NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

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NORTH ANNA POWER STATION, UNIT 1	0 5 0 0 0 3 3 8	1 OF 0 8

TITLE (4)

RESIN INTRUSION INTO THE SECONDARY SIDE WATER SYSTEM

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
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0 1 1 3 8	8	8	- 0 0 4	-	0 0	0 3	1 6	8 8		0 5 0 0 0

OPERATING MODE (9)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
2	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10)	20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
0 0 2	20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	X OTHER (Specify in Abstract below and in Text, NRC Form 366A)
	20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	VOLUNTARY
	20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
	20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
	AREA CODE
E. Wayne Harrell, Station Manager	7 0 3 8 9 4 - 5 1 5 1

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	
B	K I D	V I S I L	G 2 2 0	Y							

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

This voluntary LER is being submitted for a Powdex resin intrusion into the Unit 1 secondary side water system including the Steam Generators (S/G's). The resin intrusion was caused by equipment problems in the Condensate Polishing System vessels resulting from improper filter installation.

The following items summarize the actions which were performed after the resin intrusion was discovered. 1) The Unit was ramped down and placed in Mode 5 (Cold Shutdown) in order to drain and flush the S/G's and place them in wet lay-up recirculation. 2) Extensive secondary side cleanup actions were performed, and 3) The condensate polishing vessels were inspected and the necessary repairs performed. To prevent recurrence of similar events, the applicable procedures will be revised to include the additional tests recommended by the manufacturer.

No immediate effects have resulted from the resin intrusion into the secondary side water system. Any long term degradation effects on the S/G's will be detected and corrected as necessary under the currently existing S/G Inservice Inspection Program. The health and safety of the general public were not affected.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

1.0 Description of the Event

This voluntary LER is being submitted for a resin intrusion into the Unit 1 secondary side water system including the Steam Generators (S/G's). The resin intrusion was caused by equipment problems in the Condensate Polishing System (EIIS System Identifier KD, Vendor Identifier G220).

The Condensate Polishing System filters and purifies the condensate water. The condensate water is then heated and admitted to the Feedwater System (EIIS System Identifier SJ) and the S/G's (EIIS System Identifier SB, Component Identifier SG). To remove impurities, the Condensate Polishing System uses powdered ion exchange resin. This resin has limited thermal stability and breaks down at approximately 400 degrees F. If the resin escapes from the ion exchange vessel (which operates at approximately 105 to 110 degrees F), it would be carried by the condensate/feedwater flow and ultimately trapped in the S/G's. This condition is referred to as a resin intrusion. When resin heats up and breaks down, the following chemical parameter changes occur within the secondary side water: 1) pH decreases, 2) cation conductivity increases, and 3) the sulfate concentration also increases.

The following discussion describes the sequence of events leading to the discovery of this condition and the actions taken.

On January 8, 1988, Unit 1 was manually tripped from 100 percent (%) power in anticipation of a loss of the main condenser vacuum (see LER N1-88-002-00). Following the reactor trip, cleanup of secondary side water system, to restore chemistry parameters within the limits prescribed in Administrative Procedure 19.22, Secondary Side Chemistry, was slower than anticipated. Administrative Procedure 19.22 requires that various chemistry parameters be within specified limits prior to increasing power above 5% and 30%, respectively.

A review of plant chemistry data following the reactor trip showed that out of specification sulfate concentration was the principal reason for delaying the increase in power above 5%. The understanding that an increase in sulfate concentration can occur as a result of resin breakdown lead the chemistry department to suspect that there might have been a resin intrusion event. To evaluate this possibility, a S/G blowdown sample was taken using the newly installed On-line Chemistry Monitoring System. The results of this sample did not show any indication of resin. At this time, chemistry personnel did not realize that the on-line monitoring sample line they had used contained a filter upstream of the sample collection point which trapped the resin. A Total Organic Carbon Test was also performed to determine if the delay in reducing the sulfate concentration was a result of an oil intrusion. The results of this test did not indicate that oil had entered the secondary side.

