UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W., SUITE 2900
ATLANTA, GEORGIA 30323-0199

Report Nos.: 50-280/94-09 and 50-281/94-09

Licensee: Virginia Electric and Power Company
Glen Allen, VA 23060

Docket Nos.: 50-280 and 50-281 License Nos.: DPR-32 and DPR-37

Facility Name: Surry Power Station Units 1 and 2

Inspection Conducted: April 11-15 and June 6-10, 1994

Inspector: Larry S. Mellen 6/29/94
Larry S. Mellen, Reactor Inspector Date Signed

Inspector: 7/5/94
Larry P. King, Reactor Inspector Date Signed

Inspector: 6/29/94
Curt W. Rapp, Reactor Inspector Date Signed

Accompanying Personnel: Don Prevatte, PowerDyne Corporation

Approved by: 7/1/94
Paul J. Kellogg, Chief Date Signed
Operational Program Section
Operations Branch
Division of Reactor Safety

SUMMARY

Scope:

This special, announced inspection was conducted on April 11-15 and June 6-10, 1994, in the areas of service water system operational performance and in accordance with NRC Temporary Instruction (TI) 2515/118 Section 11.03, Reduced Scope Inspections. The reduced scope inspection was appropriate because the licensee performed an assessment that was equivalent in scope to a SWSOPI.

Results:

The inspection was divided into two distinct phases. The first portion of the inspection was conducted at the midpoint of the licensee's self assessment and focused on the licensee's ability to perform a self assessment, the scope of the assessment, and an overview of their assessment progress. This included a review of the assessment team members qualification and an assessment of the licensee's SWSOPA process. The NRC reviewed these aspects and found the performance acceptable.

The second phase followed completion of the licensee's assessment and focused on their inspection results, scope of their inspection, and assessment finding disposition. The NRC reviewed the depth, breadth, and scope of the licensee's inspection and found these aspects to be adequate. The NRC also concluded that leadership of the licensee's assessment and response teams were effective. Review of the licensee's corrective actions to assessment team findings as well as NRC identified items will be conducted at a later date.

REPORT DETAILS

1. Persons contacted

Licensee employees

K. Basehore, Supervisor Nuclear Analysis & Fuels
*H. Blake, Superintendent NSS
*M. Bowling, Manager Nuclear Licensing
*D. Christian, Assistant Station Manager O&M
C. Duong, ISI Engineering Group
*J. Downs, Superintendent Outage and Planing
M. Earl, Senior Licensing Engineer
J. Erb, Nuclear Analysis & Fuels Engineer
*M. Kansler, Station Manager
S. Kline, Engineering Consultant
M. Matras, Nuclear Analysis & Fuels Engineer
B. McCloskey, Supervisor Mechanical Design Engineering
*W. Miles, Supervisor QA
*J. Price Assistant Station Manager
B. Rasnick, Mechanical Engineering Supervisor
*V. Shiftlett, Licensing Engineer
*K. Sloane, Superintendent Operation - Acting
*B. Stanley, Supervisor Procedures
*M. Surface, Senior Staff Engineer
F. Terminella, Corporate Nuclear Safety
*G. Thompson, Supervisor Maintenance Engineering
*E. Turko, Supervisor Testing
J. Waddill, Staff Engineer Mechanical
D. Wendall, Drawing Update Group
M. Wilda, Surry System Engineer Service Water
S. Wiser, Design Engineering & Support

Other licensee employees contacted included engineers, technicians, operators and office personnel.

NRC Resident Inspectors

*S. Tingen, Resident Inspector
*D. Tamai, Inspector Intern
*T. Peebles, Region II, Operations Branch Chief

*Attended exit interview on June 10, 1994.

A list of abbreviations used in this report is contained in Appendix A.

2. Inspection Scope and Objectives

Numerous problems identified at various operating plants in the country have called into question the ability of the SWSs to perform their design function. These problems have included the following: inadequate heat removal capability, biofouling, silting, single failure concerns, erosion,

corrosion, insufficient original design margin, lapses in configuration control or improper 10 CFR 50.59 safety evaluations, and inadequate testing. NRC management concluded that an in-depth examination of SWSs was warranted based on the identified deficiencies.

