

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

February 11, 1993

NRC INFORMATION NOTICE 93-12: OFF-GASSING IN AUXILIARY FEEDWATER
SYSTEM RAW WATER SOURCES

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to problems that could result from off-gassing in safety-related raw water sources. It is expected that recipients will review this information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

In March and April 1992, personnel at the McGuire Nuclear Station discovered air pockets in the nuclear service water discharge piping supplying the safety grade auxiliary feedwater for both Units 1 and 2. Duke Power Company (the licensee) determined the source of this air to be the off-gassing of the raw lake water caused by the warming of the water by the components cooled by the nuclear service water system. The air intrusion is a safety concern because it could cause air binding or damage to the auxiliary feedwater pumps.

The auxiliary feedwater system at McGuire Nuclear Station consists of two 450 gallon per minute (gpm) motor-driven pumps and one 900 gpm turbine-driven pump that take suction from either of two sources. The normal, condensate grade source of water for auxiliary feedwater is either the upper surge tank, the condenser hotwell, or the condensate storage tanks. The safety grade, seismic category I source of auxiliary feedwater is the nuclear service water system. When aligned to take suction from the nuclear service water system, train "A" and "B" of the auxiliary feedwater system take suction from the corresponding nuclear service water system train "A" and "B" (Figure 1). The turbine driven auxiliary feedwater pump can take suction from either train "A" or "B" of the nuclear service water system. In addition to the train "A" and "B" nuclear service water, nuclear service water can be supplied to the suction of the auxiliary feedwater system through a supply line controlled from the standby shutdown facility. (The standby shutdown facility is used to mitigate certain fire and security events.)

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The licensee discovered two different sources of air in the nuclear service water system that could have potentially affected the operability of the auxiliary feedwater system. On March 27, McGuire personnel discovered air at a high point in the Unit 1 standby shutdown system line upstream of the isolation valves that separate the nuclear service water and the auxiliary feedwater systems (Valves 1CA161C and 1CA162C, Figure 2). McGuire personnel repeatedly vented this line over the following days, but air continued to be produced at the high point. After thoroughly searching for air inleakage and performing a detailed engineering and chemical evaluation of the system, McGuire staff concluded that the air was produced by off-gassing of the heated raw lake water. As a result of this discovery, the licensee searched for and found the second source of air at high points in the "A" train of the nuclear service water discharge header (Detail A-A, Figure 2). Under certain operating conditions, these additional sources of air could have affected the "A" auxiliary feedwater pumps and the turbine-driven auxiliary feedwater pumps on both units.

The auxiliary feedwater line from the "A" train on each unit is attached to the discharge line of the emergency diesel cooling heat exchanger, near the point where this line discharges into the main "A" train service water discharge header. The cooling water from the diesel generator heat exchanger flows at the rate of 900 gpm. With the diesel running and only one auxiliary feedwater pump drawing water from the diesel line, sufficient diesel coolant would be supplied to the feedwater pump suction without drawing water from the main "A" train discharge line. However, if the "A" diesel generator cooling is lost, or if both a motor-driven and a turbine-driven auxiliary feedwater pump are operated simultaneously, water could be drawn from the high point on the main "A" train discharge line along with any air that might have collected in this discharge line. The "B" train on each unit was not affected because it had a different piping configuration.

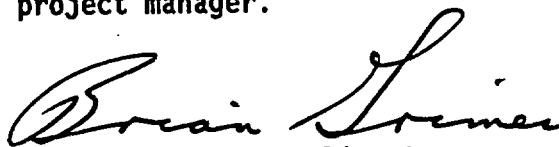
Discussion

The events discussed in this information notice highlight the potential for off-gassing in auxiliary feedwater system raw water sources. According to Henry's law, the solubility of a gas in water at a constant temperature is approximately proportional to the partial pressure of the gas. The solubility at a constant pressure, however, generally decreases with increasing temperature. The solubility of air in water at atmospheric pressure, for example, is reduced from 29 milliliter per liter at 0°C (32°F) to 16 milliliter per liter at 30°C (86°F). Raw water that has become saturated with air in the outside environment is not likely to emit gas in the service water system supply piping because the pressure of the water has been increased by pumping while the temperature of the water remains near its original value. As this water is heated by the various plant systems, and as the pressure of the water decreases to near atmospheric levels in the discharge piping, some of the air can be expected to evolve from the water and collect above any elevated, slow moving water volumes in the discharge piping.

