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NYN-94029

March 25, 1994

United States Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Document Control Desk

References: (a) Facility Operating License No. NPF-86, Docket No. 50-443

(b) North Atlantic Letter NYN-94019 dated February 24, 1994, "Licensee Event Report (LER) 94-01-00: Reactor Trip and Safety Injection Due to Inadvertent MSIV Closure," T. C. Feigenbaum to USNRC

Subject: Licensee Event Report (LER) 94-01-01: Reactor Trip and Safety Injection Due to Inadvertent MSIV Closure

Gentlemen:

Enclosed please find supplemental Licensee Event Report (LER) No. 94-01-01 for Seabrook Station. This submittal, which supplements the submittal provided via Reference (b), documents an event that occurred on January 25, 1994. This event is reported pursuant to 10CFR50.73(a)(2)(iv).

Should you require further information regarding this matter, please contact Mr. James M. Peschel, Regulatory Compliance Manager at (603) 474-9521 extension 3772.

Very truly yours,

Ted C. Feigenbaum

TCF:JES/jes

Enclosures: NRC Forms 366/366A

cc: Mr. Thomas T. Martin
Regional Administrator
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NRC FORM 366 (5-92)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 5/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Seabrook Station	05000443	1 OF 7

TITLE (4)
Reactor Trip and Safety Injection due to Inadvertent MSIV Closure

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 NAME	DOCKET NUMBER
										05000
01	25	94	94	01	01	03	25	94	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)					
		20.402(b)		20.405(c)	X	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10)	100	20.405(a)(1)(i)		50.36(c)(1)		50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)		50.36(c)(2)		50.73(a)(2)(vii)	OTHER
		20.405(a)(1)(iii)		50.73(a)(2)(i)		50.73(a)(2)(viii)(A)	(Specify in Abstract below and in Text, NRC Form 366A)
		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 (Include Area Code)
Mr. James M. Peschel, Regulatory Compliance Manager	(603) 474-9521 Ext. 3772

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

CAUSE	SYSTEM	COMPONENT	MANUFAC URER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
X/B	SB	FSV	E-095	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 15 single-spaced typewritten lines) (16)

On January 25, 1994, at 0934 an automatic reactor trip from 100 percent power occurred when a main steam [SB] isolation valve (MSIV) closed during MSIV quarterly surveillance testing. The reactor trip, which was due to low-low narrow range steam generator level, was followed by a Safety Injection and Main Steam Isolation. This event was reported to the NRC at 1000 on January 25, 1994 as a one-hour notification pursuant to 10CFR50.72(b)(2)(ii), actuation of the Reactor Protection System (RPS) an Engineered Safety Feature (ESF) System.

There were no adverse safety consequences as a result of this event.

The physical cause of the MSIV malfunction was determined to be a combination of contaminated hydraulic fluid, a sticking main dump valve, and other related hardware issues. Collectively, these factors allowed the hydraulic pressure to bleed off and cause the MSIV to continue to close during testing. A root cause analysis was performed at two levels: the first to evaluate MSIV hardware specific issues and a second to evaluate organizational and programmatic performance. The root causes for this event include inadequate failure analysis of previous MSIV events, an inadequate preventative maintenance program for the MSIVs, and inadequate workmanship and quality assurance practices when the MSIV hydraulic subsystems were rebuilt in 1991.

North Atlantic has taken actions to correct the hardware specific MSIV conditions. North Atlantic will implement actions to address the root and contributing causes of this event.

Description of Event

On January 25, 1994, at 0934, an automatic reactor trip from 100 percent power occurred when a main steam [SB] isolation valve (MSIV) did not return to the full open position, but continued to close, during the performance of procedure OX1430.02, "Main Steam Isolation Valve Quarterly Valve Test." OX1430.02 implements the requirements of Technical Specification 4.0.5 by performing a partial stroke test of the MSIVs. Each MSIV is tested by stroking the valve to ten percent closed twice, once per MSIV hydraulic control train. During the testing of MS-V86 B train, the reactor tripped automatically on low-low narrow range steam generator level as a result of steam generator level shrinkage. At approximately the same time, safety valves on the steam header from the A steam generator lifted. Subsequently, a Safety Injection and Main Steam Isolation occurred as a result of the rate compensated low steam line pressure.

