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

LICENSEE EVENT REPORT (LER)

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 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
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TITLE (4)
Potential Vortex Formation in the CST to HPCI Suction Nozzle Due to Original Design Error

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
									Dresden Unit 3	05000249
11	26	97	97	017	00	12	26	97	FACILITY NAME: N/A	DOCKET NUMBER: 05000

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR § (Check one or more) (11)							
POWER LEVEL (10)	099		20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
			20.2203(a)(2)(i)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
			20.405(a)(1)(ii)		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)	X	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)
John Fox, Design Engineer	(815) 942-2920 ext 2952

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)

While assisting the Quad-Cities Station during an NRC inspection, Dresden engineering personnel became aware of a technical issue regarding vortexing at the High Pressure Coolant Injection (HPCI)/Reactor Core Isolation Cooling suction nozzle in the Condensate Storage Tank (CST). No previous calculations addressing vortexing at the HPCI suction nozzle on the CST had been performed for Dresden Station and the issue was judged applicable to Dresden Station. An operability determination found that significant amounts of air could be entrained into the HPCI suction piping before the CST low-low level would be reached and automatic transfer of the HPCI suction from the CST to the torus initiated. The Unit 2 and Unit 3 HPCI systems were declared inoperable and the applicable Technical Specification Limiting Condition for Operation was entered. Dresden has two CSTs and HPCI is generally aligned to one CST. Based on alignment of both CSTs to the HPCI systems and administratively maintaining water level in the CSTs and tori above low level alarm limits, it was determined that there was no line break accident scenario where the low-low CST level switches would be needed to initiate a transfer of the HPCI pump suction. For line breaks inside containment, automatic transfer of the HPCI pump suction from the CST to torus would be initiated by high level in the torus before the low-low CST level setpoint is reached. For line breaks outside of containment, the amount of water required for HPCI is small compared to the available inventory and no automatic transfer of the suction path is required. The primary root cause appears to be an original design error. The effect of vortexing on the useable CST volume was not considered in the original design of the HPCI system. Further evaluation will be performed to ensure that the HPCI suction path from the CSTs is automatically transferred to the torus prior to entraining significant amounts of air into the HPCI pump. No previous occurrences were identified. The safety consequences of a degraded HPCI system would have been minimal at the time of the event since the automatic depressurization system and other ECCS systems were available as a backup to the HPCI subsystem to mitigate the consequences of an accident.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
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TEXT *(If more space is required, use additional copies of NRC Form 366A) (17)*

PLANT AND SYSTEM IDENTIFICATION:
General Electric - Boiling Water Reactor - 2527 Mwt rated core thermal power

Energy Industry Identification System (EIIS) Codes are identified in the text as [XX] and are obtained from IEEE Standard 805-1984, IEEE Recommended Practice for System Identification in Nuclear Power Plants and Related Facilities.

EVENT IDENTIFICATION:

High Pressure Coolant Injection Systems (HPCI)[BJ] were declared inoperable due to potential vortex formation in the CST to HPCI suction nozzles as a result of design error.

A. PLANT CONDITIONS PRIOR TO EVENT:

Unit: 2(3) Event Date: 11-26-97 Event Time: 1730
Reactor Mode: 1(1) Mode Name: Run(Run) Power Level: 099(099)
Reactor Coolant System Pressure: 1000(1000) psig

B. DESCRIPTION OF EVENT:

This LER is being submitted pursuant to 10 CFR 50.73(a)(2)(v)(D) which requires the reporting of any event or condition that alone could have prevented the fulfillment of the safety function of a system required to mitigate the consequences of an accident.

While assisting the Quad-Cities Station during an NRC inspection, a Dresden engineering supervisor became aware of a technical issue regarding vortexing at the HPCI/Reactor Core Isolation Cooling [BN] suction nozzle in the Condensate Storage Tank (CST)[KA]. On November 20, 1997, after confirmation that the issue was applicable to Quad-Cities Station, the engineering supervisor sent information describing the vortexing issue to Dresden engineering personnel and requested that the applicability of this issue to Dresden Station be evaluated.

The CSTs have level switches that initiate an automatic transfer of the HPCI suction from the CST to the torus when low-low level in the CST is reached. The issue concerned the potential to entrain air in the HPCI pump suction because of vortexing during the transfer of the HPCI suction path from the CST to the torus. The Dresden engineer reviewed the configuration of Dresden's HPCI suction path and CSTs to that of Quad-Cities and found the designs to be similar. The review did not identify calculations that addressed the effects of vortexing at the HPCI CST suction. A Problem Identification Form was then prepared and submitted according to Dresden's corrective action program indicating that the HPCI vortexing issue may be applicable to Dresden.

