ACCELERATED DISTRIBUTION DEMONSTRATION SYSTEM

REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:8905030031 DOC.DATE: 89/02/24 NOTARIZED: NO DOCKET #
FACIL:50-331 Duane Arnold Energy Center, Iowa Electric Light & Pow 05000331
AUTH.NAME AUTHOR AFFILIATION
PROBST,J.R. Iowa Electric Light & Power Co.
HANNEN,R.L. Iowa Electric Light & Power Co.
RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 89-007-01:on 890224,isolation of HPCI sys on high steam flow due to improper speed control signal from trubine.
W/8 ltr.

DISTRIBUTION CODE: IE22D COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 7
TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

NOTES:

	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL
	PD3-3 LA	1	1	PD3-3 PD	1	1
	HALL,J.R.	1	1			
INTERNAL:	ACRS MICHELSON	1	1	ACRS MOELLER	2	2
	ACRS WYLIE	1	1	AEOD/DOA	1	1
	AEOD/DSP/TPAB	1	1	AEOD/ROAB/DSP	2	2
	DEDRO	1	1	IRM/DCTS/DAB	1	1
	NRR/DEST/ADE 8H	1	1	NRR/DEST/ADS 7E	1	0
	NRR/DEST/CEB 8H	1	1	NRR/DEST/ESB 8D	1	1
	NRR/DEST/ICSB 7	1	1	NRR/DEST/MEB 9H	1	1
	NRR/DEST/MTB 9H	1	1	NRR/DEST/PSB 8D	1	1
	NRR/DEST/RSB 8E	1	1	NRR/DEST/SGB 8D	1	1
	NRR/DLPQ/HFB 10	1	1	NRR/DLPQ/QAB 10	1	1
	NRR/DOEA/EAB 11	1	1	NRR/DREP/RPB 10	2	2
	NRR/DRIS/SIB 9A	1	1	NUDOCS-ABSTRACT	1	1
	REG FILE 02	1	1	RES/DSIR/EIB	1	1
	RES/DSR/PRAB	1	1	RGN3 FILE 01	1	1
EXTERNAL:	EG&G WILLIAMS,S	4	4	FORD BLDG HOY,A	1	1
	L ST LOBBY WARD	1	1	LPDR	1	1
	NRC PDR	1	1	NSIC MAYS,G	1	1
	NSIC MURPHY,G.A	1	1			

NOTE TO ALL "RIDS" RECIPIENTS:

PLEASE HELP US TO REDUCE WASTE! CONTACT THE DOCUMENT CONTROL DESK, ROOM P1-37 (EXT. 20079) TO ELIMINATE YOUR NAME FROM DISTRIBUTION LISTS FOR DOCUMENTS YOU DON'T NEED!

TOTAL NUMBER OF COPIES REQUIRED: LTTR 44 ENCL 43

RIDS/ADDS

RIDS/ADDS

NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1): Duane Arnold Energy Center (DAEC)

DOCKET NUMBER (2): 0 5 0 0 0 3 3 1

PAGE (3): 1 OF 0 6

TITLE (4): Isolation of the High Pressure Coolant Injection System on High Steam Flow Due to an Improper Speed Control Signal From Turbine Governor (Woodward EG-M)

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)
0 2	2 4	8 9	8 9	0 0 7	0 1	0 4	2 4	8 9	None	0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): N

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)	X 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)	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: James R. Probst, Technical Support Engineer

TELEPHONE NUMBER: AREA CODE 3 1 9 — 8 5 1 - 7 3 0 8

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	B J	6 5	W 2 9 0	NO							

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)