Seabrook Station is a four loop Westinghouse plant, with an MSIV in each of the four main steam lines. Each MSIV is controlled by a hydraulic/pneumatic actuator that uses nitrogen to maintain pressure on top of an operating piston (which tends to close the MSIV) and hydraulic pressure on the bottom of the operating piston to keep the valve open. (Refer to the attached diagram). The MSIVs are closed by draining the hydraulic fluid (Fyrquel 220 MLT) under the operating piston back to a hydraulic reservoir. During fast closure, a solenoid pilot valve directs hydraulic fluid to open a main dump valve which allows for rapid draining of hydraulic fluid back to the reservoir. During 10 percent slow close testing, another solenoid pilot valve inserts a slow close orifice into the main dump valve's flow path thereby limiting the speed at which hydraulic fluid is drained back to the reservoir and the speed at which the MSIV is closed. An air operated hydraulic pump is utilized to increase hydraulic pressure to open the MSIVs. There are two independent trains of hydraulic control for each MSIV to increase reliability of the MSIV performing its safety function. MSIV operability has been verified once per quarter during power operation by cycling each valve through ten percent of valve travel with each train of hydraulic control using a test panel on the main control board.

The train A test of MS-V86 and MS-V92, and the train B test of MS-V92 had been successfully performed earlier during the same shift. However, during the train B test of MS-V86, the valve continued past the ten percent closed position. MS-V86's continued closure was verified by indications of steam generator level shrinkage, steam flow reduction from steam generator A, a delta temperature deviation alarm in the affected reactor coolant loop, and by local observation. An NSO (Nuclear Systems Operator) stationed locally at MS-V86 during testing attempted to stop MS-V86 from closing by closing a hydraulic drain isolation valve. This action, which was part of a proceduralized contingency plan to ensure that the MSIVs would not fully close during testing, was unsuccessful due to mechanical binding of the valve's locking plate. Approximately one and one-half minutes after the start of the MS-V86 B train test, an automatic reactor trip occurred due to low-low narrow range level in the A steam generator.

As a result of the MS-V86 closure, the Reactor Coolant System (RCS) loop temperature (Tavg) increased sharply to approximately 595 degrees Fahrenheit, due to the decrease in heat transfer from the A steam generator. Steam generator safety valves opened in response to the increasing pressure in the A steam generator due to the MSIV closure. When the reactor trip occurred, all twelve condenser steam dump valves tripped open to lower RCS temperature to the no-load value of 557 degrees Fahrenheit. Since the steam dump controls are based on auctioneered

high Tavg, the steam dumps responded to the higher Tavg condition in RCS loop 1. The full steam demand through the steam dump valves was shared by the B, C, and D steam generators. This caused a rapid drop in pressure in those steam generators and their respective main steam headers. The rapid drop in steam pressure caused the steam pressure low Safety Injection bistables to actuate for these loops. Although the steam pressure did not reach the setpoint of 585 psig, the instrument loops are lead compensated and the high negative rate of change in a steam generator pressure created the anticipatory response. An SI and Main Steam Isolation were initiated in both trains. The MSIVs in the unaffected loops closed in less than 3 seconds. MSIV fast closure recovered steam pressures and deenergized the steam pressure low SI bistables.

Primary plant system response was normal with respect to the Engineered Safety Feature actuations, Safety Injection [JE] and Main Steam Isolation [SB] in response to low main steam line pressure.

At 1000 on January 25, 1994 North Atlantic made a one-hour notification to the NRC pursuant to 10CFR50.72(b)(2)(ii).

