NRC Form 366
(9-83)

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

LICENSEE EVENT REPORT (LER)

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TITLE (4) Main Turbine Trip on High Reactor Water Level and Subsequent Reactor Scram Due to Malfunction of the 3A Feedwater Regulating Valve.

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)
										N/A	0 5 0 0 0
0 7	1 1	8 7	8 7	0 1 2	0 0		0 8	0 6	8 7	N/A	0 5 0 0 0

OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
N		20.402(b)	20.405(c)	X 50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10)	0 2 5	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	TELEPHONE NUMBER
Ronald Jackson Technical Staff Engineer (X-549)	AREA CODE 8 1 5 9 4 2 - 2 9 2 0

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	S J	F C V	C 6 3 5	Y	X	S J	Z 1	M 4 3 0	Y
X	S J	T D	F 1 3 0	Y					

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 fifteen single-space typewritten lines) (16)

On July 11, 1987 at 0210 hours the Dresden Unit 3 reactor scrammed from 25% rated thermal power following an automatic primary containment Group I isolation. Reactor power was being reduced in preparation for separating the unit from the grid for repairs to the main generator neutral grounding transformer. The root cause of the event was feedwater system instabilities which occurred while operating the feedwater level control (FWLC) system in three-element mode at low power levels. Vibrations at the feedwater regulating station induced a malfunction of the 3A feedwater regulating valve; increasing reactor water level initiated an automatic trip of the main turbine. Trip of the main turbine is believed to be the source of vibrations to instruments which initiated the Group I isolation and resulting reactor scram. Safety significance was minimal due to the availability of the high pressure coolant injection system to supply reactor inventory if necessary. Corrective actions to prevent recurrence include procedural changes and evaluation of new instrument rack designs. A previous event involving an automatic turbine trip due to FWLC problems on Dresden Unit 2 is listed under Reportable Occurrence 87-016 on Docket #050237.

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

EVENT IDENTIFICATION:

Main Turbine Trip on Vessel High Water Level and Subsequent Reactor Scram Due to Malfunction of the 3A Feedwater Regulating Valve.

A. CONDITIONS PRIOR TO EVENT:

Unit: 3 Event Date: July 11, 1987 Event Time: 0210 hours
Reactor Mode: N Reactor Pressure: 1000 psi Power Level: 25%
Mode Name: Run

B. DESCRIPTION OF EVENT:

On July 11, 1987, the load on Unit 3 was being reduced in preparation for taking the unit off-line in order to perform repairs to the main generator neutral grounding transformer [TB]. Control rods [AA] were being inserted to further reduce reactor power prior to tripping the main turbine [TA]. The 3A Reactor Feed Pump (RFP) [SJ] and the 3A Feedwater Regulating Valve (FWRV) [SJ] were in service with the Feedwater Level Control System [JB] in the three element control mode, which utilizes reactor water level, steam flow and feedwater flow input signals. The 3B FWRV had been closed and isolated at 2125 hours on July 10, 1987.
At approximately 0210 hours, the Unit 3 Reactor Operator observed rapid blinking of the open indication for the 3A RFP discharge motor operated isolation valve 3-3201-A. The Operator also observed an increase in the reactor water level, an increase in feedwater flow from 2.2 million to 5.6 million pounds per hour and a full open indication on the 3A FWRV. Other observations included half scale oscillations in feedwater and condensate system pressures and annunciation of the 3A RFP high vibration and feedwater regulating station high vibration alarms. The Reactor Operator immediately shifted the feedwater control from three element mode to single element mode (which utilizes solely reactor water level as an input signal) and placed the controller for the 3A FWRV in manual and valve demand to "zero". Since these actions were not effective in controlling the vessel water level increase, the Operator began closing the 3A FWRV motor operated isolation valve. However, the valve did not close in time to prevent an automatic main turbine trip at +55 inches reactor water level. The turbine trip was followed one second later by a primary containment Group I isolation [JM], which initiates closure of the Main Steam Line [SB] Isolation Valves (MSIVs). An automatic reactor scram on MSIV closure then occurred. The reactor scram was reset at 0236 hours and normal unit shutdown commenced at 0700 hours per Dresden General Procedure DGP 2-1, Unit 2(3), Normal Unit Shutdown.

The feedwater flow oscillations lasted approximately one minute causing feedwater system piping vibrations which initiated the RFP and FWRV vibration alarms. The Station Technical Staff was notified, and an inspection of the condensate and feedwater piping systems was initiated. This inspection was conducted by Technical Staff personnel with assistance from the Station Nuclear Engineering Department (SNED) and Sargent & Lundy (S & L) structural engineers. The walkdown included

visual inspection of feedwater and condensate piping from the main condenser to the primary containment. The inspection teams looked for damage to piping supports, structural steel, equipment anchorage, insulation and any other evidence that would indicate significant pipe movement. During the walkdown inspection, there were minor discrepancies found which are listed below.

1) Two pipe clamps connected to snubbers #3-3201-B-02 and 3-3201A-07 at the feedwater regulating station were partially rotated out of position.

