

LICENSEE EVENT REPORT (LER)

Form Rev. 2.0

Facility Name (1) Quad Cities Unit One	Docket Number (2) 0 5 0 0 0 2 5 4	Page (3) 1 of 0 8
Title (4) The Unit One Emergency Diesel Generator (EDG) Received an Inadvertent Start Signal When a Relay Was Bumped During Testing, the EDG Failed to Start as Would Be Expected on Receipt of this Signal, and the EDG Was Inadvertently Started 15 Minutes Later Due to an Error by an Operator Who Was Responding to the Failure to Start.		

Event Date (5) Month: 0 1 0 5 9 8 Day: 9 8 Year: 8 9 8			LER Number (6) Year: 8 9 8 Sequential Number: 0 0 1 Revision Number: 0 1			Report Date (7) Month: 1 0 2 7 9 8 Day: 1 0 2 7 9 8 Year: 8 9 8			Other Facilities Involved (8) Docket Number(s) Facility Names: 0 5 0 0 0 0 0 0 0 0 0 0					
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OPERATING MODE (9) 4

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (11)

POWER LEVEL (10) 0 0 %	<input type="checkbox"/>	20.402(b)	<input type="checkbox"/>	20.405(c)	<input checked="" type="checkbox"/>	50.73(a)(2)(iv)	<input type="checkbox"/>	73.71(b)
	<input type="checkbox"/>	20.405(a)(1)(i)	<input type="checkbox"/>	50.36(c)(1)	<input type="checkbox"/>	50.73(a)(2)(v)	<input type="checkbox"/>	73.71(c)
	<input type="checkbox"/>	20.405(a)(1)(ii)	<input type="checkbox"/>	50.36(c)(2)	<input type="checkbox"/>	50.73(a)(2)(vii)	<input type="checkbox"/>	Other (Specify in Abstract below and in Text
	<input type="checkbox"/>	20.405(a)(1)(iii)	<input type="checkbox"/>	50.73(a)(2)(i)	<input type="checkbox"/>	50.73(a)(2)(viii)(A)	<input type="checkbox"/>	
	<input type="checkbox"/>	20.405(a)(1)(iv)	<input type="checkbox"/>	50.73(a)(2)(ii)	<input type="checkbox"/>	50.73(a)(viii)(B)	<input type="checkbox"/>	
	<input type="checkbox"/>	20.405(a)(1)(v)	<input type="checkbox"/>	50.73(a)(2)(iii)	<input type="checkbox"/>	50.73(a)(2)(x)	<input type="checkbox"/>	

LICENSEE CONTACT FOR THIS LER (12)

Name Charles Peterson, Regulatory Affairs Manager, ext. 3609	TELEPHONE NUMBER AREA CODE 3 0 9 6 5 4 - 2 2 4 1
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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

SUPPLEMENTAL REPORT EXPECTED (14)

YES (If yes, complete EXPECTED SUBMISSION DATE) NO

Expected Submission Date (15) Month: Day: Year:

ABSTRACT (Limit to 1400 spaces, i.e. approximately fifteen single-space typewritten lines) (16)

ABSTRACT:

On 010598 at 1659, Unit One was in Cold Shutdown at 0 percent power when an Electrician (EM) accidentally actuated a relay during Core Spray System Logic Testing. An auto-start signal was generated for the Unit 1 EDG, but the EDG did not start. At 1714, the Nuclear Station Operator (NSO) directed an operator to reset an EDG alarm which inadvertently started the EDG. At 1736, the Unit 1 EDG control switch was placed in stop. There were three distinct concerns involved with this event:

1. The EM made contact with the 1-1430-127B relay resulting in an auto-start signal to the Unit 1 EDG. This was caused by an inadequate work practice.
2. The Unit 1 EDG did not start upon receipt of the auto-start signal. The cause has not been determined.
3. The Unit 1 EDG was inadvertently started when operators were responding to the failure to start. This was caused by misapplication of a procedure step by the NSO.

The corrective actions include training, counseling, component testing and evaluation, replacement of components, procedure revisions, and tailgate briefings.

Additional investigation of a subsequent event indicated a flickering "RUN" indication in the control room was caused by a degraded fuse clip in the EDG control power circuit. This was the likely cause of the EDG failure to start on 01051998

The safety significance of this event was minimal. In the event the Unit 1 EDG failed to start when needed, the Unit 1/2 EDG would be available to provide emergency power.

