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R.J. Adney
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February 6, 1997

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

Gentlemen:

TENNESSEE VALLEY AUTHORITY - SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 AND 2 - DOCKET NOS. 50-327 AND 50-328 - FACILITY OPERATING LICENSES DPR-77 AND DPR-79 - LICENSEE EVENT REPORT (LER) 50-327/95001 Revision 1

The enclosed voluntary report is being revised to provide the results of a detailed evaluation of the accumulation of gas in the residual heat removal system. This revision includes changes to the root cause, safety significance and corrective actions.

Sincerely,

R. J. Adney

Enclosure
cc: See page 2

120029

Enclosure
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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)
Sequoyah Nuclear Plant (SQN), Unit 1	05000327	1 of 8

TITLE (4) GAS Accumulation in the Residual Heat Removal (RHR) System Results in Pipe Movement Following Starting of the RHR Pumps

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
									SQN, Unit 2	50-328
01	18	95	95	001	01	02	06	97	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	100	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)	X 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)
J. W. Proffitt, Licensing Engineer	(423) 843-6651

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 15 single-spaced typewritten lines) (16)

This voluntary LER is being revised to provide the results of a detailed evaluation of a condition involving the accumulation of gas in the RHR system. On January 18, 1995, while performing a walkdown of a damaged hanger, a loud metallic noise was heard, and movement of the RHR piping was observed. At the time the noise was heard, RHR Pump 1A-A had just been started for a scheduled quarterly pump test. Management and the system engineer were notified of the observations. After discussions with the involved personnel, it was considered that there may be a gas void in the system. The RHR system was inspected for voids. Three areas were determined to include voids, approximately eight cubic feet, and were subsequently vented. The cause of the accumulation of gas has been determined to be normal leakage from the cold leg accumulators. Monitoring and venting of gas accumulation was performed and will continue to be performed on a periodic basis. The RHR quarterly pump tests were revised to minimize pipe movement. Additional vent valves are scheduled to be added in each units next refueling outage.

I. PLANT CONDITIONS

Units 1 and 2 were in power operation at approximately 100 percent.

II. DESCRIPTION OF EVENT

A. Event

On January 18, 1995, while performing a walkdown of a previously damaged hanger located in the Unit 1 669 elevation penetration room, a loud metallic noise was heard, and movement of the residual heat removal (RHR) (EIIS Code BP) piping was observed. At the time the noise was heard, RHR Pump 1A-A had just been started for a scheduled quarterly pump test. Management and the system engineer were notified of the observations. After discussions with the involved personnel, it was considered that there may be a gas void in the system. Work requests were initiated to inspect the RHR piping for voids.

The high points in the RHR system in the 690 pipe chase were inspected for voids with the use of ultrasonic testing (UT). The accessible areas inside containment of the RHR suction from RCS and the RHR discharge piping (cold leg injection lines and hot leg injection lines) were inspected. The RHR suction piping was determined to be full of water (i.e., no gas accumulation). The hot leg piping was determined to be approximately 50 percent full of water for a 10-foot run of horizontal piping. Five locations were checked on the cold leg injection line with the following results: the first location was full of water, the second location was 95 percent full of water, the third location was 80 percent full of water, the fourth location was 90 percent full of water, and the fifth location piping was found empty for a length of 30 feet. The areas with voids, approximately 14 cubic feet in both the hot and cold legs, were subsequently vented.

The previously damaged hanger was reinspected. It was determined to be in the same condition as before the event and was determined to be operable. A review identified 17 other hangers that could be susceptible to damage as a result pipe movement. Sixteen hangers had no visible signs of damage. One hanger was found with installation anomalies that were documented in the walkdown report. The hanger was determined to be operable. Also, insulation and penetrations were inspected, and no damage was identified.

The Unit 2 hangers susceptible to a gas induced pipe movement were inspected, and no damage was identified. UT measurements on the Unit 2 cold leg piping were performed, and approximately 0.5 cubic feet of gas was calculated based upon the measurements taken. The locations checked were similar to those checked on Unit 1. The gas was not vented, and it was concluded that this small amount of gas would not cause significant pipe movement on a pump start. The 2A-A RHR pump was started, and no significant pipe movement was observed.

B. Inoperable Structures, Components, or Systems that Contributed to the Event

None.

C. Dates and Approximate Times of Major Occurrences

January 18, 1995 — RHR pump 1A-A was started for a scheduled quarterly pump test. A loud metallic noise was heard, and movement of the refueling water storage tank (RWST) suction piping was observed by personnel in the area. Management and the system engineer were notified of the observations. After discussions with the involved personnel, it was considered that there may be a gas void in the system. Work requests were initiated to inspect the system for voids.

January 18, 1995 — The RHR system piping was inspected for voids with approximately eight cubic feet identified. The previously damaged hanger and 14 other hangers were inspected and were determined to be operable. Insulation and penetrations were inspected, and no damage was identified. The Unit 2 hanger in the same location as the damaged hanger on Unit 1 was inspected and no damage was identified.

