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R I D S / A D D S

SUBJECT: LER 93-009-00:on 930217,concluded that existence of noncondensible gases in reference leg of RPV Instrumentation.Caused by design deficiency.Credit was taken for existing flood watch.W/930319 ltr.

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March 19, 1993
G02-93-065

Docket No. 50-397

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

Subject: **NUCLEAR PLANT WNP-2, OPERATING LICENSE NPF-21
LICENSEE EVENT REPORT NO. 93-009**

Reference: Letter G02-93-051, dated March 2, 1993, J. W. Baker (SS) to J. B. Martin (NRC), "Existence of Noncondensable Gases in the RPV Narrow Range Instrumentation"

Transmitted herewith is Licensee Event Report No. 93-009 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.

This LER changes the Supply System's commitment on backfilling while pressurized. The reference stated that procedures were being developed. At this time backfilling at pressure is still being evaluated.

Sincerely,

JW Baker

J. W. Baker
WNP-2 Plant Manager (Mail Drop 927M)

JWB/CLF/cgeh
Enclosure

cc: Mr. J. B. Martin, NRC - Region V
Mr. R. Barr, NRC Resident Inspector (Mail Drop 901A, 2 Copies)
INPO Records Center - Atlanta, GA
Mr. D. L. Williams, BPA (Mail Drop 399)

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LICENSEE EVENT REPORT (LER)

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TITLE (4)
EXISTENCE OF NONCONDENSABLE GASES IN THE REFERENCE LEG OF REACTOR PRESSURE VESSEL INSTRUMENTATION

EVENT DATE (5) MONTH	DAY	YEAR	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	REPORT DATE (7) MONTH	DAY	YEAR	OTHER FACILITIES INVOLVED (8) FACILITY NAMES	DOCKET NUMBERS(S)
0 2	1 7	9 3	9 3	-- 0 0 9	-- 0 0	0 3	1 9	9 3		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): 1

POWER LEVEL (10): 1 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

20.402(b)	20.405(C)	50.73(a)(2)(iv)	77.71(b)
20.405(a)(1)(i)	50.36(c)(1)	X 50.73(a)(2)(v)	73.73(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)	
20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
C. L. Fies, Compliance Engineer	AREA CODE 5 0 9 3 7 7 - 4 1 4 7

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 (16)

On February 17, 1993, after a period of engineering review and evaluation, plant management concluded that the existence of noncondensible gases in the reference leg of Reactor Pressure Vessel (RPV) Instrumentation could have affected the point at which a RPV Level 3 isolation actuated. This acutation is required in response to a postulated pipe crack and would have delayed a Nuclear Steam Supply Shutoff System (NS^4) Groups 5 and 6 isolation.

As an immediate corrective action credit was taken for an existing flood watch to assure a leak would be detected and any flood could be terminated. Further corrective actions include procedure changes and training to provide plant operators with information on how to recognize the noncondensible gas problem and to describe actions to be taken if the conditions are observed. Boiling Water Reactor Owners Group (BWROG) activities associated with this problem are being tracked to provide a short and long-term solution to this issue.

The root cause of this event was a design deficiency. The RPV level instrumentation designer did not recognize the impact of noncondensible gases in the system.

The event posed no threat to the health and safety of either the public or plant personnel.

Plant Conditions

Power Level - 100%
Plant Mode - 1

Event Description

On February 17, 1993, after a period of engineering review and evaluation, plant management concluded that the existence of noncondensible gases in the reference leg of Reactor Pressure Vessel (RPV) Instrumentation could have affected the point at which the RPV Level 3 isolation actuated. This trip is used to mitigate a postulated moderate energy line crack during shutdown cooling. During shutdown cooling a RPV Level 3 trip results in a Nuclear Steam Supply Shutoff System (NS^4) Groups 5 and 6 isolation. This isolation closes the Residual Heat Removal (RHR) Shutdown Cooling Outboard and Inboard Supply Valves (RHR-V-8 and RHR-V-9) plus other RHR system valves (please see the attached figure). The purpose of this isolation function is to prevent draining the RPV water to areas outside containment in the unlikely event of a pipe crack in the RHR piping. Four Level Indicating Switches (MS-LIS-24A, B, C, and D) are used to detect a loss of water level during this shutdown cooling condition. Each of these instruments is associated with a separate condensing chamber (MS-CU-4A, D, C, and B, respectively) and reference leg instrument tubing. The logic associated with Group 5 and 6 isolation is a two-out-of-two arrangement. One trip system (Division) of the logic operates the outboard valves and the other the inboard valves. A RPV low water level condition detected by MS-LIS-24A (associated with MS-CU-4A) and MS-LIS-24B (associated with MS-CU-4D) would result in an outboard isolation (closure of RHR-V-8, plus other valves). Likewise, a RPV low water level condition detected by MS-LIS-24C (associated with MS-CU-4C) and MS-LIS-24D (associated with MS-CU-4B) would result in an inboard isolation (closure of RHR-V-9 plus other valves).