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PLANT AND SYSTEM IDENTIFICATION:

General Electric - Boiling Water Reactor - 2511 MWt rated core thermal power.

EVENT IDENTIFICATION: The Unit One Emergency Diesel Generator (EDG) Received an Inadvertent Start Signal When a Relay Was Bumped During Testing, the EDG Failed to Start as Would Be Expected on Receipt of this Signal, and the EDG Was Inadvertently Started 15 Minutes Later Due to an Error by an Operator Who Was Responding to the Failure to Start.

A. CONDITIONS PRIOR TO EVENT:

Unit:	1	Event Date:	010598	Event Time:	1659
Reactor Mode:	4	Mode Name:	Cold Shutdown	Power Level:	000%

This report was initiated by Licensee Event Report 254/98-001

Cold Shutdown (4) - Mode switch in Shutdown position with average reactor coolant temperature \leq 212 degrees F.

B. DESCRIPTION OF EVENT:

On 010598 at 0930, Unit 1 was in Cold Shutdown at 0 percent power when QCTS 0300-05, "Core Spray Logic Functional Test", was commenced on Unit 1. A Nuclear Station Operator (NSO) was assigned to assist in coordinating the test from the Control Room (CR). Electrical Maintenance workers (EM's) assigned to the test were with the engineer assigned as Test Director (TD) in the Auxiliary Electrical Room. During the performance of QCTS 0300-05, various relay covers were removed in the Auxiliary Electrical Room by the EM's. Although the covers have a window, removal and replacement of these covers was an accepted work practice if they felt it was necessary to view the operation or position of various relays. An EM removed a cover from the 1-1430-127B relay to ensure that his vision of the relay position was not obscured. A finger block is installed on relay 1-1430-108B in step I.103 of QCTS 0300-05 to prevent a Loss of Coolant Accident signal auto-start of the Unit 1 EDG [EK] during the testing.

At approximately 1655, step I.155 of QCTS 0300-05 was performed, removing the finger block and re-enabling the auto-start of the Unit 1 EDG. After step I.155, one of the EM's in the Auxiliary Electrical Room was replacing the covers on the relays and experienced difficulty when replacing the cover on the 1-1430-127B relay. The EM noted that the spring arms that hold the cover had to be pressed together slightly in order to slide on the cover. The EM rocked the cover when sliding it on, bumped the relay arm, and momentarily actuated the relay.

At 1659:20, the Unit 1 NSO in the CR received 2 alarms "EDG 1 Trouble: GEN" and "EDG Auto Start Blocked/AUTOSTART". The Unit 1 NSO noted that the red operating light was lit for the Unit 1 EDG, the Unit 1 EDG Cooling Water Pump had started, and there was no voltage present at the Unit 1 EDG. At 1659:36, the "EDG 1 Fail To Start" alarm was received and the Unit 1 NSO announced that the Unit 1 EDG had failed to start and requested assistance from the Unit Supervisor (US). The CR dispatched Non-Licensed Operators (NLO's) to the Unit 1 EDG Room to investigate and the US requested the EM's to stop work in the Auxiliary Electrical Room and to report to the CR. The US discussed the situation with the Unit 1 NSO, identifying that a short duration signal might start the 11-minute cooldown timer, but not energize all of the auto-start logic. The US determined it would not be appropriate to place the EDG control switch in stop. The US had seen such a scenario previously in

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the CR and the simulator, and wanted to preserve the current status of the logic to avoid losing evidence concerning the failure to start.

The Unit 1 NSO entered the applicable annunciator procedures. The "EDG 1 Fail To Start" procedure directs the operator to QCOA 6600-01, "Diesel Generator 1(2) Fails To Start". The Unit 1 NSO turned to step D.6 of QCOA 6600-01 which begins: "If EDG failed to auto-start upon a valid start signal, and will not manually start, then...". A "valid" actuation is described in the ComEd Reportability Manual as "actuation initiated in response to actual plant conditions or parameters satisfying the requirements for actuation". There were no indications that the signal originated from actual or impending plant conditions. The NSO incorrectly viewed the signal as "valid" in the sense that an actuation signal had to have been present to produce the indication. In addition, there had been no attempt or intent to manually start the EDG as predicated by step D.6 of the procedure.

