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Georgia Power
the southern electric system

March 29, 1994

Docket No. 50-366 HL-4547

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

Edwin I. Hatch Nuclear Plant - Unit 2
Licensee Event Report
Manufacturing Error, Normal Wear, and Personnel Error
Result in Inoperable HPCI System

Gentlemen:

In accordance with the Requirements of 10 CFR 50.73(a)(2)(v), Georgia Power Company is submitting the enclosed Licensee Event Report (LER) concerning a manufacturing error, normal wear, and personnel error which resulted in the inoperability of the High Pressure Coolant Injection System. This event occurred at Plant Hatch - Unit 2.

Sincerely,

J. T. Beckham, Jr.

OCV/cr

Enclosure: LER 50-366/1994-002

cc: *Georgia Power Company*
Mr. H. L. Sumner, General Manager - Nuclear Plant
NORMS

U.S. Nuclear Regulatory Commission, Washington, D.C.
Mr. K. Jabbour, Licensing Project Manager - Hatch

U.S. Nuclear Regulatory Commission, Region II
Mr. S. D. Ebneter, Regional Administrator
Mr. L. D. Wert, Senior Resident Inspector - Hatch

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NRC FORM 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Edwin I. Hatch Nuclear Plant - Unit 2	0 5 0 0 0 3 6 6	1 OF 7

TITLE (4)
Manufacturing Error, Normal Wear, and Personnel Error Result in Inoperable HPCI System

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 NAME	DOCKET NUMBER(S)
0 3	0 1	9 4	9 4	0 0 2	0 0	0 3	2 9	9 4		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): 1
POWER LEVEL (10): 0 7 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)	X	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)		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 (include area code)
Steven B. Tipps, Nuclear Safety and Compliance Manager	912 367-7851

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
X	BJ	CPLG	K200	Yes					
X	BJ		D245	Yes					

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-space typewritten lines) (16)

On 3/1/94 at 0918 EST, Unit 2 was in the Run mode at a power level of 1705 CMWT (70 percent of rated thermal power). At that time, plant personnel began the monthly operability test of the High Pressure Coolant Injection (HPCI) system. During this test the turbine thrust bearing temperature increased to approximately 437°F before rapidly decreasing below 200°F. Licensed personnel did not shut down the turbine when the bearing temperature exceeded the procedural limit of 160°F. On 3/2/94, the HPCI system was declared inoperable, the turbine bearing was disassembled, and found damaged. HPCI was returned to service by 0246 EST on 3/11/94.

The causes of this event were a manufacturing error in the thrust bearing housing, normal wear in the turbine to pump coupling, and personnel error.

Corrective actions for this event included replacing the failed bearing and worn coupling, modifying the oil hole, temporarily removing the involved individuals from licensed duties, and holding discussions with operations shift personnel. This event will be covered in licensed training to alert licensed personnel to the lessons learned. This action will be completed by 6/1/94. Other spline gear type shaft couplings on both units' HPCI systems will be inspected during upcoming refueling outages.

PLANT AND SYSTEM IDENTIFICATION

General Electric - Boiling Water Reactor
Energy Industry Identification System codes appear in the text as (EIIS Code XX).

DESCRIPTION OF EVENT

On 3/1/94 at 0918 EST, Unit 2 was in the Run mode at a power level of 1705 CMWT (70 percent of rated thermal power). At that time, plant personnel started the High Pressure Coolant Injection (HPCI, EIIS Code BJ) system turbine as part of a planned surveillance per procedure 34SV-E41-002-2S, "HPCI PUMP OPERABILITY." This test requires operation of the turbine and pump to simulate flows and pressures corresponding to an actual safety injection. The test procedure also requires plant operators to record various pump and turbine bearing temperatures as the test is in progress and to trip the turbine if any bearing temperature exceeds 160°F. Approximately 6 minutes into the test, a licensed operator reviewed the required bearing temperatures from chart recorder 2E41-R605 and identified that the temperature of the turbine thrust bearing was approximately 405°F. The licensed shift supervisor was then alerted to the indicated temperature. The shift supervisor reviewed the chart recorder and identified that the bearing temperature had decreased from the previous reading. Since all other bearing temperatures were normal and personnel stationed in the HPCI pump room had not reported any unusual conditions, the supervisor concluded that the temperature reading was not valid. Nonetheless, the supervisor decided to consult a drawing to investigate the recorder point being measured, i.e., whether it was oil temperature in the bearing well or actual metal temperature of the bearing race. While the investigation was in progress, the bearing temperature increased to 437°F and then decreased rapidly. After approximately ten minutes, the supervisor returned to the chart recorder and noticed the bearing temperature had decreased to 200°F and was decreasing at about 10°F per minute. Licensed personnel in the Control Room then contacted the system engineer in the HPCI pump room monitoring the test to determine the remaining time required for system operation in order to complete data gathering. The system engineer informed licensed personnel that the test would be completed in approximately five minutes. Since the bearing temperatures had returned almost to normal and the test was nearing completion, the supervisor elected to allow the test to be completed before tripping the HPCI turbine.

