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Dresden Nuclear Power Station
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May 6, 1991

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Licensee Event Report #91-007-0, Docket #050237 is being submitted as required by Technical Specification 6.6, NUREG 1022 and 10 CFR 50.73(a)(2)(i)(B).

E. D. Eenigenburg
Station Manager
Dresden Nuclear Power Station

EDE/ade

Enclosure

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

(ZDVR/204)

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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) Violation of Core Thermal Power Limits Due to Unplanned 2B Reactor Recirculation Pump Speed Increase

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 4	1 1	9 1	9 1	0 0 7	0 0	0 5	0 6	9 1	N/A	

OPERATING MODE (9)		THIS REPORT IS SUBMIBTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (11)			
N		___ 20.402(b)	___ 20.405(c)	___ 50.73(a)(2)(iv)	___ 73.71(b)
POWER LEVEL (10)	0 9 9	___ 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)	X 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
Jerry Larson, Technical Staff System Engineer Ext. 2816	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	A D	C O N	X X X X	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 April 11, 1991 at 1601 hours, with Unit 2 at 99% power, the Nuclear Station Operator (NSO) was attempting to reset the 2B recirculation pump motor-generator (MG) set scoop tube in accordance with approved procedures; however, the 2B recirculation pump speed increased from 94% to 100% speed, causing an unplanned increase in reactor power. The scoop tube was locked out again and an Operator was dispatched to manually reduce the speed of the 2B recirculation pump. Mechanical binding of the 2A feedwater regulating valve was also observed. During these evolutions, maximum core thermal power of 102.04% was approached, which exceeded DPR-19 License Condition 2.G. limits. A Qualified Nuclear Engineer instructed the NSO to insert a rod step in an attempt to reduce power. Reactor power was further reduced to less than 100% by manually reducing the speed of the 2B recirculation pump. There was no safety significance because all core thermal limits as governed by the Technical Specifications had a minimum margin of 17%, at no time did the 8 hour average thermal power exceed the licensed power level, and recirculation pump speed run-up is a previously analyzed non-limiting transient. Investigation revealed a faulty MG set speed error limiting network socket, which was replaced. A piece of a shaft split ring for the second-stage impeller of a reactor feed pump was found to be the cause of the 2A feedwater regulating valve binding. This is believed to be the first event involving violation of core thermal power limits caused by this type of failure.

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:

Violation of Core Thermal Power Limits Due to Unplanned 2B Reactor Recirculation [AD] Pump Speed Increase

A. CONDITIONS PRIOR TO EVENT:

Unit: 2 Event Date: April 11, 1991 Event Time: 1601 Hours

Reactor Mode: N Mode Name: Run Power Level: 99%

Reactor Coolant System (RCS) Pressure: 1008 psig

B. DESCRIPTION OF EVENT:

On April 11, 1991 at 1601 hours, with Unit 2 in the Run mode at 99% power, the Nuclear Station Operator (NSO) was attempting to reset the 2B reactor recirculation pump motor-generator (MG) set [AD] scoop tube per Dresden Operating Procedure (DOP) 202-12, Reactor Recirculation System Flow Controller Operation. The NSO verified the 2B deviation meter on the 902-4 panel to be indicating that the 2B recirculation pump speed controller demand signal matched the actual recirculation pump speed, as is required by the procedure to prevent unplanned speed changes upon reset of the scoop tube. The Station Control Room Engineer (SCRE) also observed that these requirements were satisfied. However, when the 2B scoop tube was reset, the 2B recirculation pump speed increased from 94% to 100% speed in approximately 10 seconds. Total core flow increased from 95 E 6 lbm/hr to approximately 99 E 6 lbm/hr. The SCRE immediately instructed the Utility NSO to lock-out the 2B scoop tube again at the 902-18 Control Room panel. Reactor power subsequently started to increase as a result of the increase in core flow.

Average Power Range Monitor (APRM) [IG] indication (neutron flux) then reached a maximum of 103% for approximately 5 seconds. A High Voltage Operator (HVO) was dispatched to the MG set to manually reduce the speed of the 2B recirculation pump. Reactor power began to decrease due to a reduction in vessel water level to approximately 25 inches above instrument zero (168 inches above the top of active fuel). The 2B Feedwater Regulating Valve (FWRV) [JB] went to 100% open in automatic control. The NSO also opened the 2A Feedwater Regulating Valve to 55% open to assist with restoration of normal reactor water level. It was subsequently observed that the 2A FWRV had become mechanically bound at 55% open. The increase in feedwater flow subsequently caused core thermal power to again begin to increase. APRM indication then reached a maximum of 103% for approximately 5 seconds. A Qualified Nuclear Engineer (QNE), who was also present during the evolution, then instructed the NSO to insert control rod step number 141 (array 10B1 16 to 14). This immediately reduced APRM indication to less than 102%, and generator output [EL] from approximately 831 MWe to 820 MWe. The HVO manually reduced the speed of the 2B recirculation pump to further reduce APRM indication below 100%.

