Ref: 10CFR50.73(a)(2)(iv)

LOUISIANA POWER & LIGHT / WATERFORD 3 SES • P.O. BOX B • KILLONA, LA 70066-0751

MIDDLE SOUTH UTILITIES SYSTEM

W3A90-0135
A4.05
QA

April 23, 1990

U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, D.C. 20555

Subject: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Reporting of Licensee Event Report

Gentlemen:

Attached is Licensee Event Report Number LER-90-002-00 for Waterford Steam Electric Station Unit 3. This Licensee Event Report is submitted pursuant to 10CFR50.73(a)(2)(iv).

Very truly yours,

J.R. McGaha
Plant Manager - Nuclear

JRM/DME/rk

(w/Attachment)
cc: Messrs. R.D. Martin
J.T. Wheelock - INPO Records Center
E.L. Blake
W.M. Stevenson
D.L. Wigginton
NRC Resident Inspectors Office

IE22
1/1

NRC Form 366
(9-83)

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)
Waterford Steam Electric Station Unit 3	0 5 0 0 0 3 8 2	1 OF 0 9

TITLE (4)

Reactor Trip Caused by Dropped Control Element Assemblies

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 3	2 2	9 0	9 0	— 0 0 2	— 0 0	0 4	2 3	9 0	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)			
1		20.402(b)	20.405(c)	X 50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10)		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
1 0 0		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
T.R. Leonard, Maintenance Superintendent	5 0 4 — 4 6 4 - 3 1 3 8

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 A	C O N	E 1 4 6	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)

At 2133 hours on March 22, 1990, an automatic reactor trip occurred at Waterford Steam Electric Station Unit 3 while the plant was operating at 100% power. The reactor trip was initiated by the Plant Protection System when two control element assemblies (CEAs) dropped to the fully inserted position while their drive mechanisms were being transferred from their normal power supply to the control element drive mechanism system (CEDMCS) hold bus. This event is reportable by reason of the occurrence of an automatic reactor protection system actuation.

The root cause of this event was an equipment malfunction. Inspections subsequent to the trip revealed that several electrical connectors used to transmit power from the CEDMCS panels to a CEA drive mechanism were damaged from misalignment during previously performed maintenance. This condition disrupted the power supply circuitry of the CEA drive motors affected, causing disengagement of the drive mechanisms for these CEAs. The damaged components in the power supply circuitry were replaced and operationally checked to be satisfactory. All plant protective features functioned as designed and no threat was posed to the health or safety of the general public or plant personnel during this event.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Waterford Steam Electric Station Unit 3	0 5 0 0 0 3 8 2	9 0	— 0 0 2	— 0 0	0 2 OF 0 9

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

On March 21, 1990, at 0337 hours, Waterford SES Unit 3 was operating at 100% power when a control element drive mechanism system (CEDMCS) (EIIS Identifier AA) timer failure alarm was annunciated in the control room. This alarm is provided to alert the control room operator when a malfunction has occurred within the reactor's CEDMCS circuitry. An operator dispatched to the CEDMCS panels reported that abnormal voltage alarms were present for control element assemblies (CEAs) (EIIS Identifier AA - ROD) 36, 38 and 40. These three CEAs along with CEA 42 comprise CEA subgroup nine, which is one of the 23 CEA subgroups.

In accordance with operating procedures, CEA subgroup nine was transferred to the CEDMCS hold bus (EIIS Identifier - RJX) at 0348 hours. The hold bus is a fixed output power supply from which the upper gripper coil of each control element drive mechanism (CEDM) (EIIS Identifier AA - 75) in one subgroup can be temporarily powered when troubleshooting or maintenance of the subgroup's normal power supply or logic circuitry is necessary. While powered from the hold bus the CEDMs, which are of the Combustion Engineering magnetic-jack type design, maintain the position of their respective CEAs that existed at the time of transfer from their normal supply.

Troubleshooting of the problem ensued for approximately 36 hours that involved the acquisition and analysis of CEDM coil traces, which are recorded signatures of the current applied to the CEDM operating coils, to determine the cause of the malfunction. During the course of troubleshooting, the subgroup was transferred from the hold bus to the normal supply and back to the hold bus on several occasions without incident.

The subgroup's CEDMC circuitry functioned normally with the CEDMs powered from the hold bus, however, the control circuitry for CEA 38 would not function properly when the subgroup was transferred to the normal supply. In addition to obtaining coil current traces for a CEDM, there are several other indications used in determining whether a CEDM's normal power supply and logic circuitry is functioning properly. Upon transfer from the hold bus to the normal supply, the CEDM's upper gripper coil is expected to remain energized with supply voltage that is in its normal range. If during the transfer, the logic circuit senses a problem with the upper gripper control circuit, it will instead energize the lower gripper coil to hold the CEA in place. The lower gripper coil of CEA 38 was observed to energize when the CEA was transferred to the normal supply. Additionally when powered from its normal supply, the voltage applied to the CEDM for CEA 38 was outside of the normal range and the coil current traces were abnormal.

