetic particle examination of a reactor pressure vessel stud.

M2.2 Unit 2 Containment Liner Repairs (62707)

On September 23 during an engineering inspection of the 3/8-inch thick Unit 2 reactor containment liner, an area of blistered paint was observed about 6 feet above the 241 foot floor elevation near containment column number 5. After removal of the blistered paint in order to perform a repair of the liner coating, a small localized area of heavy corrosion was found. Within this area, licensee personnel observed a small 1/4-inch through-wall hole in the liner. Ultrasonic Test (UT) thickness measurements were made in the vicinity of the hole and results of these measurements prompted subsequent removal of a 5 inch by 7 inch piece of steel liner. Further examination of the exposed area revealed the presence of a 4 inch by 4 inch piece of wood. Another UT inspection of the liner revealed a pattern of lower than nominal (0.385 inch) thicknesses in a band about 18 inches by about 8 foot long extending in a horizontal direction about 4 foot on each side of the hole.

During the week of September 27, the inspectors observed the removal of the wood, grouting of the voided concrete area that previously contained the wood, and replacement of the steel liner material. Following the repair, a planned integrated leak rate test was performed (see Section M1.3). A preliminary analysis of the removed steel indicated that the point of contact between the steel liner and the wood created an area of active corrosion which was influenced by the residual moisture of the wood. The licensee believes that removal of the wood (and the active corrosion cell it created with the steel) should limit any future corrosion. However, the licensee plans on performing additional thickness testing in this area for the next three inservice inspection periods to confirm that the active corrosion mechanism has been removed. The inspectors found that licensee actions taken upon discovery of this through-wall corrosion on the liner were well-planned and properly executed. The inspectors confirmed that actions taken conformed to regulatory requirements.

M8 Miscellaneous Maintenance Issues (92700)

M8.1 (Open) Licensee Event Report (LER) 50-338, 339/1999006-00: Potential for safeguards exhaust flow to bypass charcoal filter due to degraded dampers. On September 4 during the performance of 2-PT-77.2B, "Safeguards Ventilation System Air Flow Capacity," Revision 5, the licensee discovered that damper 1-HV-AOD-102-3 was degraded due to

defective damper seals. 1-HV-AOD-102-3 is located on the inlet of the auxiliary building charcoal filters which are part of the auxiliary building general exhaust ventilation system. The filters are used following an accident to reduce radioactive releases from the auxiliary building ventilation to the environment. The degraded damper would have allowed a portion of the safeguards area exhaust flow to bypass the filters. This bypassing of ventilation flow would have degraded the system to a point that fulfillment of the system's safety function could not be assured. After the damper seals were repaired and other minor repairs were performed on other dampers, the PT was successfully performed. As a result of this event, the licensee revised the associated emergency and accident procedures to provide additional assurances that the desired auxiliary building ventilation system post-accident operating configurations would be met.

At the end of the inspection period, the inspectors were continuing to determine the adequacy of present and past preventative maintenance and inspection practices associated with the auxiliary building general exhaust ventilation system dampers. This issue will be addressed in the followup inspection for this LER.

III. Engineering

E8 Miscellaneous Engineering Issues

E8.1 Review of Susceptibility to Draindown During Shutdown and Common Mode Failure of Emergency Core Coolant System (TI 2515/142)

Generic Letter (GL) 98-02, "Loss of Reactor Coolant Inventory and Associated Potential for Loss of Emergency Mitigation Functions While in a Shutdown Condition," requested licensees to assess certain design features of the emergency core cooling system (ECCS) to determine if the system was susceptible to common-cause failure as a result of events similar to the Wolf Creek reactor coolant system (RCS) draindown event of September 17, 1994. During the Wolf Creek event, operators created an unintentional reactor coolant flowpath from the residual heat removal (RHR) system that allowed approximately 9000 gallons of RCS inventory to be transferred to the refueling water storage tank (RWST). When the draindown occurred, hot RCS water introduced into the common ECCS suction header could have resulted in steam binding and a common-mode failure of the ECCS.

In their November 23, 1998, response to GL 98-02, the licensee stated that the North Anna ECCS is not susceptible to the common-cause failure described in GL 98-02. The inspectors reviewed the licensee's GL 98-02 response, reviewed system flow diagrams and selected operating procedures, and performed a walkdown of portions of the RHR and ECCS systems. During this review, the inspectors determined that a flow path exists between the RHR discharge piping, the refueling purification system piping and the ECCS pump (charging and low head safety injection) suction header. The licensee informed the inspectors that this flow path was not required to be addressed in their GL 98-02 response since it was not feasible to operate in this configuration in hot shutdown. Five manual valves, including two manual containment isolation valves, need to be operated to align this flow path. Because the nonsafety-related RHR system is located inside containment and personnel access to containment is restricted during hot shutdown conditions due to the subatmospheric containment design, misalignment of this flow path during hot shutdown conditons is not considered feasible. The inspectors

agreed with the licensee's assessment and concluded that the ECCS design is not susceptible to the type of common-cause failure described in GL 98-02.

