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SUBJECT: LER 88-034-00:on 880909,pipe failure caused by introduction of liquid Nitrogen into primary containment supply purge.
W/8 ltr.

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NRC Form 366
(9-83)

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

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
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TITLE (4) Pipe Failure Caused By Introduction of Liquid Nitrogen into the Primary Containment Supply Purge Piping Due to Personnel/Design/Maintenance Problems

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)
										0 5 0 0 0
0 9	0 9	8 8	8 8	— 0 3 4	— 0 0	1 2	2 1	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)			
1	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10) 0 7 3	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)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	Informational
	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
S.L. Washington, Compliance Engineer	5 1 0 9 — 3 7 7 - 1 2 1 0 8 1 0

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)

On the evening of September 9, 1988 the Plant was at 73% power (Operational Mode 1 - Power Operation) and on a slowly increasing power ramp and Primary Containment inerting was in progress. At 1916 hours, Equipment Operators in the Reactor Building heard a loud, sharp noise and notified the Control Room Operator. At 1917 hours, the Control Room Operator isolated the Containment Nitrogen line and closed the Containment Supply Purge Valves. At 2010 hours, while investigating the cause of the noise, a crack was found in the 30-inch Containment Supply Purge (CSP) line in the area where the 6-inch Containment Nitrogen (CN) line is welded to it.

Nitrogen inerting of the Primary Containment was begun earlier in the day but had to be terminated due to low level in the nitrogen storage tank. By 1820 hours, a Nitrogen Tank Truck was on site and had filled the tank to a level sufficient for inerting to be restarted. Several component problems existed when inerting was restarted: The Steam Temperature Control Valve (AS-TCV-1) to the Nitrogen Vaporizer (CN-VZ-1) would not function as a control valve and the Nitrogen Pressure Control Valve, which also has a system isolation function, was inoperable and bypassed.

At the time of the event, the liquid nitrogen tank was still being filled from the tank truck. The Equipment Operator at the vaporizer skid noticed that the nitrogen tank pressure had dropped from a normal pressure of 190 psi to 170 psi. The Equipment Operator directed the nitrogen tank truck driver to return the tank pressure to normal. As a result of the tank pressure increase and the inoperable automatic system controls, some liquid nitrogen passed through the vaporizer and was carried to the Containment Supply Purge (CSP) line where it caused the pipe crack.

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1/1

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

Abstract (Cont'd)

The root causes of this event are: 1) poor judgement by Plant operators in operating the system without consulting management for guidance pertaining to system operation with the identified component problems, 2) inadequate design of the Containment Nitrogen Inerting System, and 3) no preventive maintenance or periodic functional testing of the Containment Nitrogen Inerting System.

Corrective actions to correct the root causes include: 1) development of guidelines on when management should be consulted pertaining to out-of-service components, 2) a review of the Containment Nitrogen Inerting System design, and 3) development of a pre-system operation functional test to demonstrate system and component operability.

Further corrective actions included: Repair of the out of service equipment, inspections of associated equipment for damage, repair of the cracked pipe, and a revised Containment Inerting Procedure.

There are no adverse safety significant consequences associated with this event because primary containment integrity was maintained throughout the event.

Plant Conditions

a) Power Level - 73%
b) Plant Mode - 1 (Power Operation)

Event Description

On the evening of September 9, 1988 the Plant was at 73% power (Operational Mode 1 - Power Operation), on a slow increasing power ramp, and Primary Containment inerting was in progress. At 1916 hours, Equipment Operators in the Reactor Building heard a loud, sharp noise and notified the Control Room Operator (CRO). At 1917 hours, the CRO (a licensed reactor operator) closed valves CN-V-51, CSP-V-1,2,3, and 4 (See Figure 1) isolating the Containment Nitrogen (CN) supply line from the Primary Containment. At 2010 hours,the Shift Manager and Shift Support Supervisor (licensed senior reactor operators) investigating the cause of the noise found a crack in the 30-inch Containment Supply Purge (CSP) line in the area where the 6-inch line from the Containment Nitrogen (CN) system is welded to it.