Prior Events

This is the second event at Seabrook Station where MSIV testing anomalies resulted in a reactor trip (see LER 93-009-01), and the first event where testing anomalies resulted in a Safety Injection and Main Steam Isolation. The cause for the prior event was determined at that time to be debris lodged in one of the solenoid pilot valves. As a result, North Atlantic planned to drain the MSIV hydraulic reservoirs and to inspect and clean the strainer/diffuser in each of the reservoirs during the third refueling outage.

North Atlantic has experienced other anomalies and plant perturbations during slow closure testing of the MSIVs. Specifically, on six prior occasions starting in December of 1992, the MSIVs closed more than the anticipated 10 percent but less than that which would cause a reactor trip. As with the January 25, 1994 event, these anomalies only affected the ability of the valves to stop at ten percent closed during slow close testing and did not have an adverse affect on the valves' ability to fast close to perform their intended safety function. Since the safety function of the MSIVs was not affected, and since they successfully passed their surveillance testing, the valves were always operable.

Root Cause

As a result of this event and the aforementioned previous occurrences, North Atlantic performed a root cause analysis for all MSIV testing anomalies that have been experienced since December of 1992. December 1992 is the date of the first identified testing anomaly since the MSIV hydraulic actuators were rebuilt in 1991 during the first refueling outage. The root cause analysis was performed at two levels: the first to evaluate MSIV hardware specific issues and a second to evaluate organizational and programmatic performance. The results of both analyses are described in aggregate below following a description of the as-found physical conditions that had the potential to adversely affect MSIV performance during slow close testing.

Physical Conditions Affecting MSIV Performance During Testing:

As a result of this event, North Atlantic and the valve manufacturer thoroughly inspected and reworked, as necessary, the hydraulic assemblies from all four MSIVs. This effort revealed multiple physical conditions that had the potential to adversely affect MSIV performance during slow close testing. The substantive conditions for MS-V86 are described below:

- Contaminated hydraulic fluid: The hydraulic fluid was found to be contaminated with foreign material. This contamination was determined to originate from externally introduced sources, internal valve wear products, and a silicon based contaminant. No chemical degradation of the hydraulic fluid was identified.

- The train B main dump valve was determined to be sticking. The valve's disc was both out of tolerance (0.001 inches over maximum allowable size) and it had a machining burr and scoring on the outside surface.

- The train B main dump solenoid pilot valve was found to exhibit seat leakage. Foreign material was found on the valve seat and in the air side of the valve shifting mechanism.

- The hydraulic pump did not provide adequate capacity thereby delaying the repressurization of the hydraulic system. The pump's discharge filter was deformed and the filter material was split. Brass filings were found inside the hydraulic pump's air motor.

- The piston in the hydraulic system's thermal accumulator was found in a fixed position.

Similar conditions of lesser magnitude were found in the hydraulic subsystems of the other three MSIVs. While not a factor for the January 25, 1994 event, electronic control logic timing problems were a factor in the other MSIV testing anomalies. Specifically, upon reaching ten percent of valve travel, the timing logic allows the slow close orifice to reset slightly before the main dump valve is fully closed. This results in a momentary fast closure response of the MSIV. This issue was not a factor in the January 25, 1994 event since the slow close orifice was manually jumpered in the throttled position.

Root Cause:

Three primary root causes and a number of contributing causes have been identified for this event and the previous MSIV testing anomalies. The primary root causes are described below.

The first primary root cause was determined to be inadequate failure analysis of previous MSIV events. The previous MSIV events resulted in plant perturbations that were not adequately evaluated at the time for all possible causes.

The second primary root cause was determined to be an inadequate preventative maintenance program for the MSIVs. As described above, contaminants were found in the MSIVs' hydraulic fluid. Routine sampling and trending of the MSIV hydraulic fluid may have provided indicators of the contaminant level or the types of contaminants in the hydraulic fluid.

The third primary root cause was determined to be inadequate workmanship and quality assurance practices when the valves were rebuilt in 1991. A large number of deviations and contaminants were identified during the MSIV inspections that could only have been introduced when the valves were rebuilt during the first refueling outage.

