U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
MCGUIRE NUCLEAR STATION UNIT 1	0 5 0 0 0 3 6 9	1 OF 8

TITLE (4): HIGH GAS CONCENTRATION IN UPPER HEAD INSPECTION ACCUMULATOR

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)
1 0	2 9	8 4	8 4	0 2 9	0 0	1 1	2 9	8 4	MCGUIRE-UNIT 2	0 5 0 0 0 3 7 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)	[ ] 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)	[X] 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 (AREA CODE)	
SCOTT GEWEHR - LICENSING	7 0 4	3 7 3 - 7 5 8 1

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
	B G	V	F 1 3 0	N					

SUPPLEMENTAL REPORT EXPECTED (14)

[ ] YES *(If yes, complete EXPECTED SUBMISSION DATE)* [X] NO

EXPECTED SUBMISSION DATE (15): MONTH | DAY | YEAR

ABSTRACT *(Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines)* (16)

At 12:15 on October 30, 1984, a shutdown of McGuire Unit 1 was initiated due to a concentration of nitrogen in the upper head injection (UHI) accumulator in excess of technical specification limits. The unit was at 100% power at the time shutdown was begun. Technical specification limits for dissolved nitrogen (which is used to pressurize the system) are 80 cubic feet of nitrogen per 1800 cubic feet of water; approximately two hours before the shutdown was begun UHI dissolved gases were measured at above 24 cubic feet. The high concentration of nitrogen is suspected to be caused by repetitive continuous make-up to the accumulator from the UHI surge tank, which allowed nitrogen into the accumulator. The continuous make-up was made necessary by valve leakage in the system. The unit was in Mode 3 approximately 6 hours after the shutdown was begun.

Corrective actions are being implemented to determine and isolate leakage flowpaths, and will evaluate the possibility of modifying or eliminating the system if isolation of leakage flow paths do not solve the problem.

As required by McGuire technical specifications, a shutdown of Unit 1 was begun on October 30, 1984 due to a high concentration of nitrogen in the upper head injection (EIIS:BG) accumulator. Nitrogen concentrations in technical specifications are limited to 80 cubic feet per 1800 cubic feet of water in the upper head injection (UHI) accumulator; shortly before the shutdown was begun, nitrogen concentration was measured at about 124 cubic feet. As a result, the UHI system was declared inoperable and the shutdown initiated. The unit was at 100 percent power at the time.

During routine boron sampling of the UHI water accumulator on October 25, 1984, Chemistry personnel noticed the sample did not contain the normal clarity of previous samples. The cloudy sample was suspected to contain dissolved gases in the solution but that fact was not immediately verified due to the type and method of sampling, and the lightning in the sampling area. Boron samples are liquid and are normally collected in milk colored poly bottles in a dimly lit area; therefore, the degree of clarity of the sample was not obvious. When additional boron samples were collected on October 26, 27, and 28, specific attention was paid to the clarity of the water. The water appeared to contain dissolved gases like the October 25 sample.

The UHI accumulator is normally sampled and analyzed for dissolved gases every 18 months using two procedures, Periodic Chemistry Sampling Requirements, and Chemistry Procedure for Sampling the Upper Head Injection Accumulator for Total Dissolved Gas. No method for accumulator tank recirculation exists; therefore, a representative sample and consistent dissolved gas data is difficult to obtain.

Because of the inconsistency in data, sampling frequency and decisions on system operability based on the data are determined by McGuire and General Office Technical Service Management. When Station Chemistry supervisory personnel were notified at home the evening of October 28, they elected to wait until the next morning to contact management personnel concerning the suspected dissolved gas. A meeting was held and a decision to sample the accumulator tank six separate times (3 from the top of the tank and 3 from the bottom) was made. The sample dates, times, and results are as follows:

Top of Tank			Bottom of Tank		
10/29/84	20:15	86.5 ft_3	10/30/84	08:40	93.8 ft_3
10/29/84	21:45	73.9 ft_3	10/30/84	09:45	101.2 ft_3
10/29/84	22:44	86.9 ft	10/30/84	10:50	123.7 ft_3

The UHI system was declared inoperable and reactor shutdown commenced at 12:15 on October 30. Unit 1 was in Mode 3 by 1813.

