TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

December 14, 1982

Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Ms. Adensam:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

By your letter to H. G. Parris dated April 19, 1982, TVA was requested to provide additional information concerning the Watts Bar Nuclear Plant diesel generators. Enclosure 1 is TVA's responses to NRC questions 40.127 and 40.128 which address these issues.

Also enclosed (Enclosure 2) is information to resolve open item 14 of the Safety Evaluation Report (SER) including operation of diesel generators without secondary coolant and location of the expansion tank.

If you have any questions concerning this matter, please get in touch with D. P. Ormsby at FTS 858-2682.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills

L. M. Mills, Manager
Nuclear Licensing

Sworn to and subscribed before me
this 14th day of December 1982
Paulette H. White
Notary Public
My Commission Expires 9-5-84

B001

Enclosures
cc: U.S. Nuclear Regulatory Commission
Region II
Attn: Mr. James P. O'Reilly, Regional Administrator
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

ENCLOSURE 1
WATTS BAR NUCLEAR PLANT UNITS 1 AND 2
RESPONSES TO NRC QUESTIONS

Question 40.127

Background

1. From the test data and information supplied in the December 9, 1981, letter from EMD-GM, the staff has been able to determine the following:

   a. With a minimum ambient temperature of 66°F, the jacket cooling water temperature is approximately 86°F.

   b. The lube oil cooling water circuit temperature ranges from 114°-154°F.

   c. The heat exchanger/radiator cooling water is at room ambient temperature.

   d. The temperatures associated with the cooling water system for a and c above will vary depending on the room ambient temperature.

   e. The purpose as stated by EMD-GM tests ". . . was not to verify that engine water was heated, but rather to ensure that the engine water would not be overheated." The test showed that "The 155°/125° immersion heater temperature switch setting provides adequate oil and water temperature levels without heating engine to a level where cylinder walls would be 'dried-out' or seals would be adversely affected."

   f. EMD-GM relies on natural circulation (thermo-syphon action) to circulate water within the lube oil heating portion of the system.

2. The diesel generator rooms in many plants are designed for a minimum room temperature of 40°F and a maximum of 125°F in the standby condition. In addition, since the heaters in the ventilation system are of nonseismic design, it is assumed that the heaters fail following a seismic event. In this case, the room temperature could drop to outside ambient temperature, which could be subfreezing (between 0°-32°F). Applicants have stated that no guidance has been given to them by the manufacturer or his supplier concerning room environmental conditions.

3. Other diesel engine manufacturers maintain the diesel engine cooling water system in a temperature range of 120°-140°F and provide for the continuous circulation of the water by keep-warm circulating pumps. To date no licensee event reports (LERs) have been received on failures of engines to start as a result of dried-out cylider walls or seal failure due to maintaining diesel engine cooling water in the temperature range of 120°-140°F.

4. NRC requirements - Standard Review Plan 9.5.5, "Emergency Diesel Engine Cooling Water System" Section III.1.e states that, "The engine 'first try' starting reliability has been increased by providing an independent loop for circulating heated water while the engine is in the standby mode."

B. The staff requests TVA to provide the following additional information with regards to the following areas of concern:

1. Does the manufacturer or supplier/assembler provide design guidance to ensure that the engines are installed in the proper environmental conditions for optimum starting and operating reliability? Please provide the environmental temperature ranges - maximum and minimum ambient temperatures - permitted by the design of the engines to ensure optimum first try starting reliability.

2. If the purpose of the manufacturer's tests were to show that the water was not overheated, but maintained at an adequate temperture level so that the cylinder walls would not be dried out or the seals affected, the data obtained by the NRC did not verify this for all conditions. It only verified this for standard conditions; i.e., 66°F. A D/G room at a nuclear plant on a summer day could see a room ambient termperature of 100°F or more. The cooling water in the engine block could be over 120°F, but not more than 155°F. Discuss the effect this environmental condition has on starting the engine, such as ease of starting versus the lower environmental condition stated in the EMD-GM report and the effects of cylinder dry-out or seal degradation if it could occur at these conditions over an extended period of time (greater than one week). In the event cylinder dry-out or seal degradation could occur at these conditions, has the manufacturer or supplier/assembler provided design guidance, preventive maintenance, or operator actions that should be taken to alleviate the situation? If so, discuss this guidance.

