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U.S. Nuclear Regulatory Commission
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Washington, D.C. 20555

Subject: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Reporting of Special Report

Gentlemen:

Attached is Special Report Number SR-94-001-01 for Waterford Steam Electric Station Unit 3. This revision outlines the results of the investigation into the overspeed and reverse power trips of Emergency Diesel Generator "A" previously reported in revision 0 of this report. The overspeed trip was most probably caused by worn governor parts and the reverse power trip was most probably caused by an intermittent problem with the synchronizing switch. This Special Report is submitted in

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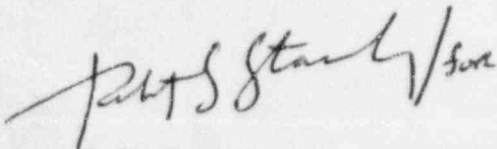
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accordance with Technical Specifications 4.8.1.1.3 and 6.9.2 and USNRC
Regulatory Guide 1.108.

Very truly yours,



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DRK/RTK/tjs
Attachment

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SPECIAL REPORT

SR-94-001-01

REPORTABLE OCCURRENCE

Emergency Diesel Generator (EDG) 'A' experienced nonvalid failures on two occasions. The first failure occurred during a nonvalid test on February 28, 1994; the second during a valid test on March 2, 1994. An additional invalid failure occurred during the troubleshooting process.

EVENT DESCRIPTION

At 1318 on February 28, 1994, Emergency Diesel Generator (EDG) 'A' was started in accordance with Operating Procedure OP-903-068, "Emergency Diesel Generator and Subgroup Relay Operability Verification", to demonstrate the operability of the diesel in accordance with Technical Specification (TS) 4.8.1.1.2. Approximately 37 minutes after reaching full load, EDG load began to oscillate between 3.8 and 4.4 MW. The EDG was subsequently unloaded, secured, and declared inoperable at 1424.

At 1605 on February 28th, operators attempted to start EDG 'A' using the mechanical governor (electronic governor disconnected) as a first step in localizing the problem. This start was unsuccessful as the EDG tripped on overspeed. A new mechanical governor was installed and tested satisfactorily. However, with the electronic governor back in service, the load oscillations were still present, indicating that any remaining fault was in the electronic and not the mechanical governor.

Subsequent troubleshooting identified faulty relay contacts associated with the electronic governor's 'droop' (test) mode of operation. After replacing the relay, EDG 'A' was started at 1237 on March 2, 1994, to verify correction of the problem and demonstrate compliance with TS 4.8.1.1.2. In the process of paralleling to the bus, the EDG tripped on reverse power.

At 1439 on March 2, 1994, EDG 'A' was restarted to perform the TS surveillance. The test was completed satisfactorily and the diesel was declared operable at 1740.

CAUSAL FACTORS

Investigation to date revealed that the load oscillations were caused by the failure of a set of relay contacts associated with the electronic governor's 'droop' mode of operation. These contacts are utilized when the EDG is paralleled to the bus for loading after an emergency mode start. They are not used during emergency ('isochronous') operation and thus would not have prevented the EDG from performing its safety function.

The mechanical governor was sent to the vendor (Cooper Bessemer) for analysis. Based on the Failure Analysis Report provided by Cooper Bessemer, it was concluded that the most probable root cause of the engine overspeed trip was worn mechanical governor parts. The wear detected was very slight. However, the sequence of events (electrical governor disconnected) which produced the overspeed trip, represents an extreme test of the capabilities of the mechanical governor actuator. Under these circumstances, the actuator must move the fuel rack from fully open to fully closed after the speed passes the hydraulic speed setting of the actuator (608 engine rpm) but before it reaches the overspeed setting (660 rpm). Based on original factory test data, this must be accomplished in 0.4 seconds or less.

An investigation has revealed that the most probable cause of the reverse power trip is an intermittent problem with the synchronizing switch. During the performance of OP-903-068, the EDG is initially started in the emergency mode of operation and later transfers to the test mode of operation when the EDG is synchronized to offsite power. The synchronizing switch is utilized to enable EDG manual speed control when the EDG is being synchronized to offsite power. If the contact blocks on this switch fail to make good electrical connections, manual speed control may not be enabled. Operations personnel may not be aware that EDG speed and frequency indications are not being supplied by the manual speed control circuitry but instead are continuing to be supplied by the emergency mode circuitry. However, the motor operated potentiometer that is used to adjust the EDG reference speed signal in the test mode can still be manipulated. If this motor operated potentiometer is left in a position that would provide a speed reference signal to the EDG that is too slow, motoring of the generator can occur when the EDG output circuit breaker is closed. This would occur because relays in the EDG speed control circuitry would cause the EDG to exit the emergency mode of operation and return to the test mode of operation which would have the effect of immediately enabling the manual speed control circuitry. The result would be an immediate reverse power trip of the EDG.

CORRECTIVE MEASURES

The mechanical governor and faulty relay were replaced.

Procedure OP-009-002 "Emergency Diesel Generator" has been revised to require Operations personnel to verify that speed control has been enabled prior to synchronizing the EDGs to offsite power. Replacement of the contact blocks on the synchronizing switch will require lifting "HOT" leads in a highly congested area. This activity is currently scheduled to

be completed during the Refuel 7 Outage. As an interim corrective measure, a Caution Tag has been placed on this switch to alert Operations Personnel as to the condition of this switch.

SAFETY SIGNIFICANCE

An engineering evaluation of EDG governor circuitry determined that the faulty relay contacts would not have affected EDG operation in the emergency mode. Similarly, the reverse power trip events would not have affected emergency mode operation because this trip is bypassed during emergency mode operation. The mechanical governor controls diesel speed during starting and functions as a backup to the electrical governor to prevent an overspeed situation if the electrical governor should fail to maximum output. The overspeed trip was caused by having the electrical governor disconnected during the troubleshooting process and slightly worn governor parts. During an emergency mode start due to degraded voltage or a loss of voltage on the 4160 volt safety bus, the demand on the mechanical governor actuator is less severe since the automatic breaker closure and load sequencing will apply immediate load to the engine. In this situation, the governor does not have to close the fuel racks for several seconds after the diesel has reached operating speed. Therefore, in the emergency mode, with the electrical governor connected, this trip would not have occurred. In addition, EDG 'B' was operable. Safety analysis assumes that a single failure disables one protection train. However, a single EDG, safety bus, and associated Engineered Safety Features equipment is adequate to protect the reactor during the worst case postulated accident. As a result, these events did not compromise the health and safety of the public or plant personnel.

In accordance with USNRC Regulatory Guide 1.108, the current surveillance test interval for EDG 'A' is 31 days. EDG 'A' was unavailable for 51.3 hours.

SIMILAR EVENTS

A similar event involving a reverse power trip is described in Special Report Number SR-94-003-00. The information available to date indicates that the synchronizing switch contact blocks were also responsible for that trip.