To facilitate understanding of this event, the following description of the basic operation of the Containment Nitrogen (CN) Inerting System is presented.

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Reference Figure 1. Liquid nitrogen supplied from the Liquid Nitrogen Storage Tank (CN-TK-1) is piped to a steam-heated Nitrogen Vaporizer (CN-VZ-1) which converts the liquid nitrogen to gaseous nitrogen. Steam is supplied to CN-VZ-1 by the Plant Auxiliary Steam (AS) System. The auxiliary steam pressure to the vaporizer is controlled by Auxiliary Steam Pressure Control Valve AS-PCV-21 and the temperature of the gaseous nitrogen exiting the vaporizer is controlled at 100°F by Auxiliary Steam Temperature Control Valve AS-TCV-1. The gaseous nitrogen pressure is controlled at 30 psi by Containment Nitrogen Pressure Control Valve CN-PCV-6 which also closes to isolate the system if the nitrogen temperature reaches 0°F. The isolation signal is from Containment Nitrogen Temperature Controller CN-TC-2. The nitrogen gas is piped via the 6-inch Containment Nitrogen Supply line and the 30-inch Containment Supply Purge lines to the containment.

Nitrogen inerting of the primary containment was begun earlier in the day but had to be terminated due to low liquid nitrogen level in CN-TK-1. By 1820 hours, a Nitrogen Tank Truck was on site and had filled CN-TK-1 to a level sufficient for inerting to be restarted.

The following conditions existed when primary containment inerting was restarted:

1) Auxiliary Steam Pressure Control Valve (AS-PCV-21) would not control steam pressure and pressure was controlled by an Equipment Operator (EO) using bypass valve AS-V-157. This valve is located in the Reactor Building (471 foot elevation) and a separate Equipment Operator was assigned to operate this bypass valve to control auxiliary steam pressure.

2) The Auxiliary Steam Supply Valve to the vaporizer (AS-TCV-1), which modulates to control nitrogen outlet temperature, would not stroke more than 50% open and bypass valve (AS-V-154) was opened to supplement steam flow to the vaporizer to maintain the nitrogen outlet temperature at +100 degrees Fahrenheit.

3) The pressure control valve on the nitrogen line from the vaporizer (CN-PCV-6) would not open and was bypassed using valve CN-V-27.

4) A single Equipment Operator was stationed at the tank, vaporizer, and pressure control valve skid to control its operation.

5) The liquid nitrogen tank was still being refilled from the truck.

The following is a summary of events between 1900 hours and 2010 hours.

At 1900 hours, the Equipment Operator left the vaporizer skid to check the refilling of the tank and noticed that the nitrogen tank pressure had dropped from a normal pressure of 190 psi to 170 psi. The Equipment Operator directed the nitrogen tank truck driver to return the tank pressure to the normal 180-190 psi range.

At 1905 hours, the Equipment Operator returned to the vaporizer skid and verified that nitrogen temperature and pressure were normal.

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At 1906 hours, the Control Room Operator controlling containment inerting in the Control Room noticed that containment pressure was increasing and that flow was increasing on the operating Standby Gas Treatment train which was being used to purge the containment during the inerting process.

At 1907 hours, the operating Standby Gas Treatment train tripped due to low differential pressure at the fan flow transmitter. The backup train started automatically and the Control Room Operator verified that it was operating properly.

At 1910 hours, the Equipment Operator at the vaporizer skid notified the Control Room Operator that flow noise had momentarily been lost at the vaporizer skid.

At 1915 hours, the Control Room Operator in the Control Room reverified that the SGT System was operating properly.

At 1916 hours, two Equipment Operators in the Reactor Building heard a loud, sharp noise. One of them noticed that the 6-inch Containment Nitrogen Supply line was covered with frost. He immediately notified the Control Room Operator of the observation.