The NLO's who had been dispatched from the CR arrived in Unit 1 EDG room and noted that the EDG auxiliary control panel indicated that the EDG cooling water pump had started as well as the starting air compressor. A NLO acknowledged the auto-start alarm on the local alarm panel. The EM's and TD arrived in the Control Room and the US inquired and discovered that an EM had accidentally actuated the 1-1430-127B relay. The 11-minute start delay timed out and the Unit 1 EDG was declared inoperable at 1711. The Unit 1 NSO was continuing in step D.6 of QCOA 6600-01 when the NLO inquired about the need to reset the "fail to start" alarm on the Engine Mounted Control Panel in the Unit 1 EDG Room. Step D.6.b.(3) of QCOA 6600-01 states: "When cause of EDG Fail to Start alarm has been corrected, then at the Engine Mounted Control Panel, reset trip by depressing alarm reset pushbutton". At this point, the Unit 1 NSO was aware that the accidental actuation of the relay was the cause of the auto-start signal and based on the report of the NLO in the EDG room, felt that the cause had been sufficiently addressed to request a reset of the alarm. The NSO did not believe that a auto-start signal was still present based on his earlier discussions with the US. The NSO recalled announcing to the US that the Fail to Start alarm would be reset and that this was acknowledged by the US. At 1714, the NLO pressed the alarm reset pushbutton and the Unit 1 EDG immediately started.

The US discussed the Unit 1 EDG start with the Shift Manager who had entered the CR at this point and it was decided to leave the EDG running while an investigation of the start was conducted. At 1736, the Unit 1 EDG control switch was placed in stop to minimize the unloaded run time for the EDG. At 1958, an Emergency Notification System (ENS) 4-hour phone call was made.

C. CAUSE OF EVENT:

There were three distinct concerns involved with this event: (1) The EM made contact with the 1-1430-127B relay resulting in an auto-start signal to the Unit 1 EDG, (2) the Unit 1 EDG did not start upon receipt of the auto-start signal, and (3) the Unit 1 EDG was inadvertently started when operators were responding to the failure to start.

1. The root cause of the EM making contact with the relay was an inadequate work practice related to control of a risk related activity. Each time a relay cover is removed or replaced, there is an element of risk for actuating the relay. The EM was acting within Electrical Maintenance Department expectations in this work practice by making what appeared to him as a reasonable decision of when he would replace the relay covers that had been removed. The replacement of this cover could have been sequenced prior to removal of the fingerblock in step I.155, and there would have been no start signal. The accepted work practice added an unnecessary element of risk to the activity by not requiring the EM to receive specific authorization to replace this cover. This work practice precluded supervision from recognizing and controlling the risk through sequencing.

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2. The root cause of the Unit 1 EDG failure to start has not been determined. Refer to the supplemental root cause information provided in section C.4, E.7, and E.8. The following describes the troubleshooting activities performed.

a. Review of EDG fail to start for Electrical Cause.

Review of electrical prints for this event reveal that the Unit 1 EDG would be auto-started by an actuation of relay 1-1430-127B. The following potential causes were eliminated through testing, walkdowns, or evaluation.

- * EDG frequency generator malfunction.
- * Additional Relay was actuated during Test (QCTS 0300-05).
- * Specific relay malfunction.
- * Pressure Switch malfunction.
- * Partial actuation of EDG start circuit.
- * Loose wiring connections.
- * Switch positions (remote/local).
- * Alarms/Lockouts.

b. Review of EDG fail to start for Mechanical Cause.

The basic Air Start Circuit Operation was checked. A walkdown was done of the Unit 1 EDG to inspect for the any visible conditions that could have affected the start as well as inspections, tests and evaluations which were unable to identify a mechanical cause. Specifically inspected items are documented below.

- * Valve misposition.
- * Fuel rack assembly binding.
- * Governor integrity (oil level).
- * Gross mechanical errors (obstructions near flywheel, generator, etc.)
- * Oil residue from starter exhaust.
- * Air start motor pinions/abutment.
- * Fuel oil contamination/problems.
- * Foreign material/obstruction in air start lines (3/8" tubing).
- * AO 1-4699-226 malfunction.
- * Air start solenoid.

On 010598, as a result of an inspection of the Air Start System by the System Engineer, electrical tape was found covering both the inlet and outlet ports of the air start solenoid operated valve. The solenoid was installed on 121697 during the performance of QCEPM 0400-14, "Emergency Diesel Generator Electrical Preventative Maintenance", and the tape was left on the valve due to a foreign material exclusion (FME) error by maintenance personnel. Subsequent start operations punctured holes through the tape to allow the system to operate. Further testing is needed to evaluate the effect of the tape on the air start solenoid valve.