Following completion of the test, shift personnel initiated a further investigation of the indicated bearing temperature by requesting Instrument and Control technicians to check the instrument loop. By the next morning (3/2/94), the instrument loop and recorder were proven to have been in good working condition and confirmed that the indications had been valid. Therefore, based on the high temperatures the bearing experienced, plant personnel assumed bearing damage had occurred and declared the HPCI system inoperable. Repairs were initiated at that time.

Upon disassembly of the bearing housing on the HPCI turbine, it was discovered that the outboard thrust bearing had experienced significant friction heating and had been damaged. The thrust collar was damaged and required replacement. Replacing this collar required lifting the turbine shaft from its bearing standards and, consequently, required disassembly of the turbine. The reassembly was completed by the afternoon of 3/9/94, and the HPCI pump operability surveillance procedure was performed by 0200 EST on 3/10/94. Following completion of post-surveillance maintenance activities, the HPCI system was returned to service in its normal standby condition by 0246 EST on 3/11/94.

CAUSE OF EVENT

The causes of this event were a manufacturing error in the turbine, normal wear in the turbine shaft to pump shaft machine coupling, and personnel error.

A manufacturing error occurred when the oil feed hole was drilled into the HPCI turbine thrust bearing housing at the time the turbine was originally manufactured. The thrust bearing is supplied with oil through an angled 1/4-inch hole. The angled oil feed hole is formed by drilling two intersecting 5/32-inch pilot holes into the lower portion of the bearing housing, then reaming the holes to 1/4-inch afterward. In this case, the two pilot holes were drilled and the point of intersection was reached to form the correct angle, but in the reaming process, one of the holes was not reamed to the full 1/4-inch throughout its full depth. This in effect left a 5/32-inch restricting orifice in the oil hole. Since the oil piping which supplies this portion of the bearing housing incorporates a 7/32-inch restricting orifice, the cross sectional area available for oil supply was reduced by about 49% with consequent reduction in oil flow. Combined with other factors described below, the reduced lubrication contributed to the bearing failure.

Normal wear in the shaft coupling between the turbine and pump also contributed to the failure of the bearing. The coupling is a spline gear hub typical of industrial machine shaft coupling applications. It is designed to provide flexible torque transfer between the turbine and pump shafts to accommodate small imperfections in machine alignment as well as normal shaft lengthening and turbine rise which occur due to thermal expansion. During normal operation, the coupling gear splines must slip, and the force required to make them slip is generated by the outboard thrust bearing in the turbine as the turbine shaft thermally expands against it. As the coupling experienced normal wear, the coefficient of friction increased due to the gradual roughening of the gear tooth surfaces on the splines. As the frictional forces in the coupling gradually increased over time, the load which the thrust bearing could carry with the reduced oil flow was eventually exceeded. Consequently, the thrust bearing failed before it could overcome the friction in the coupling splines.

Personnel error occurred when licensed personnel did not comply with the requirement in procedure 34SV-E41-002-2S to trip the turbine if any bearing temperature reached 160°F. In this event, the involved licensed personnel mistakenly determined the high temperature indication was invalid. During pre-test discussions, one of the operators discussed a previous occurrence of a temperature "spike" on this equipment. Therefore, the Superintendent of Shift directed that the surveillance should not be terminated if a temperature "spike" was observed on the chart recorder. After the test was initiated and a licensed operator observed the rapid increase in indicated bearing temperature, the Shift Supervisor suspected a temperature "spike" was occurring and began an investigation to determine the validity of the indication before shutting down the turbine. He initially concluded that since all the other bearing temperatures were normal and personnel in the HPCI pump room saw no signs of problems with the HPCI turbine, the indication was not valid. When the Shift Supervisor returned to the chart recorder and bearing temperature was still above 160°F (though rapidly decreasing toward normal), he re-evaluated the potential for an actual high temperature condition. However, the termination of the test was delayed by approximately five minutes to allow final data acquisition. By the time the test was terminated, bearing temperature had decreased to around 170°F.

REPORTABILITY ANALYSIS AND SAFETY ASSESSMENT

This event is reportable per 10 CFR 50.73(a)(2)(v) because a single failure occurred which alone could have prevented the fulfillment of a safety function designed to mitigate the consequences of an accident. Specifically, the HPCI system was rendered inoperable because a bearing failed as a result of a manufacturing error, normal age-related wear on the turbine/pump coupling, and failure to follow a plant procedure.

