

# WOLF CREEK

NUCLEAR OPERATING CORPORATION

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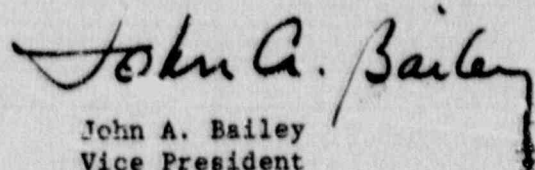
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Subject: Docket No. 50-482: Special Report 90-002

Gentlemen:

The attached Special Report is being submitted in accordance with Technical Specifications 4.8.1.1.3 and 6.9.2.

Very truly yours,



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JAB/jra

Attachment

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## SPECIAL REPORT 90-002

### **Invalid Failures of Emergency Diesel Generator "B"**

This report describes invalid failures of Emergency Diesel Generator (EDG) "B", two of which occurred on April 21 and one on April 23 of 1990. This report is being submitted in accordance with Technical Specifications 4.8.1.1.3 and 6.9.2.

#### DESCRIPTION OF EVENTS

On April 6, 1990, EDG "B" was removed from service for planned maintenance during Wolf Creek Generating Station's fourth refueling outage. Part of the planned maintenance activities included a 24-hour run of the EDG to demonstrate reliability following maintenance. The EDG was started for this reliability run at 1517 hours on April 20, 1990. However, on April 21, 1990, at approximately 0630 hours, operators noticed an increasing temperature reading on one temperature indicator in the exhaust inlet for one of the diesel engine turbochargers. Other exhaust temperature indicators did not show a corresponding increase in temperature, indicating the problem was limited to the temperature indicator itself. Although this did not require the EDG to be shut down, in order to further investigate the cause, the EDG was unloaded and secured at 0637 hours on April 21, 1990. Investigation revealed a failed thermocouple. The thermocouple was replaced and the EDG was restarted at 1019 hours on April 21, 1990, for the 24-hour reliability run. However, the EDG was secured a second time at 2336 hours when a fuel oil leak was discovered on the fuel injector leak-off return header. The leak was caused by a break in the 3/8-inch leak-off line from the #8 cylinder at its connection to the return header. Since the fuel oil is at atmospheric pressure at this location, the leak was relatively small (approximately 1/4 gallon per minute) with no spraying of the fuel oil.

The leak was discovered almost immediately and very little fuel oil had leaked onto the lower part of the engine or the EDG room floor. The leaking fuel oil was well away from any areas of the diesel engine hot enough to cause ignition and therefore the leak did not pose a fire hazard.

The broken line was repaired and the EDG was restarted on April 22, 1990, at 1050 hours for the 24-hour reliability run. The run was successfully completed on April 23 at 1133 hours. Following the 24-hour reliability run, EDG "B" was started at 1219 hours on April 23, for performance of a one hour surveillance test, which is normally performed prior to declaring the EDG operable. The test was completed and all test criteria were satisfied. However, the EDG was not declared operable due to leaks in the exhaust



manifold which were discovered following the test. The leaks were in the exhaust manifold piping located between the cylinders and the turbochargers. The leaks were caused by the loss of gasket material in several bolted joints that exist in the exhaust piping. The gaskets were replaced and the manifold reassembled by April 29, 1990. A successful 24-hour reliability run was performed on April 30 at 0005 hours followed by a successful one hour surveillance test at 0208 hours on May 1, 1990. EDG "B" was declared operable on May 1, 1990, at 0331 hours. These events extended the length of time EDG was out of service for maintenance by approximately 9 days to approximately 24 days total.

#### ROOT CAUSE AND CORRECTIVE ACTIONS

The cause of the first event was a failed thermocouple on the exhaust inlet to the diesel engine turbocharger. This is the first failure of this type and appears to be a random event with no generic implications. Therefore corrective actions were limited to replacing the thermocouple.

The cause of the second event was related to maintenance which had been performed just prior to the reliability run. The maintenance activity replaced a portion of the fuel oil leak-off line as a result of minor fretting. It has been concluded that the maintenance activity introduced abnormal strain on the connection to the return header which, combined with the normal vibration experienced during operation, led to the failure at the connection. This conclusion is based on the analysis performed on the failed piping by an independent test lab, which concluded the pipe failed as a result of overload. They found no evidence of a fatigue mechanism or any evidence of substandard material. Maintenance was not performed on any of the other leak-off lines, therefore, no other failures of this type are expected. Corrective actions were to replace the failed section of piping and to visually inspect the other leak-off lines to verify they were not in a degraded condition.