January 20, 1995 — An operability evaluation was performed which determined that the gas in the system and the damaged hanger do not affect operability of the RHR system in normal or accident conditions.

January 21, 1995 at 0430 Eastern standard time (EST) — The RHR piping is vented in accordance with procedures. A sample of the gas was obtained and was determined to be 1 percent oxygen, 0.5 percent hydrogen, and the remaining nitrogen.

January 23, 1995 at 1300 EST — RHR Pump 1A-A was started with various locations being monitored. Movement of piping was noted, and various check valves were heard to close. However, the noise in the 669 penetration room was not unusually loud, and pipe movement was not severe. It was concluded that the noise and pipe movement were significantly less than that observed on January 18, 1995.

January 27, 1995 — A walkdown of the hangers on Unit 2 that would be susceptible to gas induced pipe movement was performed. No damage was identified.

January 30, 1995 UT measurements on the Unit 2 cold leg piping were performed, and approximately 0.5 cubic feet of gas was calculated based upon measurements taken. The locations checked were similar to those checked on Unit 1. The gas was not vented, and it was concluded that this small amount of gas would not cause significant pipe movement on a pump start.

January 31, 1995 The 2A-A RHR pump was started, and the monitoring of the piping was performed. No significant pipe movement was observed, and the RWST piping in the Unit 2 669 penetration room did not move.

February 3, 1995 A walkdown of the other two Unit 1 hangers that would be susceptible to gas induced pipe movement was performed. No damage was identified.

February 7, 1995 The 2B-B RHR pump was started, and the monitoring of the piping was performed. No significant pipe movement was observed, and the RWST piping in the Unit 2 669 penetration room did not move.

February 9, 1995 UT measurements on the Unit 1 piping were performed again, and approximately six cubic feet of gas was calculated based upon measurements taken.

February 10, 1995 The Unit 1 piping was vented, and gas samples and water samples were taken. The sample results showed 96 percent nitrogen, 3.5 percent oxygen, 0.25 percent hydrogen, and the remainder unknown; boron concentration was 2485 parts per million (ppm). The piping was measured after venting and was determined to be full.

February 13, 1995 The SIS test header was determined to be pressurized to the same pressure as the accumulator. Therefore, it is believed that the leakage from the accumulator is the source of the gas.

October 21,1996 An evaluation was issued that documented that a gas volume of 50 cubic feet did not substantially increase the loads on the piping.

November 16, 1996 A vent valve was added to the Unit 1 RHR piping system.

D. Other Systems or Secondary Functions Affected

None.

E. **Method of Discovery**

During the performance of a walkdown of a damaged hanger located in the Unit 1 669 penetration room near the 20-inch RWST suction line, a loud metallic noise was heard, and movement of the piping was observed by personnel in the area.

F. **Operator Actions**

No operator actions were required.

G. **Safety System Responses**

No safety system response was required.

III. CAUSE OF EVENT

A. **Immediate Cause**

The immediate cause of the event on the RHR system was caused by voids in the cold leg injection piping.

B. **Root Cause**

The cause of the gas accumulation was determined to be expected leakage from the cold leg accumulators past the injection line secondary check valves. A small amount of leakage from the accumulator can contribute significant quantities of gas over a long period of time. Based upon the samples taken, nitrogen represents the vast majority of gas per volume. The gas accumulation results from the degassing of high pressure nitrogen saturated water from the accumulator tanks in the lower pressure RHR system. The estimates of gas volume in the piping inside containment was 14 cubic feet total. This is greater than the calculated amount of nitrogen based upon VCT conditions after shutdown of the RHR system. The amount of gas identified on Unit 1 was greater than that identified on Unit 2, with similar VCT conditions following a refueling outage. Therefore, it is concluded that the water leakage from the accumulators is the source of the gas.

C. **Contributing Factors**

The system design and layout may have contributed to this event in that the system layout allows the gas to accumulate in the system high points.

IV. ANALYSIS OF EVENT

The safety significance of this issue is the potential damage to the RHR system resulting from hydraulic loading of the pipe supports when an RHR pump is started with gas voids in the downstream piping. The RHR suction piping was determined to be full of water. The operability evaluation determined that the amounts of gas in the cold leg injection piping can be injected into the vessel on a large-break loss of coolant accident without any impacts because of the volume of the reactor vessel. If all of the RHR cold leg piping inside containment were empty, it would be less than 200 cubic feet. The selected hangers on the RHR system have been walked down and no damage was identified. The evaluation on the previously damaged hanger concluded that the hanger was operable.