The HPCI system is designed to inject water to the reactor vessel over a wide range of reactor pressures from approximately 160 psig through rated pressure. The HPCI system starts and injects automatically whenever a reactor water level decrease or a high drywell pressure indicates the possibility of an abnormal loss of coolant inventory. The HPCI system is designed to replace lost reactor coolant inventory in cases where a small line break occurs which does not result in full depressurization of the reactor vessel. The HPCI system consists of a tangential flow steam turbine which drives a main pump and booster pump. The design of the turbine and pump system incorporates a spline gear type machine shaft coupling to absorb small imperfections in alignment which occur due to machine positioning and thermal expansion in the turbine shaft, turbine casing, and piping. The thrust bearing in the turbine is designed to keep the turbine rotor centered in the casing during operation. It is a Kingsbury type thrust bearing consisting of a circular steel thrust collar riding between two brackets containing self-adjusting, babbit-surfaced bearing shoes. The bearing is lubricated by continuous oil flow while the pump is in operation. Flow to the bearing is pressure controlled.

The backup for the HPCI system is the Automatic Depressurization System (ADS) together with two fully independent and redundant low pressure injection systems, the Residual Heat Removal/Low Pressure Coolant Injection (RHR/LPCI, EIIS Code BO) system and the Core Spray (CS, EIIS Code BM) system. In the event that a small line break loss of coolant accident (LOCA) occurs and high pressure injection to the vessel is not available, ADS depressurizes the reactor pressure vessel through safety relief valves to the suppression pool, lowering reactor pressure to the point where RHR/LPCI and CS inject to the vessel. Both the CS system and the RHR/LPCI system contain two fully independent, redundant, 100 percent capacity loops, for a total of four low pressure injection loops. ADS, the CS system, and RHR/LPCI remained operable without interruption throughout the entire period of this event from 3/1/94 through 3/11/94.

In this event, the HPCI thrust bearing failed because its bearing capacity was exceeded in an environment of reduced oil flow. To address situations where the HPCI system is unavailable, the Unit 2 Final Safety Analysis Report (FSAR) conservatively assumes that the HPCI system will not be available for the purposes of analyzing the probability of core damage during a design-basis accident (DBA). The approved SAFER/GESTR - LOCA analysis shows that no core damage will result from a LOCA with the HPCI system out of service and only ADS and two of the four loops of low pressure injection available. Since ADS and all four loops of low pressure injection were available, the plant configuration remained well within the bounds of existing accident analyses at all times during this event.

Based on this analysis, it is concluded that this event had no adverse impact on nuclear safety. This analysis is applicable to all power levels.

CORRECTIVE ACTIONS

Corrective actions for this event included the following:

1. The failed bearing has been replaced with a new thrust bearing.

2. The restriction in the oil hole has been reamed out to correct design dimensions.

3. The spline gear coupling between the turbine and pump has been replaced with a new coupling.

4. The involved licensed personnel have been counseled regarding the event and were temporarily suspended from licensed duties.

5. The Manager of the Operations Department has discussed this event with all shift personnel in the Operations Department. These discussions included information concerning potential precursors to the event, the need to document apparent equipment problems, and the requirement to follow plant procedures.

6. This event will be covered in licensed training to alert licensed personnel of the potential "lessons learned" from the event. This action will be completed by 6/1/94.

7. Data packages for several of the past monthly Unit 1 HPCI pump operability surveillances were reviewed to determine whether excessively high bearing temperatures were observed and recorded; none were noted.

8. Other spline gear type shaft couplings on both units' HPCI systems will be inspected during upcoming refueling outages. This action will be completed on Unit 2 by 05/01/94 and Unit 1 by 11/30/94.

ADDITIONAL INFORMATION

1. Other Systems Affected: No systems were affected by this event other than those already mentioned in this report.

2. Failed Equipment Information:

Master Parts List Number: 2E41-C002	EIIS System Code: BJ
Type: Fast's 4-Inch Mill Motor Coupling	EIIS Component Code: CPLG
Manufacturer: Koppers Company, Inc.	Root Cause Code: X
Model Number: N0996505M	Reportable to NPRDS: Yes
Manufacturer Code: K200	

Master Parts List Number: 2E41-C002	EIIS System Code: BJ
Type: Thrust Bearing	EIIS Component Code: None
Manufacturer: Dresser-Rand	Root Cause Code: X
Model Number: 105099A01	Reportable to NPRDS: Yes
Manufacturer Code: D245	

3. Previous Similar Events: No other events have been reported in the past two years in which the similar causes that led to this event resulted in equipment damage or unavailability of Emergency Core Cooling Systems.