Safety Consequences

There were no adverse safety consequences as a result of this event. Plant equipment functioned as designed and operator actions were determined to be correct. At no time during the event was there any adverse affect on the health and safety of plant employees or the public.

North Atlantic has determined that for this event, and all past MSIV testing anomalies, the MSIVs were always operable and capable of fast closure as required to fulfill their intended safety function. This determination is based on the as-found condition of the valves' hydraulic subsystems and on the fact that the MSIVs were operable prior to January 25, 1994 as evidenced by successful completion of their required surveillance testing. The evaluation of the as-found conditions concluded that MS-V86 would have performed its safety function if called upon to do so. Hence, MS-V86 train B would have closed and the plant would not be adversely affected by a design basis accident.

Corrective Actions

In response to this event, North Atlantic conducted an event evaluation, root cause analysis, and a Human Performance Evaluation (HPES). Additionally, the following actions were performed during the process of troubleshooting and repairing the MSIVs. Although there were some minor differences in the level of investigation/repairs for each of the four MSIVs, the following general strategy was typical.

The hydraulic subsystems of each MSIV, with the exception of the main actuating cylinders, were disassembled. During this process, hydraulic fluid samples were obtained at key locations within the subsystem. Chemical analyses were performed on these fluid samples to determine the presence and type of contaminants and to determine if the fluid had degraded. Any foreign materials that were found in the hydraulic subsystems were also analyzed to determine their origin.

After the solenoid pilot valves and the main dump valve were disassembled for MS-V86, North Atlantic sent the hydraulic manifolds for all four MSIVs to the valve manufacturer's facility for inspection, cleaning, and rebuilding as necessary. At the manufacturer's facility the hydraulic manifolds were inspected for foreign material, worn/damaged components, and selected machining tolerances. The solenoid pilot valves were also inspected and rebuilt as necessary. Any worn/damaged parts were replaced as was the pipe thread sealant on all hydraulic subsystem mechanical joints. North Atlantic provided Quality Control oversight at the valve manufacturer's facility during the inspection/rebuilding effort.

North Atlantic also performed a series of flushes of the MSIVs' main actuating cylinders using a temporary flushing rig with high efficiency filters. Additionally, the air subsystem components in-line with the hydraulic pump air motor were inspected and rebuilt. The air supply system was evaluated and determined to be adequate. North Atlantic also inspected and renewed environmental seals on the valves' electrical components.

North Atlantic reassembled the MSIVs when the hydraulic manifolds and solenoid pilot valves were returned from the manufacturer. The hydraulic subsystems of each MSIV were flushed by stroking the valves. The valves were then adjusted for timing and limit switch settings and slow and fast closure tests were conducted to establish valve operability.

North Atlantic also reviewed open work activities in critical plant systems to identify to management any recurring equipment issues. Identified equipment issues were evaluated and dispositioned prior to restart. All short term hardware related corrective actions associated with this event were also resolved prior to restart.

North Atlantic will implement the following corrective actions to address the primary root causes:

- Procedure OE 4.2, "Cause and Failure Analysis," is one of the North Atlantic procedures that provides guidelines for determining the cause and preventing recurrence of an adverse condition or failure involving plant equipment, personnel, or programs. The root cause analysis for this event showed that this process could benefit from an abbreviated Kepner-Trego style approach and additional training. To address the first primary root cause, North Atlantic will evaluate the application of OE 4.2. Recommendations will be provided to increase the effectiveness of this tool and to increase the consistency of its use to analyze mission critical and important to safety systems and components.