Upon discovering air in the auxiliary feedwater supply line for the Unit 1 standby shutdown system, the licensee declared all three of the auxiliary feed water pumps to be inoperable. The licensee concluded that these pumps had technically been inoperable since initial plant operation. The licensee isolated the auxiliary feedwater line by closing one of the isolation valves in this line and removing the power supply to this valve. Although this action made the standby shutdown line inoperable, the action was initially considered to be sufficient to return the rest of the auxiliary feedwater system to operability. However, after discovering the second source of air in the high points of the "A" nuclear service water train discharge lines of both units, the licensee isolated the turbine-driven pumps of both units from the "A" service water lines and declared the turbine-driven pumps to be inoperable. This action returned the "A" motor driven pumps to operability, because these pumps alone could not draw sufficient water to ingest air from the main nuclear service water discharge lines.

The licensee considered several options to correct the problem permanently. One possible solution was to reroute the safety-grade auxiliary feedwater lines to take suction from the nuclear service water supply piping. A second possible solution was to reroute the suction of the auxiliary feedwater lines to sections of the nuclear service water discharge piping that were not susceptible to the formation of air pockets. However, the licensee chose a third alternative, which was to install permanent vent valves at the high points where air was accumulating (Valves 1RN1060, 1RN835 and 2RN815, Figure 2). The licensee piped these vent valves to drains and throttled the valves to provide a continuous drainage flow that was sufficient to vent any air that might accumulate in the emergency feedwater supply.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.



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Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

Technical contacts: P. Kim Vandoorn, RII
(704) 875-1681

Don Kirkpatrick, NRR
(301) 504-1849

Attachments:

