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May 2, 1997

Re: Indian Point Unit No. 2
Docket No. 50-247
LER 97-07-00

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

The attached Licensee Event Report 97-07-00 is hereby submitted in accordance with the requirements of 10 CFR 50.73.

Very truly yours,

Attachment

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

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NRC FORM 366 (6-89) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-104
EXPIRES: 4/30/92

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Indian Point No. 2	0 5 0 0 0 2 4 7	1 OF 0 9

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 NAMES	DOCKET NUMBER(S)
										0 5 0 0 0
0 4	0 2	9 7	9 7	- 0 0 7	- 0 0	0 5	0 2	9 7		0 5 0 0 0

OPERATING MODE (9)	N
POWER LEVEL (10)	1 0 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)		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 336A)*
	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
James J. Maylath, Senior Engineer	AREA CODE 9 1 4 7 3 4 - 5 3 5 6

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 K	P S	S 3 8 2								

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 2, 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) 23 had been out of service for scheduled maintenance. EDG 21 was run to establish operability in accordance with Technical Specification 3.7.B.1 because an alarm switch had improperly actuated in the output breaker that was being used for EDG 23 on the previous day. Following the run of EDG 21, a control power fuse blew which rendered EDG 21 inoperable. Since EDG 23 was already out of service, the loss of EDG 21 resulted in the unplanned entry into Technical Specification 3.0.1. A failed jacket water pressure switch caused the EDG 21 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 four hours later, the plant exited Technical Specification 3.0.1 when EDG 23 was returned to service (after the EDG 23 output breaker had been repaired and satisfactory operation was demonstrated). At this time the unit had already been reduced to approximately 42% power. Following operator verification that the plant was stable, power ascension to 100% was commenced. The failed jacket water pressure switch was replaced, and EDG 21 was subsequently returned to service.

PLANT AND SYSTEM IDENTIFICATION:

Westinghouse 4-Loop Pressurized Water Reactor

IDENTIFICATION OF OCCURRENCE:

Technical Specification 3.0.1 Entry

EVENT DATE:

April 2, 1997

REPORT DUE DATE:

May 2, 1997

REFERENCES:

Condition Identification and Tracking System (CITRS) No. 97-E01092

PAST SIMILAR OCCURRENCE:

NONE

DESCRIPTION OF OCCURRENCE:

On April 2, 1997 at 0945 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) 23 had been out of service for scheduled maintenance since March 31,1997. On April 1, 1997, EDG 23 was run in accordance with station operating procedures to demonstrate satisfactory operation following its planned maintenance outage. EDG 23 was satisfactorily run for 60 minutes at 1750 kw and was then unloaded in accordance with procedure by opening the output breaker. Following the opening of the output breaker, the breaker's amber disagreement light came on in the control room. Also, the 480 V Emergency Generator Breaker Trip alarm annunciated, the 480 V Bus 6A Normal/Lockout light went off and Lockout Relay 86/6A chattered

for about a minute. EDG 23 was then shutdown in accordance with procedures and remained out of service for investigation of the output breaker under the limiting condition of operation that commenced on March 31, 1997 with the start of the planned maintenance. This breaker had been installed at the EDG 23 output when the previous EDG 23 output breaker was removed for planned maintenance (under the limiting condition of operation that commenced on March 31, 1997). An anomaly was found on an internal spring linkage of the replacement breaker that resulted in the events described above following the opening of the breaker. The spring linkage was replaced, and the breaker was satisfactorily tested.

Because of the operational experience with the EDG 23 output breaker, the remaining two EDGs were tested for operability in accordance with Technical Specification 3.7.B.1. Subsequent to successful operability testing, EDG 21 was shut down and placed in service (automatic mode) at 0935 hours on April 2, 1997. Approximately ten minutes later, the 21 Diesel Generator Trouble alarm annunciated in the control room. Immediate investigation revealed the DC control power was lost, rendering EDG 21 inoperable. Since EDG 23 was still out of service, this placed the plant into Technical Specification 3.0.1. At 1044 hours on April 2, 1997, the operators commenced a unit shutdown in accordance with Technical Specification 3.0.1 and associated station procedures. At 1435 hours on April 2, 1997, EDG 23 was successfully tested for operability following satisfactory testing of its output breaker. At this time, the plant exited Technical Specification 3.0.1. Following operator verification that the plant was stable, power ascension to 100% was commenced.

