

LICENSEE EVENT REPORT (LER)

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|---|------------------|----------------------|---|-------------------|-----------------|--------|-----------|-----------------|----------------------|--|-------------------------------|--|-------------------------------|--|----------------------------|--|--|------------------------------------|-----------|-----------------|----------|-----------------|-------------|----------------|----------|------------------|-------------|--|---|-------------------|----------------|----------------------|----------------------------------|------------------|-----------------|----------------------|--|---|------------------|----------------|--|--|--|--|--|--|--|
| Facility Name (1) QUAD-CITIES NUCLEAR POWER STATION, UNIT ONE | | | | | | | | | | Docket Number (2) 0 5 0 0 0 2 5 4 | | | | | Page (3) 1 of 0 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Title (4) 1/2B Diesel Fire Pump Starter Motor Fire Due to Loose Connection and Corrosion | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 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) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | Quad Cities Unit Two | | | | 0 5 0 0 0 2 6 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| OPERATING MODE (9) | | | THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (11) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| POWER LEVEL (10) | | | <table border="0" style="width:100%;"> <tr> <td>20.402(b)</td><td>20.405(c)</td><td>50.73(a)(2)(iv)</td><td>73.71(b)</td> </tr> <tr> <td>20.405(a)(1)(i)</td><td>50.36(c)(1)</td><td>50.73(a)(2)(v)</td><td>73.71(c)</td> </tr> <tr> <td>20.405(a)(1)(ii)</td><td>50.36(c)(2)</td><td>50.73(a)(2)(vii)</td><td>X Other (Specify in Abstract below and in Text)</td> </tr> <tr> <td>20.405(a)(1)(iii)</td><td>50.73(a)(2)(i)</td><td>50.73(a)(2)(viii)(A)</td><td>Technical Specification 3.12.B.3</td> </tr> <tr> <td>20.405(a)(1)(iv)</td><td>50.73(a)(2)(ii)</td><td>50.73(a)(2)(viii)(B)</td><td></td> </tr> <tr> <td>20.405(a)(1)(v)</td><td>50.73(a)(2)(iii)</td><td>50.73(a)(2)(x)</td><td></td> </tr> </table> | | | | | | | | | | | | | | | 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) | X Other (Specify in Abstract below and in Text) | 20.405(a)(1)(iii) | 50.73(a)(2)(i) | 50.73(a)(2)(viii)(A) | Technical Specification 3.12.B.3 | 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) | | | | | | | |
| 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) | X Other (Specify in Abstract below and in Text) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20.405(a)(1)(iii) | 50.73(a)(2)(i) | 50.73(a)(2)(viii)(A) | Technical Specification 3.12.B.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 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) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td colspan="10">LICENSEE CONTACT FOR THIS LER (12)</td> </tr> <tr> <td colspan="10">Name Diane Doliber, Technical Staff Engineer, Ext. 2156</td> </tr> <tr> <td colspan="10">TELEPHONE NUMBER AREA CODE 3 0 9 6 5 4 - 2 2 4 1</td> </tr> </table> | | | | | | | | | | | | | | | | | | LICENSEE CONTACT FOR THIS LER (12) | | | | | | | | | | Name Diane Doliber, Technical Staff Engineer, Ext. 2156 | | | | | | | | | | 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 NRC | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NRC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X | K P | M S T R | C 7 4 2 | N | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SUPPLEMENTAL REPORT EXPECTED (14) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Yes (If yes, complete EXPECTED SUBMISSION DATE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X NO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

On November 11, 1987, Quad Cities Unit One was in the REFUEL mode at 0 percent power and Unit Two was in the RUN mode at 95 percent thermal power. At 0528 hours, a low fire protection header pressure automatic start signal should have started the 1/2B Diesel Fire Pump. The 1/2A pump was unavailable for maintenance reasons (see LER 254/87-032, Revision 00). The 1/2 B pump subsequently did autostart at 0540 hours and the Electrical Maintenance Department (EMD) initiated an inspection of the 1/2B pump to determine why it did not start upon low suction pressure. The EMD observed two successful autostarts, but a third autostart resulted in the failure of the diesel engine starter motor. This occurred at 1335 hours. The motor failure caused a lot of smoke and a small fire which was quickly extinguished. The 1/2B Fire Pump was declared inoperable. A backup fire suppression water system was established to comply with Specification 3.12.B.3.

The initial failure to start when expected was due to corrosion on some of the engine start relay contacts. The starter motor failure was caused by a loose connection at the voltage regulator. The 1/2B Fire Pump fire damaged components were replaced and the loose wire was retightened. The 1/2B Fire Pump was tested and deemed operable on November 21, 1987 at 0345 hours. This report is submitted per Specification 3.12.B.3.

