GULF STATES UTILITIES COMPANY

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U.S. Nuclear Regulatory Commission
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Gentlemen:

River Bend Station - Unit 1
Docket No. 50-458

Enclosed you will find an Informational Report concerning the discovery of traces of engine cooling water discovered in samples of lube oil in the Division I emergency diesel generator. GSU is submitting this report per NRC request during a telephone conversation on October 26, 1992. This conversation included GSU personnel and NRC representatives from Region IV, including the River Bend Senior Resident Inspector, Region II and NRR.

Sincerely,

W.H. Odell
Manager - Oversight
River Bend Nuclear Group

LAE/JS /FRC/DCH/KRK/kvm

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INFORMATIONAL REPORT

INTRODUCTION

On October 15, 1992, with the reactor operating at 100% power (Operational Condition 1), the Division I Emergency Diesel Generator (EDG) was intentionally removed from service to investigate traces of engine cooling water that had been found in samples of the lube oil. The plant entered a 72-hour shutdown LCO under Technical Specification 3.8.1.1, at 0811 hours on October 15, 1992.

The source of the jacket water was identified as a minute leak from the #4 cylinder head into the valve train area on top of the head. From this area, the water migrated to the engine base through the push rod access area and camshaft gallery, and then to the oil sump in the auxiliary skid. Much of the water collected in a low point drain located between the base and sump. It is from this drain that the oil samples containing the water were taken.

The decision was made to declare the diesel inoperable and replace the affected cylinder head within the time limit of the LCO which was entered into for the investigation. However, discovery of the leakage source did not constitute a valid test or failure as defined in Reg. Guide 1.108. The evaluation which reached this conclusion is given below. Since there was no test or failure, a Special Report under Technical Specification 4.8.1.1.3 is not required. GSU does consider this event to be significant, and has verbally discussed it with the NRC staff. Additional relevant information is being provided to NRC in this report.

BACKGROUND, INVESTIGATION AND EVALUATION

On October 13, 1992, the Division I EDG was started for a monthly surveillance test under STP-309-0201. After the engine had started and reached synchronous speed, the operator noticed that the differential pressure across the oil filter was higher than normal, and the lube oil manifold pressure was slightly lower than normal. The operator manually shut down the engine. As defined in Reg. Guide 1.108, this occurrence did not qualify as a valid test or failure, because the filter and manifold pressures would not have prevented the EDG from performing its safety function, had it not been shut down. The lube oil manifold pressure was 46 psi, well above the 30 psi minimum. The Alarm Response Procedure instructs the operator to switch the oil filters while the engine is running, and the EDG is designed to accommodate this action. In this case, since there was no emergency or accident in progress, the operator acted in a properly conservative manner in shutting down the engine.

While the engine was shut down, the lube oil system was switched to the redundant filter, and the EDG was restarted under the STP. Lube oil pressures in all components were normal, but the engine shut down automatically due to a malfunctioning trip valve in the non safety-related shutdown control system. This invalid failure was addressed in a Special Report dated November 10, 1992. The failure is not in any way related to the presence of water in the lube

oil. After the trip valve was replaced, a maintenance run was performed to check the control logic. Several hours later, the STT was successfully completed to verify the operability of the EDG. During these runs, no abnormal oil pressures or other engine operating parameters were observed.

A lube oil sample taken on October 13, from the drain valve between the engine base and oil sump, contained approximately 25 ml of water. A second sample was immediately taken at the same location, and no water was found. A subsequent analysis of the water revealed traces of the corrosion inhibitor used in the jacket water, isolating jacket water as the source. On October 14, another set of multiple oil samples was taken from the drain valve, with 25 ml of water found in the first, and none in the second. Twelve hours later, another drain valve sample found no water. Additional samples were also taken at various places around the engine, including all the oil filter drains and the oil cooler drain, and no water was found. Samples were pipetted from the bottom of the skid-mounted oil sump, and later from the engine base. A trace of water was found in the sump. These samples isolated the source of the jacket water intrusion to the engine, eliminating a tube leak in the oil cooler.

