NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98
ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20603

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Browns Ferry Unit 1	05000259	1 OF 6

Containment Atmosphere Dilution Nitrogen Supply Does Not Meet the Design Basis

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
									Browns Ferry, Unit 2	05000260
06	16	1998	1998	003	0	10	28	1998	FACILITY NAME: Browns Ferry, Unit 3	DOCKET NUMBER: 05000296

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	000	20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)
		20.2203(a)(1)	20.2203(a)(3)(i)	X 50.73(a)(2)(ii)	50.73(a)(2)(x)
		20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
		20.2203(a)(2)(ii)	20.2203(a)(4)	50.73(a)(2)(iv)	OTHER
		20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
		20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
A. T. Rogers, Senior Licensing Project Manager	(256) 729-2977

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)

On June 16, 1998, site engineering determined that the required Technical Specifications (TS) minimum nitrogen onsite storage for Containment Atmosphere Dilution (CAD) was not sufficient to meet the design capacity for 7 days of post-Loss-of-Coolant-Accident (LOCA) operation. Engineering determined an apparent error had been made in the original design of the system converting liquid to gaseous nitrogen. Hence, at the minimum TS level and tank boiloff rate at the time of the event, the site storage capacity was below the design 7-day required supply.

Browns Ferry Nuclear Plant (BFN) implemented interim corrective actions by administratively maintaining the CAD tank levels at a minimum of 3307 gallons to meet the design basis of a 7-day supply. In addition, BFN initiated maintenance to reduce the boiloff rate and contacted General Electric (GE) to verify the minimum gaseous nitrogen requirements to meet the design basis.

Subsequently, GE determined that the quantity of gaseous nitrogen required for a 7-day supply was actually less than the original design basis value. However, due to higher than design value boiloff rates, it could not be concluded that a 7-day supply was available under all circumstances in the past. BFN completed maintenance on both CAD storage tanks to improve the insulation capability and reduce the boiloff rate. BFN procedures were revised to more accurately monitor CAD storage tank vacuum space and evaluate the boiloff rate if the vacuum begins to degrade.

TVA is reporting this event pursuant to 10 CFR 50.73(a)(2)(ii)(B), as any event or condition which resulted in the nuclear power plant being in a condition that was outside the design basis of the plant.

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TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

I. PLANT CONDITIONS

At the time the event occurred, Units 2 and 3 were in the Run Mode at 100 percent power. Unit 1 was shutdown and defueled.

II. DESCRIPTION OF EVENT

A. Event:

During a review for the Thermal Power Uprate program, the requirements for post-Loss-of-Coolant-Accident (LOCA) nitrogen usage were reevaluated. BFN TS require 2500 gallons of liquid nitrogen in each of the two Containment Atmosphere Dilution (CAD) [BB] tanks. The basis for this requirement as stated in the TS Bases is that this volume will provide a 7-day supply of gaseous nitrogen to dilute the containment atmosphere following a LOCA. The Final Safety Analysis Report states that 210,000 Standard Cubic Feet (SCF) of gaseous nitrogen is required for the 7-day supply. During this review, it was apparent that the method used to convert liquid to gaseous nitrogen required for the 7-day supply was in error. This error has existed since the original CAD system design.

On June 16, 1998, at 2111 hours (CDT), TVA made a one-hour non-emergency notification to the NRC via the Emergency Notification System pursuant to 10 CFR 50.72(b)(1)(ii)(B).

Subsequently, GE provided TVA with an analysis which showed that the required amount of gaseous nitrogen required for 7-days of post-LOCA operation was actually 155,000 SCF which was less than the TS minimum level in the CAD tanks. However, due to the excessive boiloff rate which was due to insufficient vacuum being maintained in the insulation space of the storage tanks, TVA concluded that a 7-day supply was not available under all circumstances in the past.

TVA completed maintenance on both CAD storage tanks to improve the insulation capability and reduce the boiloff rate. BFN procedures were revised to more accurately monitor CAD storage tank vacuum space and evaluate the boiloff rate if the vacuum begins to degrade.

This report is submitted pursuant to 10 CFR 50.73 (a)(2)(ii)(B) as any event or condition which resulted in the nuclear power plant being in a condition that was outside the design basis of the plant.