The average gas accumulation rate on Unit 1 since January 1996 has been approximately 4 cubic feet per quarter. Based upon inspections and maintenance of the injection line secondary check valves, this rate represents minimum leakage for the system operating conditions (i.e. 600 psid.). At this leakage rate as much as 24 cubic feet of gas may accumulate in the RHR system over an 18-month fuel cycle if no gas is vented. During the period from 1980 to 1994, the RHR system high points were not routinely vented. This combined with significantly greater leakage through the injection line check valves, in previous operating cycles, indicates that each pump was started in an alignment for quarterly pump testing that would have resulted in gas induced pipe movements at least 40 times. Given the source of the accumulated gas, the rate of accumulation, since measurements began in 1995, and past system operational/test practices (i.e. no high point venting during the operating cycle) it is extremely likely that the RHR system has been operated with gas accumulation in excess of 24 cubic feet. The lack of any pipe system failures in these previous operating cycles demonstrates the ability of the RHR system to operate without damage with the total amount of gas that would be accumulated during the operating cycle (24 cubic feet).

Industry experience has shown that stainless steel piping systems are inherently rugged and ductile. Piping supports are designed for ductile behavior to prevent sudden failure. SQN design practices provide for flexibility in branch line connections to prevent attached piping failure. The RHR system piping design is expected to accommodate some pipe movement without damage.

In addition, a conservative analysis of relative hydraulic loads during an RHR pump start for 8 cubic feet, 24 cubic feet, and 50 cubic feet of non-condensable gas in the downstream piping was performed. The results demonstrate that the hydraulic loads for 24 cubic feet are only 9 percent larger than the loads for 8 cubic feet and only 10 percent larger for 50 cubic feet relative to the loads for 8 cubic feet. It is concluded that 24 cubic feet of accumulated gas will not produce hydraulic loads of sufficient magnitude to cause pipe support damage. Therefore, it can be concluded that there were no adverse consequences to plant personnel or to the public as a result of this event.

V. CORRECTIVE ACTIONS

A. Immediate Corrective Action

Work requests were initiated to inspect the system for voids. The RHR system piping was inspected for voids with approximately eight cubic feet identified. The previously damaged hanger and 17 other hangers susceptible to a water hammer were inspected and were determined to be operable. Insulation and penetrations were inspected; no damage was identified. An operability evaluation was performed which determined that the gas in the system and the damaged hanger do not affect operability of the RHR system in normal or accident conditions. The RHR piping was vented in accordance with procedures. A sample of the gas was obtained and was determined to be 1 percent oxygen, .5 percent hydrogen, and the remaining nitrogen. RHR Pump 1A-A was started with various locations being monitored. Movement of piping was noted, and various check valves were heard to close. However, the noise in the 669 penetration room was not unusually loud, and pipe movement was not severe.

The Unit 2 hangers susceptible to gas induced pipe movement were inspected, and no damage was identified. UT measurements on Unit 2 were performed, and approximately .5 cubic feet of gas was calculated based upon the measurements taken. The gas was not vented, and it was concluded that this small amount of gas would not cause significant pipe movement on a pump start. The Unit 2 RHR pumps were started, and the monitoring of the piping was performed. No significant pipe movement was observed, and the RWST piping in the Unit 2 669 penetration room did not move.

UT measurements on the Unit 1 piping was performed again, and approximately 6 cubic feet of gas was calculated based upon measurements taken. The Unit 1 piping was vented, and gas samples and water samples were taken. The sample results showed 96 percent nitrogen, 3.5 percent oxygen, 0.25 percent hydrogen, and a boron concentration of 2485 ppm. UT was performed on the piping after venting, and the piping was determined to be full.

B. Corrective Action to Prevent Recurrence

UT measurements were performed on the Unit 1 cold leg piping, and approximately eight cubic feet of gas was identified and vented. Additional monitoring and venting of gas accumulation will continue to be performed on a periodic basis as determined appropriate. The RHR quarterly pump tests were revised to include a step to minimize pipe movement.

An evaluation was performed of relative hydraulic loads during an RHR pump start for 8 cubic feet, 24 cubic feet, and 50 cubic feet of non-condensable gas in the downstream piping was performed. The results demonstrate that the hydraulic loads for 24 cubic feet are only 9 percent larger than the loads for 8 cubic feet and only 10 percent larger for 50 cubic feet relative to the loads for 8 cubic feet. It is concluded that 24 cubic feet of accumulated gas will not produce hydraulic loads of sufficient magnitude to cause pipe support damage.

A vent valve was installed in the RHR system on Unit 1 and two additional valves are scheduled to be added during the next Unit 1 refueling outage. Additional vent valves are scheduled to be added on Unit 2 during the next Unit 2 refueling outage.

VI. ADDITIONAL INFORMATION

A. Failed Components

None.

B. Previous Similar Events

There have been two previously reported similar events. LER 50-327/94001 was associated with the accumulation of gas in the reactor head and steam generator tubes during low reactor coolant system pressure operation. LER 50-328/90012 was associated with gas accumulation in the suction piping of the centrifugal charging pump (CCP). It is believed that the hydrogen gas is coming out of solution because of a gas stripping effect at the CCP miniflow line flow restricting orifices. These events are similar in that the plant configuration and operating characteristics result in the formation of gas in plant systems. The corrective actions from these events could not have precluded this event.

VII. COMMITMENTS

None.