In summary, APRM indicated power (neutron flux) was greater than 102% for less than 2 minutes and was reduced to less than 100% within approximately 15 minutes. The maximum core thermal power during the event (heat balance) was 2578.6 MWt, or 102.04% rated. At no time did the 8 hour average thermal power exceed the licensed power level.

C. APPARENT CAUSE OF EVENT:

This event is being reported in accordance with DPR-19 License Condition 2.G which requires that any event that violates the Technical Specifications, including exceeding the licensed rated thermal power of the unit, be reported. A 24 hour phone notification was also completed at 1550 hours on April 12, 1991 as required by the Unit 2 Technical Specifications.

An error limiting network in the reactor recirculation pump MG set speed control circuitry serves to ensure that the speed of the recirculation pump matches the demand signal from the speed controller. While the recirculation pump MG set scoop tube is locked out, the speed controller (262-28A(B) on Control Room panel 902-18) continues to send an automatic signal to the scoop tube. Because the scoop tube does not respond, the error deviation signal causes the controller to go to a full increase or decrease demand signal. This causes the speed control circuitry to saturate and the speed demand deviation meter indicating needle to go to a full limit in the increase or decrease demand direction. As a result, the speed demand must be matched to the actual speed and properly balanced (a zero indication on both upper and lower deviation meter pointers on Control Room panel 902-4) prior to resetting the scoop tube or a severe unplanned speed change can occur.

The root cause of the increase in speed of the 2B recirculation pump during resetting of the 2B MG set scoop tube was a failed error limiting network. Investigation by the Instrument Maintenance Department (IMD) revealed that a connector socket that the error limiting network plugs into was not properly contacting the pins of the error limiting network. As a result, the deviation meter on the 902-4 panel was not receiving proper feedback from the speed control circuitry. This caused the speed demand signal pointer and the speed pointer on the deviation meter to both indicate a zero position, corresponding to no mismatch in speed versus demand. In actuality, the speed control circuitry was saturated, with the demand signal being significantly higher than the actual speed. This caused the 2B recirculation pump to run-up in speed from 94% to 100% when the 2B MG set scoop tube was reset. The recirculation pumps were limited to approximately 100% of rated speed both mechanically and electrically.

A maintenance history review revealed that this error limiting network was last worked on under Work Request (WR) 85658 in June, 1989; the error limiting network was replaced following an event where the recirculation pump ran back in speed after resetting the scoop tube. However, resetting of the scoop tube has been performed satisfactorily numerous times since that time. The connector problem is believed to have occurred on or subsequent to April 9, 1991, when the reset operation was last performed without difficulty. The socket is located in an accessible rear area of a main Control Room panel and could have been inadvertently bumped during work or inspections; however, this could not be confirmed. This type of event has not been a recurring problem.

The root cause of the binding of the FWRV was a piece of a shaft split ring for the second-stage impeller of a reactor feedwater pump. The piece had become lodged between the plug and the seat of the valve. A maintenance history review revealed that there have been two previous occurrences of mechanical binding due to broken pieces of the shaft split ring of a reactor feedwater pump. A piece of a split ring was removed from the 2A FWRV under WR 78114 on September 3, 1988, and a piece of a split ring was removed from the feedwater pump minimum flow valve under WR 88165 in January, 1991.

D. SAFETY ANALYSIS OF EVENT:

Based on core conditions immediately prior to the event, it was determined that the impact of the pump runup and level transient had minimal impact on the fuel. The most limiting fuel thermal limit was the Maximum Fraction of the Limiting Critical Power Ratio (MFLCPR), which initially had approximately 17% margin to the Minimum Critical Power Ratio (MCPR) operating limit specified in the Technical Specifications. All other thermal limits had at least a 30% margin to the Technical Specification limits. The most limiting fuel node in the core prior to the event was 0.19 kw/ft below the preconditioned state for the fuel. The pump runup and subsequent level transient resulted in a power increase from approximately 99% to just over 102% rated core thermal power. Based on this power increase as compared to the amount of margin to thermal and preconditioning limits that existed prior to the event, it is clear that these limits were not violated. A two-pump runup event has been analyzed for Dresden Unit 2 Cycle 13 operation by Advanced Nuclear Fuels (ANF) for transients starting at less than rated conditions up to the 120% power/110% flow point. This analysis is used to determine the MCPR (Minimum Critical Power Ratio) LCO (Limiting Condition for Operation) for this event. The scoop tube mechanical and electrical stops are set to limit flow to less than 110% of rated core flow. Therefore the ANF (Advanced Nuclear Fuels) analysis bounds this event. Failure of a FWRV is also previously analyzed and travel of this type of lost part to the reactor vessel is not probable. For these reasons, this event was of minimal safety significance.