Previously, on January 21, 1993, during depressurization after 140 days at power, RPV level notching and degassing were observed as part of preplanned data gathering for the Boiling Water Reactor Owners Group (BWROG). The notching and degassing are both believed to have been initiated by the build up of noncondensable gases in the level instrumentation reference legs during the approximately 140 day run prior to the scram. During operation, these gases can move into the reference legs by several methods. These include, 1) leakage at the instrument racks, which allows the water with the dissolved gases to migrate down the reference legs, 2) thermal mixing within the reference leg, 3) gas diffusion down the reference legs and 4) gases introduced by surveillance test activities when test equipment is connected to the instrument lines.

The term notching is used to describe indicated alternating step increases in level indication of about six inches lasting for about one minute. It is believed to be a result of gas bubbles that accumulate and are released as relatively large bubbles during depressurization and eventually propagate to the vertical sections resulting in momentary water head perturbations. The notching is repetitive and may reflect the instrument piping geometry. The term degassing is used to describe erratic noise like pulses that can result in an increased level biased error. It is a result of the noncondensable gases coming out of solution forming many small bubbles that propagate to vertical sections resulting in momentary water head perturbations. The quantity of noncondensable gasses released during depressurization by this mechanism, possibly in combination with the phenomenon resulting in notching, can displace water from the reference leg as the bubbles move up the reference leg lines. A reference leg level water volume decrease results in a higher than actual water level indication.

Following the reactor scram on January 21, 1993, notching on narrow range channels B and C (associated with condensing chambers MS-CU-4B and MS-CU-4C respectively) was observed by high resolution recording provided by the computer system. This data was being collected to support BWROG activities associated with this subject. No notching was detected on Channel A and Channel D is not recorded. The first notch occurred on Channel C about 7.7 hours after the scram when reactor pressure was about 120 psig. The notch gave a false high level indication of about four inches lasting for about one minute. Channel C notching indications reappeared at ten to fifteen minute intervals until they were masked by significant degassing at about 10.7 hours after the scram. Notching appeared on Channel B about 8.6 hours after the scram with pressure about 50 psig. Channel B showed repeated double notches of about seven inches in height with the first notch having duration of about one minute followed by a second notch of about 0.8 minute duration. The Channel B notching continued throughout the monitored period.

Some degassing was observed on all narrow range channels monitored by the computer starting about eight hours after the scram when pressure was about 80 psig. The degassing for Channels A and B did not produce an appreciable bias; the indicated increase was less than about two inches. Channel C showed increased degassing of about 10 inches at about nine hours after the scram when pressure was 35 psig. At about 10.7 hours after the scram, coincident with the initiation of shutdown cooling and a pressure drop from 20 to 10 psig, significant degassing occurred on narrow range Channel C. The degassing resulted in a peak level offset of about 32 inches within four minutes of the pressure reduction. Within about 25 minutes narrow range Channel C recovered to an average value of about six inches above the expected level and within two hours it had fully recovered to the expected level; probably in response to the condensing chamber refilling the reference leg.

This observed behavior of the RPV level instrumentation could have delayed the initiation of a Level 3 trip in the event of a pipe crack in the RHR piping. The inboard isolation function is initiated only if level indicating Switches MS-LIS-24C and MS-LIS-24D are both actuated. Thus, the trip could have been delayed until the level was 32 inches below Level 3 based on the observed degassing behavior of narrow range Channel C. The response of the redundant outboard logic as a result of degassing is indeterminant. No high resolution recording data is available for the instrumentation associated with condensing Chamber MS-CU-4D and connected indicating Switch MS-LIS-24B. No degassing was observed associated with MS-CU-4A and its connected MS-LIS-24A. However, the two-out-of-two logic requires both channels to trip for isolation.

This condition could have impacted the flooding analysis and the capability to remove decay heat from the reactor.

Immediate Corrective Action

Credit was taken for an existing flood watch using surveillance cameras and an hourly flood tour to assure a leak is detected and any flood could be terminated. These compensatory measures were initiated as compensatory action for problems experienced with the ECCS pump room penetration seals as explained in LER 92-034.