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

None.

C. Dates and Approximate Times of Major Occurrences:

June 16, 1998 2025 hours CDT	Site engineering notified the Shift Manager of the apparent non-conservative TS.
June 16, 1998 2111 hours CDT	One-hour non-emergency notification made to the NRC via the Emergency Notification System pursuant to 10 CFR 50.72(b)(1)(ii)(B).
August 14, 1998	BFN completed corrective maintenance on both CAD storage tanks.

August 21, 1998	BFN revised site procedures to more accurately monitor CAD storage tank vacuum space and evaluate the boiloff rate if the vacuum begins to degrade.
August 27, 1998	GE provided TVA with revised gaseous nitrogen requirement.
August 28, 1998	TVA approved a revision of the Final Safety Analysis Report (FSAR) to reflect the revised design basis for the nitrogen requirement.

D. Other Systems or Secondary Functions Affected:

None.

E. Method of Discovery:

Site engineering review of the nitrogen requirements for the Thermal Power Uprate program

F. Operator Actions:

No operator actions contributed to occurrence of this event.

G. Safety System Response:

None.

III. CAUSE OF THE EVENT

A. Immediate Causes:

This event had two contributing factors which cumulatively resulted in the plant being in a condition that was outside the design basis of the plant.

One of the immediate causes of this condition was an apparent error in the original design of the system converting liquid to gaseous nitrogen.

The other cause of this condition was the degradation of the vacuum in the storage tank insulation space.

B. Root Causes:

The root cause of the first condition was an apparent error in the preparation and approval of the original design basis in TS.

The root cause of the second factor was lack of an effective method to monitor and maintain adequate vacuum in the storage tank insulation space to ensure the boiloff rate remains within the design margin.

C. **Contributing Factors:**

None.

IV. ANALYSIS OF THE EVENT

During a review for the Thermal Power Uprate program, the requirements for nitrogen usage were reevaluated. During this review it was determined that the method used for converting gaseous to liquid nitrogen required for the 7-day supply was apparently in error. Evidently the conversion of gaseous to liquid nitrogen in a CAD tank was based on a significantly lower pressure than the required 120 psig and thus under-predicted the correlation between stored liquid versus delivered gaseous nitrogen. The difference in pressure translates to a decrease in density rendering the 2260 gallons inaccurate to provide 210,000 SCF. The TS Bases state that 2260 gallons would be sufficient as a 7-day supply and 2500 gallons is the conservative minimum requirement. This error has existed since the original CAD system design.

TVA subsequently contacted GE to review the design basis for the requirements for the CAD gaseous nitrogen requirements for 7-days of post-LOCA operation. GE determined that the amount of gaseous nitrogen should be 155,000 SCF, not 210,000 SCF as specified in the original design basis. As a result, BFN revised the design basis calculation and determined that 155,000 SCF of gaseous nitrogen is equivalent to 2027 gallons of liquid nitrogen in each CAD storage tank.

Also, BFN had been experiencing a relatively high nitrogen boiloff rate due to degraded vacuum in the CAD tank insulation space. Specifically, the vendor recommends that the tank vacuum space be maintained at 25 microns. The storage tanks were found at 80 and 120 microns in the A and B CAD storage tanks respectively. BFN initiated corrective maintenance to improve the vacuum in the insulation space which substantially reduced the boiloff rate and improved the longevity of the storage supply. Previously, BFN procedures required the vacuum to be maintained between 25 and 200 microns in order to limit the boiloff rate. The boiloff rate was monitored by trending nitrogen refill frequency and vacuum pumping frequency. BFN revised the procedures to specify the tank vacuum space be maintained below 25 microns as recommended by the vendor. In addition, corrective maintenance will be initiated if the vacuum is above 25 microns and engineering will be required to evaluate the boiloff rate.

With the TS minimum level of 2500 gallons and the post-LOCA requirement of 2027 gallons of liquid nitrogen, the margin for boiloff is 473 gallons for 7-days or about 68 gallons per day. The boiloff rate prior to corrective maintenance varied depending on environmental conditions, but was as high as 80 gallons per day. Therefore, the boiloff rate exceeded the margin allowed for in the design basis.