E. CORRECTIVE ACTIONS:

The immediate corrective action concerning the sudden increase of the 2B recirculation pump speed following the reset of the 2B MG set scoop tube was to lock out the 2B scoop tube. An Operator was then dispatched to the 2B MG set to manually reduce the speed of the 2B recirculation pump. A QNE instructed the NSO to insert a rod step to decrease power. Power was then further reduced by manually reducing the speed of the 2B recirculation pump.

The IMD replaced the failed error limiting network socket in accordance with WR 00823 and satisfactory operation was then observed. The Mechanical Maintenance Department (MMD) disassembled the 2A FWRV in accordance with WR 00824 and removed a piece of a reactor feedwater pump shaft split ring. A review of maintenance records did not disclose the origin of the broken pieces of the shaft split ring.

Further corrective actions in progress include the following items. DOP 202-12 will be revised by the Operations Staff to ensure that the Operator verify that the deviation meter is capable of indication prior to resetting the scoop tubes. In addition, this revision will require an NSO to be stationed at the 902-18 Panel to ensure that the scoop tube can be locked-out again quickly, should a run-up occur following the reset (237-200-91-07001). The System Engineer, IMD Staff and Project Management are evaluating potential replacement of the Recirculation MG Set Control System with upgraded equipment, under modification M12-2(3)-89-050. Preliminary engineering designs are presently undergoing cost benefit analysis. Additionally, the System Engineer will evaluate the installation of a scoop tube lock button on the 902-4 Control Room panel, to facilitate easier Operator response to this type of event, based on the resolution of the above stated modification (237-200-91-07002). The Reactor Engineer will also evaluate potential changes to operating practices concerning mitigation of the consequences of unplanned recirculation pump speed change events (237-200-91-07003). The MMD is currently reviewing the installation configuration of the RFP shaft split rings (237-200-91-07004).

F. PREVIOUS OCCURENCES:

The following non-reportable station deviation reports (DVRs) were reviewed for applicability concerning the recirculation pump speed control problem:

DVR Number	Title
12-3-81-030	3B Reactor Recirculation Pump Runback
12-2-87-066	Recirculation Pump Scoop Tube Lockout Due to Spurious Signal
12-2-89-098	2B Reactor Recirc MG Set Scoop Tube Lockout and Subsequent Pump Runback Due to Failed Error Limiting Network
12-3-90-101N	3A recirculation pump runup due to faulty MV/I converter

In the first event, the 3B recirculation pump ran back to minimum pump speed subsequent to clearing the pump speed mismatch interlock. The corrective action consisted of making a permanent change to the scoop tube drive motor speed in order to slow down the movement of the scoop tube.

In the second event, the 2B recirculation pump scoop tube received a spurious lockout signal. The signal subsequently cleared spontaneously and no corrective action was required.

In the third event, the 2B recirculation pump scoop tube had been locked out due to a loss of power to the scoop tube. When this condition cleared, the 2B recirculation pump ran back in speed when the 2B scoop tube was reset due to a failed error limiting network and a resultant apparent balanced indication on the deviation meter. Corrective action was to replace the error limiting network.

In the fourth event, the 3A recirculation pump ran back due to a faulty MV/I converter. Corrective action was to replace the MV/I converter.

Review of system records for the previous five years indicated no previous events of a failed socket for an error limiting network for the speed control circuitry.

A previous event involving FWRV mechanical binding is listed below.

DVR Number	Title
12-2-87-102	2A Feedwater Regulating Valve Jams Due to Discharge Check Valve Keeper Bolt Lodging in its Internals

In this event, a keeper bolt that had come free from a reactor feedwater pump discharge check valve became lodged in the 2A FWRV. Corrective action included lockwiring all keeper bolts to prevent reccurrence.

G. COMPONENT FAILURE DATA:

Manufacturer	Nomenclature	Model Number	Mfg. Part Number
SPC Technology	8 pin socket	ORS-8	23N3609

An industry wide NPRDS data base search revealed no other similar failures of this type of error network socket. An NPRDS history search listed seven events involving foreign material causing FWRV mechanical binding at General Electric Boiling Water Reactor sites; corrective action generally involved removal of the foreign material and efforts to prevent future loss of similar parts.