At 1917 hours, the Control Room Operators in the Control Room shut the Containment Nitrogen Supply Valve (CN-V-51) and the Containment Supply Purge Valves (CSP-V-1,2,3 and 4) to terminate inerting of the containment. These actions caused the relief valve (CN-RV-16) at the vaporizer skid to lift and the nitrogen inerting header to frost. The Equipment Operator at the vaporizer skid isolated the nitrogen supply header at the skid.

At 1918 hours, the Shift Manager and the Shift Support Supervisor went to the Reactor Building and found the 6-inch Containment Nitrogen Supply line at CN-V-51 completely covered with dry frost. The 30-inch CSP line was found to have some areas of wet frost. They noticed that the local temperature indicator (CN-TI-12) was reading approximately 100 degrees Fahrenheit and called the Equipment Operator at the vaporizer skid requesting the temperature at CN-TI-2.

At 1920 hours, the Shift Support Supervisor inspected the CSP Valves (CSP-V-1 and 2) and found very little frost. The Equipment Operator at the vaporizer skid reported that CN-TI-2 was reading 120 degrees Fahrenheit.

At 1923 hours, the Shift Support Supervisor reported to the vaporizer skid to check on conditions. He found CN-TI-2 still reading 120 degrees Fahrenheit with the line fully frosted. (Subsequent investigation showed that the needle of the temperature indicator had rotated past the 0°F indication and was actually sensing a temperature below 0°F, but was indicating a positive temperature. He noticed that the green indicating lamp was not lit for temperature controller (CN-TC-2) which provides the signal for the automatic closure of CN-PCV-6.

At 1925 hours, the nitrogen tank truck disconnected from the Nitrogen Storage Tank and left the site.

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At 2110 hours, the Shift Manager and the Shift Support Supervisor returned to the Reactor Building to inspect the piping involved and found the 30-inch CSP line cracked where the 6-inch CN supply line is welded to it.

Immediate Corrective Action

Control Room Operators shut the inerting nitrogen supply valve (CN-V-51) and CSP Valves (CSP-V-1,2,3 and 4) to terminate Containment inerting. The Equipment Operator at the vaporizer skid isolated the nitrogen supply header at the skid.

The Shift Manager and Shift Support Supervisor inspected the CN supply and CSP piping.

Further Evaluation and Corrective Action

A. Further Evaluation

This event is submitted as a voluntary report.

The following components were out of service prior to the event and contributed to the event:

Auxiliary Steam Pressure Control Valve (AS-PCV-21). The function of this valve is to maintain the auxiliary steam pressure to the nitrogen vaporizer at 50 psig. The valve (AS-PCV-21) controller design is inadequate and will not maintain system pressure in response to movement of AS-TCV-21. To compensate for this, an Equipment Operator is stationed at AS-PCV-21 to control pressure by operating bypass valve AS-V-157. This component design problem had no effect on the event.

Auxiliary Steam Temperature Control Valve (AS-TCV-21). The function of this valve is to regulate steam to the nitrogen vaporizer to maintain the nitrogen gas temperature exiting the vaporizer at 100°F or greater. This valve would only stroke 50% open and the manual bypass valve AS-V-154 was opened to compensate. The effect was the skid Equipment Operator had to monitor the vaporizer nitrogen outlet temperature and adjust the bypass valve to maintain the correct nitrogen temperature.

Containment Nitrogen Temperature Controller (CN-TC-2). The function of this controller to to close the Containment Nitrogen Pressure Control Valve (CN-PCV-6) if the nitrogen temperature exiting the vaporizer reaches 0°F. A blown fuse in the CN-TC-2 control power circuit caused the solenoid pilot valve (CN-SPV-1) to be deenergized which caused (CN-PCV-6) to be held closed. The function of CN-PCV-6 is to control the pressure of the nitrogen gas exiting the vaporizer. Following the event, the diaphram of CN-PCV-6 was found cracked also making the valve inoperable. It is not known whether the diaphram cracked as a result of this event or was cracked prior to this event. The effect was the Equipment Operator at the skid had to control nitrogen line pressure manually using bypass valve CN-V-27. A second effect was that the automatic nitrogen line isolation on low temperature was inoperable.

