Commonwealth Edison
Dresden Nuclear Power Station
R.R. #1
Morris, Illinois 60450
Telephone 815/942-2920

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Licensee Event Report #91-024-0, Docket #050237 is being submitted as required by Technical Specification 6.6, NUREG 1022 and 10 CFR 50.73(a)(2)(iv).

L. D. Eenigenburg

E. D. Eenigenburg
Station Manager
Dresden Nuclear Power Station

EDE/ade

Enclosure

cc: A. Bert Davis, Regional Administrator, Region III
NRC Resident Inspector's Office
File/NRC
File/Numerical

(ZDVR/320)

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LICENSEE EVENT REPORT (LER)

Form Rev 2.0

Facility Name (1)	Docket Number (2)	Page (3)
Dresden Nuclear Power Station, Unit 2	0 5 0 0 0 2 3 7	1 of 0 6

Title (4) Unit 2 Reactor Scrams Due to Spurious Main Steam Line Low Pressure Signals

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 8	2 6	9 1	9 1	0 2 4	0 0	0 9	1 9	9 1	NONE	0 5 0 0 0
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OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (11)			
POWER LEVEL (10)	0 2 8	___ 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)
		___ 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 AREA CODE
Neil Spooner, Technical Staff System Engineer Ext. 2789	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

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)

At 1113 hours on August 26, 1991, with Unit 2 at 28% power, a main turbine trip occurred, followed by an unplanned Primary Containment Group I Isolation caused by spurious Main Steam Line (MSL) low pressure signals. The reactor scrammed as a result of the Group I Isolation closure of the Main Steam Isolation Valves (MSIVs). Investigation revealed that the root cause of the turbine trip was inadequate clearances within the thrust bearing assembly, which required disassembly and installation of proper shim material. In order to diagnose the cause of the unplanned scram, a test program was developed to duplicate the initial conditions while instrumenting the MSL low pressure logic; during performance of this test on August 30, 1991, a similar Primary Containment Group I Isolation / reactor scram occurred. Review of the test data concluded that the root cause was a combination of resonating pressure waves within the MSLs and the MSL low pressure switch instrument lines. Procedural actions were implemented pending review of design changes to correct this phenomenon. Safety significance of these events was minimal as the Group I Isolation logic responded as expected when challenged by the spurious signals. Previous related events are reported by LERs 91-17/050237 and 88-17/050249.

PLANT AND SYSTEM IDENTIFICATION:

General Electric - Boiling Water Reactor - 2527 MWt rated core thermal power

Nuclear Tracking System (NTS) tracking code numbers are identified in the text as (XXX-XXX-XX-XXXXX)

EVENT IDENTIFICATION:

Unit 2 Reactor Scrams Due to Spurious Main Steam [SB] Line Low Pressure Signals

A. CONDITIONS PRIOR TO EVENT:

Unit: 2 Event Date: August 26, 1991 Event Time: 1113 Hours

Reactor Mode: N Mode Name: Run Power Level: 28%

Reactor Coolant System (RCS) Pressure: 939 psig

B. DESCRIPTION OF EVENT:

At 2101 hours on August 25, 1991 with Unit 2 in the Run mode at 38% rated core thermal power, a main turbine [TA] trip was experienced. During this event, several Primary Containment Group I and Group II valves were observed to spuriously actuate (see LER 91-017/050237 for investigation on the cause of these unplanned actuations). The cause of the turbine trip was actuation of the turbine thrust bearing trip device [JJ], which had tripped the turbine and then reset itself 2 seconds after actuation. Inspection of the turbine thrust bearing wear detector trip device was inconclusive in that the as-found setpoints should not have resulted in the turbine trip. It was therefore decided to perform further checks of the wear detector trip device upon turbine roll following restart. On August 26, at 1110 hours, the Unit 2 generator [TB] was synchronized to the system grid and load was increased to 200 MWe. At 1113 hours, with Unit 2 in the Run mode at 28% rated core thermal power, the turbine thrust bearing trip device again actuated, tripping the main turbine. All turbine stop valves went closed and all turbine bypass valves went open as expected; however, approximately 1 second after the turbine trip a full Primary Containment [JM] Group I Isolation signal was received on Main Steam Line (MSL) low pressure. A reactor scram subsequently occurred upon closure of the Main Steam Isolation Valves (MSIVs). Investigations were initiated to determine the cause of the turbine trip and possible explanations for receiving the Group I Isolation.