IV. Plant Support

R1 Radiological Protection and Chemistry (RP&C) Controls

R1.1 General Observations (71750)

On numerous occasions during the inspection period, the inspectors reviewed radiation protection (RP) practices including radiation control area entry and exit, survey results, and radiological area material conditions. No discrepancies were noted, and the inspectors determined that RP practices were proper.

R1.2 As Low As Is Reasonably Achievable (ALARA)

a. Inspection Scope (83750)

Review maximum individual occupational radiation worker doses to verify all exposures were less than regulatory limits. Review licensee efforts in maintaining collective occupational radiation workers' exposures ALARA.

b. Observations and Findings

In the period January 1999, through September 1999, the maximum occupational radiation exposures for any individual monitored for radiation exposures at North Anna was 1.569 rem for whole body and skin and 14.4 rem to a worker's extremity. All personnel exposures were well within regulatory limits. The licensee was evaluating several small internal exposures received in the Unit 2 RFO (Cycle 13) that were also within the regulatory limits.

The licensee had seen collective doses decrease significantly since 1991. However, in 1998, the collective dose for the Unit 2 RFO (Cycle 12) reversed the trend and collective occupational radiation dose increased by approximately 50 person-rem over the previous Unit 2 RFO (Cycle 11) collective dose in 1996. Prior to the 1998 Unit 2 RFO, the planned crud burst during shutdown for the outage resulted in an unanticipated higher concentration of Cobalt 58 in the reactor coolant system than was previously experienced during similar evolutions. In response to the high concentration of Cobalt 58 in the reactor coolant system and associated increase in collected dose, the licensee began searching for methods to prevent a similar recurrence. The licensee performed a Category 1 root cause evaluation and sent a team to observe shutdown chemistry controls at another facility that had experienced elevated crud levels following a steam generator replacement. The licensee participated in industry groups studying effects of shutdown chemistry initiatives and established a shutdown chemistry and operation review team to review and implement the methodologies learned into the North Anna operating and shutdown chemistry programs. The licensee successfully optimized these programs in time for the 1999 Unit 2 RFO shutdown. Due to the success of the planned crud burst prior to the 1999 Unit 2 RFO, the licensee was able to reduce the goals for the Unit 2 RFO collective dose from 128 to 78 person-rem and the annual collective dose from 146 to 100 person-rem.

Other ALARA initiatives supported by licensee management that have helped lower site collective dose in recent years included continued use of mockups, increased staff support in ALARA awareness and participation in outage planning and implementation, and emphases on eliminating previous experienced problems by documenting them for corrective actions.

c. Conclusions

Management of the ALARA program has been effective. Removal of radioactive material from the Unit 2 reactor coolant system prior to the RFO allowed the licensee to reduce their collective dose goals for the Unit 2 RFO and the 1999 calender year.

R1.3 Personnel Contaminations

a. Inspection Scope (83750)

Review the licensee's effectiveness in controlling personnel contaminations.

b. Observations and Findings

The inspectors reviewed lists of personnel contaminations for the site in 1999 and selected several contamination reports for further review. Approximately 27 personnel contaminations had been documented during the Unit 2 RFO. Overall, there were few personnel skin contaminations (approximately 7) during the outage. Most of the contaminations were found on worker clothing and shoes. The inspectors found that a large number (approximately 80 percent) of the personnel contaminations were particles. The high percentage of contaminations due to particles challenged the effectiveness of the licensee's contamination survey and control processes. Approximately 35 percent of the particles were found by gamma sensitive detectors outside the radiological control area (RCA) at the protected area exit portal. The inspectors also noted that the majority of personnel contaminations documented during non-outage periods (19 of 23) were also particle contaminations and two of those were also identified at the protected area exit portal. The licensee's survey techniques, frequency, and personnel contamination monitoring capabilities at the primary RCA exit were discussed with licencee personnel. Licensee management agreed the number of personnel contaminations detected outside the RCA was too high. The licensee was considering the installation of gamma sensitive portal monitors at the primary RCA exit portal.

The inspectors reviewed licensee controls and dose calculations for a personnel contamination event which resulted in the licensee assigning an extremity dose of 14.4 rem to a worker's foot. The worker was cleaning reactor head stud holes with a vacuum cleaner. Licensee personnel reported the process had been performed previously without any significant contaminations. Following the contamination, the licensee increased radiological controls for personnel working in the lower cavity and designated the cavity as a hot particle area.

The inspectors reviewed the licensee's survey methods for detecting hot particles in the reactor cavity and found them to be adequate. Survey techniques and their frequency were not always clearly documented on radiation survey records.

c. Conclusions

With the exception of a personnel contamination in the lower cavity resulting in a 14.4 rem extremity dose, contamination particles had not resulted in significant personnel exposures. On a number of occasions, byproduct particles were detected outside the RCA on worker's clothing and shoes. As a result, the last contamination barrier between licensee workers and the public (gamma detectors at the protected area exit portal) was being challenged.