3. Since the engine will see a wide range of ambient environmental conditions (0°F through 100°F+), in order to assure the NRC that first try starting reliability will not be degraded, state whether or not there is a difference in the ease of starting the diesel engine over the ambient temperature range stated. In addition, we need to know how the engine is affected over the entire temperature range (i.e., engine clearances, loading capability, water temperatures, etc.), but in particular, the lower temperature range (less than 66°F ambient).

Response

B.1 - The WBN diesel generators were furnished by Power Systems - a Morrison-Knudsen Divison to function in the specified temperature range of 40°-110°F. The diesel generators were provided with a heating system to maintain optimum starting reliability over this temperature range.

B.2 - Even with an ambient diesel generator building (DGB) temperature of 110°F, the jacket water temperature during standby will not exceed 155°F at the temperature switch which controls the heater. Since this heat is transferred into the engine by the heated oil and convection currents through the jacket water system, the temperature of the water within the engine will be between 110°-155°F. This range is below the 175°F normal jacket water temperature during engine operation. Since the jacket water system within the engine is filled during standby, the probability of the adverse effects mentioned is less during standby than during operation. The GM-EMD E645-E4 engine has proven its reliability for continuous running in many other applications. Based on supplier information and our experience with these engines, there is no appreciable difference in the ease of starting the engines from standby temperatures or from operating temperatures.

B.3 - The present jacket water system is equipped with a 15 kW heater capable of furnishing more than 850 Btu/min to the jacket water system. In addition, each engine is equipped with a low standby jacket water alarm which will annunciate should the standby jacket water temperature fall below the supplier's recommended value. This method provides notification of an improper temperature condition, for each diesel generator unit, in sufficient time to perform corrective action.

Question 40.128

Diesel Engine Lubricating Oil System

A. Background - From information supplied to date, the NRC has been able to determine that:

1. Maintenance instruction M.I. 9644 provides a fix for an Inspection and Enforcement Bulletin issued in 1979 on turbocharger lubrication on restart. It also partially alleviates the NRC-NUREG/CR-0660 concern on dry starting of the engine. The modification proposed lubricates the lower portion of the engine (crankshaft, bearings, etc.) but not the upper portions (rocker arm assembly, camshaft, etc.). The reason given for not lubricating upper portions on a continuous basis was that hydraulic oil lock could occur in the cylinders.

2. The manufacturer recommends a 3 to 5 minute prelubrication prior to starting the diesel only if it has not been run in the preceeding 48 hours.

3. The manufacturer states in M.I. 9644 that "Wear is minimized if lube oil is supplied to engine and turbocharger bearings prior to and during high speed emergency starts."

B. We request you provide us with additional information with regards to the following areas of concern:

1. Diagrams and drawings in the maintenance manuals show the main bearing pump lube oil system providing lubrication to the camshaft rocker arm assembly and other upper engine wearing parts except the cylinders and pistons. The M.I. 9644 mods provide a continuous "Trickle" flow to the main bearing pump system. Indicate whether this trickle flow is sufficient to provide lubrication to the upper engine parts and the means used to prevent the oil from lubricating these parts during standby conditions. Also, provide a description with the appropriate diagrams of the lubrication system in the engine.

2. Several applicants have proposed to provide manual or automatic intermittent prelubrication for the entire engine. This lubrication would be for a few minute (less than 10 minutes) a day or a week. Does TVA propose to provide this prelubrication? If not, does TVA or the manufacturers have any problems with this proposal in light of the manufacturer's prelube recommendation? If so, discuss the objections.

3. (a) If TVA proposes to modify the engines using that proposed in EMD-GM's M.I. 9644, show how this modification will not cause undue wear to the failure to start over the lifetime of the plant for both emergency and periodic test starts. In your response, consider the NRC's concerns on dry starting and the manufacturer's concern on undue wear on high speed emergency engine starting.

(b) If TVA does not propose to provide the modifications of 3(a), state how TVA will prevent undue wear to the upper engine parts, degradation of engine reliability, or diesel engine failure to start considering the conditions stated in 3(a).