Disassembly of the turbine thrust bearing revealed that the cause of the turbine trips was inadequate shim installation between the two halves of the thrust bearing ball assembly. Installation of proper shim material was then completed on the turbine thrust bearing under Work Request 03301. Investigation into the Group I signal determined that an actual reactor low pressure condition did not occur during this event; however, the exact cause for the spurious low pressure trip could not be explained. As a conservative measure, all 4 MSL low pressure switches were replaced under Work Request 03352. Additionally, a test program was developed to determine the cause of the low pressure trip. A pressure transducer was attached to the sensing line of MSL low pressure switch 2-261-30C, per Temporary Alteration II-34-91, and vibration equipment was attached to instrument rack 2252-1, which contains the MSL low pressure switches. A special test procedure, SP 91-8-101, was written in an attempt to duplicate the main turbine trip which had occurred on August 26.

On August 30, 1991, Unit 2 Startup was sucessfully completed. During turbine roll at 600 rpm the turbine was manually tripped. No adverse instrument responses occurred. Startup was continued, and the generator was synchronized to the grid. At 2009 hours, the main turbine was manually tripped in accordance with test procedure SP 91-8-101. Similar to the August 26th event, all turbine stop valves fully closed, turbine bypass valves opened, a Primary Containment Group I Isolation signal was received on MSL low pressure within a second of the turbine trip, and a reactor scram was experienced upon closure of the MSIVs. An investigation confirmed that an actual reactor low pressure condition did not exist during this event. After evaluation of the data obtained from performance of SP 91-8-101 and consultations with General Electric, it was concluded that interim compensatory actions would reduce the likelihood of similar events until permanent modifications could be developed. On September 1, 1991, Unit 2 Startup was sucessfully completed, and the main generator was synchronized to the system grid.

C. APPARENT CAUSE OF EVENT:

This report is submitted in accordance with 10CFR50.73(a)(2)(iv), which requires the reporting of any unplanned automatic Engineered Safety Feature (ESF) actuation, including the Reactor Protection System.

As described in Section B of this report, a previous event involving the thrust bearing wear detector trip device occurred on August 25, 1991. Disassembly of the thrust bearing assembly following the August 26 event revealed that the root cause of these events was excessive clearances within the thrust bearing ball assembly, which required installation of shim material between the two halves of the thrust bearing ball assembly. Further investigation concluded that the shim material had inadvertently not been installed following turbine maintenance activity in February, 1991. Review of Work Request Package 97500 (under which the February, 1991 work was performed) indicated that performance of a thrust bearing pinch test (which measures for proper clearances) was not specified. Inadequacy of the Work Request Package is therefore considered to be a contributing factor. The inadequate thrust bearing assembly clearances were not discovered following the earlier events because complete disassembly was not performed at that time and adjustment to the wear detector setpoints initially appeared to provide satisfactory operation.

Investigation into the cause of the spurious MSL low pressure isolation on August 26 revealed that an actual reactor low pressure condition did not exist; however, the cause of the trip could not be determined via existing data. Data obtained from the August 30th special test, consisting of vibrations on the 2252-1 instrument rack, a pressure surge trace of the sensing line to MSL low pressure switch 2-261-30C, and strip chart recordings of all 595-103 relay actuations (595-103 relays are de-energized when its corresponding MSL low pressure switch trips), indicate that a MSL pressure wave is primarily responsible for the spurious MSL low pressure signals. The MSL low pressure sensing lines tap into the MSLs approximately midway between the MSL equalizing header and the turbine stop valves. Upon stop valve closure during a turbine trip, steam flow is abruptly halted and a pressure wave is directed back towards the equalizing header. This pressure wave travels back and forth between the stop valves and the header until it can be sufficiently discharged to the main condenser through the turbine bypass valves. It is believed that this pressure wave in the MSLs creates a secondary pressure wave that resonates within the low pressure switch instrument sensing lines, and is the root cause for the spurious MSL low pressure trips. The pressure surge trace taken from the sensing line of the 2-261-30C MSL low pressure switch shows a pressure swing as large as 120 psi peak to peak, with a dominant frequency of about 6 cycles per second. On one cycle, the pressure swing dipped low enough to reach 850 psig, clearly low enough to trip the switch, which has a trip setpoint of 871 +/- 4 psig. Chart recordings of the 595-103 relay actuations show that the 2-261-30C MSL low pressure switch tripped during this event, along with MSL low pressure switches 2-261-30A, and -30D. It is believed that these pressure waves occur in all lines and were also responsible for tripping the -30A and -30D low pressure switches, but did not fluctuate enough to trip the -30B switch in this event. Although floor transmitted vibrations were experienced at instrument rack 2252-1, they were relatively minor in amplitude and are not considered a factor to the spurious MSL low pressure switch trips that were experienced in these events.