R1.4 Control of High Radiation Areas (83750)

The inspectors reviewed procedures for control of high radiation areas (HRAs), Locked high radiation areas (LHRAs), greater than15 Rem LHRAs, and very high radiation areas. The inspectors reviewed licensee procedures and surveys and verified selected LHRAs were properly secured. The inspectors found that the licensee effectively controlled keys for access to the HRAs.

R1.5 Radiological Controls for Radiography

a. Inspection Scope (83750)

The inspectors reviewed a recent radiography event resulting in unplanned radiation exposures to licensee personnel to assess whether regulatory requirements were met.

b. Observations and Findings

The inspectors reviewed corrective action record PI-N-1999-27187-E1 which documented an unplanned radiation exposure to three laundry workers on September 21, 1999. During a planned radiographic exposure of a feedwater line, an unshielded pathway (a ventilation duct) to areas located below the mechanical equipment room was not identified by the radiography contractor. As a result, high radiation levels exceeding 100 mrem per hour were created in the laundry room when the radiography began. Laundry room personnel were wearing dosimetry set to alarm at radiation dose rates exceeding 500 mrem per hour. The dosimeter for one of the employees working in the laundry room alarmed on high dose rate. The employee with the alarming dosimeter exited the area and reported to the Health Physics (HP) Shift Supervisor. The radiation from the radiography source caused other radiation monitoring equipment in areas adjacent to the laundry room to alarm and the two other employees working in the laundry room exited the area. The site HP technicians in their work area adjacent to the laundry room, also observed the elevated radiation levels and the HP Shift Supervisor suspended radiography operations. The unplanned and uncontrolled exposures to the laundry room personnel were 6 mrem for two of the employees and 3 mrem for another.

No significant personnel exposures resulted from this event, however, such events indicate a potential for significant radiation exposures. The radiography contractor was ultimately responsible for ensuring worker safety by maintaining proper access controls for areas affected by radiographic operation. However, the licensee agreed that site radiation protection staff assisting the radiographer had an opportunity to prevent this exposure event.

The inspectors reviewed the licensee's investigation and corrective action reports documenting the event and discussed them with licensee personnel. The licensee concluded the cause of the event was human error as contractor personnel and supporting site radiation protection staff failed to identify the unshielded pathway to areas below the radiography area. The inspectors concluded that the laundry room personnel and the HP Shift Supervisor's actions during and following the unplanned radiation exposure were appropriate.

c. Conclusions

A radiography contractor's failure to identify and control high radiation boundaries during radiography resulted in unplanned personnel exposure to licensee personnel. In this case, no significant personnel exposures of more than 6 mrem resulted. Health Physics personnel missed an opportunity to prevent the unplanned exposure.

S1 Conduct of Security and Safeguards Activities (71750)

On numerous occasions during the inspection period, the inspectors performed walk-downs of the protected area perimeter to assess security and general barrier conditions. No deficiencies were noted. The inspectors concluded that security posts were properly manned and that the perimeter barrier's material condition was properly maintained.

V. Management Meetings

X1 Exit Meeting Summary

The inspectors presented the inspection results to members of licensee management at the conclusion of the inspection on October 15, 1999. The licensee acknowledged the findings presented.

The inspectors asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

D. Christian, Vice President, Nuclear Operations
E. Dreyer, Supervisor Health Physics Technical Services
B. Foster, Superintendent Station Engineering
C. Funderburk, Manager, Station Safety and Licensing
J. Hayes, Director, Nuclear Oversight
D. Heacock, Manager, Station Operations and Maintenance
L. Jones, Assistant Superintendent Radiological Protection
P. Kemp, Supervisor, Licensing
L. Lane, Superintendent, Operations
T. Maddy, Superintendent, Security
N. Nicholson, Senior Staff Health Physicist
W. Matthews, Site Vice President
H. Royal, Superintendent, Nuclear Training
D. Schappell, Superintendent, Site Services
R. Shears, Superintendent, Maintenance
A. Stafford, Superintendent, Radiological Protection

INSPECTION PROCEDURES USED

IP 37551:	Onsite Engineering
IP 40500:	Effectiveness of Licensee Controls in Identifying, Resolving, and Preventing Problems
IP 60710:	Refueling Activities
IP 61726:	Surveillance Observations
IP 62707:	Maintenance Observations
IP 71707:	Plant Operations
IP 71750:	Plant Support Activities
IP 73753:	Inservice Inspection
IP 83750:	Occupational Radiation Exposure
IP 92700:	Onsite Followup of Written Reports of Nonroutine Events at Power Reactor Facilities
TI 2515/142:	Draindown During Shutdown and Common-Mode Failure

ITEMS OPENED, CLOSED AND DISCUSSED

Opened

50-338, 339/99006-01	NCV	Failure to follow ISI procedures (Section M2.1)

Closed

50-338, 339/99006-01	NCV	Failure to follow ISI procedures (Section M2.1)

Discussed

50-338, 339/99006-00	LER	Potential for safeguards exhaust flow to bypass charcoal filter due to degraded dampers (Section M8.1)