2) Air operator mounting bolts were found broken on the Unit 3 condensate booster pump minimum flow valve A03-3401.

3) Fallen asbestos insulation was observed from piping in the feedwater pump room, at the feedwater regulating station, and in the high pressure heater bay area.

4) A loose operator was found on the feedwater minimum flow valve.

Repairs were performed on the above equipment per Work Request Nos. 66849, 66850, 66819 and 66838 and cleanup of the asbestos debris was conducted by station personnel. Although there were minor discrepancies found during the walkdown inspection, no signs of significant damage was discovered on the feedwater and condensate system piping. Based upon the information collected during the walkdown, S & L conducted an evaluation of the piping structural integrity. The evaluation concluded that the system experienced a short period of vibratory loads of a relatively low magnitude and consequently the resulting support and nozzle loads and piping stresses were within their design limits.

In addition to the walkdown inspection, feed pump vibration measurements were taken and a verification of feedwater pump discharge check valve integrity was performed. These checks were performed to ensure that no pump misalignment had occurred and to verify feedwater system integrity. Station personnel performed this surveillance per Special Procedure #87-7-110, which found that the check valves were operable and the RFPs were not misaligned. An in-service leak test was also conducted to verify feedwater system integrity. No leakage was found within the system.

C. CAUSE OF EVENT:

In the three-element mode, the FWLC system utilzes inputs from reactor steam flow, feedwater flow, and reactor water level. At low reactor power levels, it was found that significant changes in the steam flow input signal resulted in erratic FWLC output signals. This induced FWRV position oscillations which resulted in vibration of the feedwater regulating station. The valve oscillations then induced hydraulic transients in the feedwater and condensate systems. The period of oscillation lasted approximately 50 seconds and appeared to terminate when the operator shifted to single element or manual control of the FWRV. During the period of oscillation, the feedback spring on the FWRV valve positioner malfunctioned such that when the operator demanded "zero" valve position, the valve would close no further than to the 28% open position, which caused an increase in reactor vessel water level and subsequent main turbine trip at +55 inches. The following items were repaired upon inspection of the 3A FWRV per Work Request Nos. 66812 and 66820:

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

1) A broken feedback guide wire to the valve position indicator. A broken 3B FWRV feedback guide wire was also repaired.

2) The E/P transducer was re-adjusted.

3) The zero/span adjustment range spring on the valve positioner was re-adjusted.

4) The valve operator piston cylinder and piston O-ring seals were replaced.

In addition, the 3A FWRV was found to be at a 28% open position during inspection. Since the feedback guide wire to the valve position indicator was found broken, the Control Room indication remained at 100% open but the valve had actually closed to 28% open. It is believed that the valve E/P transducer and positioner out-of-adjustments caused the 3A FWRV to close no further than 28% open upon receiving the zero demand closing signal. Although the valve closed to 28% open, it was apparently insufficient in decreasing the reactor water level since the valve was approximately 15% open prior to the event. The anomalies found on the FWRV, with the exception of an accumulation of oil and dirt on the E/P transducer, were caused by FWRV cycling and feedwater piping vibrations generated from the feedwater transient. The oil and dirt buildup on the E/P transducer was due to continuous valve operation over an extended period of time. It is believed that the transducer was last cleaned on January 11, 1986 while Instrument Mechanics were rebuilding the transducer. To prevent recurrences of this type, routine calibrations will be performed on the E/P transducer once the Instrument Maintenance Department implements this item on a preventive maintenance program. The calibrations will enable station personnel to detect any developing problems with the transducer. The preventive maintenance program is currently in the process of being written and reviewed. In addition to the inspection of the 3A FWRV, an inspection of the 3B FWRV was performed per Work Request #66815. No further anomalies were found during the inspection.

Following the main turbine trip at +55 inches, a Group I isolation occurred which caused a reactor scram on main steam line valves not full open with reactor mode switch in run. It is believed that the Group I isolation was caused by vibration of instrument rack 3-2253-1 induced by the main turbine trip. Main steam line low pressure switches PS3-261-30A, B, C and D are installed on this instrument rack.

Although there was an automatic trip of the main turbine at +55 inches, there was not an automatic trip of the 3A RFP. As a result, Work Request #66816 was written to verify adequate calibration of level switches LITS 3-263-59A and B and to verify operability of the relays that initiate the RFP trip. The tripping logic for the RFP and the main turbine is such that either of the two level switches will trip the main turbine while both switches are required to actuate to trip the RFPs. The relays and level switches were checked per Dresden Instrument Surveillance (DIS) 5600-1, Main Turbine Trip, Reactor Feedwater Pump Trip and Feedwater Runout Reset on High Reactor Level. No anomalies were found during the surveillance. However, it is believed that the reactor vessel level did not rise high enough to trip both switches since the level setpoints were found at different settings but within the required setpoint tolerance in accordance with the surveillance procedure. This report is submitted in accordance with the requirements of 10 CFR 50.73(a)(2)(iv).