Enterprise Engine Services of Cooper Industries, the EDG manufacturer, was consulted to evaluate the effect of a minor jacket water intrusion on the operation of the engine. Enterprise engineers and field service representatives stated that, considering the 700 gallon volume of the lube oil system, this trace amount of water was much too small to potentially cause a problem with the engine bearings or other sliding surfaces. It was noted that all oil samples taken downstream of the main filters, in the engine supply lines, were within specifications. They also stated that during an extended run, any additional water intrusion, if it occurred, would tend to vaporize due to the elevated temperatures inside the engine. The vapor would be eliminated through the sump and crankcase vents to the atmosphere. Based on this, Enterprise stated that the engine would have run for 30 days if necessary, without deleterious effects.

GSU and Enterprise agreed that the possible engine-related sources of the jacket water intrusion were a leaking head or cylinder liner below the ring travel area, or leaking lower liner seals. Neither a cracked cylinder head fire face nor a liner leaking water above the ring travel area could have been the source, as numerous evolutions of barring over and air-rolling this engine had shown that no liquid was present in any cylinder.

A maintenance work package was initiated and planned to determine the source of the moisture in the crankcase, and the engine was taken out of service as described above. The crankcase access covers and valve covers were removed to check for leaks at accessible locations. No water was found in oil samples from the engine base. Some condensed water vapor was found under each valve cover, over the access passage to the camshaft gallery, as if condensation had risen from below. On the #4 valve cover, however, condensed water was found all over the underside, indicating that a top end leak on this cylinder could be the source.

To expedite the investigation, the jacket water system vent was closed, and a regulated compressed air supply connected. The jacket water system was pressurized to approximately

24 psi. (Note: Operating pressures are about 16 psi at the water pump and just above atmospheric in the cylinder heads. Factory pressure tests were at 40 psi for the exhaust shroud; 100 psi for the block, 125 psi for the heads, 225 psi for the ASME III components, etc. Twenty-four psi was therefore safe.) A visual inspection inside the crankcase found no water leaking past the liner seals, and no water seeping from between the liners and piston skirts. This eliminated a leaking liner lower seal as the source of the jacket water intrusion, isolating it to the top end of the engine. Inspections of the top end revealed a very small leak on the #4 cylinder head. The water was seeping around the threads of one of the bolts which secure the cylinder head subcover to the head. The apparent source of the water was a leak from the water passage in the cylinder head into the tapped hole for the subcover bolt. The installed bolt appeared to provide some restriction to flow of the leaking water.

The remaining seven cylinder heads were carefully inspected before the pressure was reduced, and no other leaks were found. As the pressure was decreased, the leak rate diminished significantly. When the vent was opened and the system returned to its standby condition pressure, which is about 24" water gauge at the heads, the leak was barely discernable.

TEST/FAILURE DETERMINATION, REG. GUIDE 1.108

Reg. Guide 1.108 was consulted to determine whether water leakage from this part of the engine could have constituted a test or failure. Regulatory Position C.2.e.(8) states: "Cranking or venting procedures that lead to the discovery of conditions (e.g., excessive water or oil in a cylinder) that would have resulted in the failure of the diesel generator unit during test or during response to a bona fide signal should be considered a valid test and failure." Although the source of the jacket water leak had not been discovered during cranking or venting, and there was certainly no water or oil in any cylinder, an unusual "condition" had been discovered; therefore, the evaluation was needed.

The focus of the evaluation first addressed whether the EDG would have started, loaded, and completed an extended run of 30 days at the time the source of the leak was discovered. As explained above, the EDG would have successfully started and run, carrying out its safety-related mission, as the traces of water leaking in would tend to vaporize rather than accumulate over time. The actual amount of water intrusion during operation would have been little more than at standby condition, owing to the restriction created by the installed subcover bolt. The pressure test described above had verified this.

Also evaluated was a continual slow (approximately 25 ml/day) leak of jacket water into the lube oil under standby conditions, when the engine is not running and the internal temperatures are somewhat cooler. In this case, the jacket water would be more likely to accumulate in the sump than vaporize. It could be postulated that if the water accumulated unnoticed for 30 days, which is the time between scheduled surveillances and oil samples, and the EDG auto-started from a bona fide signal, that the filter would be restricted to the point of starving the engine for oil, damaging it and preventing it from carrying out its mission. This would seem to suggest a valid

test and failure under C.2.e.(8), but the October 13 engine runs invalidate this postulation.