Further Evaluation, Root Cause and Corrective Action

A. Further Evaluation

1. This event is being reported per the requirements of 10CFR 50.73(a)(2)(v) as, "....an event or condition that along could have prevented the fulfillment of the safety function of....systems that are needed to....remove residual heat." A four hour nonemergency report in accordance with 10CFR 50.72(b)(2)(iii) was made at 1656 hours on February 17, 1993.

2. A further evaluation was performed for each of the instruments attached to the condensing chambers. The instrumentation can be divided into three functional categories: those that provide signals for automatic actuations or process variable information for plant operator use at pressures above 450 psig; those that provide process variable information for plant operator use at pressures below 450 psig; and those that provide signals for automatic actuations at pressures below 450 psig. The following is a discussion of each category:

    a. Functions that use instrumentation to provide signals for automatic actuation or process variable information for operator action at pressures above 450 psig include High Pressure Core Spray (HPCS) high level trip, RPV low water level scram, Reactor Core Isolation Cooling (RCIC) high level trip, HPCS RPV low water level initiation, containment isolation initiation, post accident RPV level and pressure monitoring, Main Steam Isolation Valve (MSIV) high pressure scram interlock, RPV high pressure scram, reactor feedwater RPV high water level trip, RPV low water level ATWS initiation, ECCS/RCIC RPV low water level initiation, Automatic Depressurization System (ADS) initiation on low RPV level, Safety Relief Valve (SRV) actuation, ECCS injection valve interlock on low RPV pressure, and ATWS initiation on RPV high pressure. Since these functions all occur at high pressure the evaluation concluded there would be no impact from notching or degassing.

b. Functions that use instrumentation to provide information for plant operator use at pressures below 450 psig include post accident water level monitoring (main control room and remote shutdown panels), post accident RPV pressure monitoring (main control room and remote shutdown panels), and post accident fuel zone, shutdown range, and upset range RPV water level monitoring. For these functions plant operators have been provided with guidance in determining RPV vessel water level following depressurization when degassing may have resulted in inaccurate water level displays.

   In addition, in this category the MSLC function provides a permissive for Operator initiated MSLC following a LOCA at a pressure which will protect the low pressure piping. This variable actuates at 61 psig which is within the range at which WNP-2 and other Plants have experienced the effects of instrument line degassing. The worst case result of degassing is a premature initiation of MSLC at approximately 79 psig. This has no safety significance since WNP-2 has preliminary calculations which indicate that the MSLC piping will not fail from an inadvertent opening of the system inlet valves with the MSIVs closed and leaking at maximum Technical Specification rates.

c. There is one function that uses instrumentation signals for automatic actuation at RPV pressure below 450 psig; RHR Isolation during shutdown cooling.

   The RHR shutdown cooling isolation valves are held closed by a reactor pressure interlock to prevent opening these valves during high reactor pressure conditions and exposing the low pressure piping to high pressure. For moderate energy pipe crack events (RHR piping), during shutdown cooling operation when the reactor is depressurized, these valves are automatically closed by reactor low water signals (Level 3 trip). Under Mode 3 conditions, the RPV Level 3 trip could experience water degassing and not be available to actuate RHR valve isolation at the correct time. The corrective actions below describe how the plant will be operated within the bounds of the Technical Specification under these conditions.

   Further evaluation has been completed assuming that the reactor Vessel Level 3 trip signals are not available. In this case, the crack will continue to flood the RHR pump room without automatic isolation (refer to FSAR Question Response 211.031). This condition will continue until the pump room flood monitors actuate and alert Plant Operators of flood conditions. The accident analysis assumes that Operator action can occur from the Control Room 20 minutes after the condition is known. This event will result in loss of approximately 63 inches of reactor with loss being terminated by Operator action at a vessel of approximately -22 inches; this is 138 inches above the Top Of Active Fuel.

The above Shutdown Cooling scenario assumes that the pump room flood monitor actuates. Since these monitors are not single failure proof, it is necessary to postulate loss of this signal. In this case, no safety related backup signals exist which will actuate under all post accident operating conditions to alert operators to the need for flood mitigation. Flooding can be mitigated by either the hourly tour or surveillance cameras. This will result in a scenario where operators will begin RPV makeup if water drops within the EOP control band preventing core uncovery. The break will continue to flood the pump room until it is identified by the tour (the most conservative option) and operator action is taken to terminate the flood. The flood tour or camera monitoring will continue until the cause of degassing is corrected or until the specific effects of degassing are known and shown to be acceptable. During shutdown cooling, the flood tour or continuous monitoring need only be continued until the four narrow range instrument legs can be back filled to the condensing chambers.

