LICENSEE EVENT REPORT (LER)

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 8

Title (4) Unit 2 Reactor Scram on Low Level Due to 2A Feedwater Regulating Valve Failure

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 8	2 1	8 7	8 7	0 2 4	0 0	0 9	2 1	8 7	N/A	0 5 0 0 0	

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 9 3		___ 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
Jerry Lizalek, Technical Staff Engineer (X-421)	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					

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 August 21, 1987 at 1755 hours with Unit 2 at approximately 2350 MW thermal (93% power) the reactor scrammed on a low reactor water level signal of +8 inches. The root cause of the event was the failure of the 2A Feedwater Regulating Valve (FWRV). The stem and plug assembly of the 2A FWRV separated due to a fatigue crack.

Corrective actions entailed replacement of the stem/plug assembly with a new welded stem/plug. Also to prevent recurrence a new trim package incorporating a lighter plug that is less susceptible to fatigue cracking will be considered as replacement parts in the future. This decision will be made following the testing being performed on Unit 3 as a result of the 8/7/87 Unit 3 scram due to feedwater system oscillating.

The safety significance was minimal since all emergency core cooling systems were available, however, no actuation was necessary, the feedwater level control system remained capable of manual control of reactor level at all times and the reactor scrammed at the specified conservative setpoint. Five (5) previous occurrences were reported by Licensee Event Reports #87-12 and #84-10 on Docket 050249 and #87-23, #87-16 and #84-9 on Docket 050237.

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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:

Unit 2 reactor scram during power operation due to low reactor water level resulting from an unanticipated closure of the 2A Feedwater Regulating Valve (FWRV).

A. CONDITIONS PRIOR TO EVENT:

Unit: 2 Event Date: August 21, 1987 Event Time: 1755 hours
Reactor Mode: N Mode Name: Run Power Level: 93%

The 2A and 2C Reactor Feedwater Pumps (RFP) [SJ] were in service with the 2A FWRV [SJ] controlling reactor water level in the automatic mode and the 2B FWRV in the manual mode at 25% open. The low flow FWRV was in the manual closed position.

B. EVENT DESCRIPTION:

On August 21, 1987 at 1755 hours, with Unit 2 in the run mode with reactor power steady at approximately 2350 MW thermal (93% power), with the 2A FWRV controlling reactor level in the automatic mode, the 2B FWRV in manual approximately 25% open, and the low flow FWRV in manual closed, a low reactor water level scram was received as reactor level dropped below the +8 inch (+151 inches above top of active fuel) setpoint. Following the scram, it was discovered that the 2C RFP had unexpectedly tripped off. The Unit 2 Nuclear Station Operator (NSO) immediately restarted the 2C RFP. The 2C RFP operated as required, however the "RFP ON" alarm did not print on the alarm computer. Reactor water level was quickly restored and the unit placed into hot shutdown. After the scram signal was received it was noticed that the Isolation Condenser [BL] air-operated (AO) vent valves AO-1301-17 and 20 along with the recirculation sample [AD] valves AO-220-44 and 45 were in the closed position. These valves are open during normal operation and should have remained open during this scram. Another problem noted was the loss of the inboard Main Steam Isolation Valves (MSIVs) [SB] AC pilot solenoid light indication. The pilot solenoid lights should have remained energized. During the post trip review Control Room alarm typer revealed that a number of control rod [AA] motion alarms were printed with time stamps two minutes later than the time the scram actually occurred. Although all rods had properly inserted into the core, the alarm printout indicated that many control rods scrammed as required.

While returning systems to normal, the Unit 2 High Voltage Operator (HVO) was unable to reclose the generator Output Circuit Breaker (OCB) [EL] 2-7. During normal operation this OCB is closed in the circuit with the Unit 2 main generator [EL]. Following a scram, the OCB will open to prevent motorizing the generator.

C. CAUSE OF EVENT:

This event is being submitted to comply with 10 CFR 50.73 (a)(2)(iv) which requires the reporting of any event or condition that resulted in manual or automatic actuation of an Engineered Safety Feature [JE], including the Reactor Protection System.

