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May 15, 1998

Re: Indian Point Unit No. 2
Docket No. 50-247
LER 97-08-01

Document Control Desk
US Nuclear Regulatory Commission
Mail Station PI-137
Washington, DC 20555

The attached Licensee Event Report 97-08-01 is hereby submitted in accordance with the requirements of 10 CFR 50.73.

Very truly yours,

Paul H. Kinkel

Attachment

cc: Mr. Hubert J. Miller
Regional Administrator - Region I
US Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Mr. Jefferey Harold, Project Manager
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NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98
ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Indian Point No. 2	05000-247	1 OF 8

TITLE (4)
Technical Specification 3.0.1 Entry

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 NAME	DOCKET NUMBER
										05000
04	24	1998	1998	-- 008	-- 01	05	15	1998	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	N
POWER LEVEL (10)	100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	20.2201(b)		20.2203(a)(2)(v)	X	50.73(a)(2)(i)		50.73(a)(2)(viii)
	20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
	20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
	20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)		OTHER
	20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
James J. Maylath	(914) 734-5356

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
X	EK	PS	E062	Y						
X	EK	PS	U069	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 15 single-spaced typewritten lines) (16)

On April 24, 1997, with the unit operating at 100% power, an unplanned entry into Technical Specification 3.0.1 took place due to equipment inoperability. Emergency Diesel Generator (EDG) 22 had tripped on overspeed during a monthly surveillance test. This placed the plant in a limiting condition of operation that required EDG 21 and 23 be run for operability. Following the operability run of EDG 23, a control power fuse blew which rendered EDG 23 inoperable. Since EDG 22 was already out of service, the loss of EDG 23 resulted in the unplanned entry into Technical Specification 3.0.1. A failed jacket water pressure switch caused the EDG 23 control power fuse to blow. Within one hour of the entry into Technical Specification 3.0.1, a plant shutdown was commenced in accordance with Technical Specification 3.0.1. Approximately six and one half hours later, the plant exited Technical Specification 3.0.1 when EDG 23 was returned to service following replacement of the jacket water pressure switch and a satisfactory operability determination. At this time the unit had been reduced to approximately 11% power. Following operator verification that the plant was stable, power ascension was commenced.

PLANT AND SYSTEM IDENTIFICATION:

Westinghouse 4-Loop Pressurized Water Reactor

IDENTIFICATION OF OCCURRENCE:

Technical Specification 3.0.1 Entry

EVENT DATE:

April 24, 1997

REPORT DUE DATE:

May 27, 1997

REVISION DATE:

May 15, 1998

REFERENCES:

Condition Identification and Tracking System (CITRS) No. 97-E01265

PAST SIMILAR OCCURRENCE:

LER 97-007

DESCRIPTION OF OCCURRENCE:

On April 24, 1997 at 1123 hours, with the unit operating at 100% power, an unplanned entry into Technical Specification 3.0.1 took place due to equipment inoperability. Emergency Diesel Generator (EDG) 22 had tripped out on overspeed at 0905 hours approximately 30 seconds following the start of all three EDGs for the performance of monthly surveillance test PT-M21. Following the trip of EDG 22, EDGs 21 and 23 continued to run. EDG 21 was manually shutdown and returned to the standby mode (the engine control switch was placed in 'auto') at 0933 hours. EDG 23 was paralleled to 480 V Bus 6A and satisfactorily run for 60 minutes at 1750 kw to demonstrate operability. A similar operability run with EDG 21 paralleled to 480 V Bus 5A was planned to occur following the EDG 23 operability run (only one EDG at a time is

paralleled to a 480 V for operability demonstration). Upon completion of the test, EDG 23 was unloaded in accordance with procedure by opening the output breaker and then manually shutting down the engine. While the engine was coasting down, one set of contacts on jacket water pressure switch PS-3-2 failed to reset. This resulted in the field flash circuit remaining energized causing the 125 VDC control power fuse to blow. The loss of 125 VDC control power rendered EDG 23 inoperable. Since EDG 22 was already inoperable following the overspeed trip, the loss of EDG 23 placed the plant into Technical Specification 3.0.1. At 1210 hours on April 24, 1997, the operators commenced a unit shutdown in accordance with Technical Specification 3.0.1 and associated station procedures. At 1810 hours on April 24, 1997, EDG 23 was determined to be operable following replacement of the failed jacket water pressure switch and satisfactory testing that included paralleling EDG 23 to 480 V Bus 6A. At this time, the plant exited Technical Specification 3.0.1. Following operator verification that the plant was stable, power ascension was commenced. At 2050 hours, an operability run on EDG 21 was successfully completed. This operability run included paralleling EDG 21 to 480 V Bus 5A.