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On 011898, during air start motor pinion/abutment testing, one of the air start motors was found to have resistance when turning by hand. Further testing is needed to evaluate the effect of this binding on the Unit 1 EDG failure to start. Abutment was ruled out as a cause by the design of the currently installed air start motors. During an abutment, there is sufficient air at the air operated valve to open the valve allowing air to turn the motors.

On 012498, ten fast starts of the Unit 1 EDG were performed and each time the EDG started as expected. A 24 hour EDG endurance run was also successfully completed on 012698.

c. Demand Analysis.

There were 5 total demands prior to the start failure since the last maintenance (121697) was performed. The circumstances of each of the starts and the relevant plant conditions surrounding them were reviewed. All of the demands were deemed as successful demands. In each case, the EDG started as expected.

3. The root cause of the inadvertent start of the Unit 1 EDG when responding to the failure to start was misapplication of a procedure step by the Unit 1 NSO. QCOA 6600-01 Step D.6 was misapplied as there was no valid start signal or attempt to start the EDG manually. Interviews with other operators revealed the term "valid" may not be consistently interpreted as described in the ComEd Reportability Manual. Although step D.6.b.(3) is identified as a trip reset, the NSO perceived he was only resetting an alarm when he directed the NLO to press an "alarm reset pushbutton" on the Engine Mounted Control Panel. This knowledge error is also described in LER 237/97-016, when Dresden Station operators also caused an unexpected start of the EDG by pressing this button to clear a low cooling water pressure indicator alarm. In addition, the NSO should have consulted directly with the US that the cause of the failure to start had been corrected prior to directing the NLO to press the alarm reset pushbutton.
4. In a subsequent event on 03171998 during a normal monthly EDG surveillance test, the output breaker tripped unexpectedly. In conjunction with this, the EDG "RUN" indication in the control room appeared to be flickering. This event was investigated under PIR 1-98-018. The root cause was due to a "degraded" fuse clip in the control power circuit. Upon further analysis, it has been determined that this was the likely root cause for the start failure that occurred on 01051998. In addition, an independent root cause evaluation on this event was performed by Performance Improvement International (PII). The conclusions drawn in the outside investigation support those formed by station personnel.

D. SAFETY ANALYSIS:

The safety significance of this event was minimal. Unit 1 was in Cold Shutdown as required for the performance of QCTS 0300-05 and the Unit 1/2 EDG was operable to provide emergency power to Unit 1 throughout the event. In the event of a Loss of Coolant Accident (LOCA) and the Unit 1 EDG failed to start, the Unit 1/2 EDG would be available to provide emergency power to shutdown and cooldown the Unit if the failure occurred during power operation. The Unit 1 and Unit 2 Station Blackout Diesels were also available to provide power in the event of a loss of off-site power. There was no increased risk for the general public or on-site personnel.

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E. CORRECTIVE ACTIONS:

Corrective Actions Completed:

1. The NSO was counseled on this event.
2. All Operations crews were briefed on this event. This briefing included the following discussion:

...lessons learned from other events describe the need to carefully review appropriate actions to take after dealing with the initiating event. In the case of the Unit 1 EDG auto-start, the Shift Manager/Unit Supervisor should have gathered more information and involved other departments as necessary to understand exactly what happened...If the crew had taken more time to analyze the situation and verify the proper step in the QCOA, then the correct step of the procedure would have been performed and the EDG would not have started. Once something happens that is unexpected, the first question to ask is if the plant is in a stable condition. If the answer is no, and a transient is in progress, then by all means take actions to restore the plant to a stable condition. If the plant is stable, then stop, initiate a prompt investigation to determine the cause prior to taking further actions, and notify senior Operations management.
3. All EM work was suspended until all EM crews could be briefed on the event. This briefing addressed the following subjects:
 - a. Procedural Adherence issues: Procedure usage, steps completed accurately, proper sequence, and procedural adherence observed.
 - b. Correct Task Performance issues: Proper skills demonstrated, proper tool/equipment usage, FME adherence, self check, and good work ethic.
 - c. Use of good communications skills and proper terminology.
 - d. The high level of risk when working on relays, including the need for caution at all times when working on and around relays in panels.
4. Logic Testing was immediately suspended.
5. The Unit 1 air start solenoid which was taped and the air start motor which would not rotate freely were both replaced.
6. Caution placards were installed on the alarm reset pushbutton on the Engine Mounted Control Panel for the EDG's identifying their ability to start the EDG if a start signal is present.
7. An off-site evaluation of the binding of the EDG air start motors was conducted by Supplier Evaluation Services (SES) with support of the vendor, Engine Systems, Inc. (ESI) on 03041998. The first step performed a functional test on the air start motors. Air was applied to the motor while it was verified to accelerate to 1600-2500 rpm. Neither of the two start motors manually bound prior to the functional test; however, upon completion, one was noted to have some manual binding. A second functional test was performed on this motor and again the motor accelerated to between 1600-2500 rpm, indicating it was capable of performing its function of starting the EDG. Results of the functional tests were recorded and turned over to a member of the ComEd C-Team Parts Engineering Group, who witnessed the test.