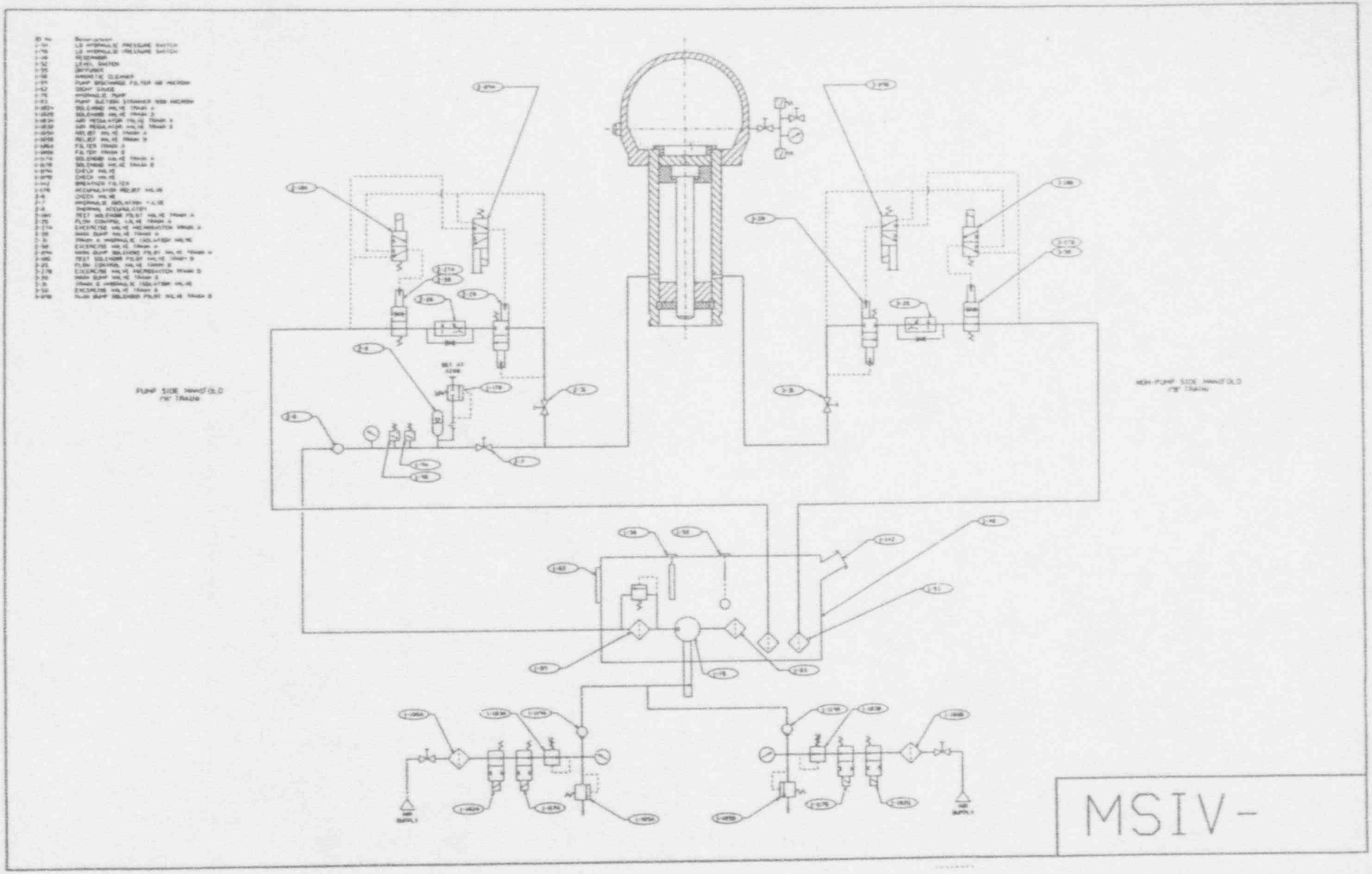
- The root cause analysis noted that information was available to warrant a more conservative MSIV preventative maintenance program than that recommended by the valve manufacturer. Routine sampling and trending of the MSIV hydraulic fluid may have provided indicators of the contaminant level or the types of contaminants in the hydraulic fluid. Similarly, a trending program for other MSIV performance indicators may have been beneficial. To address concerns regarding preventative maintenance, North Atlantic will develop and implement a comprehensive preventative maintenance program for the MSIVs including specific tasks.