A more detailed review of the issue was then performed according to Dresden's procedure for determining the operability of systems, structures, and components. Information and test data from NUREG-0897, Rev. 1, "Containment Emergency Sump Performance", was reviewed. Preliminary calculations of required submergence were performed. These calculations were based on a Froude Number of 0.8, which is the industry accepted value to ensure little or no air is entrained in the suction.

Drawings of the CST were also reviewed to determine the height of the nozzles above the bottom of the tank floor and other dimensional details. Design requirements from the UFSAR and the Technical Specifications for the transfer of the HPCI suction from the CST to the torus (suppression chamber) were also reviewed.

On November 26, 1997, it was concluded that if the HPCI suction is aligned to only one CST, significant amounts of air could be entrained into the HPCI suction piping before the CST low-low level would be reached and transfer of the HPCI suction from the CST to the torus initiated. Because the HPCI systems were aligned to the 'A' CST at that time, the Unit 2 and Unit 3 HPCI systems were declared inoperable and the applicable Technical Specification Limiting Condition (LCO) for Operation actions were entered.

Preliminary calculations indicated that if the HPCI systems were aligned to both CSTs, the transfer of the HPCI suction path from the CSTs to the torus would be completed before significant amounts of air would reach the HPCI pump. This evaluation was documented in an operability determination documentation package. A 10 CFR 50.59 Safety Evaluation and change to the UFSAR were prepared to allow the HPCI suction to be aligned to both CSTs. Based on this evaluation, the HPCI suction was realigned such that both the 'A' CST and 'B' CST would supply flow to the HPCI pumps. Both the Unit 2 and Unit 3 HPCI systems were then declared operable on November 28, 1997.

As required by the operability determination procedure, plant personnel further reviewed the operability determination information. On Monday, December 1, 1997, the level switches that initiate the transfer of the HPCI suction path were visually inspected. During this inspection, it was discovered that the switches would actuate 4 inches lower than previously assumed, but still above the Technical Specification limit. Because of this lower setpoint, it could not be conclusively proven with the available test data that the HPCI pumps would have functioned as designed because of entrained air. At this point, the effects of bubble rise velocity in the HPCI suction piping and the impact of water with entrained air on pump performance were further evaluated. The potential that the HPCI suction would automatically transfer to the torus based on high water level in the torus was also examined.

Based on the subsequent review of the level instrumentation, the HPCI system was considered operable with compensatory measures in place. These actions included administratively maintaining water level in CSTs and tori above low alarm setpoints. With these actions in place, it was concluded that there was no line-break accident scenario where the low-low CST level switches would be needed to initiate a transfer of the HPCI pump suction. For line breaks inside containment, the HPCI suction would automatically transfer to the torus based on high level in the torus before low-low level in the CST would be reached. For line breaks outside of containment, the amount of water required by HPCI is small compared to the volume available in the CSTs and the level in the CSTs would remain several feet above the vortexing limit.

C. CAUSE OF EVENT:

The original system Design Specification and Data Sheets for the HPCI system approved in October 1969, state the following design requirements:

"The pump assembly shall be located below the level of the condensate storage tank and below the minimum water level in the suppression pool to assure positive suction head to the pumps. Adequate submergence and line size shall be provided to obtain the required pump NPSH."

"Switches to be located on the condensate storage tank at an elevation where the useable volume for pump suction is 10,000 gallons."

The primary root cause appears to be a design error. It appears that the effect of vortexing on the useable CST volume was not considered in the original design of the HPCI system. This is supported by the fact that various NUREGs concerning vortexing were not published until the early to mid 1980's.

In addition, a review was performed to identify any Dresden evaluations of operating experience information. A recent NRC Information Notice, dated August 1, 1997, was identified. On August 11, 1997, Dresden Station personnel performed an evaluation of NRC Information Notice (IN) 97-60, "Incorrect Unreviewed Safety Question Determination Related To Emergency Core Cooling System Swapover From The Injection Mode To The Recirculation Mode". IN 97-60 concerned changes to emergency operating procedures that required operators to manually trip ECCS pumps to prevent vortexing and protect the ECCS pumps. IN 97-60 refers to a system in which a manual trip of the ECCS pumps was required during a swapover of the pump suction from the refueling water storage tank to the containment sump. However, the changes to the swapover procedure for the above introduced reliance on manual actions to stop and restart ECCS pumps during and accident where no such action previously existed. The NRC had found that the licensee failed to properly identify the reliance on manual actions as an Unreviewed Safety Question. IN 97-60 was deemed not applicable to Dresden Station since the HPCI suction swapover from the CST to torus is a completely automatic function.

