



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

Report Nos.: 50-280/94-16 and 50-281/94-16

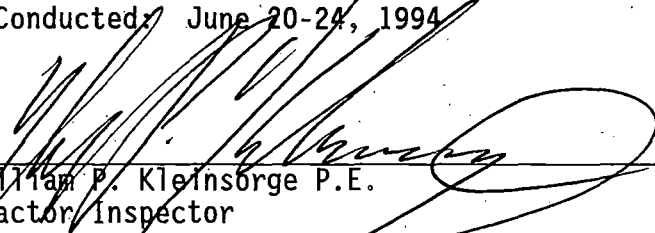
Licensee: Virginia Electric and Power Company  
 Glen Allen, VA 23060

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: June 20-24, 1994

Inspector:   
 William P. Kleinsorge P.E.  
 Reactor Inspector

July 5 '94  
 Date Signed

Approved by:   
 Jerome J. Blake, Chief  
 Materials and Process Section  
 Engineering Branch  
 Division of Reactor Safety

7/14/94  
 Date Signed

SUMMARY

Scope:

This routine, announced inspection was conducted in the areas of Chemically Enhanced Pressure Pulse Cleaning (PP/CC) treatment of the three Unit 2 Steam Generators (S/G)s, feedwater system leak, and flow accelerated corrosion.

Results:

Interviews, observations and records review indicated that the Unit 2 S/G PP/CC project was well planned and executed, and appeared to be effective. With the exception of the weakness noted concerning the accuracy of weld documentation, the licensee's actions related to the feedwater line failure were appropriate to the circumstances. The licensee has established an effective program to maintain high energy carbon steel piping systems within acceptable wall thickness limits.

In the areas inspected, no violations or deviations were identified.

## REPORT DETAILS

### 1. Persons Contacted

#### Licensee Employees

- W. Benthall, Supervisor, Licensing
- \*B. Graber, Licensing
- \*D. Hanson, Maintenance
- \*L. Moris, Radiation Protection
- \*J. Price, Assistant Station Manager
- \*E. Turko, Engineering

Other licensee employees contacted during this inspection included engineers, operators, technicians, and administrative personnel.

#### NRC Resident Inspectors

- \*M. Branch, Senior Resident Inspector
- S. Tingen, Resident Inspector

\*Attended exit interview

Acronyms and initialisms used throughout this report are listed in the last paragraph.

### 2. Steam Generator (S/G) Cleaning (92903)

#### Background

In May 1993, Unit 2 noted small oscillations in "C" steam generator water level. By August 1993, the "C" S/G water level oscillations had enlarged to 15% to 20%. Investigation indicated that the "C" S/G level water level oscillations were independent of feedwater flow rate. It was determined that the water level oscillations were the result of density wave (hydrodynamic) instability, the root cause of which was blockage of flow area in the Tube Support Plates (TSPs), in particular the upper TSPs. In order to stabilize plant operation, the licensee incrementally decreased reactor power. By early November 1993, reactor power had dropped to 96%.

During a forced outage in November 1993 (trip caused by a loss of power, to all three feedwater regulation valves), Westinghouse Company (W) performed a pressure pulse cleaning treatment on "C" S/G. The cleaning removed a certain amount of the blockage, but significant blockage remained. Subsequent to the outage the unit was stable at full power. S/G water level oscillations of 10% soon returned and reactor power was ramped back in 1% to 2% steps.

It was evident that the pressure pulse cleaning treatment, performed by W, had not adequately corrected the S/G water level oscillations. In late February 1994, the licensee started vendor interviews, planning for a more aggressive cleaning process. By late March 1994, the licensee decided on Chemically Enhanced Pressure Pulse Cleaning (PP/CC) treatment

for the three Unit 2 S/Gs. PP/CC is a process in which chemicals are selectively introduced into the S/Gs at varying temperatures, pH levels, and concentrations to remove iron and copper. Due to system load demands, the licensee elected to perform PP/CC in June 1994. The licensee solicited bids for PP/CC in March-April 1994. The Unit 2 PP/CC outage commenced June 3, 1994.

W was selected to perform the PP/CC as the prime-contractor (the project manager and the provider of corrosion monitoring). The subcontractors were Vectra (provider of personnel and the majority of the equipment) and DIS (provider of some equipment, chemicals and the chemical laboratory facility). The project was conducted under the umbrella of the W Quality Assurance Program.