Operations personnel began to determine what corrective actions would be necessary to reduce the dissolved gases and to identify the cause. A system walkdown was initiated to determine leakage and a decision was made to drain and fill the water accumulator. During the rapid drain down of the accumulator, the rupture disc tore,

requiring a new replacement before the refilling of the tank could be completed. (The rupture disc prevents nitrogen from dissolving in water and isdesigned to tear at a differential pressure of 40 psi. The rupture disc was sacrificed in order to speed up the draining process. It was determined that less time would be involved by rapidly draining the tank and replacing the disc as opposed to the normal drain technique. Several minor leaks were identified during the walkdown with 1NI-270 and 1NI-271 suspected as being the primary cause of system leakage. The basis for the suspicion of 1NI-270 and 1NI-271 and 1NI-273 were opened with 1NI-270 and 1NI-271 closed. (see enclosure 1.0)

Maintenance personnel replaced the internals of 1NI-270 and relapped the seat on 1NI-271; however, these valves, when repaired, did not prevent further system draindown. In an effort to prove leakage by 1NI-270 and 1NI-271, a freeze plug was installed downstream of 1NI-271 (see Enclosure 1.0) and valves 1NI-272 and 1NI-273 were opened. Water flowed from the vent at the same rate as before, indicating that leakage was not occurring through 1NI-270 and 1NI-271. Additionally, motor operated isolation valves were inspected to assure proper torque and closure. No problems were identified.

It should be noted that makeup to the UHI system has been occurring daily since May of 1984, and had been occurring at least every two days in the 12 months preceeding May. Makeup to the system begins when water level falls to the 20% level in the surge tank and continues until the 80% level is achieved. This constant feed and bleed of the system is believed to have allowed the gradual migration of nitrogen to the accumulator. The most recent sample obtained under the 18 month periodic test program was collected on April 24, 1984, and contained only 31.19 ft^3 of dissolved gases.

Verification of the dissolved gases on October 29 and 30 required six separate samples from different sample locations, each total inconsistent with the others. The normal sample location, the same one used on April 24 , is at the lower portion of the tank while the higher concentrations of dissolved gases were collected (for verification on October 30) from the bottom of the tank. Gas migration has been proven by Westinghouse in studies of the UHI system at the Sequoyah Nuclear Station which indicated the migration occurs when tank temperatures vary 10°F on a daily basis (due to expansion and shrinkage of water). Studies of the McGuire UHI system show migration would cause the tank nitrogen concentration to exceed 80 ft^3 in 390 days if the same 10°F temperature swing existed. At McGuire, the UHI system and surrounding air are maintained at a relatively constant temperature; however, the constant level changes in the system due to leakage would have the same effect as level changes due to temperature swing.

As a result of the data obtained from Unit 1, the Unit 2 accumulator was sampled on October 31 and found 767 ft^3 of dissolved gases. These results prompted the

collection of four additional samples from different tank locations with the date, results and times as follows:

Date	Time	Total Dissolved Gas
10/31/84	12:15	789 ft^3
10/31/84	15:54	1086 ft^3
10/31/84	20:05	964 ft^3
10/31/84	20:40	888 ft^3

At 2115 on October 31, the Unit 2 UHI was declared inoperable and load reduction commenced and continued until a power level of 45% had been reached. An analysis by Westinghouse concluded that UHI is not necessary as long as the initial fuel core is in use and power does not exceed 45%. During the power reduction, McGuire applied for and received a change to the Technical Specifications that would allow power operation at less than 46% power with the UHI discharge isolation valves closed. The unit reached 45% power at 0330 on November 1, at which time the isolation valves were closed and drain down of the accumulator commenced. The accumulator dissolved gases were suspected to have occurred as a result of system leaks similar to those on the Unit 1 UHI system. Excess leakage to the RWST and through packing leaks on the UHI discharge isolation valves required daily makeup to the accumulator in October, November, and December of 1983. These leaks were repaired and makeup to the system was reduced to less than once every two weeks. The tank had not been sampled for the 18 month periodic test of dissolved gases; therefore, the concentrations were not suspected to be in excess of the T.S. limits until problems identified with Unit 1 prompted the collection of the gas sample on Unit 2. The accumulator was subsequently refilled and sampled 3 times on November 4 indicating a maximum of 47 ft^3. The accumulator was declared operable at 1526.