Response

B.1 During standby, a trickle flow of lubrication oil is furnished by a motor-driven pump with a capacity of 6 gpm. This 6 gpm is sufficient to maintain an oil film on the intended parts with the lessened drain-down due to the venting scheme employed by M. I. 9644. As requested, the lubricating oil system description is provided below.

LUBRICATING OIL SYSTEM

The engine lubricating oil system is a combination of four (4) separate systems for installation with turbocharged engines. FSAR Fig. 40.128-1 is a pictorial diagram illustrating the interaction between the cooling system and the lube oil system on a typical turbocharged engine. However, for a detailed schematic of the lube oil system supplied on these engines, refer FSAR Fig. 40.128-2.

The four systems are the main lubricating system, piston cooling system, scavenging oil system, and the motor driven circulating pump and soakback pump system. Each system has its own pump. The main lubricating oil pump and piston cooling oil pump, although individual pumps, are both contained in one housing and driven from a common shaft. The main lubricating, piston cooling, and scavenging oil pumps are driven from the accessory gear train at the front of the engine. The auxiliary system for turbocharged, fast-start engines has a circulating oil pump and a soakback oil pump driven from a common electric motor mounted on the side of the engine base.

The main lubricating oil system supplies oil under pressure to the various moving parts of the engine. The piston cooling system supplies oil for piston cooling and lubrication of the piston pin bearing surface. The scavenging oil system supplies the other systems with cooled, filtered oil.

In the operation of these system, oil is drawn from the engine sump by the scavenging oil pump through a strainer in the strainer housing. From the strainer, the oil is pumped through the lube oil filter and the lube oil cooler. The cooler absorbs heat from the lube oil to maintain proper operating temperature. The oil then flows to the strainer housing to supply the main lubricating and piston cooling pumps. After being pumped through the engine, the oil returns to the engine sump to be recirculated through the system.

In order to be capable of automatic fast starting, the engine has an auxiliary lube oil system driven by an electric motor. The motor drives two pumps, one on either side, and each pump has a seperate function. A 3 gpm soakback pump draws oil from the engine sump and pumps it through the accessory rack mounted auxiliary turbo lube oil filter and through the head of the engine mounted turbocharger oil filter into the turbocharger bearing area. The auxiliary turbocharger oil filter purifies the oil supplied to the turbocharger by the soakback pump. A relief valve allows oil to be bypassed to the circulating pump system when the outlet pressure exceeds 75 psi.

The soakback system has a two-fold job. It prelubes the turbocharger bearing area so that the bearing will be fully lubricated when the engine receives an automatic start signal requiring rated speed and application of rated load within a matter of seconds. It also removes residual heat from the turbocharger bearing area upon shutdown of the engine.

The 6 gpm circulating oil pump circulates warm oil through the oil system and keeps the engine in a constant state of readiness for an immediate start.

The immersion heater heats the engine cooling water which circulates through the lube oil cooler. As the oil is circulated through the lube oil cooler (operating as a heater at this time) it is warmed.

The lube oil circulating pump draws oil from the oil pan and pumps it through a 30 psi check valve, in-line wye strainer, main lube oil filter, lube oil cooler, and is returned to the oil pan through the strainer housing. This system also serves to continously prelube the engine, the main engine oil galley stays full and the camshaft area is supplied through a separate exterior line. The pump operates continously.

B.2 The flow provided by the soakback system constitutes a constant prelubrication of the engine and therefore we propose no intermittent prelubrication. Our supplier, Power System - a Morrison-Knudsen Division, concurs with this proposal.

B.3 We are in the process of modifying the WBN engines per EMD-GM's M. I. 9644 and will have it completed prior to Unit 1 fuel loading. As previously stated, these modifications are designed to reduce lubricating oil system drain-down during standby. By continously furnishing a small quantity of oil and thereby keeping the system full, an oil film would be maintained on the moving parts without causing leakage into the cylinder or into the exhaust system by introducing oil above the cylinders or due to excessive oil pressure during standby. Leakage into the cylinders could cause a hydraulic lock upon receipt of a start signal whereas leakage into the exhaust system could result in fires as outlined in NUREG/CR-0660, "Enhancement on On-Site Emergency Diesel Generator Reliability."