The inspectors reviewed the licensee's SWSOPA. The SWSOPA focused on the mechanical design, operational control, maintenance, surveillance and quality assurance. The inspectors found that the SWSOPA's primary objectives were in accordance with TI 2515/118.

At Surry, the licensee committed to perform such an examination themselves. As a result, the NRC concluded that a full NRC team inspection was unnecessary.

However, it was considered prudent to observe the activities of the licensee's assessment team and review the inspection results in order to verify that the depth, breadth, and scope of the inspection was comparable to NRC imposed inspections. The purpose of the inspection described in this report was to make these verifications. The inspectors focused on two basic areas in performing their verifications; (1) observing the conduct and results of the licensee's inspection, and (2) performing an overview review of the SWS to serve as a spot check on the work of the licensee's assessment team and to provide the technical basis for review of the licensee's work.

3. System Description

The SWS provides cooling water to various safety-related and nonsafety-related heat exchangers during normal and accident conditions and constitutes the Ultimate Heat Sink for the plant. The safety-related heat loads include the RSHXs, the charging pump lubricating oil and intermediate seal coolers, and the control and relay room air conditioning chiller condensers. Two trains of service water are provided to these loads to assure the capability of the system even with a single failure. The nonsafety-related heat loads include the bearing cooling water heat exchangers, the component cooling water heat exchangers, and other turbine building heat loads.

Water is supplied to the system by gravity feed from the elevated intake canal to the river level discharge canal. The intake canal also supplies water by gravity flow to the circulating water system during normal operation. For various accident conditions, loss of offsite power, or loss of intake canal level, various isolation combinations are automatically initiated for system heat exchangers and the main condenser to conserve intake canal level while providing the required responses to the conditions. For the design basis LOCA, the inventory of the canal at the isolation setpoint is sufficient to provide the required cooling water to the RSHX for 24 hours without makeup.

Water from the James River is normally provided to the elevated intake canal for both the circulating water system and the SWS by four circulating water pumps which deliver a total of 840,000 gpm. In the event of failure of these pumps or loss of power, water is supplied to the intake canal by three diesel-driven emergency service water pumps capable of delivering 15,000 gpm each, one of which is also electric motor driven. Any two of these pumps have the capacity to supply all of the water required to maintain the level of the intake canal under all accident or safe-shutdown conditions. Fuel for these pumps is provided from a 4800-gallon tank which is sufficient to operate all 3 pumps for 96 hours.

All equipment in the system which must function post-accident, is powered from redundant 1E electrical power sources or redundant diesel engines.

4. Generic Letter 89-13 Implementation

The NRC issued GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment," requesting licensees take certain actions related to their SWS. These actions included establishing biofouling surveillance and control techniques, monitoring safety-related heat exchanger performance, establishing a routine inspection and maintenance program, reviewing the design to assure intended safety functions could be accomplished, and training personnel in the operation, maintenance, and testing of the SWS. Based on a review of the completed licensee's assessment report, the following items of concerns were noted.

a. Flow Testing or Flushing of SWS Lines

The assessment team identified that the site was not flushing or flow testing SWS lines 8 inches or less in diameter. Instead, the site was performing visual inspections of SWS lines 8 inches or less. The assessment team questioned if these visual inspections were sufficient to ensure equipment cooling water supplied by SWS lines 8 inches or less could perform its' design function. Furthermore, the assessment team observed this was especially significant with smaller SWS lines because the length of time for a SWS line to be considered infrequently used had not been defined.

b. Heat Exchanger Performance Monitoring

The procedure used for operability verification does not have criteria to measure microfouling or fouling factor. Also, the assessment identified that the site had not performed regular retests of heat exchanger performance and had not committed to frequent and regular maintenance as required by GL 89-13. The assessment team further identified that the site practice of monitoring cooler performance did not meet the intent of GL 89-13.

c. Maintenance and Inspection of SWS Piping and Components

The assessment team noted that visual inspection of SWS lines less than 8 inches should be performed to ensure these lines are not fouled. The assessment team found that the ESW pump right angle gear coolers did not receive adequate maintenance to ensure the coolers will perform their design function.