The root cause of the low water level scram was component failure of the 2A FWRV. Immediately following the scram, the 2A FWRV was cycled under direction of the Instrument Maintenance Department and no immediate problems were identified. Work Request #D68219 was immediately written to inspect and repair the 2A FWRV. Upon dismantling the 2A FWRV, the stem and plug were discovered to be separated. This separation allowed the plug to lower back into its seat blocking flow through the 2A FWRV. This caused the reactor level to drop rapidly until the scram setpoint of +8 inches was achieved. The valve plug and stem were examined by the Systems Materials Analysis Department (SMAD). An initial review determined that the failure was due to fatigue cracking of the valve stem at a point just above its connection to the valve plug. The valve stem/plug assembly had been in service for a period of 30 months at the time of the failure. Inspections of a stem/plug assembly from a Unit 3 FWRV revealed no indications of fatigue cracking after a similar period. The 2A FWRV stem and disc were replaced.

The root cause of the 2C RFP trip could not be positively identified. Following the scram, a review of the Computer Alarm Log, the Scram Event Log and the Scram Results Log raised three concerns. These concerns are as follows:

1) Interviews with NSOs indicated that the 2C RFP had tripped. However, flow had been indicated on the 2C pump until the high reactor water level setpoint occurred tripping all the feed pumps.

2) The 2A RFP flow decreased to almost zero when there was no indication that the pump had tripped. Additionally, the 2A RFP minimum flow valve opened.

3) The computer alarms for "RFP ON" and "RFP NORMAL" did not print out during the event for the 2C RFP.

In order to resolve these issues, interviews were conducted with the NSOs and a Special Procedure (SP) #87-8-129, "Reactor Feed Pump Trip and Annunciation Test" was written. The purpose of this SP was to test the RFP trip and annunciation circuits. The results of the interviews and SP #87-8-129 are as follows:

1) While performing the SP, the computer alarms indicated that two C RFP trips occurred with no corresponding C "RFP ON" alarms occurring between the two trips. Since the NSO interview indicated that the NSO did start a feed pump and SP #87-8-129 proved that the "RFP ON" and "RFP NORMAL" alarms did not work, it is apparent that the Operator started the 2C RFP. The root cause of the failed "RFP ON" and "RFP NORMAL" alarms has been attributed to dirty breaker contacts. This answers Concerns #1 and #3.

2) As for Concern #2, it has been determined to be a result of the A feed pump flow being choked off by the operation of the B feed pump which started in response to the C pump trip. The A minimum flow valve opening was a normal response to the reduced flow. The total feedwater flow was sufficient to raise reactor water level following the scram.

The root cause of the Isolation Condenser Valves AO-1301-17 and 20, Recirculation Sample Valves AO-220-44 and 45 closing, and the loss of the inboard MSIV AC pilot solenoid light indication is believed to be the result of a momentary loss of power to auxiliary relays associated with the above equipment. These relays are supplied by the 120V AC instrument bus [EE] which is provided by the unit auxiliary transformer through 4 KV Bus 23, 480V Bus 28 and Motor Control Center (MCC) 28-2 (see Figure 1). Following a unit scram, an automatic transfer of power occurs between the unit and reserve auxiliary transformers which result in a momentary loss of power to the instrument bus. The momentary loss of power to the instrument bus occurs because Air Circuit Breaker (ACB) [FK] 2303 must open prior to ACB 2311 automatically closing. This is accomplished by means of an ACB 2303 "b" auxiliary contact ("b" contact is closed when the ACB is open) installed in the auto close circuit of ACB 2311. The automatic transfer occurs in cycles and apparently lasts long enough for the relays to occasionally drop out causing the above equipment to de-energize. The relay drop out does not always occur under this condition and is sporadic. Since seal-in circuits are used, the de-energized equipment remains de-energized until the circuitry is reset by the NSO.

