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FACIL: 50-316 Donald C. Cook Nuclear Power Plant, Unit 2, Indiana & 05000316
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RECIP. NAME RECIPIENT AFFILIATION

SUBJECT: LER 87-007-00: on 870714, ESF reactor trip occurred due to undervoltage of reactor coolant busses. Caused by failure of main generator voltage control sys. Failed & suspected components of sys replaced. W/870813 ltr.

DISTRIBUTION CODE: IE22D COPIES RECEIVED: LTR 1 ENCL 1 SIZE: 6
TITLE: 50.73 Licensee Event Report (LER), Incident Rpt, etc.

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	NRR/DEST/PSB	1	1	NRR/DEST/RSB	1	1
	NRR/DEST/SGB	1	1	NRR/DLPQ/HFB	1	1
	NRR/DLPQ/QAB	1	1	NRR/DOEA/EAB	1	1
	NRR/DREP/RAB	1	1	~~NRR/DREP/RPB~~	2	2
	NRR/PMAS/ILRB	1	1	REG FILE 02	1	1
	RES DEPY GI	1	1	RES TELFORD, J	1	1
	RES/DE/EIB	1	1	RGN3 FILE 01	1	1
EXTERNAL:	EG&G GROH, M	5	5	H ST LOBBY WARD	1	1
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U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
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TITLE (4) ESF Actuation (Reactor Trip) Due to Undervoltage of the Reactor Coolant Pump Busses as a Result of Component 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)
0 7	1 4	8 7	8 7	— 0 0 7 —	0 0	0 8	1 3	8 7		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): 1

POWER LEVEL (10): 0 8 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	TELEPHONE NUMBER: AREA CODE	
J. R. Sampson - Safety & Assessment Superintendent	6 1 6	4 6 5 - 5 9 0 1

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	E L	U J X	3 4 5 5	N	X	E L	7 7	3 4 5 5	N
X	E L	S C R	3 4 5 5	N	X	E L	A M P	3 4 5 5	N

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 14, 1987, at 0707 hours, an Engineered Safety Features Actuation (Reactor Trip) occurred due to undervoltage of the reactor coolant pump busses. The undervoltage condition was the result of the failure of the main generator voltage control system.

The Unit was stabilized in Mode 3 (Hot Standby) at approximately 0755 hours, July 14, 1987. No abnormal reactor trip sequence responses were noted. The NRC was notified of the event via the ENS at 0815 hours, July 14, 1987.

Post-event testing of the voltage control system components revealed two failed power supplies (automatic and manual), and six failed SCR Modules. All failed/suspected components were replaced. Investigation regarding industry experience with Brown Boveri voltage control systems indicates that the failures which occurred are consistent with those experienced at other plants and is not a result of operator error or lack of maintenance. Evaluation as to the necessity for the redesign of the voltage control system, via the Plant Modification program, continues - however, no specific preventive measures have been identified to date.

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

Conditions Prior to Occurrence

Unit 2 in Mode 1 (power operations) at 80 percent Reactor Thermal Power.

Description of Event

On July 14, 1987, at 0707 hours, an Engineered Safety Features Actuation (Reactor Trip Sequence) occurred due to undervoltage of the reactor coolant pump busses (EIIS/EA). The undervoltage condition was the result of the failure of the main generator voltage control system (EIIS/EL).

At approximately 0637 hours, July 14, 1987, the incoming Unit Supervisor (Utility-Licensed Operator) noticed that the output from the main generator automatic voltage regulator (EIIS/EL-RG) was not nulled with the manual voltage regulator (EIIS/EL-RG). The automatic regulator was currently in service and had been operating at the lowest value of the voltage band throughout the previous shift. When the Unit Supervisor adjusted the manual regulator to match the automatic setpoint, the main generator voltage and exciter current indication dipped momentarily and returned to normal [the adjustment should have had no effect on the main generator (EIIS/EL-GEN)]. He then requested that a Reactor Operator (RO) (Utility-Licensed Operator) be posted at the regulator to monitor the indication. The RO reviewed the generator panel status with the incoming Unit Supervisor and noticed that the generator output voltage was slightly below the minimum of the operating band. The RO increased the automatic regulator to restore the generator output voltage to the bottom of the operating band. For the remaining period prior to the trip sequence, the volt-amps reactive, generator field temperature, and to a lesser degree the generator output voltage indication showed unstable behavior. No alarms occurred until seconds before the trip sequence.

Following the trip sequence [opening of the reactor trip breakers (EIIS/JE-BKR), insertion of the reactor control rods (EIIS/AA-ROD), feedwater isolation (EIIS/JB), automatic starting of the motor-driven and turbine-driven auxiliary feedwater pumps (EIIS/BA-P)] operations personnel immediately implemented the special Emergency Operating Procedure, 1 OHP -4023.E-0, to verify proper response of the automatic protection system (EIIS/JC) and to assess plant conditions for initiating appropriate recovery actions. There was no automatic or manual actuation of the intermediate head safety injection system (EIIS/BQ).