Following the replacement of the rupture disc, the refill of the accumulator and repairs to the level instrumentation, Unit 1 returned to service on November 4. A daily sampling surveillance program was set up to trend gas concentrations matched with makeup to the tank. As data is collected and analyzed, sampling frequency will be adjusted as necessary. To reduce the potential for gas migration, makeup to the tank now occurs when the level in the surge tank falls to 40% and continues until the 80% level is obtained.

The exact cause of the system leakage has not been identified; however, system walkdowns by Operations personnel have provided several potential flowpaths. These flowpaths have been submitted to Design personnel in an effort to determine if system modifications would be necessary. Additionally, Design personnel are evaluating several modifications for both short term and long term solutions. The primary short term solution will provide full couplings with solid internals (similar to blank flanges) along the suspected flowpaths (see Enclosure 1.0). The suspected leakage flowpaths (indicated by arrows) through soft seated Kerotest valves 1NI-255B (circled), 1NI-261 (circled), 1NI-257 (circled), and 1NI-262 (circled) would be prevented from entering the RWST due to the full couplings. As system leakage along these flowpaths becomes water solid, pressure would equalize

across each valve and the leakage would stop. This modification is presently being evaluated for installation during the maintenance outage scheduled following the Thanksgiving Holiday. Long term solutions under evaluations are 1) providing a means to recirculate and deaerate the tank thus providing a representative sample and the capability for removing dissolved gases from the water 2) modify the system to provide faster filling and draining of the water accumulator and nitrogen accumulator 3) eliminate valves not necessary in the test header (one of the suspected flowpaths) and 4) the possibility of eliminating the UHI system entirely. Most of the long term solutions are not being pursued at this time but will be considered if the short term corrective action proves to be ineffective. The main concern at the present time is to find a way to eliminate the system leakage.

The present gas sample frequency of once per day on Unit 1 and every other day on Unit 2 shows that the gas concentrations have stabilized. The use of a positive displacement pump to inject RWST water through 1NI-396 with letdown to the RWST has set up a temporary recirculation path. This recirculation path is believed to be the primary cause of the consistent samples.

Corrective actions performed to date include repair of valves 1NI-270 and 271, and a system walkdown was performed to identify other potential leakage flowpaths. Other corrective actions which are being considered include: installation of full couplings with solid internals; elimination of the UHI system; delection of valves, where possible - in cases where deletion is not possible, installation of leak-tight valves; and a system modification to allow more rapid filling and draining of nitrogen and water accumulators. The last three actions will be seriously evaluated only if the installation of the couplings and valve repair prove ineffective.

This event has implications for both McGuire Unit 2 and Duke's Catawba Station. As a result of the discovery of excessive nitrogen in the UHI accumulator, both locations performed dissolved gas sampling procedures, McGuire Unit 2 also found a high nitrogen concentration. As a result of a technical specification change to allow continued operation, power was reduced to 46 percent until the situation was corrected. Catawba's nitrogen concentration was within technical specification limits.

As a result of the draindown of the UHI water accumulator, it was discovered that the accumulator level transmitters were installed incorrectly. This is being treated as a separate incident and will be reported in LER 369/84-30, which is scheduled to be submitted by December 3, 1984.

A safety evaluation of the condition where the UHI water accumulator nitrogen concentration exceeded the technical specification limit has been performed in order to identify any adverse impact on the FSAR Chapter 15 accident analyses. This evaluation resulted in the identification of four potential safety concerns:

(i) During a rapid injection of the UHI inventory, such as would occur following a large LOCA, dissolved nitrogen in excess of the saturation concentration would effervesce in response to the depressurization. The gas would then

become entrained in the injection flow stream and reduce the liquid delivery rate to the reactor vessel. In addition, the injection rate would also be reduced due to sonic choking effects in the water-nitrogen mixture. This phenomenon was bounded in a conservative manner to form the basis for the current 80 scf technical specification limit.