The W PP/CC process uses the EPRI/SGOG (described in EPRI NP-6354-M, Qualification of PWR Steam Generator Chemical Cleaning for Indian Point-2, May 1989) chemical cleaning solvents at low temperature combined with pressure pulse cleaning to remove sludge buildup at the TSP elevations. The main chemical ingredient used in PP/CC operation was the chelating agent ethylene diamine tetra-acetic acid (EDTA). Other major ingredients included corrosion inhibitors, ammonia, oxidizing agents, and hydrazine. The PP/CC process included real-time insitu corrosion monitoring of the S/Gs. The effectiveness of the PP/CC process was monitored by inprocess chemical analysis of the cleaning solutions and selected remote visual examinations of the S/G internals.

### Inspection

To evaluate the PP/CC process in the areas of process control, personnel qualification, and protection of safety related equipment, the inspector conducted interviews with licensee and contractor personnel; examined selected records and video tape; and observed work activities.

### Documents Reviewed

Identification	Revision	Title
2-SSS 2.13.2-VIR-01 6/1/94	0	Master Governing Procedure for Chemically Enhanced Pressure Pulse Cleaning of Surry-2 Steam Generators
0-SSS 2.13.2-VIR-02 6/1/94	0	Steam Generator Equipment and Pressure Pulse Operation for Chemical Cleaning
2-SSS 2.13.2-VIR-03 6/1/94	0	Sampling and Analysis Procedure for Surry-2 Steam Generator Chemically Enhanced Pressure Pulse Cleaning
2-SSS 2.13.2-VIR-04 6/1/94	0	Process Application and Termination for Surry-2 Steam Generator Chemically Enhanced Pressure Pulse Cleaning

## Documents Reviewed

Identification	Revision	Title
2-SSS 2.13.2- VIR-05 6/1/94	0	Set-Up and Operation of Corrosion Monitoring Equipment for Chemically Enhanced Pressure Pulse Cleaning
SECL-94-091 6/1/94	-	Safety Evaluation for: Surry Unit 2 Steam Generator Chemically Enhanced Pressure Pulse Cleaning
NSD-JLH-4028 SG-94-01-026 1/18/94	-	Analysis of Performance and Hydrodynamic Stability for Water Level Oscillation in Surry Unit 2 Steam Generators
<u>W</u> STD-OP-1994- 6823 5/27/94	0	Corrosion Monitoring Application Code and System Qualification Procedure

In addition to the documents indicated above the inspector examined documentation attesting to and certifying personnel qualifications and equipment calibration.

The inspector viewed a video tape of remote visual examinations of the internals of the "C" S/G, depicting before and after views of the top of the seventh TSP. Virtually all the deposits had been removed from the surfaces of the TSPs, the quatrefoil flow passages, and the tube surfaces visible in the limited field of view.

A significant quantity of material was removed from the generators, which is indicated below.

## Materials Removed From Unit 2 S/G

	Copper (Lbs.)	Iron (Lbs.)	Sludge (Lbs.)
S/G A	350	2600	1258
S/G B	470	3050	984
S/G C	500	3900	610
Total	1,320	9,550	2,852

The inspector conducted a walk-through inspection of the chemical handling facilities used for the PP/CC. The inspector noted the dikes erected to contain spills and to prevent the commingling of chemicals with the potential of synergistic reactions. The inspector observed de-activation activities.

Interviews, observations and records review indicated that the Unit 2 PP/CC project was well planned and executed, and appeared to be effective.

Within the areas examined, no violations or deviations were identified.

### 3. Feedwater System Pipe Leak (92903)

#### Background

The licensee noted water on the floor adjacent to the 2A Feedwater heater. On May 25, 1994, after isolation and cool down of the 2A Feedwater heater, the insulation was removed exposing a through-wall hole in heater drain line 10"-WLD-101-301, at a 10" x 14" expander. The hole was located at the 12:00 position in the heat affected zone of the weld connecting the horizontal expander to a down directed 10" elbow (see Figure 1). The licensee cut out the carbon steel expander and elbow and replaced the fittings with low alloy steel, 2½Cr 1Mo, fittings. At this writing, the licensee is conducting a metallurgical failure analysis.

In 1992, prior to the implementation of the CHECMATE® program, the licensee ultrasonically examined the elbow and expander on the Unit 1 "B" train line (in the same relative position as above). The minimum wall thickness value found, though acceptable then, would have been unacceptable prior to the end of the next fuel cycle. The maximum point of wear was approximately 16" to 20" down the extrados of the elbow at the 12:00 position (see Figure 1).