3. There were no structures, components or systems that were inoperable prior to the start of this event which contributed to the event.

B. Root Cause

The root cause of this event was a design deficiency. The RPV instrumentation designer did not recognize the impact of noncondensible gases in the system. Very low leakage criteria were not a requirement of the original design.

C. Completed Corrective Action

The following corrective actions have been completed in response to this issue.

1. Criteria have been developed for operability of RPV Water Level Isolation Logic for RHR Isolation.

    a. Channels A through D are operable in Modes 1 and 2 as the phenomenon observed can only exist during depressurization.

b. An operability assessment of water level instrumentation isolation will be made when the plant enters Mode 3. To be conservative the Supply System will assume Channel C is inoperable in Mode 3 for Technical Specification 3/4.3.2, Trip Function 5.a. Channel C will be declared inoperable when the plant enters Mode 3 and the required response of Technical Specification Action Statement (3.3.2.b.2) will be taken promptly without regard to the 12 hours allowed by the Action Statement. The Supply System will inform the NRC resident inspector when Channel C is declared operable.

c. Notches that exceed six inches in height and a duration of two minutes are deemed unacceptable notches. When an unacceptable notch is observed, the trip channel associated with that signal is deemed inoperable.

d. If a trip channel has been deemed inoperable, the function of that channel may be recovered. Recovery of the channel requires the indication to return to the water level value that is consistent with the other operable water level channels and maintain that recovered water level indication for at least five minutes.

2. It is the Supply System's position that channels A, B, and D are operable in Mode 3. This is based upon the recognition that the notching observed in these channels is well defined, of short duration, produces a small error in RPV level indication and is much different from what would be expected for actual loss of RPV inventory that would put the plant at risk.

3. RPV water level instrumentation will be closely monitored whenever RPV pressure is below 450 psig until cold shutdown conditions are reached. This observation will be enhanced by using a real time plot of available Transient Data Acquisition System (TDAS) computer channels, when available, and local observation of MS-LIS-24B (narrow range Channel D). In addition, the plant process computer will be configured to display available RPV narrow range data. In Mode 3, if water level degassing is observed and the trip channel is deemed inoperable per the criteria in Paragraph 1 above, the Technical Specification Action Statement for MS-LIS-24A/B/D (3/4 3.3.2) will be entered.

4. In Mode 3, if entry into the Shutdown Cooling Mode has occurred and degassing is observed, the Plant will either continue to cold shutdown within the applicable Technical Specification actions or will remain in Hot Shutdown and restore the inoperable channel to an operable condition per the requirements of Paragraph 1 above, prior to continuing plant shutdown to cold shutdown.

5. If any channel(s) is inoperable, the existing hourly flood tour (or continuous camera surveillance) will continue in the associated RHR pump room whenever the Shutdown Cooling mode is entered when the Plant is in Mode 3 and will remain in effect until the Plant is in Mode 4.

6. Plant Procedures PPM 3.2.1, Normal Shutdown to Cold Shutdown, PPM 3.2.2, Normal Shutdown to Hot Shutdown, and PPM 3.3.1, Reactor Scram have been revised to accomplish the following: a) provide the operators instructions for enhanced monitoring of the narrow range RPV data to facilitate the identification of notching and degassing; b) provide the operators with guidance on how to recognize these conditions; and c) describe the actions to take if they are observed.

7. Operator training on the recognition of degassing and notching and on the determination of RPV water during depressurization has been completed.

8. A plant walkdown to visually identify any leaks has been completed. Leakage was measured over a four day period ending on March 1, 1993. Evidence of past leakage was present on valves and fittings associated with all condensing chambers. At the time of the inspection no visible leakage was observed on equipment associated with MS-CU-4A. Those areas that had the potential for significant leakage were bagged in an effort to quantify the leak. Measured leakage from equipment associated with MS-CU-4B was 41 milliliters over 98 hours. Leakage from devices associated with MS-CU-4C was 10 milliliters over 117 hours and leakage from MS-CU-4D was 15 milliliters over 99 hours.

D. Further Corrective Action

1. Procedures are being developed to backfill in Mode 4 while depressurized. These will be completed by April 15, 1993.

2. Procedures and methods are being evaluated for instrument line backfilling while pressurized. This evaluation will be completed by April 1, 1993.

3. An evaluation will be performed to identify any maintenance that can be implemented in the near term to minimize the RPV level inaccuracies. This evaluation will be completed by April 15, 1993.