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At 0200 hours on January 13, 1988, the chemistry department notified operations personnel that the 5% chemistry hold had been lifted (all parameters were within the required specifications). At 0307 hours the unit was placed on line but approximately 8 minutes later, a reactor trip occurred due to a Hi-Hi level in the "B" S/G (See LER N1-88-005-00).

Following this reactor trip, on January 13, 1988, the sulfate and cation concentrations increased slightly and the pH decreased slightly (as determined from S/G blowdown on-line sample results). Due to these parameter changes, a S/G blowdown grab sample was taken through a millipore filter and analyzed. Results of the analysis showed that resin was present. Prior to both reactor trips, various condensate polishing vessels were placed in and out of service in an effort to improve the chemistry of the secondary side water system.

All condensate polishing vessels were removed from service when test results indicated resin was present in the secondary side. The "B", "C", and "D" vessels were then tested for leaking filters by recirculating the precoat tank through each vessel and filtering a dip sample. No positive indication of leaking filters was observed. Later these vessels were again tested for leakage by applying an additional precoat of 2 bags of anion resin, drawing a sample of the outlet, filtering the sample and checking for resin. The "C" and "D" vessels indicated resin leakage (with "C" indicating a lesser resin leak than "D"). The "B" vessel did not indicate any resin leakage.

To enhance cleanup of the secondary side water system chemistry, the reactor was taken critical and reactor power was held at approximately 5% with maximum S/G blowdown in operation. Subsequently, a Westinghouse representative arrived on site and alternative ways to remove the resin from the steam generators were discussed with station management. As a result of this discussion, the Unit was shutdown and cooled down so the steam generators could be drained and flushed. A shutdown commenced at 1840 hours on January 13, 1988.

Certain anions/cations will "hideout" under heat transfer conditions and have limited solubility at operating conditions. "Hideout return" describes the chemical return of these anions/cations into secondary water solution during cooldown and is the most sensitive technique available to evaluate the ingress of contaminants over a period of time. The operations and chemistry departments performed an extensive "hideout return" cleanup. This cleanup consisted of a 2 hour hold at 530, 450, and 400 degrees F, a 15 and 1/2 hour hold at 340 degrees F, and a 2 hour hold at 275 degrees F. Chemistry samples were taken at each hold and taken every 2 hours at the 340 degrees F hold until the cation conductivity levels peaked and then began to decrease. At 1033 hours on January 15, 1988, Mode 5 was entered.

Cleanup of the secondary side water system has consisted of the following:

- o The train "A" and train "B" FW heaters were flushed.
- o The Main FW regulating valve bypass lines were flushed - resin was found in the "C" Main FW regulating valve bypass line.
- o The "C" Main FW Regulating Valve bypass line was reflushed - resin was still found in the sample.
- o The "C" Main FW Regulating Valve bypass line was flushed a third time - minimal resin found in the sample.
- o The hotwell was drained and inspected by chemistry and operations personnel - small amounts of phosphorescent material were found on the floor - samples were taken for future analysis (if necessary).
- o The grating from the condensate pump suction to the hotwell was removed to allow for removal of accumulated material.
- o The Hotwell was cleaned and reinspected with satisfactory results.
- o The train "A" and train "B" FW heaters were drained.
- o The "A", "B", and "C" S/G's were drained and refilled until the acceptance criteria was met and then placed in wet lay-up recirc.

The condensate polishing vessel inspection results are summarized below.

- o The "A" condensate polishing vessel was examined by station personnel - (not in service prior to or during this event due to a pre-existing problem with the vessel)-No potential resin escape paths could be identified because some filter hardware had been removed from the "A" vessel filters and installed on the "C" vessel filters.
- o The "B" condensate polishing vessel was examined by station personnel - four filters were found unlatched and one filter was slightly misaligned between the tube sheet adapter and the latch spring. (The unlatched and misaligned filters created a potential resin escape path).
- o The "C" condensate polishing vessel was examined by the manufacturer (Graver Chemical) technical representative and station personnel - 5 filters were found with the top sealing cup bent over and many of the tube sheet adapters were cracked. (The bent sealing cups and the cracked tube sheet adapters created a potential resin escape path).
- o The "D" condensate polishing vessel was examined by the manufacturer (Graver Chemical) technical representative and station personnel - 23 filters were found unlatched, and 8 filters had missing spring retaining washers. (The unlatched filters and the filters with the missing spring retaining washer created a potential resin escape path).
- o The "E" condensate polishing vessel (not in service prior to or during this event) was examined by station personnel - 12 filters were found to be improperly seated. (This improper seating created a potential resin escape path).