The corrective actions for these items identified by the assessment team will be reviewed by the NRC at a later date. This is identified as an example of IFI 50-280,281/94-09-01, "Follow-up on SWSOPA Corrective Actions."

5. Design Basis Document

The inspectors reviewed the design basis document for the SWS in its entirety. There were references in the DBD for the SWS to a overall plant DBD which was not reviewed. The document was prepared for the licensee by a contractor. The DBD for the SWS contained all the design bases for the systems and list of all the industry standards and NRC commitments made over the life of the plant. It included a list of questions which required responses. The inspectors reviewed the list of questions generated as a result of the initial revision and selected what they considered to be the most important from a safety viewpoint. The licensee then provided the latest revision which responded to most of the issues. The inspectors then requested that the licensee respond to any of the remaining issues which the inspectors deemed to be safety significant. The licensee provided responses to all of these issues. The inspectors concluded that the DBD for the SWS was well done and comprehensive.

6. Mechanical Design Review

The inspectors reviewed the mechanical design of the SWS, including the design and licensing bases, functional requirements, design assumptions, calculations, boundary conditions, analyses, and models to determine if the designs met licensing commitments and regulatory requirements. The SWS's capability to meet the thermal and hydraulic performance specifications during accident and abnormal conditions was also reviewed. This review included drawings, calculations, procedures, licensing documents, vendor documents, and licensee event reports.

The following areas of particular concern were reviewed in detail:

a. Charging Pump Lube Oil Cooler Temperature Control Valves

One of the licensee's assessment questions concerned the safety versus nonsafety classification of charging pump lube oil cooler temperature control valves SWTCV-108/208A-C and their associated controllers. This equipment is safety-related and was originally designated and purchased as such. The controllers had been subsequently downgraded

to nonsafety-related for reasons which could not be determined by the licensee's assessment team. As a result, replacement controllers purchased for modification DCP 9213-3 had been specified as nonsafety-related. However, these had not been installed.

The disposition of this concern entailed a recommendation by Engineering to modify the valve controllers/positioners to make them failsafe. The original valves were already failsafe in that they failed to the open position upon loss of instrument air. However, the controllers/positioners were not failsafe in that failure of a controller would cause the associated valve to close. Engineering's recommended disposition was to modify the controllers/positioners to make them reverse acting and therefore failsafe (upon failure, they would move the valves to the open position). The disposition stated that once this modification was implemented, there would no longer be any need for this equipment to be classified safety-related. The inspectors determined this proposed disposition was inappropriate.

b. Inconsistent Fuel Oil Tank Sampling Acceptance Criteria

The SWS pumps were diesel powered, and fuel for their engines was supplied from a common tank, 1-SW-TK-1. The inspectors were concerned with the potential for loading of contaminated or out-of-specification fuel into the tank and thereby inducing failure of all three engines. The inspectors reviewed the following four fuel sampling procedures applicable for this tank as well as normal site practices:

- CH-32.110, Rev 3, October 6, 1992, "Fuel Oil Tanks: Sampling."
- CH-93.210, Rev 1, July 30, 1991, "Fuel Oil: Sampling and Analysis Control."
- CH-93.211, Rev 0, March 26, 1991, "Fuel Oil Tank HS-TK-1 [above ground storage tank]: Sampling and Analysis After Fuel Addition."
- CH-93.212, Rev 1, March 30, 1991, "Diesel Fuel Tank Number 2 [underground storage tank]: Sampling and Analysis After Fuel Addition."

The inspectors identified inconsistencies in the fuel oil sampling acceptance criteria.

c. Incorrect UFSAR Statement

The inspectors identified that Section 1.4.49 of the UFSAR, "Containment Design Basis," incorrectly stated "The heat removal capacity of the containment spray systems for the minimum safeguards returns the containment pressure to a subatmospheric condition in less than 30 min [sic] after a design basis accident." However, Sections

5.4, 6.1, and 6.3.1.1 correctly stated that the pressure is returned to subatmospheric in 60 minutes, which is consistent with the design analyses for the plant. After this discrepancy was identified by the inspectors, the licensee generated UFSAR Change Request FS 94-19, to correct this discrepancy.

d. Canal Inventory Control

One of the key calculations reviewed by the inspectors was the canal inventory calculation (ME-0166, Rev 2, May 2, 1989). No significant discrepancies were discovered.