It should be recognized that this phenomenon is only of concern for very high UHI water injection velocities that can only occur with large LOCA events. The adverse impact is limited to a reduction in the water delivery rate during the last 8 seconds of the total UHI injection phase, approximately the 1 to 23 second time interval for the worst case LOCA. This result can be explained by the nitrogen staying in solution during the first 15 seconds of the injection phase, due to the Reactor Coolant System (RCS) pressure remaining sufficiently high. The integrated volume of liquid delivered is unaffected, only the delivery rate in the latter stage. The phenomenon is also strongly dependent on the dissolved nitrogen concentration.

No adverse impact is expected for concentrations up to twice the technical specification limit. As the concentration increases toward the saturation limit, the impact is potentially greater.

(ii) Delivery of non-condensible gases into the RCS from any source has the potential for adversely impacting forced circulation. The gases will accumulate in the system high points, including the steam generator tube U-bends. A significant accumulation in the U-bends can degrade primary-to-secondary heat transfer during natural circulation and even interrupt heat transfer by blocking the flow of the working fluid.

A volume of 70 ft^3 per steam generator (280 ft^3 total) to block natural circulation. Assuming a maximum injected dissolved nitrogen volume of 700 scf (highest measured data was 1086 scf and only ~60% of the UHI water inventory is injected by design, interruption of natural circulation is not a credible operational problem. Steam generator heat transfer is not required below the pressure and temperature conditions (385 psig, 350°F) at which the Residual Heat Removal System (RHRS) is aligned. 700 scf compresses to less than 50 ft^3 at these conditions. In addition, feed and bleed cooling is available as an independent method for decay heat removal if all steam generator heat transfer were lost.

(iii) UHI water injection is designed to be terminated by isolation of the tank discharge on the actuation of a low level indication in the water accumulator. A question was raised concerning the potential for nitrogen effervescence to somehow result in an invalid low level signal and a premature isolation of UHI. This effect might occur due to nitrogen bubbles displacing liquid between the pressure taps of the level instrumentation. A

review of the instrumentation determined that the upper and lower taps correspond approximately to the top and bottom of the tank. There is no means of displacing liquid with nitrogen other than out the tank discharge piping. Therefore, any distribution of nitorgen bubbles within the tank will result in a valid level indication, and premature isolation of the UHI injection path cannot occur.

(iv) The potential for adversely affecting transient response due to hydrodynamic interaction of injected nitrogen was considered. Of particular concern were any effect on post-LOCA dynamics and reflooding. The conclusion reached was that the maximum volume of nitorgen injected was too small to have any effect. If forced circulation was maintained during the transient, the nitrogen would either be entrained in the liquid flow stream, dissolve into solution over a period of time, or collect in the system high points as previously discussed. The limited volume of concern would not displace enough liquid or have enough momentum to impact the hydrodynamic response.

In summary, the only potential safety concern of any significance due to the high dissolved nitrogen concentration is item (i). This item is only applicable to large LOCAs with a UHI nitrogen concentration in excess of twice the technical specification limit. The negative impact is limited to a reduction in the UHI water delivery rate during approximately the ~15-23 second time interval following the design basis LOCA.

A review of the FSAR Chapter 15 LOCA analysis, in particular the peak clad temperature (PCT) response versus time, indicates two periods of cladding temperature increase. The first occurs during the blowdown phase and peaks at approximately 10 seconds, and the second occurs during the reflood phase following blowdown and continuing until the temperature excursion is terminated at about 150 seconds. The blowdown PCT is only ~1200 °F, whereas the limiting PCT of 2175 °F occurs during reflood. Since the time interval impacted by nitrogen effects is the ~15-23 second interval, and since a large margin exists between the PCT of 1200 °F at that time and the 10 CFR 50.46 limit of 2200 °F, it is concluded that the sufficient margin exists to offset the penalty on the UHI injection flowrate due to dissolved nitrogen effects. Although the existence of high concentrations of dissolved nitrogen in the UHI water accumulator is undesirable, the results of this evaluation of the potential consequences demonstrate that the health and safety of the public were unaffected.