The most probable system dynamics of this event is that as the nitrogen tank pressure decreased, the nitrogen mass flow through the vaporizer slowly decreased. Since the steam supply was relatively constant, increasingly hotter nitrogen gas entered the system and nitrogen flow decreased until the back pressure caused by the piping thermal heat sink balanced with the decreasing nitrogen tank pressure. The Nitrogen Inerting System Procedure, PPM 2.3.1, required that the nitrogen tank pressure should be maintained at 180-190 psig. The Equipment Operator noticed that the nitrogen tank truck driver had allowed the nitrogen tank pressure to decrease to 170 psig, and he left the skid and instructed the tank truck driver to increase pressure to between 180-190 psig. He was away from the skid, observing the nitrogen tank pressure increase evolution, for what he thought to be about five minutes. As the nitrogen tank pressure increased nitrogen mass flow through the vaporizer started to increase. With the steam supply constant, cooler nitrogen gas would go into the inerting system. As more and more nitrogen received less and less thermal energy per unit mass, the mass flow rate of nitrogen through the vaporizer increased at an increasing rate. Higher differential pressures across the heat exchanger also caused still more liquid nitrogen to flow into the heat exchanger, further overloading it. The fact the operator was not at the skid monitoring nitrogen gas temperature, meant for a period of time there was no feedback mechanism (operator) in the control circuit to counter the increasing nitrogen mass flow and the system eventually reached a point where two-phase nitrogen flow was occurring.

The root causes of this event are as follows:

1) The decision of the Shift Support Supervisor and Equipment Operators to operate the system with multiple failed and inadequate components without management or technical consultation. Neither the Shift Manager nor the Control Room Supervisor were consulted with on the decision to operate the system with the identified problems.

2) The design of the nitrogen inerting system may be less than adequate. The existing design requirements for CN-PCV-6 and AS-TCV-1 may not be sufficient for expected transient conditions.

3) There was no preventive maintenance or periodic functional test of the system. Problems were only discovered during system operation.

B. Further Corrective Actions

1. An Operations Department "Night Order" was issued directing the following actions be taken until the Nitrogen Inerting Procedure is revised. The containment nitrogen inerting will be directed by a dedicated Shift Support Supervisor and two dedicated Equipment Operators. One Equipment Operator will continuously monitor nitrogen gas temperatures and manually shutdown the system if necessary.

2. A procedure is being written that will address requirements for taking manual control of automatic controllers. The procedure will require operators to notify the Shift Support Supervisor and the Shift Manager in order to review the conditions and to evaluate the proper corrective actions prior to proceeding with the evolution.

3. A Technical Evaluation Request has been issued to investigate the possibility of modifying the pressure control valve on the steam supply to vaporizer (AS-PCV-21) so that it will respond quickly enough to control steam pressure at the vaporizer.

4. CN-PCV-6, AS-TCV-1 and CN-TC-2 have been repaired.

5. A walk down of the nitrogen supply piping was performed to inspect piping, hangers, anchor points, anchor bolts and penetration seals. No damage was found other than the cracking on the 30-inch line at the CSP/CN interface.

6. Local Leakrate Tests were performed on CSP-V-1,2,3 and 4. Leakrate tests were repeated on CSP-V-1 and 2 after the valves were stroked. These tests met normal leakage requirements.

7. An Engineering evaluation to determine the effects and extent of liquid nitrogen flowing through CSP-V-1,2,3 and 4 was conducted. The evaluation determined that the valves are acceptable, but recommends that their seats be inspected during the next refueling outage.

8. A physical and Non-Destructive Evaluation (NDE) inspection was made on all ASME welds on the outside of the 30-inch line between the 6-inch nitrogen connection and containment and on the inside of the 30-inch line and the containment side of CSP-V-2. All welds were found to be satisfactory.