It should be noted that previous investigations of the spurious MSL low pressure signal phenomenon had resulted in vibration testing of the MSL low pressure instrument racks, MSL instrument line support inspections, and sensing line configuration enhancements. These actions had effectively reduced the occurrence of spurious MSL low pressure signals prior to these recent events.

D. SAFETY ANALYSIS OF EVENT:

The turbine thrust bearing absorbs the axial thrust of the turbine and generator rotors, holding the rotors in a stationary longitudinal position. There is only 100 thousandths of an inch (mils) clearance between the rotating blading and the stationary diaphragms in the turbine. Excessive longitudinal movement of the turbine could therefore result in significant turbine damage. A thrust bearing wear detector is provided to protect the turbine in the event of thrust bearing failure. The device will sound an alarm and trip the turbine if either (front or back) thrust plate wears more than 35 mils. The wear detector also provides a means to detect gradual wear in either one of the two thrust plates when a comparative record of the detector's dial readings is maintained.

The function of the MSL low pressure switches is to limit inventory loss so that fuel is not uncovered in the event of an Electro-Hydraulic Control (EHC) [TG] pressure regulator malfunction which would cause the turbine control and/or stop valves to fully open. It also provides protection against fast reactor depressurization, and the resulting rapid cooldown of the vessel. Technical Specification Table 3.2.1 states that there shall be two operable MSL low pressure trip channels when the Unit is in the Run mode. If an instrument within either trip channel is inoperable, that channel shall be tripped; if instruments in both trip channels are inoperable, an orderly load reduction shall occur with the Unit in hot standby condition within 8 hours. These requirements were maintained because operability of the MSL low pressure logic was unaffected.

Operations personnel responded promptly to both the Unit 2 scrams in accordance with procedure and operator training. A review of the turbine thrust bearing plate temperatures revealed that the turbine axial thrust conditions were not excessive. Plate temperatures were normal during each event, indicating that the thrust bearing plates have not been damaged. All Primary Containment Group I Isolation actions and Engineered Safety Functions (ESF) [JE] responded as designed, during both Unit 2 reactor scrams. For the above reasons, the safety significance of this event was considered minimal.

E. CORRECTIVE ACTIONS:

Corrective action for the main turbine trips consisted of the initiation of Work Request 03301 to install proper shim material between the two halves of the thrust bearing ball/ring assembly. As part of the performance of SP 91-8-101, the turbine was brought up to 600 rpm and a manual trip was initiated. Turbine parameters, including the thrust bearing wear detector, were monitored during the trip with no adverse conditions or responses observed. The turbine was then brought up to 1800 rpm, in accordance with SP 91-8-101, the main generator was sychronized to the grid and another manual turbine trip was initiated. Turbine parameters were again monitored during the trip, with no adverse conditions or responses observed. The Mechanical Maintenance Department will investigate purchasing a new ball/ring assembly, or repair the existing assembly, for the turbine thrust bearing which will eliminate the need for the shims (237-200-91-15001). The maintenance department has formed a team which will evaluate better work control methods for turbine work performed during outages (237-200-91-15002).

The initial corrective action for the spurious MSL low pressure trip that occurred on August 26, was initiation of Work Request 03352 to replace all 4 MSL low pressure switches on Unit 2. Although the switches were performing satisfactorily and the latest switch calibration surveillance was satisfactory, it was believed that cyclic fatigue and aging during normal operation may make the switches over-sensitive to pressure fluctuations. Four new Barksdale pressure switches, model B2T-M12SS-TC were installed and calibrated with a trip setpoint of 871 +/-4 psig decreasing, per Dresden Instrument Surveillance (DIS) 250-2, Main Steam Line Low Pressure Isolation Switch Calibration, prior to performance of SP 91-8-101. An inspection/walkdown of the MSL low pressure switch sensing lines, from the taps at the MSLs to the pressure switches at instrument rack 2252-1, was also performed. Several loose unistrut support clamps were found, and were subsequently tightened; all sensing lines were intact and showed no signs of damage.