1. Figure 1
2. Figure 2
3. List of Recently Issued NRC Information Notices

See file jacket

**MCGUIRE NUCLEAR STATION
AUXILIARY FEEDWATER SYSTEM
UNIT 1**

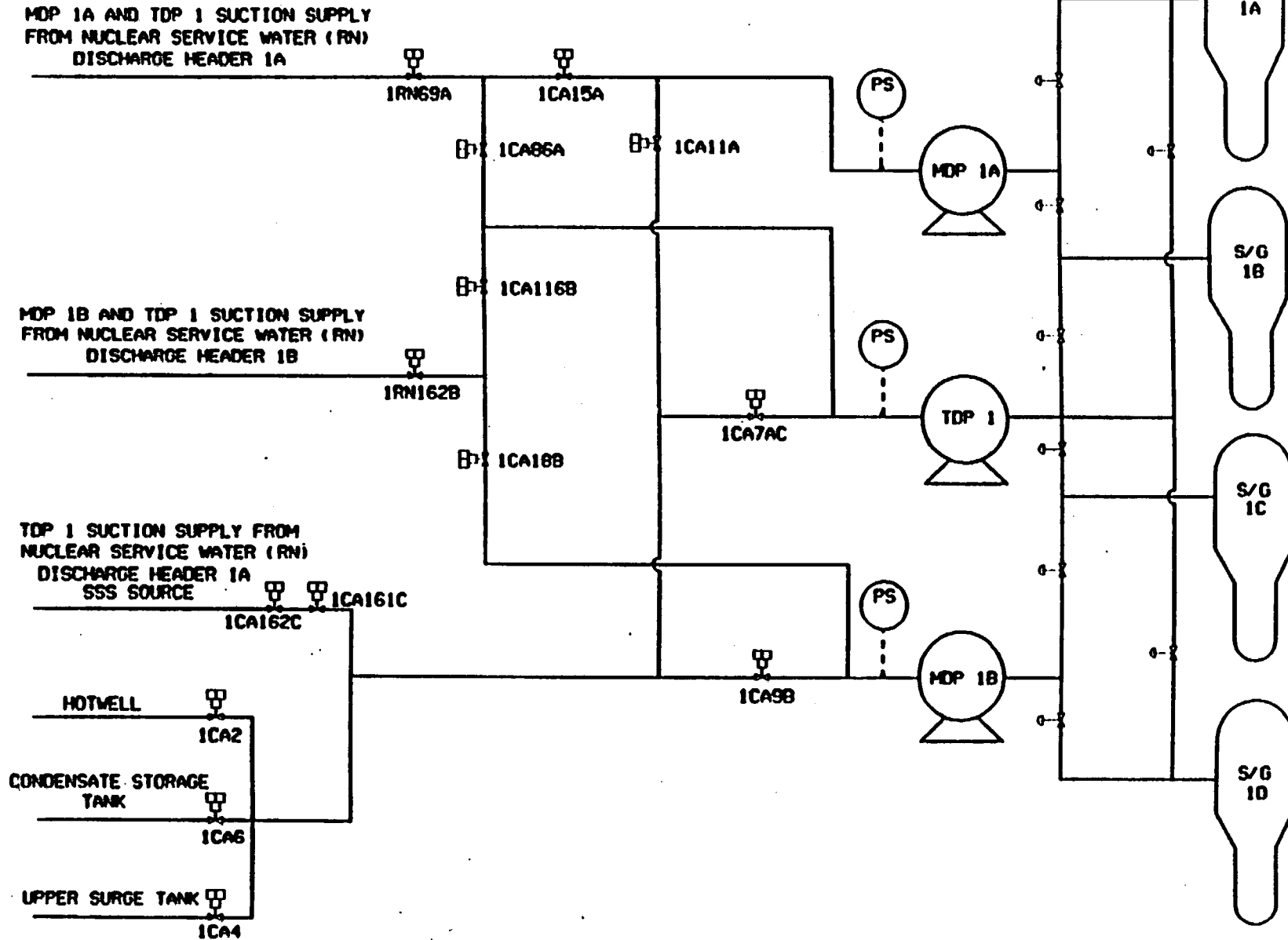
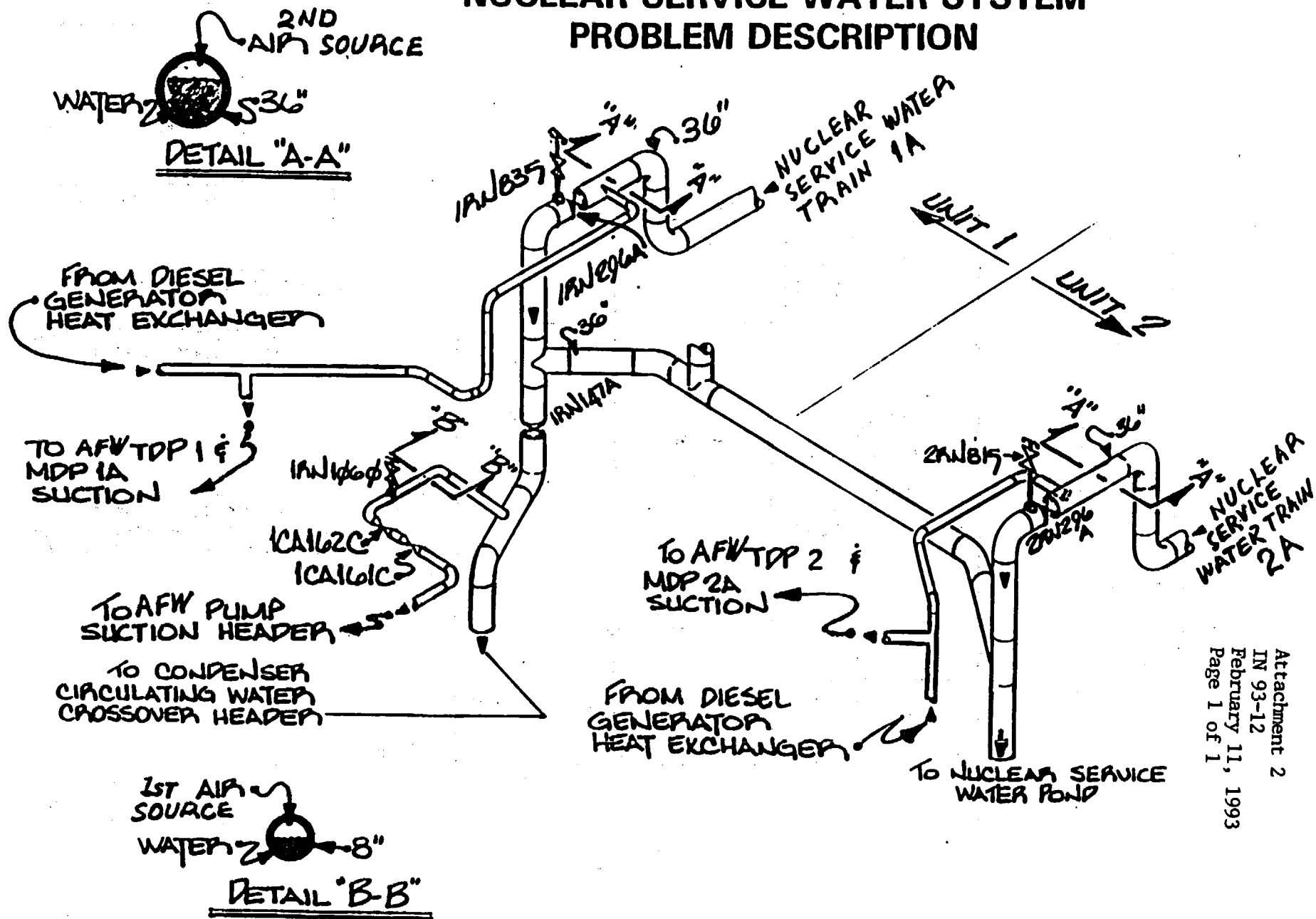