The inspectors also reviewed a related observation by the licensee's inspectors concerning failures of the intake canal level probes which actuate isolation of the nonsafety-related loads on the system as the level approaches the 23-foot TS limit. The cause of the failures had been determined to be macrofouling of the probe tips and moisture intrusion into the probe circuitry from water standing in the cable trench. Corrective actions included replacing two of the four probes during a 1993 outage with probes whose tips were coated with an antifouling copper coating, resealing the probe conduit, and improving the drainage of the cable trench. However, two new probes scheduled to be installed failed bench testing for response time, testing at 67 and 80 seconds. The response time limit was 66 seconds based on a setpoint of 23 feet, 6 inches, which, with the response time, assures that the required isolations are completed before the canal level reaches the 23-foot TS limit. Further research was being performed by the licensee into means of adjusting the response time and other potential resolutions.

The sensitivity of the plant accident analyses to this response time was explored by the inspectors. The minimum level required for design basis flow through the RSHXs was 17 feet, 2 inches. The bounding case for canal level drop over the critical twenty-four hour post-accident period analyzed in Calculation ME-0166 was to 18 feet, 6 inches. This constituted a 16-inch margin, which translated into approximately three minutes of probe response time. There were also many conservatisms incorporated into this calculation and the assumptions for the probe setpoint basis. It was therefore concluded that the accident analyses were relatively insensitive to the probe response time.

Additionally, the EOPs rely on valve position for RSHX flow. Flow instrumentation is available to the operator during RSHX operations. In light of the canal inventory consideration specified in ME-166, the licensee is investigating the inclusion of the flow instrumentation in the EOPs.

e. Heat Exchanger Design Evaluation

One of the licensing/design bases for the Surry Plant is that for a LOCA, the recirculation spray system, which is cooled by service water, shall be capable of returning the containment pressure to subatmospheric within one hour. The inspectors reviewed the calculation which demonstrates this capability, ME-0266, Rev 0, March 9, 1992, "RSHX Evaluation." The seemingly nonconservative fouling factors used in this calculation, 0.0 for the recirculation spray side of the tubes and 0.0005 for the service water side, were questioned by the inspectors. The licensee responded that these factors could be realistically used because both sides of the tubes are maintained in a dry condition during normal operation, and that after testing when the service water side is wet, it is drained, dried out, and inspected to verify that there is no fouling. The licensee also showed that with these assumptions and other somewhat conservative assumptions in the analysis, the containment would be brought to subatmospheric in 48 minutes, well under the maximum allowable 60 minutes. The inspectors therefore concluded that the heat transfer capabilities of the heat exchangers were adequate. The sensitivity of this apparent margin to variation in fouling factor was not explored.

The corrective actions for these items identified by the assessment team and items identified by the inspectors will be reviewed by the NRC at a later date. This is identified as an example of IFI 50-280,281/94-09-01, "Follow-up on SWSOPA Corrective Actions."

7. Operations

Plant walkdowns were conducted to assess present operating configurations, housekeeping, and material conditions. Additionally, the selected plant operating procedures were reviewed for adequacy. The inspectors did not identify any significant items that were not addressed by the assessment team.

The inspectors reviewed operator training documents associated with the SWS. The inspectors noted that Licensed Operator Training Module NCRODP-13, Rev 17, April 18, 1994, "Service Water System," pages 28 and 29 described the automatic isolation of the bearing cooling and component cooling heat exchangers whenever the intake level drops to a setpoint of 18 feet. Page 53 also described the intake canal level greater than 18 feet as one of the minimum requirements for the reactor to be critical or for the RCS pressure and temperature to exceed 450 psig and 350°F respectively. Training Module NCRODP-12-S, Rev 11, December 13, 1993, in Review Exercise - Part II, Item g., Page 45, also specified 18 feet as the intake canal low level trip point. However, the minimum canal level allowed by TS 3.14.A.1 was changed from 18 feet to 23.0 feet on June 19, 1989.

The corrective actions for these items identified by the assessment team will be reviewed by the NRC at a later date. This is identified as an example of IFI 50-280,281/94-09-01, "Follow-up on SWSOPA Corrective Actions."