ANALYSIS OF OCCURRENCE:

This report is being made because an entry into Technical Specification 3.0.1 occurred on April 2, 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 21 inoperable while EDG 23 was still out of service for investigation and repair of its output breaker resulted in the Technical Specification 3.0.1 entry. Operability tests were being performed on EDG 21 and 22 with EDG 23 out of service because concerns with the EDG 23 output breaker operation suggested the potential for a similar failure 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 21 while EDG 23 was out of service for scheduled maintenance. EDG 21 was rendered inoperable when its DC control power was lost. This loss of DC control power was caused by a failure of a jacket water pressure switch (PS-3) that resulted in blowing the 125 VDC control power fuses for EDG 21. The contacts of PS-3 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 21. 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 fuses. With the failure of PS-3, the field flash circuit remained energized, and the time-current characteristic of the control power fuses was exceeded, causing them to blow.

The failed PS-3 switch was manufactured by Static-O-Ring (SOR). It was sent to National Testing Services (NTS) for failure analysis. NTS observed that the switch was actuating at 0.8 psig and resetting at 0.3 psig, even though the switch is designed to be set between 2 and 25 psig (our setpoint is 8 psig decreasing). Analysis performed by NTS indicates that this particular switch was not properly assembled at the factory. NTS compared the failed switch to another SOR switch that was the same part number. The failed switch had only one spacer where four spacers are used in the comparison model. Because only one spacer was used, the piston rod could not travel sufficiently to allow for the designed setpoint range. This resulted in the switch actuating significantly below the specified setpoint keeping the switch contacts closed following the manual shutdown of EDG 21. The failed switch was also brought to the manufacturer for their evaluation. SOR stated that the number of installed spacers in their switches is not a fixed quantity. During switch assembly, spacers are added as needed to fall within the allowable piston rod travel specification. The purpose of the travel washers is to provide sufficient piston rod travel for the range spring being used and to prevent the lower stop, which is secured around the piston rod, from bottoming out on the surface of the diaphragm housing. On the failed switch, the lower stop bottomed out on the surface of the diaphragm housing. This, in turn, canceled the effect of the spring from acting as a balance force to pressure with variations in the setpoint range of adjustment. This resulted in the failure of the setpoint to be within the design range of the switch.

SOR stated that when the failed switch was first assembled, a contaminant or burr may have existed that resulted in only one spacer being installed because sufficient travel was originally obtainable. The installation could have been the result of a human error at SOR. SOR stated that the switch appeared to operate properly following assembly, and it was considered to be acceptable by SOR. The switch was successfully tested and calibrated prior to installation on EDG 21. The switch had been in service on EDG 21 for more than six months and had properly operated and reset during testing of EDG 21 during this time period. Further investigation by NTS found indentations of unknown origin that could have been the result of a contaminant. These indentations are consistent with a possible misreading of piston rod travel during the switch assembly and the apparent proper operation during testing and calibration and while in service on EDG 21. In addition to the NTS analysis, station personnel had reviewed the switch circuitry to ensure that no overcurrent condition was challenging the switch, as well as the jacket water piping and valve configuration. No anomalies were found by the station personnel.

The failure of a jacket water pressure switch to reset has occurred previously, although the failure mechanisms and manufacturers of these switches have been different. The EDGs originally had jacket water pressure switches that were manufactured by United Electric (UE). Prior to the 1995 Refueling Outage (RFO), some of the UE switches hung up (failed to reset). At that time, these failures were attributed to aging and previously setting these switches at 8 psig increasing rather than 8 psig decreasing as was originally specified (the improper setting had the deadband below 8 psig, rather than above, which is consistent with a static pressure of 3 to 5 psig). Because of the apparent aging, and since UE no longer made the model that was used in the EDGs, a modification was issued to replace UE switches. The UE switches were replaced with switches manufactured by Ashcroft in the 1995 RFO (the replacement switches were properly set at 8 psig decreasing).