The root cause of the apparent control rod motion following the scram has been determined to be a result of limited computer memory. Upon the recognition of a control rod drift by the Rod Worth Minimizer (RWM), the RWM initiates continuous control rod position scans. These scans continue until the rod drift is cleared. During the course of a unit trip, two or three complete control rod scans will be performed as the RWM is capable of scanning the entire core in approximately one second. As each scan progresses, the rod I.D. and endpoints of the travel are printed on the unit's alarm typer, along with the time that the motion was recognized by the computer. This results in stacking complete core scans in the memory of the process computer. This, coupled with the numerous alarm messages received by the computer following a scram, fills the print buffer memory and the remaining available memory. When this occurs, messages must wait on the data highways (the input lines) until space is available to process and store the message. As the time stamp is not applied to the message until the message is accepted by the computer, the wait on the data highway is reflected by a time stamp later than the actual occurrence. This problem has occurred previously, and corrective action had been initiated by Software Discrepancy Report (SDR) 12-87-22 and SDR 12-87-1 on August 4, 1987.

The cause of the OCB 2-7 failure to close was determined, upon investigation by the Operations Analysis Department (OAD), to be the result of a loose cover and gasket found on the pilot air close solenoid valve. This prevented sufficient air pressure to be developed in the under piston area of the OCB close mechanism to close it. It is not known how the cover became loose.

D. SAFETY ANALYSIS:

Although the 2A FWRV closed and could not be reopened due to the extent of the failure, the NSO was able to manually control the reactor water level via the low flow regulating valve and the 2B FWRV. Also, while the conditions for which the reactor scrammed did not warrant any automatic or manual operation of the Emergency Core Cooling Systems (ECCSs), such as High Pressure Coolant Injection [BJ], Low Pressure Coolant Injection [BO], Core Spray [BM], and Automatic Depressurization System [BS], the systems were available to provide an alternate means for reactor water make-up and for reactor cooling.

ECCS actuation occurs at -59 inches (84 inches above top of active fuel) and at no time did reactor level decrease to below -20 inches. Further, the reactor scrammed at a conservative reactor water level. Technical Specifications 2.1.C, "Limiting Safety System Setting", states that the reactor low water level scram setting shall be greater than or equal to +144 inches above top of active fuel in the vessel at normal operating conditions. This corresponds to a reactor vessel level of +1 inch indicated. Level differences inside and outside the reactor dryer skirt vary from a 0 inch difference at 0% steam flow to a 7 inch difference at 100% steam flow, therefore the actual scram setpoint is set at +8 inches indicated level. Also, RPS functioned as designed in response to the low water level scram condition. For these reasons, the safety significance of this event was considered minimal.

E. CORRECTIVE ACTIONS:

A new stem and plug were installed in the 2A FWRV. This stem/plug assembly was also welded together. In order to prevent future events of this kind a new trim package incorporating a lighter plug that is less susceptible to fatigue cracking will be considered as replacement parts in the future. This decision will be made following the Unit 3 testing being performed as a result of the 8/7/87 Unit 3 manual scram due to feedwater system oscillations.

The corrective actions performed as a result of the 2C RFP trip and subsequent failure of the "RFP ON" and "RFP NORMAL" alarms are as follows:

1) The RFP low oil pressure and low suction pressure switches which provide RFP trip functions were calibrated and found satisfactory.

2) SP #87-8-129 was performed to verify breaker operation and computer alarm inputs. The breakers operated properly, however the same problem noted during the scram for the RFP computer alarms recurred. The breaker contacts for the "RFP ON" and "RFP NORMAL" alarms were cleaned and then SP #87-8-129 was performed successfully.

No further corrective actions are required on this item.

To correct the momentary loss of power that occurred during the auto transfer of the 120V AC instrument bus and subsequent closing of Isolation Condenser Valves AO-1301-17, 20, Recirculation Sample Valves AO-220-44, 45, and the loss of the inboard MSIV AC pilot solenoid light indication due to the momentary loss of power to auxiliary relays associated with the above equipment, the station has submitted an Action Item Report (AIR) #12-87-30 to the BWR Engineering Department for replacement of the auxiliary relays with a different design and/or provide a continuous supply of power to the instrument bus. No further corrective actions are required on this item.