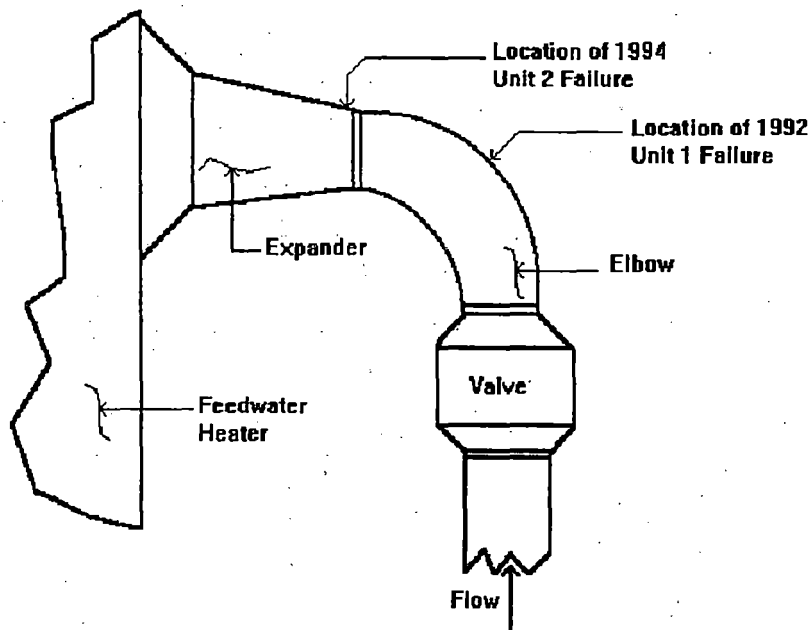


Figure 1

The licensee expanded the sample and examined the "A" train elbow and expander. They were found to be acceptable for continued service. The

Unit 1 "B" train elbow was replaced with a low alloy steel, 2½Cr 1Mo, fitting. The Unit 1 "B" train expander remains the original carbon steel.

The elbow and reducer in the Unit 2 "B" train was ultrasonically examined in June 1994, and found to be acceptable for continued service for several cycles. The licensee indicated that they intend to replace both "B" train fittings at the next Unit 2 refueling outage, when they replace the Unit 2 feedwater heaters.

### Inspection

To evaluate the licensee's actions relative to the balance of plant non-safety related feedwater system leak, the inspector conducted interviews with licensee personnel; examined the failure sites; examined the cut out elbow and expander; and examined selected records.

The inspector examined welder qualification and certification documentation; Quality Control (QC) inspector qualification, certification, and visual acuity documentation; welding filler material certified material test reports (CMTRs); and welding procedure specifications (WPSs) and their associated procedure qualification records (PQRs); involved with the replacement of the failed Unit 2, carbon steel, 10" x 14" expander and the worn, 10" elbow with 2½Cr 1Mo low alloy steel fittings. The documents were examined for compliance with licensee procedures and Sections II and IX of the ASME B&PV Code.

#### Welding Filler Material CMTRs Examined

Type	Size	Heat/Lot No.
ER-80S B2	1/8"	F5409
ER-80S B2	3/32"	F2874
E-8018-B2	1/8"	412W1371
E-8018-B2	3/32"	26847

As a result of the review of documentation for the welding filler materials, discrepancies were identified on "Weld Material Field Control" forms issued by the licensee for welding filler material control.

- On "Weld Material Field Control" form Serial No.038590, the Heat and Purchase Order Numbers for electrode type E-7018 (minimum tensile strength 70 ksi carbon steel coated electrode) filler material was annotated when type E-8018-B2 (80 ksi 1½Cr-1Mo steel coated electrode) was issued and used.
- Electrode type E-8018 (minimum tensile strength 80 ksi carbon steel coated electrode) was annotated on several "Weld Material Field Control" forms, when Type E-8018-B2 (80 ksi 1½Cr-1Mo steel coated electrode) was intended.

- Type ER-8018 (unknown type) was annotated on one "Weld Material Field Control" form, when Type ER-80S-B2 (80 ksi 1¼Cr-1Mo steel bare rod) was intended.

The licensee documented the incorrect Heat and Purchase Order Numbers on a Station Deviation Report (DR) dated June 23, 1994 (DR number was not available at this writing). The licensee indicated that they would add the discrepant material types to that DR or institute a new DR. The licensee conducted an immediate investigation into this matter. The licensee's preliminary results indicated that welding filler materials used were consistent with the materials specified in the applicable WPS. The errors were only in the documentation and did not affect plant equipment.

The above discrepancies demonstrate a weakness concerning the accuracy of welding documentation. This is of concern because the same welding filler material issue stations, personnel and procedures used for this non-safety related, balance-of-plant job, are employed for plant safety related work.