On the evening of March 21, 1990, an opto-isolator (EIIS Identifier - OB) circuit board controlling CEA 38 was replaced. A current sensor (EIIS Identifier - IT) for this CEA was also replaced. These components, which are part of the CEDMCS circuitry, have malfunctioned more often in the past than most other components in the system and are easily replaced. If these components malfunction they can cause the symptoms witnessed, however, the problems exhibited by the control circuitry of CEA 38 were still evident after they were replaced.

During the day shift on March 22, 1990, it was concluded that the filter circuit (EIIS Identifier - EM) which effects the shaping of output voltage supplied to the upper gripper coil for CEA 38 was faulty. The power switch (EIIS Identifiers - 36/PSD/EM) drawer containing the filter circuit was replaced. There is one power switch drawer for each CEA subgroup containing voltage phasing and shaping circuitry. Power is normally supplied to the CEDMs by means of output stab-type connectors (EIIS Identifier - CON) integral to these drawers. Upon inspection of the original drawer, a resistor in the suspect filter circuit was confirmed to be no longer functional.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Waterford Steam Electric Station Unit 3	0 5 0 0 0 3 8 2	9 0	— 0 0 2	— 0 0	0 4 OF 0 9

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

On the afternoon of March 22, 1990, subgroup nine was transferred to its normal supply. Abnormal coil traces and supply voltages were then observed for the four CEDMs in the subgroup and the CEDMs had shifted to their lower gripper coils, so the subgroup was transferred back to the hold bus.

Further troubleshooting revealed several other problems that were thought to be contributing to this equipment malfunction. A common lead (EIIS Identifier - GBU) for the CEA logic circuitry power supply was discovered to be loose and was tightened. The CEA logic circuitry main power supply voltage was below its normal tolerance band and was adjusted to its normal operating value. A coil driver card (a coordinating-type logic circuit board) for two of the CEAs in the subgroup was found to have several bent pins that may have been shorting together and were straightened. Another current sensor for one of the CEDMs was also replaced.

Additional coil current traces were taken while the subgroup was on the hold bus and they appeared normal. At 2131 hours, the subgroup was again transferred to its normal supply and abnormal voltage alarms were received for all four CEAs. At 2133 hours, during the course of transferring the subgroup back to the hold bus, the control room received indication that CEAs 36 and 40 had dropped to the fully inserted position and that an automatic reactor trip had been initiated by the Plant Protection System (PPS) (EIIS Identifier - JC). Upon insertion of two CEAs, both control element assembly calculators (CEAC) (EIIS Identifier JC - ZIC/CPU) sensed that unacceptable CEA position deviations had occurred and fed this information to the Core Protection Calculators (CPC) (EIIS Identifier JC - CPU). The CPC channels in turn applied penalty factors towards their calculation of departure of nucleate boiling ratio (DNBR) resulting in a calculated DNBR in each channel that was then below the minimum DNBR reactor trip setpoint, causing the PPS actuation.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Waterford Steam Electric Station Unit 3	0 5 0 0 0 3 8 2	9 0	— 0 0 2	— 0 0	0 5 OF 0 9

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

Troubleshooting subsequent to the reactor trip revealed that the female connectors (for powering the upper gripper coil of CEA 38) into which the male stabs on the subgroup nine power switch drawer insert were severely damaged. Further investigation found that a fuse for one of the three phases of input power to the power switch drawer was blown. It was concluded that the fuse was blown and the filter resistor damaged due to irregular current flow caused by the damaged power switch drawer output connectors. It was later observed that a connector stab on the original power switch drawer had also been damaged and experienced electrical arcing. This caused the scorching of several adjacent connectors as well.

One or both of the following could have occurred as a result of the connector damage, causing the CEDMs to drop the CEAs.

1. Arcing from the damaged connectors caused an unacceptable noise level in the voltage shaping, logic circuitry for the hold bus. This could have resulted in voltage waveforms delivered to these CEDMs that was of an insufficent level for the operating coils to maintain engagement of the magnetic arms of the CEDMs with the CEA extension shafts.

2. The damaged connectors could have presented an increased impedance and phase angle shift (and caused circulating currents) to the power supply circuit, suppressing overall hold bus voltage and also resulting in insufficient voltage delivered to these CEDMs to maintain CEA extension shaft engagement.

In either case, because the circuitry of a power switch drawer for a CEA subgroup remains electrically paralleled to the hold bus circuit unless the drawer is at least partially withdrawn from the cabinet, the damaged connectors prevented successful transfer of the CEDMs to the hold bus at this point. The root cause of this event was a malfunction of the CEA subgroup nine power switch drawer slide. One of the drawer slides for the subject power switch was observed to be binding at the point of drawer insertion where connector engagement occurs. It was concluded that this binding resulted in misalignment and damage of the connectors during a previous insertion of the drawer.