Figure 1

MCGUIRE NUCLEAR STATION NUCLEAR SERVICE WATER SYSTEM PROBLEM DESCRIPTION



Attachment 2
 IN 93-12
 February 11, 1993
 Page 1 of 1

Figure 2

LIST OF RECENTLY ISSUED
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
93-11	Single Failure Vulnerability of Engineered Safety Features Actuation Systems	02/04/93	All holders of OLs or CPs for nuclear power reactors.
93-10	Dose Calibrator Quality Control	02/02/93	All Nuclear Regulatory Commission medical licensees.
93-09	Failure of Undervoltage Trip Attachment on Westinghouse Model DB-50 Reactor Trip Breaker	02/02/93	All holders of OLs or CPs for nuclear power reactors.
93-08	Failure of Residual Heat Removal Pump Bearings due to High Thrust Loading	02/01/93	All holders of OLs or CPs for nuclear power reactors.
93-07	Classification of Transportation Emergencies	02/01/93	All Licensees required to have an emergency plan.
93-06	Potential Bypass Leakage Paths Around Filters Installed in Ventilation Systems	01/22/93	All holders of OLs or CPs for nuclear power reactors.
93-05	Locking of Radiography Exposure Devices	01/14/93	All Nuclear Regulatory Commission industrial radiography licensees.
93-04	Investigation and Reporting of Misadministrations by the Radiation Safety Officer	01/07/93	All U.S. Nuclear Regulatory Commission medical licensees.
93-03	Recent Revision to 10 CFR Part 20 and Change of Implementation Date to January 1, 1994	01/05/93	All byproduct, source, and special nuclear material licensees.