D. SAFETY ANALYSIS

The HPCI subsystem is designed to pump water into the reactor vessel under those LOCA conditions which do not result in rapid depressurization of the reactor pressure vessel. The loss of coolant might be due to a loss of reactor feedwater or to a small line break which does not cause immediate depressurization of the reactor vessel.

The safety function of level switches 2/3-2350-A, B, C, D is to automatically initiate the transfer of the HPCI pump suction from the CST to the torus when low-low level in the CST is sensed. When low-low level in the CST is sensed, level switch contacts cause HPCI torus suction valves MO 2(3)-2301-35 and MO 2(3)-2301-36 to open. When these valves are full open, the HPCI CST suction valve MO 2(3)-2301-6 begins to close.

The subject level switches are ECCS Instrumentation as described in Table 3.2.B-1, Item 3.c of Dresden's Technical Specifications. The trip setpoint is greater than or equal to 10,000 gallons. The trip setpoint is based on the GE High Pressure Coolant Injection System Data Sheet and is consistent with the Technical Specifications Sections 3/4.5.A and 3/4.5.B. UFSAR Sections 6.3.2.3.2 and 7.3.1.3.1 also discuss the automatic transfer of the HPCI suction path from the CST to the torus based on low-low level in the CST or high level in the torus.

The HPCI system can draw suction from the CSTs and suppression pool. Pump suction for HPCI is normally aligned to the CST source to minimize injection of suppression pool water into the reactor vessel. However, if the CST water supply is low, an automatic transfer to the suppression pool water source ensures a water supply for continuous operation of the HPCI system. The basis of the 10,000 gallons requirement is to ensure a sufficient water supply is available for continuous operation of the HPCI system while the pump suction is transferred from the CST to the torus (suppression pool).

In the event of low water level in the CST or high water level in the suppression pool, whichever comes first, the pump suction valves from the suppression pool open and the suction valves from the CST close. The valves are interlocked to prevent opening the valves from the CST whenever both valves from the suppression pool are not fully closed.

If the CST level had reached the low-low level setpoint when the HPCI system was aligned to one CST, water with entrained air could have been drawn into the HPCI pump prior to completing the transfer of the HPCI suction path from the CST to the torus. It is unknown to what degree, if any, that the HPCI pump performance would have been affected. However, an accident which requires HPCI to inject enough CST inventory to reach the vortexing limit is unlikely.

The safety consequences of a degraded HPCI system would have been minimal at the time of the event since the automatic depressurization system (ADS) was available. The ADS is an ECCS subsystem which is employed as a backup to the HPCI subsystem to depressurize the reactor pressure vessel for small area breaks. In the event that HPCI is not effective, the ADS reduces pressure by blowdown through automatic opening of the relief valves to vent steam to the suppression pool. For small breaks, the vessel is depressurized in sufficient time to allow low pressure ECCS system to inject and provide adequate core cooling.

E. CORRECTIVE ACTIONS:

The immediate corrective action was to declare the Unit 2 and Unit 3 HPCI systems inoperable and enter an LCO per the Technical Specifications. (completed)

A 10 CFR 50.59 Safety Evaluation was performed and various procedures were changed to allow the opening of the HPCI suction valve to the 'B' CST. After this valve was opened, the HPCI systems for both units were supplied by both the 'A' CST and 'B' CST. (completed)

A compensatory action was initiated per the operability evaluation to maintain the levels of the CSTs and tori above the low level setpoint alarm. Although this action was consistent with current procedures, the action was taken to ensure that the current procedures are not changed prior to final resolution of this issue. (completed)

With the compensatory actions in place, the HPCI systems will perform their intended function. Further evaluation will be performed to determine the most appropriate resolution to avoid entraining air into the HPCI pumps. (237-180-97-01701)

Other systems important to safety where vortexing could be a concern are being reviewed. Dresden Station will complete its review of other systems important to safety which may be susceptible to vortexing. (237-180-97-01702)

F. PREVIOUS OCCURRENCES:

None.

G. COMPONENT FAILURE DATA:

Not applicable. No component failed.