In early 1996, three Ashcroft switches failed when they could not be calibrated. NTS performed an extensive root cause analysis on the Ashcroft pressure switches that included vibration tests on the EDG Engine Gauge Panels during EDG starts and runs for switch installation configurations. At this time, observation of the EDG Engine Gauge Panels (where the jacket water pressure switches are mounted) revealed that the panel isolating dampers were bridged. This bridging occurred when junction boxes for new additional jacket water pressure switches (PS-6, PS-6-1 and PS-6-2) were installed during the 1993 RFO. NTS had performed vibration tests with the bridging of the isolating dampers (panel unisolated) and with the bridging removed (panel isolated). The unbridged configuration had lower vibration levels by a factor of two to three. In the vibration tests with the bridging of the isolating dampers, NTS observed

that the setpoint adjusting nut had rotated on all switches that were tested and that two of six tested switches had a measurable widening of the gap between the dual bracket assembly which holds the microswitches and the pushrod. No switch gap widening was observed with the bridging removed. NTS concluded that the failure of the three Ashcroft switches was caused by this gap widening and that the gap widening was a result of excessive vibration during diesel start up and improper initial factory setting of the switches (the effects of the vibration would have been less severe with more precise factory settings). Following these three failures, Ashcroft switches in circuits that are critical for EDG starting and running were replaced with original UE switches, and a search for an alternative switch was undertaken. This search resulted in the use of the SOR and Eaton switches.

Subsequent to the three failures described above in early 1996, four other jacket water pressure switch failures occurred prior to the SOR switch failure on April 2, 1997. For each of these failures, the switch failed to reset and caused the 125 VDC control power fuses to blow similar to the April 2, 1997 event. This is similar to the SOR switch failure. On September 9, 1996, PS-3, which was then an Ashcroft switch, failed to reset. At that time, PS-3 was replaced with the SOR switch that failed on April 2, 1997. On November 4, 1996, a UE pressure switch, PS-4-2 on EDG 23 failed to reset and was replaced by a switch manufactured by Eaton. On January 28, 1997, another Ashcroft switch, PS-3-1 on EDG 22 failed to reset and was replaced by a switch manufactured by Eaton. On March 28, 1997, the Eaton PS-3-1 failed to reset.

NTS investigated the Ashcroft PS-3 switch that failed on September 9, 1996, but the reset failure could not be replicated. The Ashcroft PS-3-1 that failed on January 28,1997 was sent to NTS for further investigation. NTS found that the switch had loose microswitches. The design of the switch has two microswitches sandwiched together with an insulator between them. Two screws tightened by locking thread nuts are used to secure the microswitches. These screws had loosened. This condition was similar to the first three failures described above in that internal components had loosened and resulted in the switch failures. NTS also investigated UE switch that failed on November 4, 1996 and found that the setpoint had drifted. NTS theorized that the switch failed to reset because of drifting of the setpoint adjusting nut which resulted from insufficient tightening of the locking nut. Induced vibration is considered to have caused the switch setpoint nut to rotate over time (the effects of induced vibration are enhanced by any inadequate tightening of parts).

The failed Eaton switch was investigated by the manufacturer. This investigation concluded that a loose front microswitch mounting screw was the root cause of the failure. The loose mounting screw allowed movement of

components which precluded proper operation of the microswitch. Eaton had already implemented an enhancement to apply an epoxy resin to prevent undesirable movement of components. This enhancement was expected to accommodate induced vibration at the EDG Engine Gauge Panel. Eaton switches installed subsequent to the March 28, 1997 Eaton failure were the enhanced (with the epoxy resin) Eaton switches. A modification had been prepared to replace any remaining Ashcroft, UE or SOR jacket water pressure switches on the EDG 21, 22 and 23 Engine Gauge Panels with the enhanced (with the epoxy resin) Eaton switches. Based on the investigations of the various manufacturers' switches, the enhanced Eaton switches were considered the preferred qualified switches for the EDG application, and the jacket water switches were being replaced with Eaton switches during planned maintenance and as replacements for failed switches.