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Following the functional tests, the air start motors were taken to a clean area for disassembly. The process was directly observed by SES and the ComEd C-Team Parts Engineer. The first air start motor showed no signs of wear or damage. The second motor showed some evidence of damage to the rotor, cylinder, and vanes. The damage appeared to be caused by foreign material introduced on the air inlet side of the air start motor. The foreign material was not found during the motor disassembly.

Documentation for the most recent rebuild of the binding air start motor was reviewed. The documentation showed that the rotor and vanes were replaced the last time the motor was rebuilt but did not note any damage to the cylinder. The vanes are replaced with each rebuild, as required by procedure. Discussions with ESI personnel indicate that although the rotor is not required to be replaced each time the air start motor is rebuilt, the rotor often shows sufficient signs of wear to require replacement.

The air start motors were then re-assembled by the ESI technicians with ComEd personnel observing.

In conclusion, the assessment of the air start motors is that even though damage was apparent, it was not to an extent that the motor would have prevented the EDG from starting.

8. Parts Engineering performed a failure analysis on the Graham-White-solenoid-operated pilot valve used in the air start circuit of the Unit 1 Emergency Diesel Generator. The valve was installed with electrical tape, which had been perforated as a result of system pressure, covering the input and output ports. Conclusions from this portion of the analysis revealed that although the tape did delay the pressurization rate of the piping downstream of the solenoid (due to a degraded flowrate), it was not significant.

Additional testing concentrated on the possibility of degraded DC voltage to the solenoid coil. Conditions observed during the surveillance did not indicate that a degraded voltage condition existed. The testing performed by Parts Engineering concluded that as long as the field voltage was maintained above the minimum threshold, no effect would be seen at the solenoid valve.

Based on the inspection and testing performed at the C-Team Facility in conjunction with the conditions of the DC power supply system during the surveillance, it can be concluded that the tape had minimal effect on the performance of the solenoid valve. Therefore there is no evidence that the solenoid valve contributed to the diesel generator auto-start failure.

9. During the course of the event, the term "valid actuation signal" was used to describe the initiation of the logic. This was done in error as can be seen by the definition of "valid" from the ComEd Reportability Manual. The term "valid" is only used if the initiating signal is caused by an actual 2.5 psig in the drywell or -59" reactor water level (energizes the 1430-127 relay). The Operations department completed training on 05061998 to reinforce the intent and content of the Reportability Manual with respect to this type of situation.
10. The work execution procedure; QCAP 0306-00, "WORK EXECUTION", was revised to include a NOTE to warn maintenance personnel NOT to remove or install relay covers unless addressed in the Work Procedure or authorized by Operations.

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11. The appropriate maintenance departments completed training on hazards of cover removal and installation on 05131998.
12. Revisions to appropriate Logic Tests, adding sequencing steps, such that inadvertent relay actuations are prevented, was completed 06261998.

F. PREVIOUS OCCURRENCES:

A review of previous LERs in the past two years, concerning similar inadvertent actuations of an Emergency Core Cooling System or involving an EDG failure to start, revealed the events listed below:

LER 254\96-003, Unit One Unexpected Start Of Emergency Diesel Generator Due To An Inadequate Procedure.

LER 265\97-005 Revision 1, The Unit 2 Reactor was Placed in Mode 2 without the required number of Emergency Diesel Generators Operable.

One of these previous events (265\97-005) was a result of an EDG failure to start, associated with installation of air start motors which did not have the same critical dimensions as the original equipment. The air start motors installed during the 010598 event were verified to have the same critical dimensions as the original equipment. One of these previous events (254\96-003) identifies inappropriate use of the alarm reset button on the EDG Engine Mounted Control Panel which was also present in the 010598 event. As a result of the recurrence of this error, a corrective action has been included in this LER for additional labeling for the alarm reset button.

G. COMPONENT FAILURE DATA:

Not applicable.