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PLANT AND SYSTEM IDENTIFICATION:

General Electric - Boiling Water Reactor - 2511 MWt rated core thermal power. Energy Industry Identification System (EIIS) codes are identified in the text as [XX].

EVENT IDENTIFICATION: 1/2B Diesel Fire pump starter motor fire occurred while troubleshooting due to a loose connection and corrosion.

A. CONDITIONS PRIOR TO EVENT:

| | | |
|-----------------|-------------------------------|------------------|
| Unit: One | Event Date: November 11, 1987 | Event Time: 1335 |
| Reactor Mode: 2 | Mode Name: Refuel | Power Level: 00% |

This report was initiated by Deviation Report D-4-1-87-101.

Refuel Mode(2) - In this position interlocks are established so that one control rod only may be withdrawn when flux amplifiers are set at the proper sensitivity level and the refueling crane is not over the reactor. Also, the trip from the turbine control valves, turbine stop valves, main steam isolation valves, and condenser vacuum are bypassed. If the refueling crane is over the reactor, all rods must be fully inserted and none can be withdrawn.

B. DESCRIPTION OF EVENT:

On November 11, 1987, Quad Cities Unit One was in the REFUEL mode at 0 percent power and Unit Two was in the RUN mode at approximately 95 percent core thermal power. At 0528 hours, while returning to service a fire system [KP] associated with the Unit One Turbine [TA, TRB] and turbine bearing lift pumps [TA, P], the main fire header pressure dropped to approximately 38 psig by Control Room indication. This pressure is less than the fire header low pressure autostart setpoint for the diesel fire pumps. Normal header pressure is 100 psig. The 1/2A Diesel Fire Pump [KP,P] was out of service for maintenance purposes (LER 254/87-021, Revision 00). The redundant 1/2B Diesel Fire Pump did not automatically start upon receipt of the low pressure condition. The 1/2B Diesel Fire Pump was found to be tripped on an overcrank condition. The fire header was slowly repressurized by the service water system [BI] through a small orifice crosstie line and the fire pump start circuit was reset. At 0540 hours, while the fire system return to service was being completed, the 1/2B Fire Pump successfully autostarted on a low fire header pressure signal. The 1/2B Fire Pump was left running to ensure that fire system pressure was adequately maintained while an investigation was initiated for the autostart inconsistency.

While troubleshooting the problem under Work Request Q61719, the Electrical Maintenance Department witnessed two successful autostarts. After the third autostart, smoke was noticed coming from the starter solenoid [SOL], and then the starter motor began burning. At 1335 hours the station fire alarm [FRA] was sounded from the control room, and the fire was quickly extinguished. The 1/2B Fire Pump was declared inoperable, and because the 1/2A Fire Pump was out of service, a backup fire suppression water system had to be provided within 24 hours as stated in Technical Specification 3.12.B.3. This Technical Specification states, that with no fire suppression water system operable, within 24 hours:

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- a. Establish a backup fire suppression water system.
- b. Notify the Commission pursuant to Specification 6.3.A.1 outlining the actions taken, the cause of the inoperability, and the plans and schedule for restoring the system to operable status.

A backup fire suppression water system was established within 24 hours per QOA 4100-2 "Fire Protection System Failure" by opening the service water crosstie line valve (1/2-3906) [KG, ISV]. In addition, an emergency diesel driven pump [P] was connected to the fire main. This was completed within one half hour of the event. Verbal notification of the event was made to the NRC Resident Inspector at 0700 hours on November 12, 1987.

C. APPARENT CAUSE OF EVENT:

This report is submitted because of the requirements of Technical Specification 3.12.B.3 which references Specification 6.3.A.1, which declares that the Commission shall be notified and a report submitted pursuant to the requirements of Section 50.73 of 10 CFR Part 50.

The failure of the 1/2B Fire Pump to autostart on the first instance of low fire header pressure was attributed to corrosion on some of the engine start relay contacts [RLY]. The root cause of the corrosion is attributed to moisture from a previous actuation of the deluge system protecting the fire pump. The cause of the starter motor fire was traced to a loose wire connection at the voltage regulator [RG].