On April 24, 1997, an enhanced Eaton switch (JWPS-3-2 on EDG 23) failed to reset and blew the 125 VDC control power fuse, similar to the SOR switch on April 2, 1997. This event also placed the plant in Technical Specification 3.0.1. Subsequent to this event, two other Eaton switches failed to reset on EDG 22. On April 29, 1997, PS-4-1 failed and was replaced with another Eaton switch. On April 30, 1997, PS-3-1 failed and was replaced with a UE switch (there were no more Eaton switches in stock at the station). On May 1, 1997, the UE switch that was installed at PS-3-1 failed to reset.

Details of the April 24, 1997 event and further developments in the root cause investigation of the jacket water pressure switch failures, including subsequent switch failures will be contained in LER 50-247/97-008 which is scheduled for submittal on May 27, 1997. Initial investigation of the latest Eaton switch failures found that the switch contacts had welded together, causing the failure to reset (the switch contacts must open to reset). This type of failure indicates the Eaton switch contacts are not able to handle the current flowing through the switch at 125 VDC. Initial investigation of the latest UE switch failure found that the switch contacts could still be opened.

Review of all of the jacket water pressure switch failures prior to April 2, 1997 shows that excessive vibration could have been a factor in most of the switch failures. Loose screws, nuts and undesirable movement of internal parts contributed to the switch failures. It is also noted that the original UE switch failure rate increased (this was thought to be due to aging) after the bridging of the EDG Engine Gauge Panel isolating dampers in the 1993 RFO. It can therefore be concluded that the bridging of the EDG Engine Gauge Panel isolating dampers contributed to excessive vibration at the jacket water pressure switches. This in turn contributed to the first three jacket water pressure switch failures. Review of the failures that occurred subsequent to

removing the bridging on the EDG Engine Gauge Panels indicates that vibration was still a factor in the switch failures, especially in combination with insufficient tightening of switch components. Also, possible overcurrent conditions of the switches could have contributed to the reset failures (evidence of an overcurrent condition was found in the Eaton switches). The determination of the root cause of the jacket water pressure switch failures is still under investigation, especially in light of the Eaton switch failures on and after April 24, 1997.

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 four hours later, EDG 23 was successfully tested for operability following inspection and repair of its output breaker. At this time, the plant exited Technical Specification 3.0.1 following a reduction in power to 42%. Following operator verification that the plant was stable, power ascension to 100% was commenced. Approximately two and a half hours later, EDG 21 was successfully tested for operability following replacement of the SOR switch with an Eaton switch.

A modification had been prepared to replace remaining Ashcroft, UE or SOR jacket water pressure switches on the EDG 21, 22 and 23 Engine Gauge Panels with the enhanced (with the epoxy resin) Eaton switches. Some of the jacket water switches were replaced with Eaton switches during planned maintenance and as replacements for failed switches. However, following the April 24, 1997 and subsequent Eaton switch failures, the failed switches were being replaced with spare UE switches (UE no longer makes the model that was originally used in the EDGs). The development of a new UE bellows type switch is being pursued. The bellows type is desirable because it is more accommodating of vibration. UE had discontinued the bellows model that was previously used for the EDGs. Further investigation of other manufacturers for a suitable replacement switch is continuing. Further developments on this issue will be detailed in LER 50-247/97-008.

A root cause investigation team consisting of engineering, maintenance and instrument and control personnel, as well as outside contractors has been established to determine the root cause of the jacket water pressure switch failures. NTS has performed extensive investigations of the various jacket water pressure switches that were used. NTS will investigate the failures that have

occurred on and after April 24, 1997. An independent review of the NTS investigation of the jacket water switches, as well as review and analysis performed by the root cause investigation team will be done by an independent third party. Further developments on these investigations will be detailed in LER 50-247/97-008.

A modification has been prepared and implemented on EDG 22 and 23 to change the jacket water pressure switch setpoint from 8 psig decreasing to 10 psig decreasing. This change will allow the switches to be more accommodating of drift. Implementation of this modification on EDG 21 is planned for the 1997 RFO. Also, a modification is being prepared to add interposing relays for the jacket water pressure switch contacts that are in the EDG field flash circuit since this is where most of the switch failures have been occurring and evidence of overcurrent was found in the latest Eaton switch failures.