D. SAFETY ANALYSIS:

The automatic main turbine and RFP trips on high reactor level are designed to prevent moisture carryover from the reactor to the turbine. These automatic actions occurred as designed, with the exception that the 3A RFP did not automatically trip. However, it is believed that reactor level did not actually exceed the setpoint band for this trip. Receipt of the spurious Group I isolation during coastdown of the main turbine resulted in automatic closure of all primary containment Group I isolation valves and an automatic reactor scram from closure of the MSIVs. Inspection of the feedwater and condensate systems showed no significant damage. The Reactor Operator promptly responded to this event in accordance with Dresden Operating Abnormal (DOA) procedure 600-1, Transient Level Control, and responded to the reactor scram in accordance with Dresden General Procedure (DGP) 2-3, Normal Unit Scram. For these reasons, the safety significance was minimal.

E. CORRECTIVE ACTIONS:

The following immediate corrective actions were taken to verify the integrity of the feedwater and condensate systems:

1) The 3A and 3B FWRVs and their valve operators were disassembled and inspected per Work Request Nos. 66815 and 66820.

2) A visual inspection was conducted on the feedwater and condensate systems.

3) A snubber inspection was performed at the feedwater regulating station.

4) Verification of feedwater pump discharge check valve integrity was performed in accordance with Special Procedure 87-7-110.

5) Feedwater pump vibration measurements were taken in accordance with Special Procedure 87-7-110 to ensure that no pump misalignment occurred during the event.

6) Following startup of the feedwater system, a visual inspection was performed to verify system integrity.

The following additional corrective actions have been or will be taken to ensure an event of this type will not recur.

1) Caution tags were placed on the Unit 2 and 3 FWRV controls to require that the FWLC system be operated in single element mode at all times until further notice.

2) SNED and S & L are developing improvments to the MSL low pressure switch instrument mounting components to prevent vibration-induced signals.

3) Possible replacement of the existing FWRVs with drag type valves will be evaluated. The drag type valves are postulated to be less susceptible to rapid demand signal oscillations.

4) To minimize the probability of feedwater flow oscillations at low power levels, Dresden Operating Procedures (DOPs) 600-2 and 4 for FWRV manipulation were revised by adding the following notes:

   a) The "B" FWRV is the preferred valve for use during startup or shutdown on Unit 2.

   b) The "A" FWRV will not normally be used for startup or shutdown on Unit 2 due to the necessity of throttling flow with the "A" FWRV motor operated inlet (MO2-3206A), at low flows through the valve to prevent system oscillations.

   c) Step F.3 of DOP 600-2 was changed to say that when the "A" or "B" FWRVs are controlling reactor level in automatic, the low flow control valve will be placed in manual and closed.

5) A review on this event will be held with all Licensed Operators. This action has been initiated by the Training Department.

6) Routine calibrations will be performed on the FWRV E/P transducers under the Instrument Maintenance Department preventive maintenance program.

7) A FWLC firmware upgrade was performed. These upgraded components had been previously scheduled for installation and are designed to limit FWLC databus disturbances.

F. PREVIOUS OCCURRENCES:

LER Number/Docket	TITLE
87-16/050237	Dresden Unit 2 Reactor Scram Occurred While at 31% Power Due to an Automatic Reactor Feed Pump Trip on High Reactor Water Level and Subsequent Level Decrease to the Low Level Scram Setpoint. This resulted from a feedwater regulating valve locking up in the full open position during testing of the feedwater level control system. A firmware change to the feedwater level control circuitry was implemented to help prevent future recurrence. This firmware change was also planned for Dresden Unit 3.

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87-11/050249

Dresden Unit 3 Reactor Scram Due to Loss of Normal Feedwater as a Result of 3C Condensate Booster Pump Motor Failure.

Corrective actions included repairs to the motor, evaluations of modification to the automatic RFP low suction pressure trip and condensate booster pump automatic start circuitry, and evaluation of modification to the FWLC circuitry such that it would automatically transfer to single element control following a scram.

G. COMPONENT FAILURE DATA:

Manufacturer	Nomenclature	Model Number
Copes-Vulcan Inc.	Regulating Valve	D-100-160
Moore Products Co.	Valve Positioner	74
Fisher Governor Co.	Valve E/P Transducer	3550T

An industry-wide NPRDS data search was conducted for failures on Copes-Vulcan model D-100-160 valves over a one year period. The search indicated 54 valve failures of which 12 were related to the valve positioner and 3 related to the valve E/P transducer. In most cases the positioner was rebuilt, replaced or recalibrated and the E/P transducer was either recalibrated or replaced.

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August 6, 1987

EDE LTR #87-511

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Licensee Event Report #87-012-0, Docket #050249 is being submitted as required by Technical Specification 6.6, NUREG 1022 and 10 CFR 50.73(a)(2)(iv).

E.D. Eenigenburg
Station Manager
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EDE/kjl

Enclosure

cc: A. Bert Davis, Regional Administrator, Region III
File/NRC
File/Numerical

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