9. The crack in the 30-inch line was repaired.

10. An Engineering design review of the Nitrogen inerting system will be performed, including consideration of transient conditions, to ensure only single-phase nitrogen gas enters the Reactor Building and that adequate nitrogen isolation capability is assured.

11. The Nitrogen Inerting System Procedure, PPM 2.3.1 is being revised to incorporate special procedure steps to compensate for existing component problems and to require a pre-operation functional test to determine the operability status of System components. It is planned that the functional test will be performed far enough in advance to allow any component problems found to be fixed prior to the need to operate the System (preventive maintenance).

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Safety Significance

There are no adverse safety significant consequences associated with this event. At the time of the event the primary containment was at 1.5% oxygen which is below the nitrogen gas requirement of less than 3.5% oxygen in the containment. The low flow containment inerting system (a separate system) was capable from this point of maintaining the nitrogen containment inerting. The requirement for a nitrogen purge is a pre-event condition only. The introduction of liquid nitrogen into the CSP line could possible have caused damage which could have prevented these lines from isolating on a Loss of Coolant Accident. An inspection of these lines showed no damage in the piping, and valves CSP-V-1,2,3 and 4 passed local leak rate tests in their "as found" condition. Therefore, the containment isolation valves were operable throughout the event. Accordingly, this event posed no threat to the health and safety of either the public or Plant personnel.

Similar Events

None

EIIS Information

Text Reference	EIIS Reference	
	System	Component
Primary Containment	NH	- - - - -
Containment Nitrogen (CN) Line	LK	PSP
Containment Supply Purge (CSP) Valves (CSP-V-1,2,3&4)	VB	ISV
Containment Supply Purge (CSP) Line	VB	PSP
(Liquid) Nitrogen Storage Tank (CN-TK-1)	LK	TK
Auxiliary Steam Temperature Control Valve (AS-TCV-1)	LV	TCV
Nitrogen Vaporizer (CN-VZ-1)	LK	VPR
Nitrogen Pressure Control Valve (CN-PCV-6)	LK	PCV
Containment Nitrogen (CN) Inerting System	LK	- - - - -
Auxiliary Steam Pressure Control Valve (AS-PCV-21)	LV	PCV
Containment Nitrogen Termperature Controller (CN-TC-2)	LK	TIC
Auxiliary Steam Pressure Control Bypass Valve (AS-V-151)	LV	V
Auxiliary Steam Temperature Control Bypass Valve (AS-V-154)	LV	V
Containment Nitrogen Pressure Control Bypass Valve (CN-V-27)	LK	V
Standby Gas Treatment (SGT) Train	BH	- - - - -
Containment Nitrogen Supply Valve (CN-V-51)	LK	V
Containment Nitrogen Relief Valve (CN-RV-16)	LK	RV
Containment Nitrogen Temperature Indicator (CN-TI-12)	LK	TI
Containment Nitrogen Temperature Indicator (CN-TI-2)	LK	TI
Containment Nitrogen Temperature Solenoid Pilot Valve (CN-SPV-1)	LK	PSV