V. ASSESSMENT OF THE SAFETY CONSEQUENCES

The CAD system is designed to deliver enough nitrogen to the drywell and suppression chamber at a rate sufficient to maintain oxygen concentrations below 5 percent by volume, based on hydrogen and oxygen generation rates as set forth in AEC Safety Guide 7, Control of Combustible Gas Concentrations in Containment Following a LOCA. The CAD system is designed with fully redundant storage capability on site to allow for the first 7 days of post-LOCA operation. The CAD system will meet the requirement of maintaining oxygen levels in the containment of 5 percent by volume. The TS Bases states that about 2260

gallons would be sufficient as a 7-day supply, and replenishment facilities can deliver liquid nitrogen to the site within one day; therefore, a requirement of 2500 gallons is conservative. BFN maintained a 7-day supply of nitrogen in each CAD tank by administratively controlling a higher than TS minimum required level of 2500 gallons. The tanks were maintained at 3307 gallons which ensured TS design basis requirements were met until the corrective maintenance and the GE analysis was completed. Following analysis by GE, the FSAR was then revised according to the updated requirements.

Based on elevated boiloff rates, beyond the margin allowable to meet the TS minimum level, BFN would reach the capacity necessary for a 7-day supply at a tank level above the TS minimum of 2500 gallons. This would require entry into a TS Limiting Condition for Operation of 30 days with one tank inoperable (or not meeting the 7-day supply). However, BFN has demonstrated that the CAD tanks can be replenished readily. Multiple suppliers have demonstrated a high reliability for delivery of nitrogen to the site within one day and BFN is accessible from multiple access roads. This ensures a supply can reach the site in a timely manner.

Nitrogen injection is not expected to be required for the bounding cold case post-LOCA containment temperature until the time that post-LOCA oxygen concentration reaches 5 percent. This is 25 hours in the drywell and 16 hours in the suppression pool, compared to 50 hours and 42 hours respectively for the typical Design Basis Accident LOCA case. This shortening of time to reach 5 percent oxygen concentration is due to the reduced water vapor content in the containment with the assumed low containment temperature. Therefore, the time requirements for CAD addition are within the time frame which the tanks can be replenished thus minimizing any effects due to boiloff. Therefore, this condition has no significant impact on the safe operation of BFN.

VI. CORRECTIVE ACTIONS

A. Immediate Corrective Actions:

BFN maintained a 7-day supply of nitrogen in each CAD tank by administratively controlling a higher than TS minimum required level of 2500 gallons. Upon discovery of the error, the tanks were maintained at 3307 gallons which ensured the TS design basis requirements were met.

BFN completed corrective maintenance on the storage tanks to reduce the boiloff rate by improving the vacuum in the insulation space.

BFN contacted GE to review the analysis for the gaseous nitrogen requirements for post-LOCA operation.

B. Corrective Action to Prevent Recurrence:

TVA completed corrective maintenance on the storage tanks.

TVA revised operating procedures to periodically monitor the vacuum in the insulation space of the CAD tanks in accordance with the vendor recommendations and evaluate the effects on the boiloff rate and maintain it within the TS design margin.[1]

GE determined that the amount of gaseous nitrogen required for 7 days of post-LOCA operation which established the basis for the TS minimum level.

TVA determined no TS change was required.

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TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

VII. ADDITIONAL INFORMATION

A. Failed Components:

None.

B. Previous Similar Events:

LER 259/97004 was similar because it identified a non-conservative TS regarding the number of Residual Heat Removal Service Water pumps. The root cause was an apparent error in the preparation and approval of the original TS. That event was reported under 10 CFR 50.73(a)(2)(ii)(B) as a condition that resulted in the nuclear plant being in a condition that was outside the design basis of the plant. No corrective actions in the previous LER would have prevented the occurrence of the condition described in this report.

No other LERs have been issued which involve a non-conservative TS.

VIII. COMMITMENTS

None.

[1]TVA does not consider this corrective action a regulatory commitment. This item will be tracked in TVA's Corrective Action Program.