8. Maintenance and Inspections

The inspectors requested information on the assessment's team finding that there was recurring leakage on the SWS pipes associated with the RSHXs inside the containment. The licensee provided WO/DCP Number 3800138723 which showed that weld repair was necessary as a result of leakage coming from the C discharge line that was noted during the flow test. The licensee stated that the leakage was as the result of general corrosion of the carbon steel pipe due to a failure of the coal tar coating. The inspector discussed the repair with the engineer who had inspected the pipe. He stated that when he crawled through the pipe that he required NDE on all areas that were suspect and that the results showed that they were well within the minimum allowable wall thickness.

The inspectors reviewed the 1994 Unit 1 Refueling Outage Report and noted that during engineering inspections of the RSHX discharge lines, the D line was not inspected due to water in the RSHX. The inspectors questioned the licensee and were told that the water was most likely the result of throttling the circulating water discharge valve during cold weather. This causes the circulating water piping which is normally under a vacuum, to see a more positive pressure which causes water to back-up into the RSHX. The licensee stated that the operators have been informed of this possibility. The inspectors will review the administrative procedures during review of the SWSOPA corrective actions to ensure the RSHXs will remain dry.

The corrective actions for these items identified by the assessment team will be reviewed by the NRC at a later date. This is identified as an example of IFI 50-280,281/94-09-01, "Follow-up on SWSOPA Corrective Actions."

9. Surveillance and Testing

The inspectors reviewed preoperational test procedures, surveillance procedures, IST program, and implementing procedures to determine if sufficient testing had been conducted to confirm SWS design and operability requirements. Also reviewed were the licensee's procedures, controls, and other activities associated with the calibration of instrumentation in the SWSs.

The inspectors were concerned about the operability of the radiation monitoring equipment located on the discharge of the SWS piping from the RSHXs. The licensee stated that during the SWS flow testing, it was determined that the suction to the pumps that supplied water to the radiation monitors was sized improperly. They were 3/4 inch in diameter

and did not provide adequate NPSH to the radiation monitoring pumps. The lines to all four pumps to each radiation monitor were changed to 2-inch lines, and the monitors operated satisfactorily. The inspectors will review the administrative procedures to ensure operability of the radiation monitoring system during review of the SWSOPA corrective actions.

The corrective actions for these items identified by the assessment team will be reviewed by the NRC at a later date. This is identified as an example of IFI 50-280,281/94-09-01, "Follow-up on SWSOPA Corrective Actions."

10. Assessment Team Qualification

The inspectors reviewed the qualifications of the assessment team. The team composition exceeded the minimum standards set forth in TI 2515/118. The inspectors interviewed most of the assessment and response team members and found that they were generally knowledgeable of their assessment area but had little assessment experience. During the interviews, the inspectors found the assessment team members were, for the most part, persistent and effective in assuring that questions were understood and answers they received were adequate. The licensee's response team was generally prompt and complete in their responses.

11. Exit Interview

The inspection scope and findings were summarized on June 10, 1994, with those persons indicated in paragraph 1. The NRC described the areas inspected and discussed in detail the inspection findings listed below. No proprietary material is contained in this report. No dissenting comments were received from the licensee.

ITEM NUMBER	STATUS	PARAGRAPH DESCRIPTION
IFI-94-09-01	OPEN	Follow-up on SWSOPA corrective actions.

APPENDIX A

ACRONYMS AND ABBREVIATIONS

CFR	-	Code of Federal Regulations
DBD	-	Design Basis Document
EOP	-	Emergency Operating Procedure
ESW	-	Emergency Service Water
GL	-	Generic Letter
GPM	-	Gallons Per Minute
IFI	-	Inspector Follow-up Item
LOCA	-	Loss of Coolant Accident
NDE	-	Nondestructive Testing
NPSH	-	Net positive Suction Head
RCS	-	Reactor Coolant System
RSHX	-	Recirculation Spray Heat Exchangers
SWS	-	Service Water System
SWSOPA	-	Service Water System Operational Performance Assessment
SWSOPI	-	Service Water System Operational Performance Inspection
TS	-	Technical Specification
UFSAR	-	Updated Final Safety Analysis Report