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The voltage transient was also detected by the T21D safeguards bus (train "A") undervoltage relays (EIIS/EA-27) which started the CD emergency diesel generator (EIIS/EK-DG) and initiated load shedding of the "A" train safeguards busses. The "B" train busses were approximately 70 to 100 volts higher than the "A" train busses immediately prior to the trip - consequently the load shedding actuation logic for the "B" train was not satisfied, and the AB emergency diesel generator did not automatically start. The East centrifugal charging pump (EIIS/CB-P) had been operating and was not restored during blackout load sequencing (as per design). Operators manually started the West centrifugal charging pump to restore reactor coolant pump seal injection (EIIS/CB) and opened IMO-911, charging pump suction from the refueling water storage tank (EIIS/CB-TK), to restore pressurizer level and to clear the letdown isolation (which occurred, as designed, due to the loss of the East centrifugal charging pump). The load shed also de-energized the lighting transformers (EIIS/FF-XFMR), isolating plant lighting and outlets (EIIS/FF-OUT). Other lighting transformer loads lost included; the analog rod position indication (EIIS/AA-XF) and the rod bottom lights (EIIS/AA-IL), chart drives for the narrow range and wide range reactor coolant temperature recorder (EIIS/JC-TR), main generator megawatt recorder chart drive (EIIS/EL-XR), normal control room lighting (EIIS/FF), and the AB emergency diesel generator recorder chart drive (EIIS/EK-XR). The load shedding sequence experienced was in accordance with undervoltage protection system (EIIS/EA) design. Power was manuallly restored to the lighting transformers within 30 minutes. The AB emergency diesel generator was manually started 45 seconds after the trip, but was never loaded. Both emergency diesels were secured after offsite power was established to the "A" train safeguards busses. The Unit was stabilized in Mode 3 (hot standby) at approximately 0755 hours, July 14, 1987. The NRC was notified of the event via the ENS at 0815 hours, July 14, 1987.

With the exception of the failure of the main generator voltage control system, there were no inoperative structures, components, or systems that contributed to this event.

Cause of Event

The cause of the event was determined to be the failure of the main generator automatic voltage regulator power supply concurrent with the failure of the manual voltage regulator power supply. Post-event testing of voltage control system components revealed six failed SCR modules, in addition to the two failed power supplies (automatic and manual). Intermittent failures of the main generator automatic voltage regulator pulse amplifier and pulse driver circuit boards are the probable cause of the SCR module failures.

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Analysis of Event

This Engineered Safety Features Actuation, which resulted in a reactor trip sequence, is reportable pursuant to 10 CFR 50.73 (a) (2) (iv).

The Operations Sequence Monitor functioned as designed. A time study of parameters monitored concluded that all automatic protection system responses; reactor trip, and resulting actuations, functioned properly as a result of the Engineered Safety Features actuation.

Based on the above, it is concluded that the event did not constitute an unreviewed safety question as defined in 10 CFR 50.59 (a) (2), nor did it adversely impact health and safety.

Corrective Actions

Immediate corrective action involved operations personnel implementing plant procedures to verify proper response of the automatic protection system and to assess plant conditions for initiating appropriate recovery actions. All failed/suspected components were replaced (automatic and manual voltage regulator power supplies, six SCR modules, two pulse generator circuit boards and two pulse amplifier circuit boards). Investigation regarding industry experience with Brown boveri voltage control systems indicates that the failures which occurred are consistent with those experienced at other plants and is not the result of operator error or lack of maintenance. Evaluation as to the necessity for the redesign of the voltage control system, via the Plant Modification program, continues - however, no specific preventive measures have been identified to date.

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

Failed Component Identification

Plant Description: Main Generator Voltage Regulator Power Supplies
Manufacturer: Brown Boveri
Manufacturer ID Number: VRCE1R39287116 AR103963R1 ND-501B
EIIS Code: EL-UJX
Number replaced: 2

Plant Description: Main Generator Voltage Regulator SCR (Thyristor Insert) Module
Manufacturer: Brown Boveri
Manufacturer ID number: 07060 GR90075/4 GR0053P1
EIIS Code: EL-SCR
Number Replaced: 6

Plant Description: Main Generator Voltage Regulator Pulse Generator Circuit Board
Manufacturer: Brown Boveri
Manufacturer ID Number: GT032A LGV455007P13
EIIS Code: EL-77
Number Replaced: 2

Plant Description: Main Generator Voltage Regulator Pulse Amplifier Circuit Board
Manufacturer: Brown Boveri
Manufacturer ID Number: 07102 A1390466 15 RUT/RU10 LGV455011P
EIIS Code: EL-AMP
Number Replaced: 2

Previous Similar Events

None

INDIANA & MICHIGAN ELECTRIC COMPANY
Donald C. Cook Nuclear Plant
P.O. Box 458, Bridgman, Michigan 49106

August 13, 1987

United States Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Operating License DPR-74
Docket No. 50-316

Document Control Manager:

In accordance with the criteria established by 10 CFR 50.73 entitled Licensee Event Reporting System, the following report is being submitted:

87-007-00

Sincerely,

W. G. Smith

W. G. Smith, Jr.
Plant Manager

/afh

Attachment

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