4. A walkdown will be performed to identify areas in the reference leg piping where line slope could cause noncondensible gases to accumulate. This will be completed by the end of refuel outage Number 8 (approximately June 15, 1993).

5. The Supply System will continue to participate in BWROG activities associated with this subject. Recommendations made by the BWROG are expected to provide both short term maintenance and long-term resolution to this issue.

<u>Safety Significance</u>

Previous plant operation without knowledge of the importance of eliminating gasses from the instrument lines could have resulted in nonconservative biased indication of the instrumentation. However, information was available to assist plant operators in responding to plant emergencies with inaccurate instrumentation. With regard to the shutdown cooling isolation, the existence of the safety related room flood monitor provides a backup to the Level 3 trip. Even with the failure of this second device the analysis shows the plant can be safely shutdown. Therefore, the Supply System concludes the specific event described in this LER involving a Level 3 trip is not safety significant. However, the general issue of noncondensible gases in the reference leg of RPV instrumentation is safety significant.

<u>EIIS Information</u>

Text Reference	EIIS Reference System	EIIS Reference Component
Reach Pressure Vessel (RPV)	--	VSL
Nuclear Steam Supply System (NS^4)	BD	--
Residual Heat Removal System (RHR)	BO	--
RHR Shutdown Cooling Supply Valves (RHR-V-8 & RHR-V-9)	BO	V
Level Indicating Switches (MS-LIS-24A, B, C and D)	SB	LIS
Condensing Chambers (MS-CU-4A, B, C and D)	SB	COND
High Pressure Core Spray System (HPCS)	BG	--
Reactor Core Isolation Cooling System (RCIC)	BN	--
Safety Relief Valves (SRV)	SB	V
Main Steam Leakage Control (MSCC)	SB	--
Transient Data Acquisition System (TDAS)	IP	--

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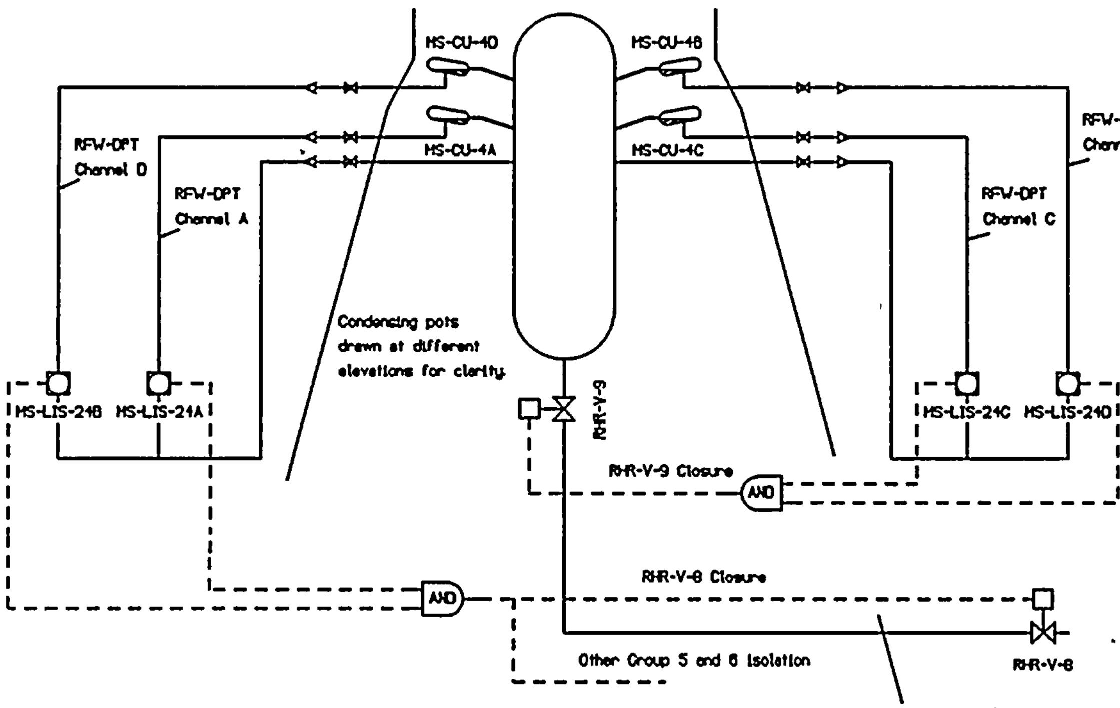
TITLE (4)
EXISTENCE OF NONCONDENSABLE GASES IN THE REFERENCE LEG OF REACTOR PRESSURE VESSEL INSTRUMENTATION



RPV Narrow Range Level