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2.0 Significant Safety Consequences and Implications

A resin intrusion into the S/G's only occurs when resin becomes detached from the filters and a resin escape path from the condensate polishing vessels to the secondary side water system exists. Resin becomes detached from the filters when differential pressure is exerted across the filters which hold the resin in place is reduced (i.e. following reactor trips or operational transients). Therefore, although potential resin escape paths existed due to the vessel problems, resin intrusion should not have occurred continuously.

When resin decomposes sulfates are formed. Sulfate is known to promote intergranular attack in crevices of alloy 600 tubing (used in NAPS S/G's), and subsequently, promotes tube denting at support plates. According to a calculation performed by the Graver technical representative, approximately 25 to 30 pounds of resin entered the secondary side. It is not likely that all of the resin thermally decomposed because during the time period between the two reactor trips only the temperature in the S/G's was hot enough to decompose the resin. The excessive "hideout return" tests, the filling and draining of the S/G's, and the cleanup actions performed on the secondary side water system (described in section 1.0) has removed the maximum amount of sulfate. Consequently, no immediate effects have resulted from the intrusion of resin into the S/G's. Any potential long term degradation effects on the S/G's will be detected and corrected as necessary under the currently existing S/G Inservice Inspection Program.

3.0 Cause of the Event

The resin intrusion into the secondary side was due to the problems in the condensate polishing vessels mentioned in section 1.0. The problems in the "B", "D", and "E" vessels are believed to be a result of improper filter installation. The problem in the "C" vessel is also believed to be a result of improper filter installation and was due to the lift plate bumper coming loose and thus allowing the top of the filter assemblies to move in the flow, strike the sides, and become bent and deformed.

4.0 Immediate Corrective Actions

When a resin intrusion was initially thought to have occurred, a S/G blowdown sample was taken using the on-line chemistry monitoring system. Following the January 13, 1988, reactor trip, additional S/G blowdown grab samples were taken through a millipore filter and analyzed. As a result of this sample analysis, which showed that resin was present, the condensate polishing system was removed from service.

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5.0 Additional Corrective Action

The following additional corrective actions have been performed:

- o A "hideout return" cleanup procedure (described in section 1.0) was performed during cooldown.
- o The cleanup actions mentioned in section 1.0 were performed.
- o Additional testing was done on the condensate polishing vessels to detect resin leakage. (Details given in section 1.0).
- o The "A","B", "C", "D", and "E" condensate polishing vessels were inspected and the necessary repairs made. (The results of these inspections are given in section 1.0 and the corrective actions performed are given below).

The corrective actions performed on the condensate polishing vessels are summarized below:

- o "A" condensate polishing vessel - 1 tube sheet adapter was plugged, the head and bolt flange area were machined, and hardware from the "C" vessel was installed on the "A" filters. When the vessel was pressed up the manways leaked. The manways will be machined to repair the problem.
- o "B" condensate polishing vessel - All the filters were removed and reinstalled, the filter caps were tightened, and 3 tubesheet adapters were removed, cleaned, and replaced.
- o "C" condensate polishing vessel - All the filters were removed, all the filter fittings were removed for use on new filters, all the tubesheet adapters were removed and reinstalled with new parts, and new filters were assembled and installed. Later, the "C" vessel was opened to repair a head leak. At this time, the tests recommended by the Graver Technical Representative were performed. As a result of this testing, one tube sheet adapter was plugged.
- o "D" condensate polishing vessel - All the loose filters were latched, the missing spring retaining washers were replaced, and the head gasket was replaced.
- o "E" condensate polishing vessel - The improperly seated filters were removed and reseated correctly.