The corrective actions performed as a result of the apparent control rod drive motion following the scram as a result of the computer memory are as follows: This problem had occurred previously and corrective actions had been initiated by SDR #12-87-22, dated April 20, 1987, and SDR #12-87-1 dated January 12, 1987. Both SDRs were completed on August 24, 1987. The corrective action taken was to prevent printing of control rod travel messages for six minutes following the receipt by the computer of a reactor scram, a generator trip, or any of the 12 turbine trips. This will reduce the memory consumed by the control rod motion alarms, minimizing the number of alarms that are forced to wait on the data highways for processing. All control rod travel messages received after the six minute wait will be printed as normal. This is the same methodology which was employed by the originally installed General Electric 4020 Process Computer. Confirmation of control rod position after a scram is accomplished through the use of process computer program OD-7, which indicates what rods require insertion. The described change was installed on the process computer on August 24, 1987, and is documented by Dresden Technical Procedure (DTP) 9900-3, "Process Computer Code Installation", Installation Report #106. No further corrective actions are required on this item.

The corrective actions performed as a result of the inability to reclose OCB 2-7 was to lighten the cover and gasket of the pilot air close solenoid valve.

F. PREVIOUS OCCURRENCES:

LER Number/Docket	Title
87-023/050237	Reactor Scram During Power Operation Due to Low Reactor Water Level Resulting From Unanticipated Closure of the 2B Feedwater Regulating Valve. The root cause of the system difficulties has not been determined. A task force has been formed and testing is being performed. A supplement will be issued.
87-012/050249	Dresden Unit 3 Main Turbine Trip on High Reactor Water Level and Subsequent Reactor Scram Due to Malfunction of the 3A Feedwater Regulating Valve.

Root cause of this event was feedwater system instabilities which occurred while operating the feedwater level control system in three-element mode at low power levels. Corrective actions to prevent recurrence included procedural changes and evaluation of new instrument rack designs.

87-016/050237 — Dresden Unit 2 Reactor Scram Occurred While at 31% Power Due to an Automatic Reactor Feed Pump Trip on High Reactor Water Level 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 was also planned for Dresden Unit 3 and has since been implemented.

87-10/050249 — Dresden Unit 3 Reactor Scram During Normal Operation Due to Low Reactor Water Level Caused by "A" Feedwater Regulating Valve Closure Due to Vibration.

Corrective actions were to drill holes into the regulating valve coupling block and install set screws to secure the stem and valve operator to the coupling block.

84-9/050237 — Dresden Unit 2 Reactor Scram Due to Reactor Low Water Level Caused by "A" Feedwater Regulating Valve Failing Closed Due to Vibration.

Corrective action was to reconnect the valve operator and stem with sheet metal locktabs to prevent the locknuts from vibrating loose.