The third event was caused by misalignment of the exhaust manifold piping sections and supports during reassembly following maintenance. The exhaust manifold had been disassembled to replace several of the original asbestos gaskets, which showed signs of degradation due to normal aging. Alignment of the piping sections is complicated due to the presence of several expansion bellows along the length of the piping. The expansion bellows are provided to allow for thermal expansion of the piping. Each bellows is located between two sections of piping and is bolted to the piping at a flanged connection. There are a total of 28 bellows in the exhaust manifold or 56 flanged, bolted connections, each sealed with a 1/16 inch thick gasket. Thirty-two of the original asbestos gaskets were replaced with a graphite-based gasket because of its improved aging properties. Reassembly of the manifold involved placing each individual bellows or piping section in its proper location and bolting it in place. Due to the flexibility of the bellows this method did not provide positive control of the alignment of

the piping sections. Although analysis of this event is continuing, it is currently believed that the misalignment of the piping sections, combined with thermal cycling of the piping, resulted in inadequate compressive forces on the gaskets, allowing exhaust gases to escape and/or blow out portions of the gaskets.

Following discovery of the exhaust leaks, the exhaust manifold was completely disassembled to replace all gaskets. Reassembly was performed by first assembling the piping sections using "dummy bellows" (short pieces of piping instead of actual bellows), then hoisting the complete assembly onto the diesel engine, bolting it in place, and then replacing the "dummy bellows" with the actual bellows. This method is similar to that used by the vendor during manufacture of the engine and provides additional control of the alignment. In addition, all the gaskets were replaced with stainless steel gaskets, which the vendor has made available as a design improvement. It is expected that the above actions will prevent exhaust leaks from occurring in the future. Any time complete manifold reassembly is required in the future it will be done using the above method or any method more effective if identified and recommended by the vendor.

#### **FAILURE CLASSIFICATION**

All three events described in this report have been classified as invalid failures. Although the first two events did not occur during a test associated with the formal periodic testing program, they did occur during a run designed to demonstrate EDG reliability. Therefore, it has been deemed appropriate to classify and report all three events in accordance with Regulatory Guide 1.108.

The first event involved the failure of a thermocouple in the turbocharger exhaust inlet. This temperature element provides no control functions and therefore its failure has no effect on the EDG. This event would not have affected EDG operation during an emergency and therefore does not constitute a valid failure, in accordance with Regulatory Position C.2.e(2) and C.2.e(6) of Regulatory Guide 1.108.

The second event resulted in a small amount of fuel oil leaking onto the lower portion of the diesel engine. During emergency operation of the EDG, the leak would most likely be detected fairly quickly by station operators as it was during this event. Although the EDG was shut down during this event to repair the failed pipe, it could easily be repaired while the EDG was operating, since it is a leak-off line at atmospheric pressure, with no effect on the EDG. Even if the leak had not been detected, it would not have affected operability of the EDG. The leaking fuel oil was not coming in contact or near any areas of the engine hot enough to cause ignition. After reaching the floor of the EDG room, the fuel oil would drain to a nearby floor drain that is designed to accept oily waste. Therefore, this event would not have affected EDG operation during an emergency and does not constitute a valid failure, in accordance with Regulatory Position C.2.e(6) of Regulatory Guide 1.108.



Although the third event was discovered after the successful completion of a periodic surveillance test, the failure of the pipe joints appears to have occurred during the test. The leaking exhaust gases were a concern due to the possibility that the EDG could have failed when operating under design basis conditions. For this reason, an extensive evaluation was performed to identify potential failure modes and determine their effect on the operability of the EDG. Potential failure modes investigated include the effects of the hot exhaust gases on nearby equipment, the effect higher EDG room temperatures would have on instrument and control devices and on fire protection devices and interlocks, the possibility for fouling the combustion air intake filters, the effect of reduced oxygen concentration in the combustion air, the decreased turbocharger efficiency, and the effect a seismic event would have on the degraded exhaust manifold. The evaluation of these potential failure modes concluded that none of them would have prevented the EDG from performing its design basis function. Therefore, this event does not constitute a valid failure, in accordance with Regulatory Position C.2.e(8) of Regulatory Guide 1.108.

Through May 1, 1990, there have been a total of 97 successful valid tests, four valid failures, and eleven invalid failures of EDG "B". From the time of the last valid failure on December 19, 1989, there have been 8 successful valid tests of EDG "B". These failures do not change the testing frequency of once every 31 days as required in Table 4.8-1 of Technical Specification 3.8.1.1.

#### **ADDITIONAL INFORMATION**

Planned maintenance was performed on the EDG during the refueling outage with EDG vendor representatives who were on-site throughout the maintenance period for consultations and support during these activities. It is expected that these activities provided continuing assurance that the EDG will maintain a high degree of availability and reliability in the future.