On February 24, 1989, the High Pressure Coolant Injection System (HPCI) isolated on high steam flow during a surveillance test. Due to a concurrent Reactor Core Isolation Cooling System (RCIC) inoperability, per Technical Specifications the plant was placed in a twenty-four hour Limiting Condition for Operation. The high steam flow isolation occurred due to problems in the HPCI turbine governor controls. The governor did not adequately control steam flow on turbine startup. The intermediate cause was an erroneous control signal from the Woodward Governor Company EG-M control box, which provides the HPCI turbine governor valve control signal. The problem was similar to one reported in LER 89-002. At that time, removable printed circuit boards in the EG-M were replaced, but the EG-M chassis, which also contains some circuitry, was not. As a corrective action for the February 24 event, a new EG-M chassis with new boards was installed. Periodic monitoring of the signal since February 24 detected no problem recurrence, and the HPCI turbine was successfully started on several occasions. The source of the erroneous control signal was isolated to within the EG-M control box. Testing by Woodward and Iowa Electric of the box and individual components failed to determine the circuitry component(s) causing the erroneous signal. Periodic replacement of the HPCI and RCIC EG-M chassis and printed circuit boards has been scheduled due to the possibility the failure was age-related. The turbine was returned to service on February 25, 1989.

This revision discusses the final outcome of the root cause review.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER(6)			PAGE(3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Duane Arnold Energy Center	0 5 0 0 0 3 3 1	8 9	- 007	- 01	2 OF 6

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

I. DESCRIPTION OF EVENT:

On February 24, 1989, at 1636 hours, with the reactor at 100% power and the Reactor Core Isolation Cooling System (RCIC, EIIS System Code BN) out of service, the High Pressure Coolant Injection System (HPCI, EIIS System Code BJ) outboard steam supply isolation valve closed due to a high steam flow signal. This occurred during the autostart portion of the HPCI surveillance test, which was being performed in accordance with the Technical Specification requirements for RCIC inoperability. RCIC had been declared inoperable at 1421 hours due to an unwarranted isolation signal from the Steam Leak Detection System (SLDS, EIIS System Code JM). The RCIC inoperability is fully discussed in LER 89-006.

A review of HPCI system pressure instrumentation and area conditions shortly after the first isolation determined the steam supply high flow signal was not due to a HPCI steam leak. The HPCI turbine was restarted at 1645 hours, and again the same steam supply valve closed on a high flow signal. HPCI was then considered inoperable.

Per the plant Technical Specification, concurrent inoperability of the HPCI and RCIC systems is a twenty-four hour Limiting Condition for Operation (LCO). In accordance with the Duane Arnold Energy Center Emergency Operating Procedures, an Unusual Event was declared. The NRC and the appropriate state and local authorities were notified. Preparations for plant shutdown were begun. The operability of the systems which provide redundancy for HPCI: the Automatic Depressurization System (ADS, EIIS System Code SB), the Low Pressure Coolant Injection System (LPCI, EIIS System Code BO), and the Core Spray System (CS, EIIS System Code BM), was verified.

Troubleshooting of the HPCI system revealed that an erroneous high speed demand signal from the turbine governor circuitry had resulted in an improperly controlled turbine governor valve. Following replacement of the HPCI governor control box and successful post-testing, the HPCI system was declared operable at 0600 hours on February 25, 1989. This ended the Unusual Event and the twenty-four hour LCO. The plant remained in a seven day LCO due to the RCIC inoperability. HPCI started and ran without problems during a plant scram on March 5, 1989 (see LER 89-008), and was successfully tested during the subsequent startup, and the next monthly surveillance.

II. CAUSE OF EVENT:

A. Troubleshooting.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER(6)			PAGE(3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Duane Arnold Energy Center	0 5 0 0 0 3 3 1	8 9	- 007	- 01	3 OF 6

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

A review of possible causes for the February 24, 1989 HPCI isolation began shortly after the event. It was recognized immediately that the turbine had responded in a similar manner on January 26, 1989. This event was reported in LER 89-002. The cause of the January event was an erroneous signal from a HPCI turbine governor component, the EG-M control box. Testing of the turbine governor components was the first step in troubleshooting the problem.