ANALYSIS OF OCCURRENCE:

This report is being made because an entry into Technical Specification 3.0.1 occurred on April 24, 1997. Entries into Technical Specification 3.0.1 are reportable under 10 CFR 50.73(a)(2)(I)(B). The loss of DC control power, which rendered EDG 23 inoperable while EDG 22 was still out of service following the overspeed trip, resulted in the Technical Specification 3.0.1 entry. Operability tests were performed on EDG 21 and 23 following the overspeed trip of EDG 22 because of the potential for a similar occurrence in EDG 21 and/or 22. This operability testing was required by Technical Specification 3.7.B.1.

There were no adverse safety implications as a result of this event. This event did not cause any injury to personnel or damage to equipment.

CAUSE OF OCCURRENCE:

The cause of the entry into Technical Specification 3.0.1 was the inoperability of EDG 23 following the overspeed trip of EDG 22. EDG 23 was rendered inoperable when its DC control power was lost. This loss of DC control power was caused by a failure of jacket water pressure switch PS-3-2 that resulted in blowing the 125 VDC control power fuse for EDG 23. The contacts of PS-3-2 failed to open on decreasing pressure (these contacts are designed to open on decreasing jacket water pressure at a specified setpoint) following the manual shutdown of EDG 23. This caused the field flash circuit to actuate and remain energized. The field flash circuit automatically actuates during startup of the diesel to establish the generator field, and it de-energizes when voltage is established at the generator output. The field flash circuit by design draws current that is above the continuous rating of the control power fuses. This circuit is designed to actuate only for a short interval during diesel startup. The field flash circuit current duration is designed to be within the time-current characteristic of the control power fuse. With the failure of PS-3-2, the field flash circuit remained energized, and the time-current characteristic of the control power fuse was exceeded, causing it to blow.

The failed PS-3-2 switch was manufactured by Eaton. It was replaced with another Eaton switch. Subsequent to the April 24, 1997 failure of PS-3-2, two other Eaton switches failed to reset during testing on EDG 22. On April 29, 1997, PS-4-1 failed and on April 30, 1997, PS-3-1 failed. PS-4-1 and PS-3-1 were replaced with UE switches. The failed Eaton PS-3-2 and PS-3-1 switches were returned to the manufacturer for examination. Eaton could not find a problem with the PS-3-2 switch because when the switch was removed from the panel, it reset and appeared to operate properly. The PS-3-2 switch was returned and subsequently sent with the failed Eaton PS-4-1 switch to ALTRAN Corporation (Engineering and Management Consultants) for examination and analysis. Destructive examination (the switches were cut open to observe the internal microswitch contacts) of the three failed Eaton switches determined that the switches experienced contact welding. An investigation and analysis of these failures was conducted by a root cause investigation team consisting of engineering, maintenance and instrument and control personnel from the station, as well as ALTRAN Corporation.

The contact welding failure mode was not identified in the jacket water pressure switch failures that occurred prior to April 24, 1997. Most of those failures were attributed to vibration, loose parts or undesirable movement of parts as described in LER 50-247/97-007 which was submitted on May 2, 1997. Destructive testing had been performed by National Testing Services (NTS) on

an Ashcroft PS-3 switch that failed on September 9, 1996. NTS had found no evidence of contact deterioration at that time. Subsequent to the April 24, 1997 event, destructive examination was performed on other pressure switches that had failed previously. This examination showed evidence of contact deterioration which could be attributed to current transients. Therefore, some of the previous pressure switch failures may have been caused by contact welding. However, this was not detected in some of the earlier investigations because welded contacts are readily broken, and once broken, evidence of that occurrence is not readily detected. Also, in some of the previous investigations, if mechanical anomalies which could have led to switch failure were found, further investigation was stopped at that point. Except for one Eaton switch, the failures that occurred prior to April 24, 1997 were on pressure switches that were manufactured by United Electric (UE), Ashcroft and Static-O-Ring (SOR). The cause of the failure of the Eaton switch prior to April 24, 1997 was previously attributed to a loose micro switch mounting screw that was found at that time.

The cause of the Eaton switch contacts welding was periodic transients from the charging of a capacitor in series with the field flash jacket water pressure switches. This capacitor was apparently installed during initial diesel start-up testing to ensure that the voltage build-up relay would remain energized during 125 VDC power transients. Since this voltage build-up relay was replaced with a latching relay, the capacitor is no longer needed to maintain the relay during 125 VDC power transients. Field verification of the jacket water pressure switch circuits found varistors to clamp voltage spikes installed across most switch contacts except for the field flash jacket water pressure switch contacts. The lack of this varistor made the field flash jacket water pressure switch contacts less tolerant of the periodic transients from the capacitor in series with the field flash jacket water pressure switches. Also, the smaller physical size of the Eaton micro switches, with respect to the switches manufactured by United Electric (UE), Ashcroft and Static-O-Ring (SOR), was less tolerant of periodic transients from the capacitor in series with the field flash jacket water pressure switches. All of the jacket water pressure switches were and are properly rated for 125 VDC at 0.5 amp resistive.