In addition, we have started the Browns Ferry units over 400 times and had no lubrication-related failures of the upper engine parts nor have we noticed any undue wear of these parts. Based on this experience, and the M.I.9644 system improvements to be made on the Watts Bar DGUs, we believe that the chance of lubrication-related failure or excessive wear of the upper engine parts are minimal. Also, based on information received from our supplier regarding other engines which retained an oil film on the upper engine parts during long storage periods, these parts tend to retain the oil film for a period greatly exceeding our standby intervals.

ENCLOSURE 2

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2

RESPONSE TO SER OPEN ITEM 14 - SECTIONS 9.5.5 AND 9.5.7

Question 1

The time period the diesel generator (DG) is capable of operating fully loaded without secondary cooling has not been addressed. Sufficient water is needed in the engine and expansion tank to absorb the heat generated during this period. The time period the diesel generator can operate fully loaded without secondary cooling should be in excess of the time needed to restore essential raw cooling water to the diesels in the event of a loss of offsite power.

Response 1

Jacket water temperature during standby will be 155°F or less. The high jacket water temperature alarm setpoint is 195°F with shutdown at 205°F. Based on supplier test data, the normal operating temperature for the DG jacket water is 175°F, with a rate of rise of 16°F per minute. Thus, the limiting condition would occur when a DG that has just been shutdown from operating temperature is required to start. Under these conditions, the DG could operate for 1.875 minutes without any cooling water whatever. Starts from standby conditions result in a substantially longer capability for the DG to operate without secondary cooling.

In the event of a loss of offsite power, it takes 10 seconds to start the diesel generator units (DGUs) and the ERCW pumps are loaded on the diesels 15 seconds after that. Therefore, 25 seconds after a loss of offsite power, the ERCW pumps are supplied power and the required ERCW flow is restored in ample time to prevent adverse effects on the DGs (i.e., ERCW flow is restored in much less than 1.875 minutes).

Question 2

The expansion tank is not located at the highest point in the system; thus, there is the possibility of the system to become air bound with potential damage from waterhammer. This has been addressed by the applicant, but the response is unacceptable.

Response 2

The span above the jacket water expansion tank is approximately 8 feet of 4-inch pipe. This pipe will contain less than one cubic foot of air during standby. The 3/4-inch vent from this span into the expansion tank vents this air upon startup. This line is slowly filled by an engine-driven pump which will not reach full speed until the engine does. Additionally, another 3/4-inch vent is installed from the lube oil cooler to the expansion tank. This venting scheme is adequate to vent the air prior to causing any deleterious effects.