A check of the EG-M output voltage on February 24 found the unit's output signal with the turbine at rest was erroneously high at 6.8 volts versus the nominal 3.0 volts. The EG-M output would also not respond to various input signals. The EG-M receives information on the turbine speed, the automatic startup rate, and a signal from the flow controller. It provides a speed demand signal to an electro-hydraulic actuator, which controls the turbine governor valve.

The cause of the HPCI isolation of February 24 was a continuous high EG-M output signal. This resulted in the turbine steam supply governor valve maintaining a full open position during the entire HPCI startup sequence. Normally the governor valve reaches a full open position during the beginning of the startup sequence, but as the turbine gains speed the valve will travel in the close direction to reduce the steam flow to that flow needed to maintain adequate turbine speed. The continuously full open governor valve led to a high steam flow condition.

The January 26 isolation of HPCI on a high steam flow signal was also due to an erroneously high EG-M output signal of approximately 6.6 volts. The EG-M box was isolated as the source of the erroneous governor signal during the January troubleshooting. During a calibration attempt the day of the January event, the EG-M output experienced a step change from its correct output to the erroneous six volt value on several occasions. Further examination of the EG-M on the following day failed to recreate the problem for some time, indicating it was intermittent in nature. At one point, the turbine was successfully started and ran for several minutes before a step change to the six volt level in the EG-M output voltage occurred, which resulted in a high steam flow isolation. All inputs to the box with the exception of the power supply were removed at that time, and the erroneous output signal remained unchanged.

The EG-M control box is manufactured by the Woodward Governor Company. It consists of three removable printed circuit cards and a chassis which also contains some electronic circuitry. The printed circuit boards were replaced following the January event (replacement of the EG-M chassis did not occur due to a wiring problem within a spare chassis) and the turbine was then

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER(6)			PAGE(3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Duane Arnold Energy Center	0 5 0 0 0 3 3 1	8 9	- 007	- 01	4 OF 6

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

successfully tested, running for approximately fifteen minutes and again for thirty minutes with no problems. The HPCI turbine also automatically started and ran without incident during a scram on February 2, 1989 (LER 89-003). Following consultation with the manufacturer, the root cause of the January event was thought to be an unanticipated age-related response of a component or components on removable printed circuit boards within the EG-M control box. The EG-M unit had been almost continuously energized for at least ten years.

The EG-M had been determined to be the source of the erroneous EG-M output signal in January, and this also appeared to be the case for the February 24 isolation. The portion of the EG-M which was the common factor in the two events was the chassis. Therefore, as an initial corrective action for the February event, the chassis of the EG-M unit was replaced (as were the printed circuit boards). Following this, on February 25 the turbine was successfully autostarted. With the addition of enhanced monitoring of the EG-M output signal (see Corrective Actions), the HPCI system was declared operable. No continuous high EG-M output signals have been observed since that time.

Extensive testing has been performed on the removed EG-M control box, both the unit as a whole, and the chassis circuitry. Following removal of the box to the site Instrumentation and Control Lab for further testing, the failure was recreated a single time for a short period. Subsequently, a field service engineer from Woodward, and a representative of an independent service company authorized by Woodward, examined the removed EG-M unit on site and were unable to recreate the failure. The chassis, and the printed circuit cards removed during the January event, have been tested at the Woodward Governor Company headquarters. This testing included simulated operation performance under high heat conditions, and individual circuitry component evaluation and examination. No problems were identified. Some additional tests have also been performed on site with no discrepancies noted. This unit will not be returned to service.

A second Woodward representative visited the site during a recent shutdown, and examined the HPCI turbine governor system as currently installed. A check of the system calibration, wiring, and EG-M power supply stability identified no operability concerns.