**Welder's Qualification Certification  
Documentation Examined**

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GM 7784, KS 5016, DB 6994, KS 4632, and RT 0360

**QC Inspector Certification and  
Documentation Examined**

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GH MT-II, GAM Visual Weld, SRW Visual Weld,  
and CWM Mechanical

**WPSs Examined**

WPS	PQR
WPS-508, Revision F 9/91	505, Revision A, 2/2/82 506, Revision A, 10/30/82 532, 8/27/90 533, 9/9/91 534, 9/9/91

The WPS examined above was properly supported by PQRs. The welds were made by properly qualified and certified welders, using appropriate welding materials in accordance with properly qualified welding procedure specifications, and inspected by properly qualified and certified inspectors/examiners.

With the exception of the weakness noted concerning the accuracy of weld documentation, the licensee's actions related to the feedwater line failure were appropriate to the circumstances.

Within the areas examined, no violations or deviations were identified.

## 4. Flow Accelerated Corrosion (FAC) (49001)

The licensee has established a FAC inspection program which implements the CHECMATE® EPRI (Electric Power Research Institute) computer code, industry experience, and previous inspection data as predictive tools for determining and prioritizing inspection locations. The inspector conducted interviews with licensee personnel and reviewed records as indicated below.

**Observations/Findings**

During Unit 1 Refueling Outage RFO 13, the licensee planned to examine 121 locations in their Unit 1 FAC program. The licensee expanded the sample size to 137 locations and identified 16 FAC degraded components: 13 were replaced and three were repaired.

The inspector examined the engineering evaluations for the 13 replaced components. The observations were compared with the applicable procedures.

**FAC Engineering Evaluations Examined**

<b>Component Identification</b>	<b>Component Type</b>	<b>System</b>	<b>Disposition</b>
1-SD-PPS-598	6" Pipe Sch. XS	Steam Drain	Replaced
1-SD-PSF2-297	6" 90° Elbow Sch. 80	Steam Drain	Replaced
1-SD-PSF1-44	6" 45° Elbow Sch. XS	Steam Drain	Replaced
1-SD-PPS-597	6" Pipe Sch. XS	Steam Drain	Replaced
1-SD-PSF2-282	6" 90° Elbow Sch. STD	Steam Drain	Replaced
1-SD-PSF1-45	6" 45° Elbow Sch. 80	Steam Drain	Replaced
1-SD-PSF2-299	6" 90° Elbow Sch. XS	Steam Drain	Replaced
1-SD-PFS2-284	6" 90° Elbow Sch. 80	Steam Drain	Replaced
1-FW-PFS2-41	8" 90° Elbow Sch. 100	Feedwater	Replaced
1-FW-PPS-27	8" Pipe Sch. 100	Feedwater	Replaced
1-FW-PSF2-44	8" 90° Elbow Sch. 100	Feedwater	Replaced



## FAC Engineering Evaluations Examined

Component Identification	Component Type	System	Disposition
1-CN-PFS2-122	18" 90° Elbow Sch. XS	Condensate	Replaced
1-CN-PPS-118	18" Pipe Sch. XS	Condensate	Replaced

The licensee is in the process of converting their CHECMATE® data to CHECWORKS® which operates in the Microsoft Windows® environment.

Notwithstanding the feedwater system leak discussed above, the licensee has established an effective program to maintain high energy carbon steel piping systems within acceptable wall thickness limits.

Within the areas examined, no violations or deviations were identified.

## 5. Exit Interview

The inspection scope and results were summarized on June 24, 1993, with those persons indicated in paragraph 1. The inspector described the areas inspected. Although reviewed during this inspection, proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

## 6. Acronyms and Initialisms

ASME	-	American Society of Mechanical Engineers
B&PV	-	Boiler and Pressure Vessel
CMTR	-	Certified Material Test Report
CN	-	Condensate
Cr	-	Chromium
DPR	-	Demonstration Power Reactor
DR	-	Station Deviation Report
EDTA	-	Ethylene Diamine Tetra-Acetic Acid
EPRI	-	Electric Power Research Institute
FAC	-	Flow Accelerated Corrosion
FW	-	Feedwater
ksi	-	10 <sup>3</sup> Lbs. per square inch
Lbs.	-	Pounds
Mo	-	Molybdenum
No.	-	Number
NRC	-	Nuclear Regulatory Commission
P.E.	-	Professional Engineer
PP/CC	-	Chemically Enhanced Power Pulse Cleaning
PQR	-	Procedure Qualification Record
QA	-	Quality Assurance
QC	-	Quality Control
Rev.	-	Revision

RFO	-	Refueling Outage
S/G	-	Steam Generator
Sch.	-	Schedule
SD	-	Steam Drain
SGOG	-	Steam Generator Owners Group
STD	-	Standard
TSP	-	Tube Support Plate
VA	-	Virginia
<u>W</u>	-	Westinghouse Company
WPS	-	Welding Procedure Specification
XS	-	Extra Strong