OL = Operating License
 CP = Construction Permit

Upon discovering air in the auxiliary feedwater supply line for the Unit 1 standby shutdown system, the licensee declared all three of the auxiliary feed water pumps to be inoperable. The licensee concluded that these pumps had technically been inoperable since initial plant operation. The licensee isolated the auxiliary feedwater line by closing one of the isolation valves in this line and removing the power supply to this valve. Although this action made the standby shutdown line inoperable, the action was initially considered to be sufficient to return the rest of the auxiliary feedwater system to operability. However, after discovering the second source of air in the high points of the "A" nuclear service water train discharge lines of both units, the licensee isolated the turbine-driven pumps of both units from the "A" service water lines and declared the turbine-driven pumps to be inoperable. This action returned the "A" motor driven pumps to operability, because these pumps alone could not draw sufficient water to ingest air from the main nuclear service water discharge lines.

The licensee considered several options to correct the problem permanently. One possible solution was to reroute the safety-grade auxiliary feedwater lines to take suction from the nuclear service water supply piping. A second possible solution was to reroute the suction of the auxiliary feedwater lines to sections of the nuclear service water discharge piping that were not susceptible to the formation of air pockets. However, the licensee chose a third alternative, which was to install permanent vent valves at the high points where air was accumulating (Valves 1RN1060, 1RN835 and 2RN815, Figure 2). The licensee piped these vent valves to drains and throttled the valves to provide a continuous drainage flow that was sufficient to vent any air that might accumulate in the emergency feedwater supply.

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*SEE PREVIOUS CONCURRENCES Document Name: OFFGAS.IN
B/DORS:NRR C/OGCB:DORS:NRR *RPB:ADM *RII
BGrimes GMarcus GHM TechEd JJohnson
01/4/93 mkm 01/21/93 11/05/92 01/26/93
*OGCB:DORS:NRR *C/SFLB:DSSA:NRR*PD2-3:ADR2:NRR *C/PD2-3:ADR2:NRR *RII
DKirkpatrick:mkm CMCracken TReed DBMatthews WMiller
11/04/92 12/04/92 12/21/92 12/22/92 01/26/93

Upon discovering air in the auxiliary feedwater supply line for the Unit 1 standby shutdown system, the licensee declared all three of the auxiliary feed water pumps to be inoperable. The licensee concluded that these pumps had technically been inoperable since initial plant operation. The licensee isolated the auxiliary feedwater line by closing one of the isolation valves in this line and removing the power supply to this valve. Although this action made the standby shutdown line inoperable, the action was initially considered to be sufficient to return the rest of the auxiliary feedwater system to operability. However, after discovering the second source of air in the high points of the "A" nuclear service water train discharge lines of both units, the licensee isolated the turbine-driven pumps of both units from the "A" service water lines and declared the turbine-driven pumps to be inoperable. This action returned the "A" motor driven pumps to operability, because these pumps alone could not draw sufficient water to ingest air from the main nuclear service water discharge lines.

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Original signed by

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DKirkpatrick:mkm	CMcCracken	TReed
11/04/92	12/04/92	12/21/92
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		DBMatthews
		WMiller
		12/22/92
		01/26/93

Upon discovering air in the auxiliary feedwater supply line for the Unit 1 standby shutdown system, the licensee declared all three of the auxiliary feed water pumps to be inoperable. The licensee concluded that these pumps had technically been inoperable since initial plant operation. The licensee isolated the auxiliary feedwater line by closing one of the isolation valves in this line and removing the power supply to this valve. Although this action made the standby shutdown line inoperable, it was initially considered to be sufficient to return the rest of the auxiliary feedwater system to operability. However, after discovering the second source of air in the high points of the "A" nuclear service water train discharge lines of both units, the licensee isolated the turbine-driven pumps of both units from the "A" service water lines and declared the turbine-driven pumps to be inoperable. This action returned the "A" motor driven pumps to operability, because these pumps alone could not draw sufficient water to ingest air from the main nuclear service water discharge lines.

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		DBMatthews
		12/22/92

RII *DCK*
JJohnson *for JJ*
01/26/93 *by phone*
RII
WMiller *DCK for*
01/26/93 *WH*
by phone

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DBMatthews	WMiller	JJohnson	GHMarcus
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			BKGrimes
			12/ /92

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