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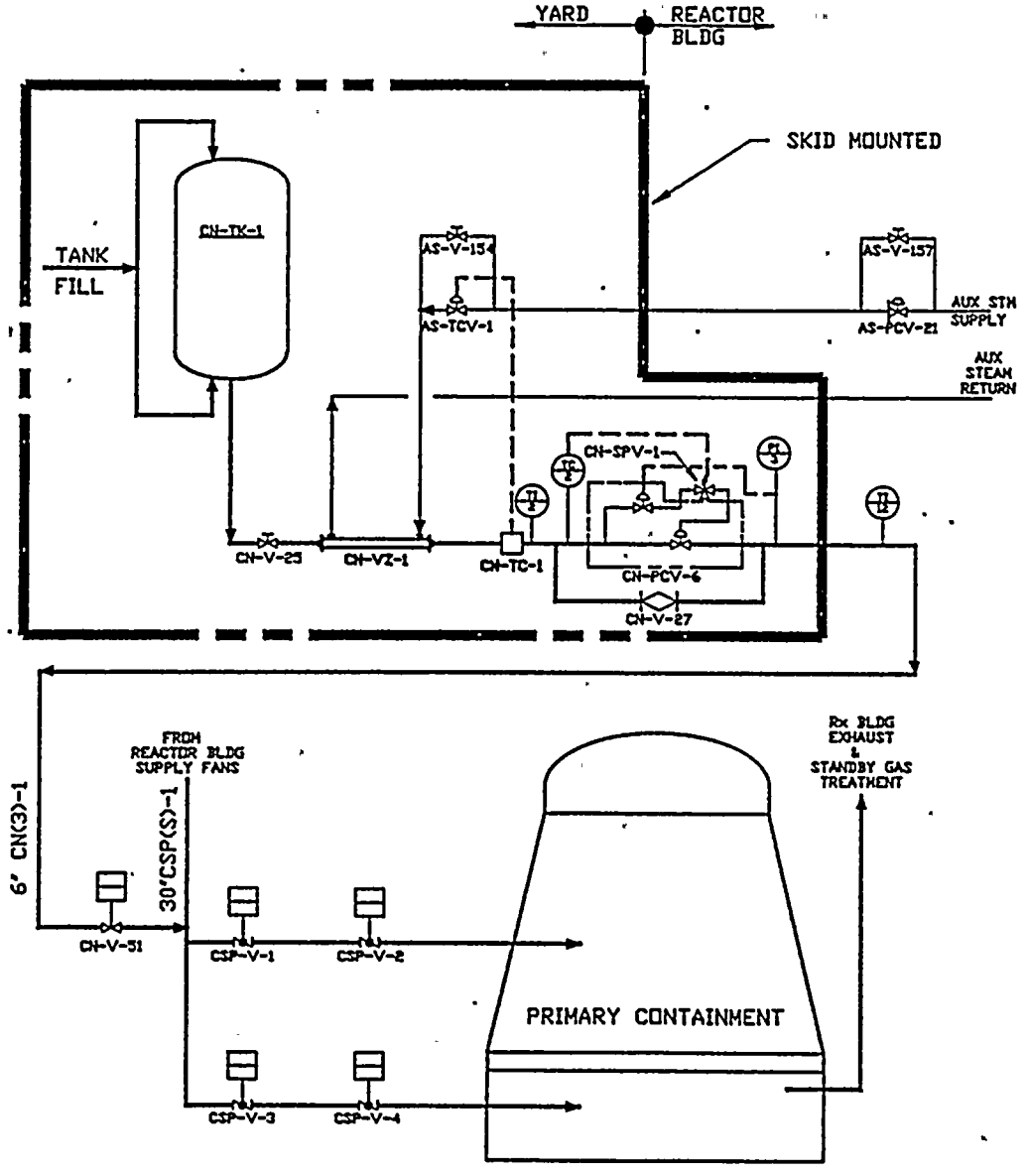

FIGURE 1 CONTAINMENT NITROGEN INERTING

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

P.O. Box 968 • 3000 George Washington Way • Richland, Washington 99352

Docket No. 50-397

December 21, 1988

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

Subject: NUCLEAR PLANT NO. 2
LICENSEE EVENT REPORT NO. 88-034

Dear Sir:

Transmitted herewith is Licensee Event Report No. 88-034 for the WNP-2 Plant. This report is submitted in response to the report requirements of 10CFR50.73 and discusses the items of reportability, corrective action taken, and action taken to preclude recurrence.

Very truly yours,

C M Powers

C.M. Powers (M/D 927M)
WNP-2 Plant Manager

CMP:lg

Enclosure:
Licensee Event Report No. 88-034

cc: Mr. John B. Martin, NRC - Region V
Mr. C.J. Bosted, NRC Site (M/D 901A)
INPO Records Center - Atlanta, GA
Ms. Dottie Sherman, ANI
Mr. D.L. Williams, BPA (M/D 399)

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