- To generically address the inadequate workmanship and quality assurance practices when the MSIVs were rebuilt in 1991, North Atlantic will perform an assessment of the site program for reviewing and approving vendor QA programs. Recommendations will be provided to preclude future problems with work quality at vendor facilities.

Additionally, North Atlantic will implement actions to address the contributing causes of this event.

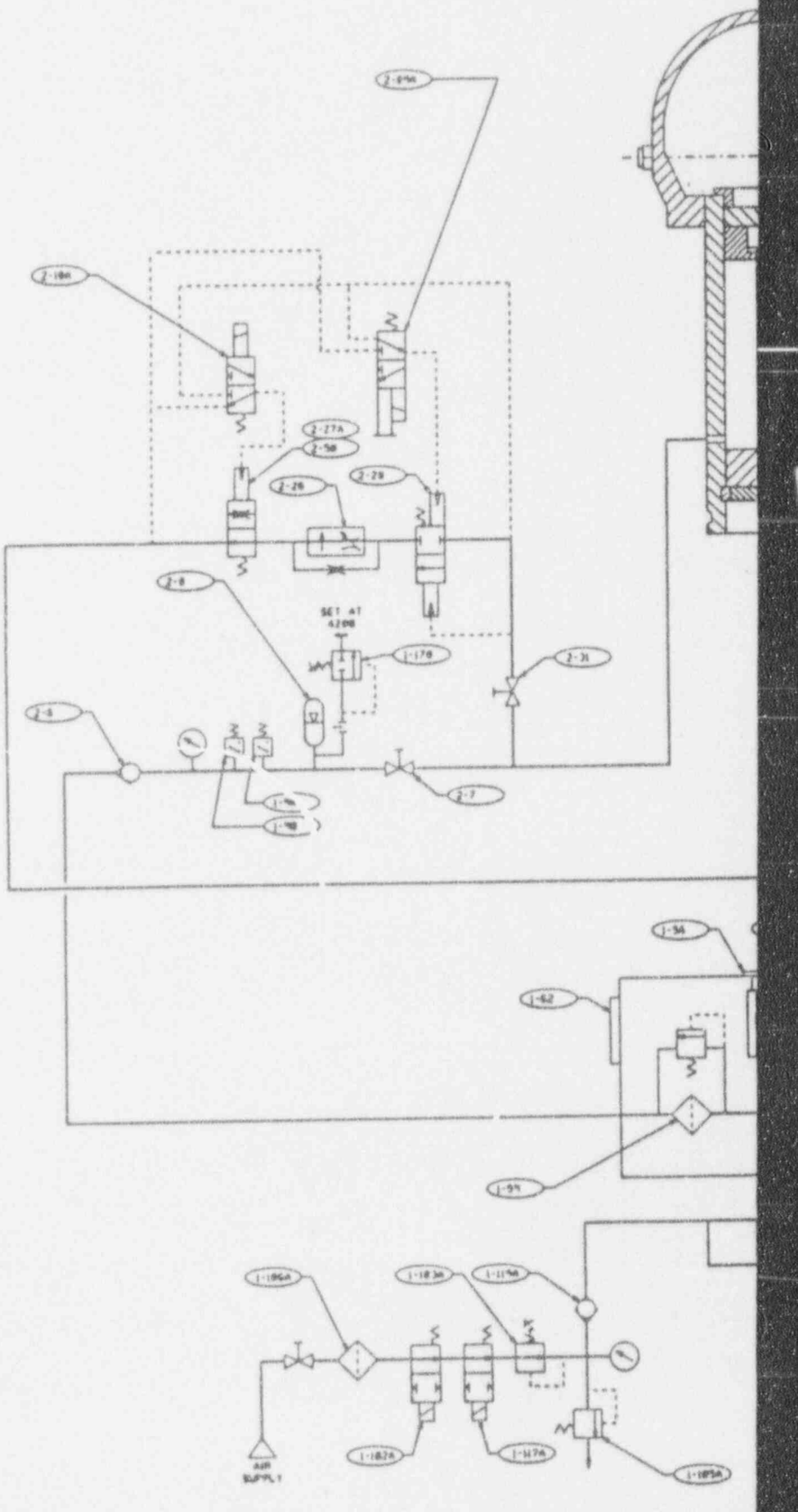
Plant Conditions

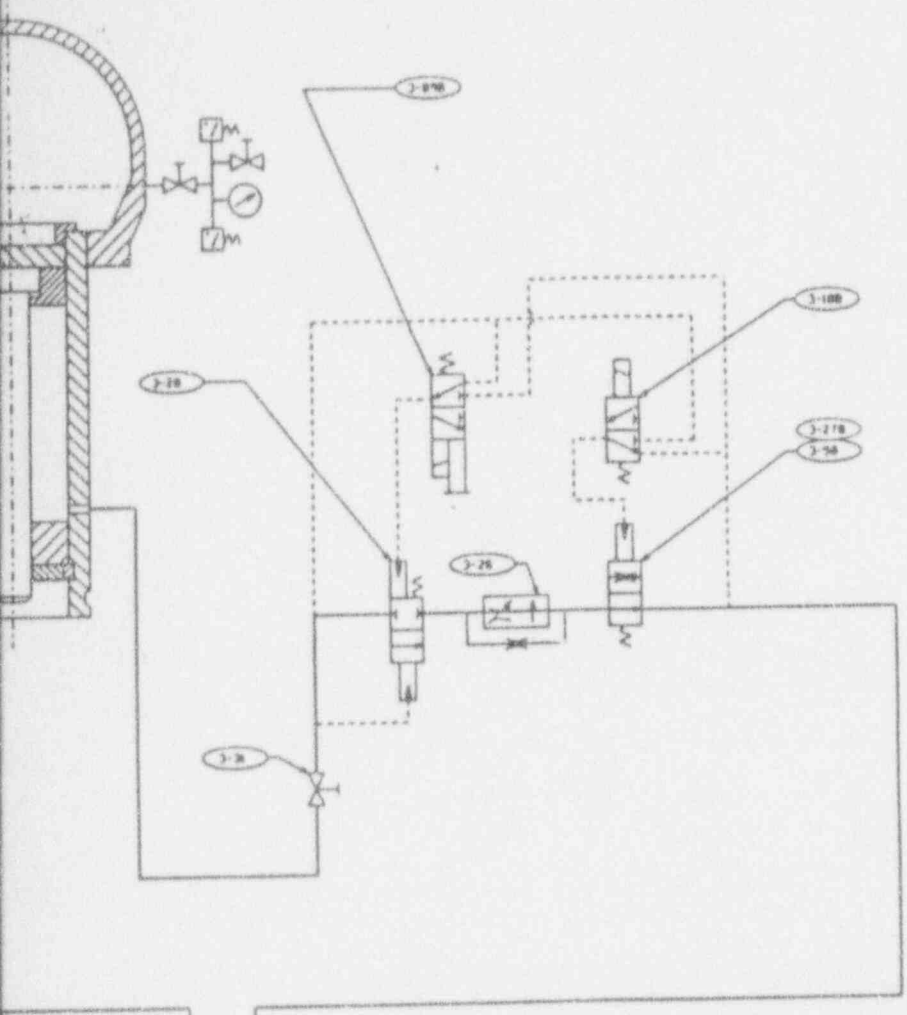
At the time of this event, the plant was in Mode 1, at 100 percent power, with a Reactor Coolant System temperature of 587 degrees Fahrenheit and a pressure of 2235 psig.


