James A. FitzPatrick
Nuclear Power Plant
P.O. Box 41
Lycoming, New York 13093
315 342-3840

NewYorkPower Authority

Harry P. Salmon, Jr.
Resident Manager

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JAFP-93-0153

United States Nuclear Regulatory Commission
Document Control Desk
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Washington, D.C. 20555

SUBJECT: DOCKET NO. 50-333
LICENSEE EVENT REPORT: 93-003-00 - Non-Safety-Related Components Connected to the Drywell Nitrogen Header Possibly Affecting Long Term Nitrogen Supply for ADS

Dear Sir:

This report is submitted in accordance with 10CFR50.73 (a)(2)(ii)(B).

Questions concerning this report may be addressed to Mr. David Holliday at (315) 349-6359.

Very truly yours,

HARRY P. SALMON, JR.

HPS:DAH:tld
Enclosure

cc: USNRC, Region 1
USNRC Resident Manager
INPO Records Center

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NRC FORM 366 (6-89)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
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TITLE (4): Non-Safety-Related Components Connected to the Drywell Nitrogen Header Possibly Affecting Long Term Nitrogen Supply for ADS

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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OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	1 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		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 (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)	
		20.405(a)(1)(iv)	X 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
Mr. David Holliday, Senior Licensing Engineer	AREA CODE 3 1 5 3 4 9 – 6 3 5 9

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	

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)

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The plant was operating at 100 percent power. During a review of component classifications, Engineering identified some non-safety-related components which were connected to the drywell (primary containment) [NH] safety-related nitrogen supply header [LK]. During efforts to upgrade the components to safety-related in accordance with plant procedures, it was determined that certain parts within the non-safety-related components were made of a material (Buna-N) that is not suitable for high temperature conditions. Failure of these parts during post Loss-of-Coolant-Accident conditions could result in the depressurization of the nitrogen supply header and lead to the inability to provide a 100 day supply of nitrogen to safety-related Automatic Depressurization System [SB] valves, as described in the Updated Final Safety Analysis Report. Short term ADS operability is assured by nitrogen accumulators and check valves. The components were damper actuators, pressure regulators, and solenoid valves. Evaluations, calculations, and tests were performed to determine materials, failure modes, and leakage rates. A Reasonable Assurance of Safety evaluation was prepared and approved to justify operation until 2/26/93 when, during a planned shutdown, the necessary modifications were made to correct the non-conforming conditions.

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Description

The plant was operating at 100 percent power in a steady state condition. During a review of component classifications, New York Power Authority (NYPA) Engineering identified some non-safety-related components which were connected to the drywell (primary containment) [NH] safety-related nitrogen supply header [LK]. During efforts to upgrade the components to safety-related in accordance with plant procedures, it was determined that certain parts within the non-safety-related components were made of a material that is not suitable for high temperature conditions. Failure of these parts during post Loss-of-Coolant-Accident (LOCA) conditions could result in the depressurization of the nitrogen supply header and lead to the inability to provide a 100 day supply of nitrogen to safety-related Automatic Depressurization System (ADS) [SB] valves, as described in the Updated Final Safety Analysis Report (UFSAR).

A Reasonable Assurance of Safety (RAS) evaluation was prepared and approved to justify operation until February 26, 1993 when, during a planned shutdown, the necessary modifications were made to correct the non-conforming condition. A brief background and a summary of evaluations and actions taken follows:

UFSAR section 5.2.3.8.4 describes the nitrogen supply to drywell instruments and states in part:

> "The nitrogen supply to the containment instrumentation system is designed to provide the pneumatic supply requirements of instruments and controls inside the drywell including the long term (100 days) pneumatic supply requirements of the Automatic Depressurization System (ADS) Valves and Accumulators following a LOCA accident."

In early January, 1993, during a review of components which are connected to the drywell nitrogen header but perform non-safety-related functions within the drywell, Engineering identified pneumatic operated piston type actuators for Drywell Cooler [VB] air operated dampers (AODs) and their associated solenoid valves (SOVs). Since these components form the pressure boundary of the safety-related nitrogen supply, they should have been classified as safety-related.