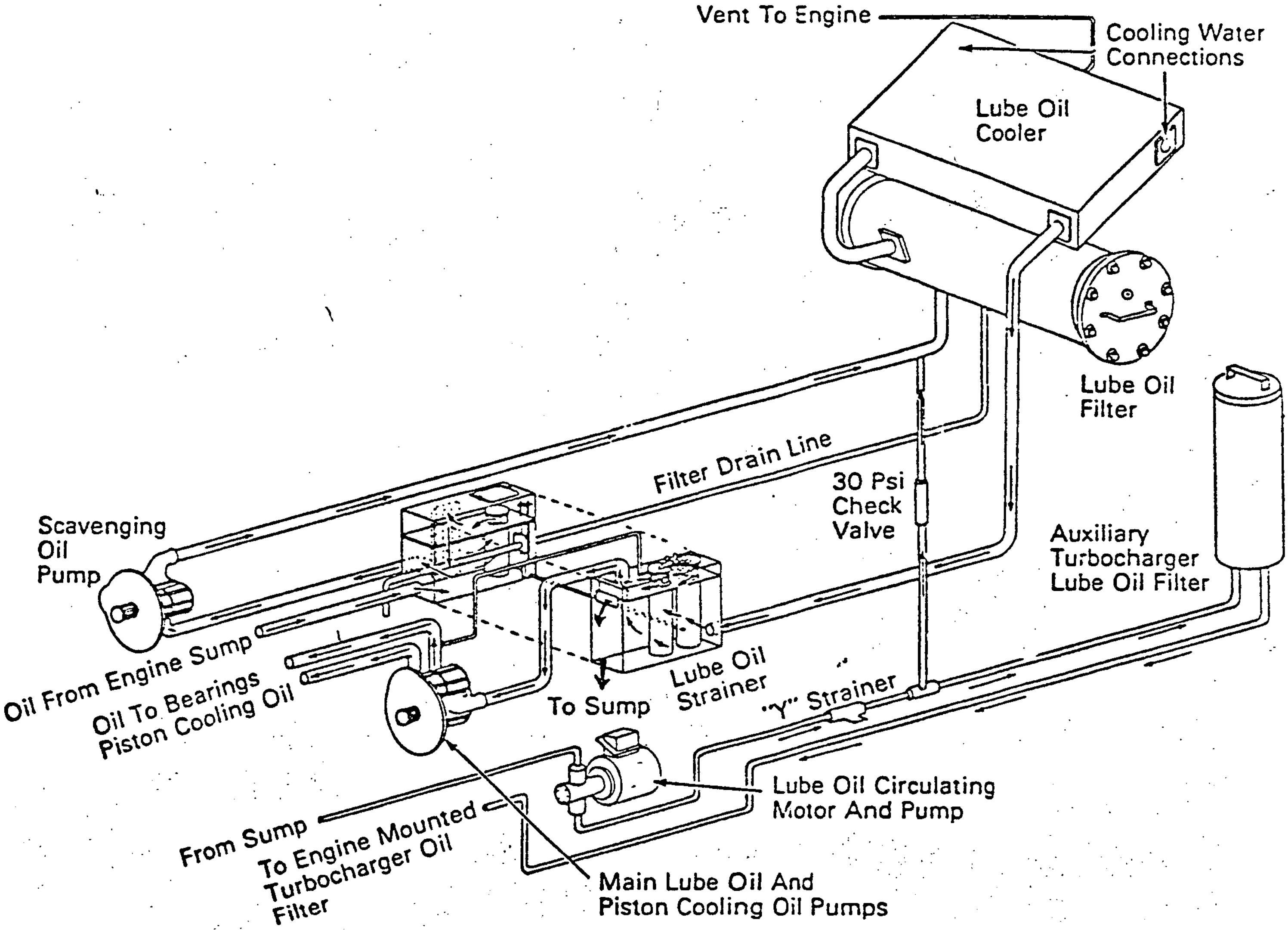
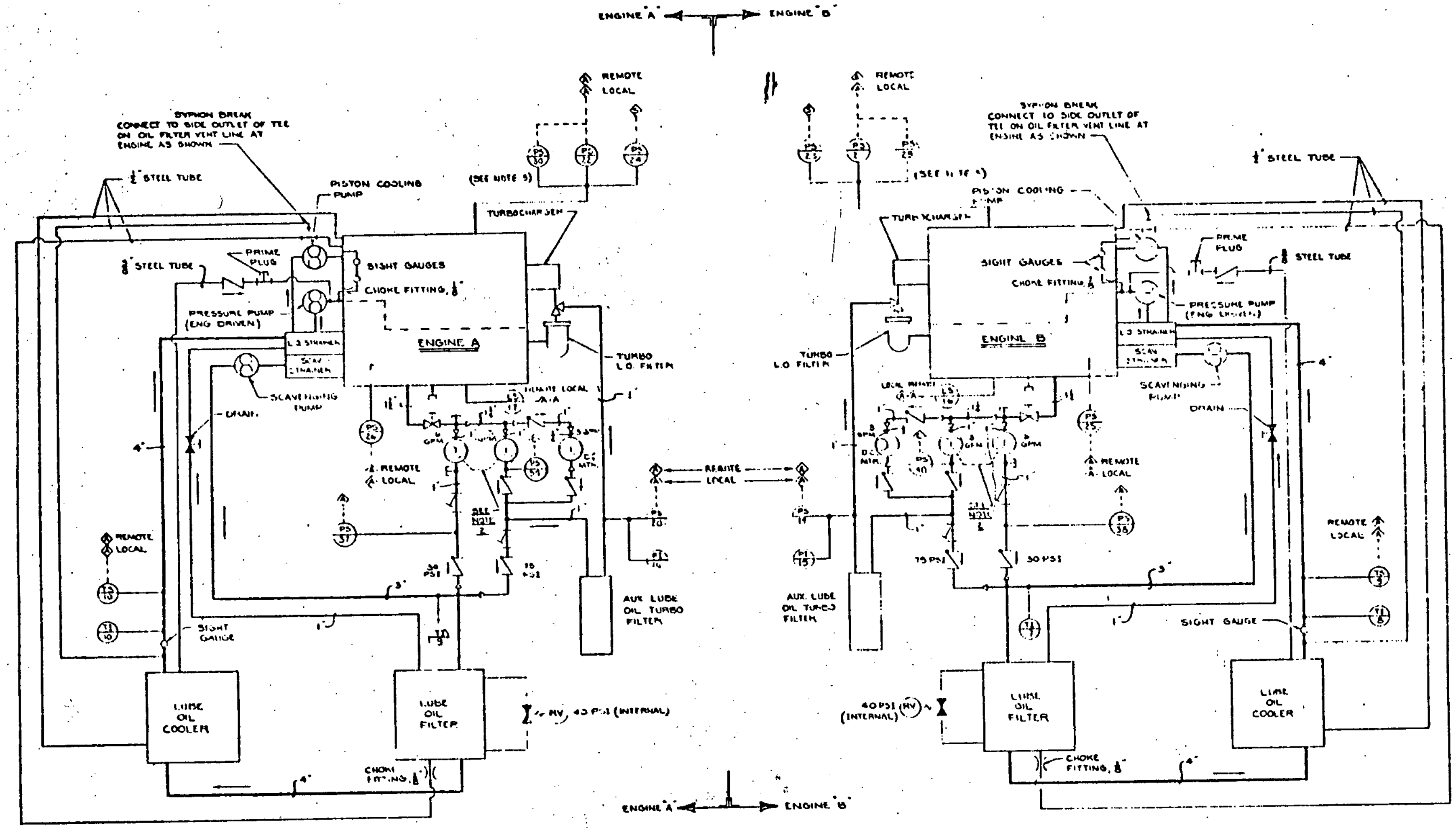


