SNUPPS

DIESEL GENERATOR
ROCKER ARM LUBE OIL
TEMPERATURE TEST REPORT

SER Confirmatory Item 26
for Callaway and Item B.26 for Wolf Creek

February, 1984

I. PURPOSE

This report provides the results of testing performed on a diesel generator at Callaway to allow the NRC to close SER confirmatory Item 26 for Callaway and Item B.26 for Wolf Creek. This item required that the performance of the diesel generator rocker arm lube oil system (RALOS) temperature be monitored to ensure that it remains below the engine manufacturer's recommended limit. This requirement was imposed because the RALOS does not include a heat exchanger to remove the heat gained while lubricating the rocker arms. The heat is lost to the surrounding atmosphere from the externally located piping and storage tank.

II. BACKGROUND

During the NRC review of the diesel generator auxiliary systems, the absence of a RALOS heat exchanger was questioned. It was noted that this subsystem is designed to be completely independent of the main lube oil system to preclude contamination of the main lube oil system with water and/or fuel. The NRC was advised that this was a standard design for the Colt-Pielstick engine and that past operating experience has not indicated any design inadequacies with respect to the ability to maintain the rocker arm lube oil temperature within the specified 165 F limit.

Since this issue was raised as a generic concern and the diesel generators, the rooms, the ventilation systems and the environmental conditions are the same, it was determined to be necessary to test only one diesel generator's RALOS. The 2 diesel generators at both sites are identical and the RALOS is completely contained on the skid. Heat rejected to the room will be the same for each diesel's RALOS, which have identical routings and components.

The RALOS piping is located external to the diesel engine block. The supply and return lines to each cylinder bank is located below the combustion air inlet manifold on the side of the engine. Air is free to flow over the common lines and the individual supply and return lines provided to each cylinder from the common headers. There are no significant heat sources in the vicinity of these lines. The exhaust manifold is located between the two banks of cylinders above the engine centerline and it is insulated.

The common supply and return headers from each cylinder bank are combined in the vicinity of the RALOS storage tank and pump, which are located on the north end of the engine skid. No significant heat sources are located near these components and lines.

Each diesel generator is located in a separate room having essentially the same dimensions and layouts. The diesel generator rooms are part of the SNUPPS power block design and are the same for both sites. The room layouts are shown on FSAR Figures 1.2-24, through 1.2-28.

As described in FSAR Section 9.4.7, each diesel generator room is provided with the same ventilation system, which maintains room ambient conditions

below the 122 F upper limit during summer operation. During winter operation, a minimum amount of outside air is brought into the room to provide combustion air for the diesel. The minimum winter room temperature during operation will be 60 F. The ventilation system hardware and controls are designed to maintain these conditions at both Callaway and Wolf Creek.

There are no known parameters which would require more than one diesel's RALOS temperatures to be monitored.

III. DESCRIPTION OF TEST CONDITIONS AND RECORDED DATA

In order to assure that the testing would provide sufficient information to allow the SER item to be closed by the NRC, special test provisions and data collection requirements were specified.

The RALOS test was specified to be conducted during a full load run in concert with the preoperational test program and ensured adequate time for stabilization at the continuous load rating of the engine. To ensure that the room temperature was sufficiently high to provide meaningful results, a minimum room temperature of 100 F was specified. The recirculation damper position temperature controller was to be reset to ensure only the minimum amount of outside air was allowed to enter the room. This was required because of preoperational testing during the winter conditions. The temperature controller was reset to 122 F and was fully operational to ensure that the maximum design room temperature was not exceeded during the test.

The ventilation fan was to be placed in the manual (on position) to ensure its continued operation and circulation of air to enhance uniform temperatures within the room.

Throughout the test period at full load operation, 3 room temperatures were to be recorded. Room temperatures were specified to be taken at the inlet to the room recirculation air system, near the diesel generator and at another location not directly in the air flow path or near significant heat sources.

The RALOS temperatures were specified to be taken at four locations and were to be recorded. The common return lines from each of the 2 cylinder banks were to be monitored as were the inlet and outlet lines from the RALOS storage tank.

Test data was taken for a 22 hour period during the full load preoperational test conducted on Callaway's diesel generator A. The conditions and prerequisites stated above were met and the data taken was evaluated for acceptability.

IV. RESULTS AND SUMMARY

The test data indicates that the RALOS temperatures stabilized as predicted and were well below the engine manufacturers limit of 165 F. The data also indicates that the RALOS fluid is progressively cooled by the room air as it returns to the storage tank and while in the tank.

The 22 hours of data is summarized as follows:

Room temperatures near the diesel averaged near 110 ±2 F throughout the test period (artificially raised by means stated above). The remote room temperature (away from heat sources and active ventilation flow paths) averaged 104 ±2 F throughout the test. These temperatures are sufficiently close to the 122 F summer limit to allow extrapolation of data to predict the response to the design summer conditions.

The fluid returned from the RALOS entering and leaving the storage tank averaged 134 ±2 F and 132 ±2 F, respectively. The fluid leaving the tank was consistently 2 F cooler than the inlet.

The RALOS common return line data (from each cylinder bank) also correlates well with the RALOS storage tank and room conditions. The return line from the east cylinder bank was slightly warmer than the common return line. The return line from the west cylinder bank was cooler than the east cylinder bank return since it was actively cooled by the overhead discharge of recirculation air.

Extrapolation of data to the summer conditions is accomplished by conservatively assuming a 1F rise in RALOS temperature for each 1F rise in ambient room temperature. This assumption is conservative because the heat input to the lube oil will be less when the lube oil is warmer (lower temperature difference) and slightly greater heat transfer from the lines at higher temperatures due to increased radiant and convective heat transfer. Since the room temperature near the diesel averaged 110 F (12 F below the summer design case) the RALOS fluid temperature leaving the storage tank is predicted to increase from 132 F to approximately 144 F when the air next to the diesel is 122 F. If this methodology were applied while using the cooler room temperature (remote from heat sources) of 104 F, the RALOS fluid temperature leaving the storage tank would only be 150 F. Both of these temperatures are well below the 165 F recommended limit.

In summary, the data taken during the 22 hour full load test fully supports the adequacy of the RALOS design for both summer and winter operation of the diesel generators at both the Callaway and Wolf Creek sites.