The overspeed trip of EDG 22 was caused by erratic operation of the EDG mechanical governor. This was determined during post-event testing of the EDG. The EDG speed control system consists of a mechanical governor and an electrical governor. During normal operation, the electric governor controls fuel to the engine through an actuator. When the engine speed reaches the level for which the mechanical governor is set (slightly higher than that for which the electrical actuator is set), the mechanical governor assumes control

of the engine. During an inspection of the mechanical governor, the linkage arm was found set hard against the clevis. Assistance by representatives from Woodward and Fairbanks Morse was requested in inspecting the physical condition of the mechanical governor and in reviewing the results of the post-event tests. Both experts expected some freedom of movement at this connection. With the linkage connection so tight, the question arose as to how much additional force may have been required to initiate linkage movement. This condition could have resulted in a longer response time in cases where the mechanical governor was called upon to take control of engine speed. In their opinion, a fraction of a second delay in this response time could have led to the overspeed condition.

In addition to the physical examination of the system, the ability of the mechanical governor to control engine speed was monitored via data traces. It was concluded that the electrical governor was sending the proper signals to the mechanical governor, however, the mechanical governor was not responding as designed. The mechanical governor is designed to provide backup speed control if the electrical governor fails, but the speed at which the mechanical governor would take control or relinquish control of the engine was found to be erratic. During a test, the mechanical governor took control of the engine at 53 Hz. Although its set point was supposed to be 62 Hz, it would not allow any increase above 53 Hz and ignored input from the electrical governor. During a subsequent test run, with the unit at 62 Hz, control was transferred from the electrical governor to the mechanical governor by dialing the electrical governor high. However, when it was dialed back down to 62 Hz, the mechanical governor would not relinquish control. Further diagnosis of the mechanical and the electrical governors from EDG 22 could not be performed in place, and they were shipped to their respective manufacturers for detailed analysis.

The electrical governor was tested, as received, and performed adequately. The mechanical governor was discovered to have various minor anomalies:

- the bleeder bolt and tubing for the shutdown assembly were both loose allowing oil to leak to the sump
- the actuator had excess "jiggle" as a result of wear in the relay pilot valve plunger and bushing
- the O - ring between the column and subgovernor was the wrong size (too thick)

- the washers were missing and the wrong screws were used on the solenoid bracket for attaching it to the subgovernor.

The vendor could not definitively establish that a specific component of the mechanical governor caused the overspeed event, so they concluded that each anomaly was a contributing factor.

CORRECTIVE ACTION:

Within an hour of the entry into Technical Specification 3.0.1, the operators commenced a unit shutdown in accordance with Technical Specification 3.0.1 and associated station procedures. Approximately six and one half hours later, the plant, at 11% power, exited Technical Specification 3.0.1 when EDG 23 was returned to service following replacement of the jacket water pressure switch and an operability determination. Following operator verification that the plant was stable, power ascension was commenced. Approximately two and a half hours later, an operability run on EDG 21 was successfully completed.

A modification to replace the remaining existing field flash jacket water pressure switches with UE switches has been implemented. UE had discontinued the bellows model that was previously used for the EDGs. A new UE bellows type switch was purchased and qualified. This new type of UE switch has been installed for the field flash jacket water pressure switches (PS-3 & 4, PS-3-1 & 4-1 and PS-3-2 & 4-2) for all three EDGs. The bellows type is desirable because it is more accommodating of vibration. Also, the piston/diaphragm Eaton switches that have been enhanced with an epoxy resin have been shown to be capable of accommodating vibration at the engine gauge panels.

The above modification also removed the capacitors that were in series with the field flash jacket water pressure switches. This was implemented on all three EDGs. This eliminated the transient current surges that were experienced by the field flash jacket water pressure switches. Also, this modification added varistors and interposing relays for the jacket water pressure switch contacts that are in the EDG field flash circuit. This was implemented on all three EDGs. This installation protects the jacket water pressure switch contacts from current transients that may be experienced in the field flash circuits.

Another modification was implemented on all three EDGs that changed the jacket water pressure switch set point from 8 psig decreasing to 10 psig decreasing. This change provides additional margin to allow for switch set point drift and slow decay of jacket water pressure. This provides greater assurance that the field flash circuit is deactivated before challenging the 125 VDC control power fuse time-current characteristic.

The mechanical and electrical governors from EDG 22 were shipped to their manufacturer for analysis. Replacement mechanical and electrical governors were installed in EDG 22. The set point at which the mechanical governor takes control of the engine was slightly reduced to provide for enhanced margin before reaching the overspeed trip set point (the trip set point did not change).

A root cause investigation team consisting of engineering, maintenance and instrument and control personnel, as well as outside contractors has determined the root cause of the jacket water pressure switch failures to be contact welding. NTS had performed extensive investigations of the various jacket water pressure switches that were used for EDG applications. An independent review of the jacket water switch failures was performed by ALTRAN Corporation.