MSIV-

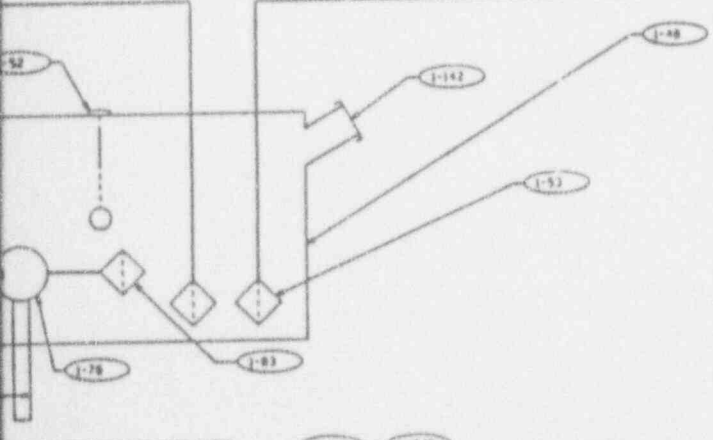
ID No	Description
1-94	LO HYDRAULIC PRESSURE SWITCH
1-96	LO HYDRAULIC PRESSURE SWITCH
1-48	RESERVOIR
1-52	LEVEL SWITCH
1-55	DIFFUSER
1-56	MAGNETIC CLEANER
1-59	PUMP DISCHARGE FILTER 10 MICRON
1-62	SIGHT GAUGE
1-76	HYDRAULIC PUMP
1-87	PUMP SUCTION STRAINER 150 MICRON
1-182A	SOLENOID VALVE TRAIN A
1-182B	SOLENOID VALVE TRAIN B
1-183A	AIR REGULATOR VALVE TRAIN A
1-183B	AIR REGULATOR VALVE TRAIN B
1-185A	RELIEF VALVE TRAIN A
1-185B	RELIEF VALVE TRAIN B
1-186A	FILTER TRAIN A
1-186B	FILTER TRAIN B
1-117A	SOLENOID VALVE TRAIN A
1-117B	SOLENOID VALVE TRAIN B
1-119A	CHECK VALVE
1-119B	CHECK VALVE
1-142	BREATHER FILTER
1-179	ACCUMULATOR RELIEF VALVE
2-6	CHECK VALVE
2-7	HYDRAULIC ISOLATION V-4 VE
2-8	THERMAL ACCUMULATOR
2-18A	TEST SOLENOID PILOT VALVE TRAIN A
2-26	FLOW CONTROL VALVE TRAIN A
2-27A	EXCERCISE VALVE MICROSWITCH TRAIN A
2-29	MAIN DUMP VALVE TRAIN A
2-31	TRAIN A HYDRAULIC ISOLATION VALVE
2-58	EXCERCISE VALVE TRAIN A
2-89A	MAIN DUMP SOLENOID PILOT VALVE TRAIN A
2-18B	TEST SOLENOID PILOT VALVE TRAIN B
2-26	FLOW CONTROL VALVE TRAIN B
2-27B	EXCERCISE VALVE MICROSWITCH TRAIN B
2-29	MAIN DUMP VALVE TRAIN B
2-31	TRAIN B HYDRAULIC ISOLATION VALVE
2-58	EXCERCISE VALVE TRAIN B
2-89B	MAIN DUMP SOLENOID PILOT VALVE TRAIN B

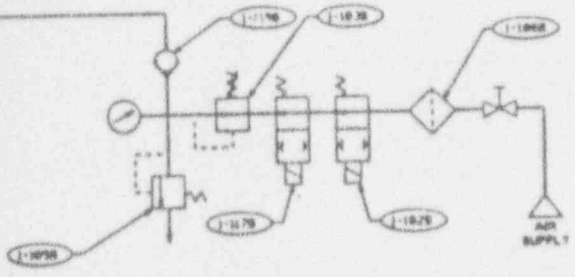
PUMP SIDE MANIFOLD
'A' TRAIN





NON-PUMP SIDE MANIFOLD
("B" TRAIN)





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MSIV-