G. COMPONENT FAILURE DATA:

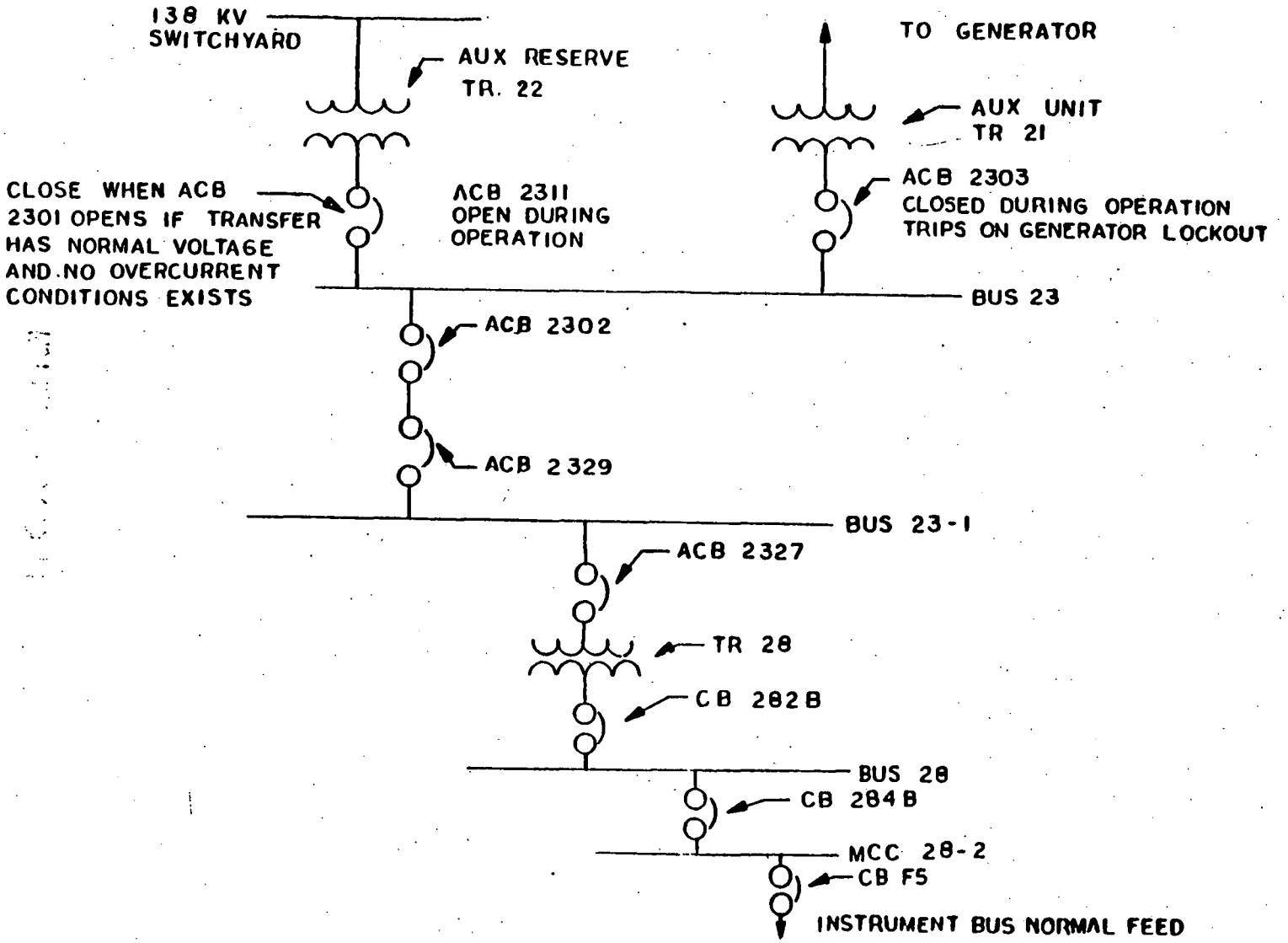
Manufacturer: Copes-Vulcan Inc.

Nomenclature: 2A FWRV

Model Number: P-200-12

An industry-wide NPRDS data search was conducted for failures of Copes-Vulcan valves over a one year period. A total of 81 failures were identified, four of which were failures of the model P-200. The failures were attributed to FWRV valve positioner operating abnormalities. The positioner was either recalibrated or replaced in each case.

FIGURE 1


138 KV SWITCHYARD
AUX RESERVE TR. 22
TO GENERATOR
AUX UNIT TR 21
CLOSE WHEN ACB 2301 OPENS IF TRANSFER HAS NORMAL VOLTAGE AND NO OVERCURRENT CONDITIONS EXISTS
ACB 2311 OPEN DURING OPERATION
ACB 2303 CLOSED DURING OPERATION TRIPS ON GENERATOR LOCKOUT
BUS 23
ACB 2302
ACB 2329
BUS 23-1
ACB 2327
TR 28
CB 282B
BUS 28
CB 284B
MCC 28-2
CB F5
INSTRUMENT BUS NORMAL FEED

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EDE/kjl

Enclosure

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File/NRC
File/Numerical

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