- o The tests recommended by the Graver Technical Representative (summarized below in section 6.0) were performed on the "A","B", "C", "D", and "E" condensate polishing vessels (as applicable, with satisfactory results) and new head gaskets were installed on all vessels before the heads were replaced.

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6.0 Actions Taken to Prevent Recurrence

To prevent recurrence of improper installation, Graver Chemical has provided a document on the installation of Graver Ecoloc Elements and Powdex Slurry Preparation. (Powdex is the name of the Graver powdered resin used at North Anna). The applicable North Anna procedures will be reviewed and upgraded as necessary. (Upgrading the applicable procedures will assure that the filter elements are properly locked in place; for example, the locking clips are properly oriented).

Based on recommendations by the Graver Chemical Technical Representative, the following tests will be performed on the condensate polishing vessels when they are opened up for maintenance and procedures will be revised appropriately.

- o Filter Element Tube Adapter Integrity Check - This is a water column pressure test which verifies the seal of the lower vessel hardware (the tube adapters) and the seal of the hold pump check valve. The vessel is filled to just below the top of the tube adapter for the performance of this test. (Performed when all filter elements are removed).

- o Filter Element Support Tube Assembly Integrity Check - This is a water column pressure test which verifies the seal of the lower vessel hardware (the tube adapter), the seal of the lower filter hardware (the flat washer), and the seal of the hold pump check valve. The vessel is filled to the bottom cap of the support tube assembly. (Performed when the filter elements are installed).

- o Filter Element Installation Check - This test is a visual observation of the filter elements for uniformity in height.

Additional actions to prevent recurrence include: 1) The creation of a periodic test which utilizes a pH indicator to detect resin. (This test will be performed any time resin leakage is suspected), 2) The revision of procedures to allow operation of the vessels with a more compact precoat (to allow finer filtration) and to require compliance within a certain specification for the maximum number of resin particles in the 9 minute precoat sample. (the required specification has not been determined at this time but Graver Chemical is supplying test procedures to determine this value), 3) Operations personnel will receive additional training on Powdex operations during Licensed Operator Requalification Training, and 4) To improve performance, the use of a new filter medium is being evaluated.

7.0 Similar Events

Previously, resin intrusion into the secondary side has occurred at North Anna Power Station on Unit 1 on February 27, 1979, July 1979, and on Unit 2 on August 16, 1981.

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8.0 Additional Information

The following list demonstrates how North Anna Power Station has significantly improved chemistry in the secondary side water system in the last few years.

- o Chemistry holds were implemented at 5% and 30% power to reduce impurity levels in the steam generators.
- o Sulfate and silica parameter specifications were included into the secondary chemistry control program.(effective 9/11/86).
- o The Arrowhead Water Purification System was installed in 1986 to provide higher quality secondary system makeup water.
- o The Westinghouse On-line Chemistry Monitoring System was installed. (Currently, the system is being tested. Data is being taken from the system in parallel with the established sampling process and compared for accuracy)
- o Manning within the Chemistry Department was increased and state of the art equipment was purchased.

Following completion of the inspection and repair of the Unit 1 condensate polishing vessels, the Unit 2 condensate polishing vessels will be inspected, as plant conditions permit, and corrective actions will be taken where necessary.

VOLUNTARY

Vepco

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION
P. O. BOX 402
MINERAL, VIRGINIA 23117

March 16, 1988

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Serial No. N-88-006
NO/DEQ: nih
Docket No. 50-338

License No. NPF-4

Dear Sirs:

The Virginia Electric and Power Company hereby submits the following Licensee Event Report applicable to North Anna Unit 1.

Report No. IER 88-004-00

This report has been reviewed by the Station Nuclear Safety and Operating Committee and will be forwarded to Safety Evaluation and Control for their review.

Very Truly Yours,

E. Wayne Harrell
Station Manager

Enclosure

cc: U. S. Nuclear Regulatory Commission
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Atlanta, Georgia 30323

Mr. J. L. Caldwell
NRC Senior Resident Inspector
North Anna Power Station

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