FIG 40.128-1
Lube Oil Circulating Pump Connection



TI - 7, 8, 9, 10 - TEMP. GAUGE 300°F
PS - 19, 20 - TURBO SOAKBACK OIL PRESS. ALARM - 6 PSI (TPS)
PS - 21, 22 - LOW ENGINE PRESS. ALARM - 40 PSI (LLOPS)
PS - 23, 24 - LOW ENGINE PRESS. SHUTDOWN - 20 PSI (LOPS)
PS - 25, 26 - HIGH CRANKCASE PRESS. ALARM - 1" H_2O (CPS)
LS - 16, 17 - LOW CRANKCASE OIL LEVEL (LLSL)
PI - 15, 16 - PRESSURE GA. 0 - 100 PSI
PS - 29, 30 - LOW ENGINE PRESS IDLE - 25 PSI (LOPI)
TS - 9, 10 - LOW LUBE OIL TEMPERATURE - 65°F (LTS)
PS - 31, 38 - CIRCULATING OIL PRESS. ALARM - 15 PSI (COP)
PS - 39, 40 - D.C. TURBO SOAKBACK PUMP CONTROL - 10 PSI (SPC)

LEGEND

- ALARM CONTACT (LOCAL)
- ALARM CONTACT (REMOTE)
- VALVE NORMALLY CLOSED
- CHECK VALVE
- (RV) RELIEF VALVE
- STRAINER
- SHUT DOWN CONTACT

NOTE:

1. FOR FILLING OF LUBE OIL SYSTEM, REFER TO MANUAL SECTION E.
2. 5 GPM & 6 GPM PUMPS ARE DRIVEN BY COMMON MOTOR.
3. THESE PRESSURE SWITCHES ARE CONNECTED TO MONITOR PRESSURE OF THE OIL FEED LINE TO THE CAMSHAFT - LINE ENTERS ENGINE AT FRONT RIGHT BANK, TOP DECK FRAME.

Figure 40.128-2

LIST OF MATERIAL OR PARTS LIST

CONTRACT NO.	74C63 - 83091 TWO 6036 - TVA SEQUOYAH / WATTS BAR
	POWER SYSTEMS
TITLE	SCHEMATIC DIAGRAM LUBE OIL SYSTEM
SIZE	F
	6E148
	6036F03001
	A