NRC Form 366A (9-83)

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

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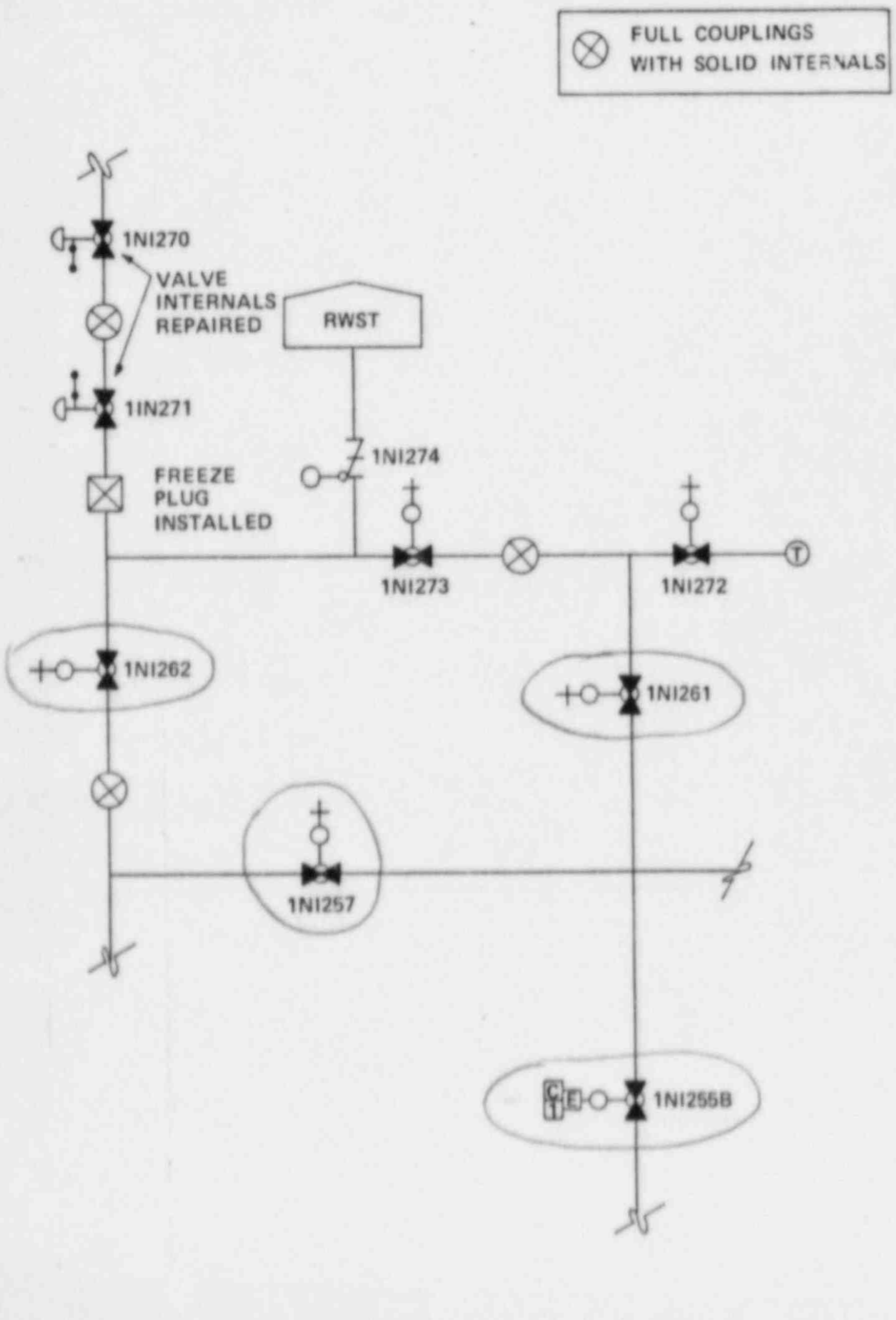
McGuire Nuclear Station UNIT 1	0 5 0 0 0 3 6 9	8 4	— 0 2 9	— 8 4	8 OF 8

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

ENCLOSURE 1.0



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