B. Root Cause.

The cause of the HPCI governor control failure on February 24, 1989 was determined to be an intermittent improper control response by the EG-M. The EG-M was isolated as the problem. It appears this was also the cause of the January 26, 1989 event, as the chassis was the same in both cases. Subsequent testing of the EG-M control

box and individual components following the February 24 event did not determine the source of the problem, which proved to be intermittent. A circuit analysis of the EG-M has been performed, taking into account early troubleshooting data when the failure was repeated. The analysis concluded that most likely root cause of the EG-M failure was an intermittent degraded response of a transistor in the EG-M chassis (designated Q9). Such a response could be age-related. This transistor was individually tested by Woodward with no problems found. Other testing, based on analysis results, proved negative as well.

A contributory factor in the February 24 event was a manufacturer's wiring error in a spare chassis. This spare was to have been installed as a corrective action for the January 26 high flow isolation. As the spare chassis could not be properly calibrated, and it appeared the problem with the installed EG-M was within one of the removable circuit boards, only these boards were replaced as the final corrective action. Based on subsequent events and analysis, had a new chassis been installed following the January 26 event, it appears unlikely the EG-M failure would have recurred on February 24, 1989.

III. CORRECTIVE ACTIONS:

As an immediate corrective action for the failure of the HPCI turbine to successfully autostart during a surveillance test on February 24, 1989, the component which was the source of the erroneous signal, the EG-M control box, was replaced. This replacement included both the removable printed circuit boards and the EG-M chassis itself. In addition, periodic monitoring of the EG-M output voltage was initiated at that time and performed over the next two months to provide continuing assurance that the erroneous high signal was not recurring. The erroneous signal did not reappear. Due to the possibility this problem was age-related, the HPCI and RCIC EG-M chassis and printed circuit boards will be replaced every four refuel outages. The manufacturer has no recommendation for periodic replacement. The RCIC EG-M was changed out in 1987.

IV. ANALYSIS OF EVENT:

The inoperability of the HPCI system on February 24-25, 1989, had a minimal effect on the operability of the plant. Due to concurrent RCIC inoperability, the HPCI problem resulted in the plant being in a twenty-four hour LCO per the Technical Specifications. Power was reduced such that cold shutdown would have been achieved within the required time period had the HPCI system not been restored to operable status. Redundant safety systems were operable throughout the period of HPCI inoperability. The worst case effect of the failure or inability of the HPCI system to operate would be the loss of the ability to maintain reactor vessel inventory after small line breaks that do

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER(6)			PAGE(3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Duane Arnold Energy Center	0 5 0 0 0 3 3 1	8 9	- 007	- 01	6 OF 6

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

not rapidly depressurize the vessel. ADS, in conjunction with LPCI or CS, provides full redundancy for HPCI. The RCIC system is not considered fully redundant to HPCI.

V. ADDITIONAL INFORMATION:

A. Failed Component Information.

The HPCI turbine governor EG-M box discussed in the text as the source of the erroneous signal is a Woodward Governor Company EG-M Control Assembly 8270-811.

The HPCI turbine is a type CS, manufactured by the Terry Steam Turbine Company.

B. Previous Similar Events.

As noted in the test, this event is very similar to one which occurred on January 26, 1989, and was reported by LER 89-002. Other HPCI problems involving the turbine governor have been reported in LERs 83-018 and 86-010. LERs documenting HPCI starting or high flow problems are 75-057, 76-089, 77-077, 77-095, 77-096, 78-025, 83-022, 83-056, 88-001, and 88-004.

This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv).

DCD

Iowa Electric Light and Power Company

April 24, 1989
DAEC-89-0336

Mr. A. Bert Davis
Regional Administrator
Region III
U. S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License DPR-49
Licensee Event Report #89-007 Rev 1

Gentlemen:

In accordance with 10 CFR 50.73 please find attached a copy of the revised subject Licensee Event Report.

Very truly yours,

4-24-89

Rick L. Hannen
Plant Superintendent - Nuclear

RLH/JRP/go

cc: Director of Nuclear Reactor Regulation
Document Control Desk
U.S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, D. C. 20555

NRC Resident Inspector - DAEC

File A-118a

APR 27 1989

IE22