During the initial investigation performed by the Electrical Maintenance Department into the 1/2B Fire Pump failure to autostart, corrosion was found on the PC (Pilot Starter Coil [CL]) and SC (Starter Coil) Relay contacts. These relays are located on the diesel engine, and operate in sequence to cause the engine starter to engage when called upon; either by a manual start or autostart. It is likely that a contact on one of these relays did not fully close during the first autostart attempt, due to the corrosion. After being cycled once, the contacts were freed of enough of the foreign material to "make up" on the second and subsequent autostart sequences. The cause of the corrosion on the start relays was likely caused by previous inadvertent actuation of the deluge system protecting the 1/2B Fire Pump.

The cause of the starter motor fire after the third successful autostart was identified as a loose wire connection which did not allow the R6 (crank cutoff) relay to be energized after engine startup. The purpose of this relay is to disengage the starter once the diesel engine is running. If this relay does not energize, the starter will remain engaged and will be forced to turn at excessive speeds. This was the circumstance which caused the 1/2B Fire Pump starter to overheat and burn. Contributing evidence was provided by the Control Room Nuclear Station Operator, because he observed that the diesel engine "Run" light, which is in parallel with the R6 relay, was dimmer than usual, indicating a low voltage on the circuit because of the loose connection. It is believed that the wire connection was apparently loosened (during the troubleshooting process or because of normal engine vibration) to the point where the R6 relay eventually failed to pick up. This scenario explains why the 1/2B engine autostarted successfully three times before the starter burned.

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D. SAFETY ANALYSIS OF EVENT:

Technical Specifications require that with both fire pumps inoperable a backup fire suppression water system be established within 24 hours. At the time of this event, the 1/2A Fire Pump was inoperable due to maintenance activities. (See License Event Report 254/87-021, Revision 00). With neither pump available, backup suppression water was provided by immediately opening the service water crosstie line valve (1/2-3906).

The service water system is capable of supplying adequate amounts of water to the fire system piping, but, under normal operating conditions, at a slightly lower pressure (5-10 psi lower) than required by the most demanding sprinkler system [KP, SRNK]. This deficiency in service water crosstie pressure would cause the sprinkler discharge pattern at a remote system to be reduced to a small extent. To compensate for this possibility, the station has two backup diesel driven pumps available which take suction from the discharge bay and can be tied into fire main hydrants [HYD] specifically designated for this purpose. Each of these pumps is rated at 140 psi which satisfies the most demanding fire system pressure requirement (100 psi).

Upon loss of both normal fire pumps, one of the backup pumps was hooked up to its hydrant. In this way, if a sprinkler system was actuated because of fire conditions, and the service water system could not maintain the necessary pressure, the backup pump would have provided additional pressure.

E. CORRECTIVE ACTIONS:

The Electrical Maintenance Department tightened the loose wire at the regulator, and replaced the fire damaged components with like-for-like parts from the 1/2A Fire Pump under Work Request Q61719, which included a SC relay and the starter assembly. Other components replaced included the 1SC and 2PC relays. Electrical connections on hardware mounted on the engine were verified to be tight. A thorough inspection was also conducted to identify and resolve any corrosion problems on components which were not replaced. On November 20, 1987 at 2150 hours, the 1/2B Fire Pump was successfully tested per QOS 4100-1, "Monthly Diesel Fire Pump Test". It was verified to operate correctly by both the low pressure autostart and the control room remote start. It was declared operable at 0345 hours on November 21, 1987. The 1/2-3906 valve was then closed.

A Work Request (Q62000) has been submitted to investigate the possibility of sealing fire diesel electrical components within the deluge system spray area to prevent water damage should another actuation occur. This Work Request will be tracked by Nuclear Tracking System number 2542008710101.

Procedure QOA 4100-2, "Fire Protection System Failure" is being revised to require the connection of the backup pumps to their hydrants to ensure adequate pressure. Currently, temporary procedure number 5076 is in place to perform this. This will be implemented as a permanent procedure (NTS 2542008710102).

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To address the low pressure condition that initiated this event, the Non-Licensed Operator Initial and Retraining Programs will incorporate the lessons learned from this event - specifically that care must be exercised when returning to service drained portions of piping systems to avoid potential low system pressure conditions (NTS 2542008710103).

F. PREVIOUS EVENTS:

The only previous event identified where both diesel fire pumps were unavailable is documented in Quad Cities Station Deviation Report 4-1-85-044. The event involved the failure of each pump to meet the capacity requirements while testing. This resulted in pump wear ring replacement on each pump.

G. COMPONENT FAILURE DATA:

The 1/2A and B Diesel Fire Pumps are products of Cummins Marine Diesel, Model NHS 6 IF. The 24 volt starter motor (part number 43604), PC relay (part number 199573), and SC relay (part number 118848) are manufactured by Cummins Mid-State Power, Incorporated.