Efforts were initiated to upgrade the components to safety-related. On or about January 13, 1993, it was determined that the diaphragms inside the AOD actuators and the core assembly plug inside one of the SOVs were made of Buna-N elastomer, a material not normally suitable for high temperature use (post-accident temperatures). There was concern that a common mode failure of the twelve diaphragms could lead to nitrogen leakage possibly exceeding the makeup capacity to the nitrogen header, resulting in loss of nitrogen header pressure.

This could lead to a loss of long term (100 day) ADS system operability, since the nitrogen system is required as a makeup system for ADS accumulators (part of a TMI Action Plan). Short term ADS operability is unaffected, since ADS accumulators and check valves ensure adequate short term nitrogen pressure.

An Engineering evaluation issued on January 19, 1993, summarized the findings and proposed a plan of action. Calculations had been performed which demonstrated that leakage through all twelve AODs and one SOV would be within the header makeup capacity. Also, the evaluation indicated that no failures of the AODs due to Buna-N deterioration had been noted since installation and that the actuators installed were essentially identical to the safety-related version except for the mounting arrangement and the diaphragm material.

Additional material reviews were then conducted for the remaining components in the twelve AOD pneumatic control lines. Engineering discovered that pressure regulators just upstream of the pneumatic control line SOVs, which reduce nitrogen system supply pressure (nominally 120 pounds per square inch {psig}) to a working pressure for the AODs (20 psig), contained nylon reinforced Buna-N diaphragms. This established the possibility of additional component failures resulting in greater leakage rates. Other components were also identified in other systems which required evaluation of materials, failure modes, and leakage rates. On February 1, 1993, Engineering recommended changes be made to Annunciator Response Procedures in order to provide instructions to isolate the AOD actuators and open a backup nitrogen supply valve to mitigate a loss of nitrogen header pressure event.

By February 11, 1993, an action plan had been developed to address all plausible failure scenarios and to pursue parallel paths for resolving the identified concerns. The action plan included analysis and component testing to assure component failure either would not occur or would not degrade long term ADS operability. An evaluation was also undertaken to consider the effect on continued short term plant operation if component integrity could not be assured.

The following systems and components were determined to have the potential for a common mode failure due to the failure of Buna-N materials at high temperatures, possibly leading to a total leakage rate greater than available nitrogen header makeup rates:

1) Twelve Drywell Cooler AOD actuators

2) Twelve Drywell Cooler AOD actuator pressure regulators

3) One Drywell Cooler AOD actuator pneumatic control line SOV

4) Two Core Spray [BM] Testable Check Valve SOVs

5) Two Reactor Vessel Head Vent Isolation Valve SOVs

On February 17, 1993, the NRC was notified of the possible inability to provide 100 day nitrogen makeup to safety-related valves using the Event Notification System.

Cause

The cause of this event is inadequate design (Cause Code B) by Engineering of a 1985 modification which upgraded the ADS pneumatic supply system to meet the long term, 100 day post accident operability requirements. This modification was intended to meet the requirements of NUREG 0737, Section II.K.3.28, regarding verification of the qualification of accumulators on ADS valves.

The objective of the modification was to ensure the long-term operability of the ADS following the design basis seismic event in a post-LOCA environment. The engineers did not upgrade all components connected to the nitrogen header. Alternatively, the design did not provide for adequate nitrogen flow in the event of their failure nor isolation of portions of the system that could fail.

Analysis

This event is reportable under the provisions of 10CFR 50.73(a)(2)(ii)(B) since the condition was outside the plant's design basis, potentially resulting in the inability to meet the 100 day long term operability requirements to which NYPA was committed.

Analysis has been performed by NYPA, and accepted by the NRC (part of the NRC TMI Action Plan Safety Evaluation, July 24, 1985), demonstrating short term ADS operability without nitrogen make-up. At elevated drywell pressures, nitrogen accumulators and check valves provide two actuations per valve for a period of 200 minutes following loss of nitrogen supply and 260 minutes under the same conditions at normal drywell pressure. Thus, ADS is operable for a period of at least 3.33 to 4.33 hours following a loss of nitrogen supply, depending upon drywell pressure.

The concern is that a loss of nitrogen makeup capability could occur, after that time period, due to post LOCA temperature induced failures in components attached to the drywell nitrogen header. The Reasonable Assurance of Safety (RAS) compared the postulated loss of nitrogen makeup (resulting in potential loss of ADS) with the limiting worst case single failure of one side of the DC power electrical distribution system. The conclusion was that a reasonable assurance of safety existed since shutdown cooling could be achieved in the worst case DC power failure scenario.