With the engine running, stresses are placed on the cylinder head which could cause some latent defect or anomaly to open up a leakage path. With the engine shut down and cooled to standby temperatures, there are no operating or thermal transient stresses on the cylinder heads at all. Therefore, the leak in question must have started during or immediately after the previous surveillance run, and the water actually did accumulate for the 30 days between the surveillances. During the first October 13 run, differential pressure across the filter was above normal, indicating that a small amount of water present in the sump had been trapped in the filter. The oil manifold pressure, however, was well above the minimum safe limit. Once the oil filters were switched, however, the differential and manifold pressures showed no variation from normal, despite two hours run time and several hours at standby conditions. This verified that the amount of water intrusion during operation is negligible, as was stated by the Enterprise engineers.

The sump is the low point in the oil system, and any accumulated water would be there and picked up during the initial start and sent to the filter, where all or most of it would be trapped. The only additional water to enter the oil would have to come from the leak itself, and this would be negligible as described above. Most or all of this would vaporize when the engine heated up. The first October 13 engine run actually demonstrated that the EDG would have responded to a bona fide signal and run without failure, because it took place under conditions identical to the worst-case postulation of 30 days unnoticed water accumulation since the previous surveillance.

The Failure Modes and Effects Analysis in the USAR specifies the period for which no operator action is assumed as the first 20 minutes into the accident scenario. After this, an operator would be present to switch the oil filters, should he deem it necessary. Credit for this need not be taken, however. Based on the pressure conditions observed during the October 13 runs, the lack of water downstream of the filter, and the fact that accumulated water must be in the sump and discharged while starting, restriction across the oil filter would not continue to increase during extended operation. Consequently, the manifold pressure would continue to remain well within safe limits. This supports the conclusion that the EDG would have run safely for a full 30 days if needed, without the need for operator action.

INITIAL CORRECTIVE ACTION

Although this condition has been found not to be a valid test or failure, or to pose a significant safety hazard, this had not been determined for certain at the time the source of the water leak was found. GSU therefore decided to declare the EDG inoperable and replace the leaking cylinder head. This conservative approach eliminated any question of the equipment being "operable but degraded" and kept at maximum its overall long-term reliability. Under Condition Report 92-0842 and an associated maintenance work order, the head was replaced, the oil was changed, and the engine base and sump were cleaned out. The EDG was then run

at 75 to 100 percent load for approximately 10 hours, stopping periodically for the required hot retorques to seat the copper gaskets under the air start valve and fuel injector. Surveillance procedure STP-309-0201 was then completed successfully to verify operability. The EDG was made available for service at about 2040 hours on October 17, and declared operable shortly thereafter.

Subsequent oil samples have detected no jacket water present.

CAUSE OF THE CONDITION

Although the source of the leak was positively identified, its root cause has not been determined as of the date of this report. The affected head has been shipped to the Cooper Industries manufacturing facility in Grove City, PA, where it awaits the arrival of GSU Engineering to witness and take part in a detailed root cause evaluation. The evaluation is scheduled to begin on November 17, 1992. The start date was delayed to allow time to retain the services of an independent failure analysis consultant, who will also witness and participate in the evaluation. GSU, however, retains the final authority in determining the root cause of the water leak.

Preliminary water tests performed at Cooper Industries found that the cylinder head leaked when pressurized with cool water, but did not leak when pressurized with hot (180°F) water. Pressure used was about 100 psi. This suggests a leak path which closes up when the engine is running and the jacket water is hot. Investigations will continue during the root cause analysis.

REPORTABILITY AND LONG-TERM CORRECTIVE ACTION

The initial corrective action taken at River Bend was to replace the leaking cylinder head, restoring the EDG to its most reliable condition. This has been completed. Also, until the root cause is determined, GSU has increased the frequency for lube oil sampling from monthly to weekly. Based on the overall history of Enterprise Group III heads, and the lack of any similar previous problems at River Bend, this condition is seen as an isolated occurrence. Replacing the affected River Bend head with another Group III head should therefore pose no question as to the reliability of this EDG.

The information gathered to date suggests that this condition is not reportable under 10CFR21. The results of the upcoming failure analysis, however, will be used in performing a final assessment concerning 10CFR21 reportability, and determining the need for additional corrective action. The experience of other nuclear utilities will also be part of the evaluation, hence, the TDI Diesel Owners' Group will be involved, as well as the engine manufacturer.