The damaged connectors for the subgroup's power switch drawer were replaced and the input power fuses were replaced. All the CEDMCS power switch drawers were removed to inspect their connectors. No other damaged connectors were observed. One other drawer slide was found to be binding. All CEDMs functioned normally during the subsequent reactor startup.

To prevent recurrence, the two power switch drawer slides found to be binding will be replaced during the next refueling outage. Additionally, the existing refueling outage repetitive work task for the CEDMCS will be augmented to 1) inspect power switch drawer connectors for damage when the drawers are removed for maintenance, and 2) inspect power switch drawer slides for binding during such maintenance. A note will be added to the Station Information Management System component information sheets for CEDMCS to reflect that the power switch drawer connectors are to be inspected whenever the drawers are withdrawn from the cabinets. The training course for CEDMCS will also be augmented to instruct technicians on the importance of performing this inspection.

This event is reportable by reason of the occurrence of an automatic reactor protection system actuation. The only protective system that actuated as a result of this reactor trip was the Emergency Feedwater system, which functioned normally. This actuation is an expected response to a reactor trip from full power. Although the CEDMCS malfunction that occurred impaired the ability to move the affected CEAs in the normal manner, at no time were these CEAs rendered untrippable or incapable of being inserted by the actuation of a reactor trip. During this event no threat was posed to the health and safety of the general public or plant personnel.

Similar Events

Prior to this event, Waterford Unit 3 experienced four reportable events attributable to control circuitry malfunctions within the CEDMCS cabinets and two events attributable to CEDM position indication malfunctions. In addition to corrective actions that have been implemented to address specific circuit malfunctions that have occurred, a CPC software modification was performed during the first refueling outage that altered how the CPC channels respond to the drop of a single CEA. Prior to this change, the CPCs were programmed to initiate a reactor trip if the CEACs sensed that a single CEA dropped beyond the acceptable deviation from its group position. Five reactor trips occurred in 1986 (before this modification) on low DNBR as calculated by the CPCs using penalty factors that applied when the CEACs detected an unacceptable position deviation of a single CEA from its group position. Three of these trips were initiated by the actual drop of a single CEA and two were initiated by CEA position indicating equipment malfunctions. Upon implementation of this modification, the CPCs no longer initiate a reactor trip in response to the drop of a single CEA and the plant can remain at power while the actions are taken to return the CEA to its group position. A change was also made to the Waterford Unit 3 Technical Specifications that requires the plant to reduce power by a specified amount during this time.

Presently however, if multiple CEAs in one subgroup or if multiple CEAs that are targeted to different CPC channels concurrently drop beyond the maximum acceptable deviation from their CEA group(s), the CPCs will apply penalty factors (for conservatism) in their calculation of DNBR and initiate a reactor trip if the resulting calculated DNBR is below the minimum trip setpoint.

Prior Similar Events:

1) LER 89-017: Late in the core life for cycle 3, a malfunctioning current sensor for a misaligned CEA prevented repositioning of the CEA to within Technical Specification limits, requiring the plant to reduce power. Axial shape index (ASI) fluctuations occurred that resulted in a reactor trip on high ASI. Several corrective actions have been initiated to address the problems experienced with CEDMCS current sensors and automatic calculator timing module (ACTM) (EIIS Identifier - TMR) cards. The capability is being developed to perform on site pre-installation testing of these current sensors and ACTM cards. Additionally, a modification is planned for the fourth refueling to widen the tolerance band of CEDM current that the ACTM cards find acceptable for proper CEDM operation.

The following events involving reactor trips occurred prior to implementation of the described CPC software modification.

2) LER 86-023: A malfunctioning CEDM's current sensor resulted in a dropped CEA, causing the CPCs to apply penalty factors for the CEA position deviation, yielding a calculated DNBR below the minimum reactor trip setpoint.

3) LER 86-002: A cooling fan for one of the CEDMCS cabinets was found deenergized, resulting in overheating and damage to a subgroup's power switch circuitry. One of the affected subgroup's CEAs dropped causing the CPCs to apply penalty factors for the CEA position deviation, yielding a calculated DNBR below the minimum reactor trip setpoint.

4) LER 86-001: A malfunctioning CEDMCS ACTM circuit card resulted in a dropped CEA, causing the CPCs to apply penalty factors for the CEA position deviation, yielding a calculated DNBR below the minimum reactor trip setpoint.

Two other reportable events involved malfunctions of equipment associated with CEDMs (LERs 86-009 and 86-013) that resulted in reactor trips, however, both occurrences entailed malfunctions of CEA position indication circuitry and did not involve a malfunction of the control circuitry within the CEDMCS cabinets.

Plant Contact

T.R. Leonard, Maintenance Superintendent, 504/464-3138.