The RAS also stated:

> "During the course of that evaluation, it was also recognized that a different single failure than that considered could occur within the shutdown cooling system which would make shutdown cooling unavailable. The shutdown cooling system at FitzPatrick is not required to be single failure proof ....
>
> "In such a single failure, HPCI would be available, negating the need for depressurization using ADS. Several means of long term cooling would be available, including the steam condensing mode of RHR, cycling HPCI to maintain steam pressure low while maintaining vessel level using HPCI/RCIC and/or LPCI, depending upon pressure."

In parallel with evaluation and analysis for the RAS, tests were performed on site in which sample components were subjected to Small Break LOCA (SBLOCA) temperature conditions to provide a reasonable assurance they would continue to function. The tests used artificially elevated temperatures to compensate for aging based on an arrehenus time-temperature equivalence methodology.

1) Drywell AOD Nitrogen Line Components - Testing was performed on a pressure regulator similar to the drywell cooler AODs to evaluate the ability of the Buna-N parts in the regulator to withstand the temperatures resulting from a SBLOCA. The test showed the regulator to be capable of performing its design functions following the combined stresses of accident temperature and system operating pressure.

Although it was demonstrated that the SOV leakage would be within system makeup capacity, a test was also performed to evaluate an SOV under accident temperature conditions. This test showed the valve to maintain its isolation and seating capability and its pressure boundary integrity throughout, with no detectable leakage, even at inlet pressures as much as 2.5 times its normal operating pressure. This provides reasonable assurance that these SOVs will operate during and after the postulated accident conditions without compromise of their pressure boundary integrity.

Both tests were performed on off-the-shelf components and did not consider radiation effects on the material. Radiation effects are not significant for the SBLOCA. The performance of the sample components is considered to be similar to that of in-service components.

2) Core Spray Testable Check Valve (TCV) SOVs - Since the seating material for these valves had been identified to be the same as that already tested, it was believed that these valves would maintain their integrity and function in post SBLOCA conditions. However, when a valve of this type was drawn from stores for inspection, it was found to be configured differently and to function differently. Partial disassembly revealed a low temperature elastomer used as a pilot valve seat. It was also noted that the valve could be installed in more than one configuration, and that it was not certain what effect failure of the pilot valve seat would have on nitrogen header pressure. It was decided to test one of these valves to verify performance in post SBLOCA temperature conditions.

Approximately 40 minutes into the test, the valve leaked. The exact effect of in-service failure of one of these valves could not be ascertained since the exact failure characteristics of the valve seat and configuration of the in plant installation could not be verified. Therefore, it was conservatively assumed that the two core spray TCV SOVs would leak.

Based upon the above test results, the analysis of the loss of DC power scenario, and other considerations, there was reasonable assurance that, during the two weeks of continued operation, the drywell nitrogen header integrity and resultant long term ADS operability would not have been compromised. An additional test performed after the RAS was issued did not artificially elevate temperatures to compensate for aging and more closely modeled the actual SBLOCA peak temperature profile. The sample SOV successfully maintained its pressure boundary integrity for approximately twelve hours with no identified leakage.

Additional evaluation has shown that other components within the drywell forming a pressure boundary for the drywell nitrogen system are suitable for post accident conditions.

Corrective Actions

1. Evaluations and calculations were performed and verified which demonstrated that leakage through all twelve AODs and SOVs on the associated pneumatic supply lines would be within the header make-up capacity if station Annunciator Response Procedures were changed. Completed: February 11, 1993.

2. Annunciator Response Procedures were changed to open a backup nitrogen header supply valve in case a low header pressure alarm is received. Completed: February 11, 1993.

3. A modification was prepared to isolate the nitrogen supply to Drywell Cooler A inlet dampers and fix the dampers in the open position, replace the outlet damper SOVs, isolate the nitrogen supply to the Core Spray Testable Check Valves, and replace SOVs on the Reactor Head Vent Isolation Valves with environmentally qualified SOVs. Completed: March 5, 1993.

Additional Information

Failed Components: None

Previous Similar Events: None

Related Industry Experience: IE Bulletin No. 80-11: Operability of ADS Valve Pneumatic Supply