During performance of SP 91-8-101, data obtained on the MSL low pressure switches during the first planned turbine trip (at 600 rpm) was reviewed but provided no definite conclusions as to the root cause of the earlier event. Since no Group I Isolation signal had been received during the first planned turbine trip and the turbine had responded normally, it was decided to continue with the performance of SP 91-8-101. Approximately 1 second after the final planned turbine trip (at 1800 rpm and 200 MWe), a full Group I Isolation signal was received on MSL low pressure. Data collected from this trip indicate that a resonating pressure wave had caused the Group I Isolation signal. The following corrective actions are currently being evaluated to prevent spurious MSL low pressure trips following turbine stop valve closure (237-200-91-15003):

1. Installation of pressure snubbers within each sensing line to attenuate the pressure surges before they reach the switches.

2. Provide an electrical time delay within the MSL low pressure trip circuitry to ensure an actual low pressure condition before initiating a Group I Isolation signal.

3. Relocation of the sensing line taps on the MSLs, and rerouting of the sensing lines to eliminate the pressure wave resonance phenomenon.

4. Technical Specification setpoint change to provide a greater pressure margin before switch actuation.

5. Installation of a different type of trip device for MSL low pressure and possible relocation/orientation of the instrument rack to improve trip reliability.

Temporary procedure changes were implemented to require increasing the turbine pressure set control by 20 psi during reactor operation below 50% rated core thermal power; these compensatory measures will remain in effect until the above design enhancement options are resolved (237-200-91-15004). This provides a greater margin between main steam throttle pressure and the MSL low pressure setpoint during low power operation, and has been reviewed to not invalidate applicable design basis transient analysis.

F. PREVIOUS OCCURENCES:

LER/Docket Numbers	Title
91-011/050237	Unit 2 Reactor Scram Following Turbine Trip Due to Main Turbine Thrust Bearing Wear Detector Malfunction

On June 9, 1991 at 0302 hours with Unit 2 in normal power operation at 300 MWe, a reactor scram was received due to valid high reactor pressure signals following a turbine trip. At the time of the event, Dresden Operating Surveillance (DOS) 5600-2, Monthly and Weekly Turbine Checks, was in progress. The root cause of this event was attributed at that time to foreign material in the turbine bearing oil, which fouled the thrust bearing wear detector, causing it to be offset. Corrective actions included a procedure upgrade to DOS 5600-2 and evaluation of a proximity probe design to enhance the wear detector configuration.

88-017/050249	Unit 3 Reactor Scram Due To Spurious Main Steam Line Low Pressure Signals Caused By Vibration

On November 27, 1988 at 0111 hours with Unit 3 at 17% rated core thermal power, a main turbine trip and subsequent reactor scram on Main Steam Line Low Pressure were experienced. The root cause of this event was attributed to instrument rack vibration during the turbine trip. Corrective actions included the installation of flexible loops within the sensing lines.

87-032/050237	Unit 2 Reactor Scram Due to Spurious Main Steam Line Low Pressure Signals Caused by Vibration

On October 20, 1987 at 0224 hours with Unit 2 at 100% rated core thermal power, a Primary Containment Group I signal and subsequent reactor scram was experienced. At the time of this event, Dresden Operating Surveillance (DOS) 1700-1, Main Steam Line Radiation Monitor Scram and Isolation Functional Test, was in progress. The root cause of this event was attributed to instrument rack vibration from turbine operation. Corrective actions included installation of vibration isolators to the low pressure switch housings.

G. COMPONENT FAILURE DATA:

Manufacturer	Nomenclature	Model Number	Mfg. Part Number
General Electric	Thrust Bearing	0606	N/A

Manufacturer	Nomenclature	Model Number	Mfg. Part Number
Barksdale	Pressure Switch	B2T-M12SS-TC	N/A

Although component failure of the turbine thrust bearing or MSL low pressure switches did not occur, the above data is provided for information.