TVA

Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

John H. Garrity
Vice President, Watts Bar Nuclear Plant

SEP 24 1991

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

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

WATTS BAR NUCLEAR PLANT (WBN) - ADDITIONAL DIESEL GENERATOR (TAC NO. 63606)

This letter provides TVA's response to NRC's request for additional information (RAI) dated July 28, 1986, concerning WBN's emergency diesel generator systems, the additional diesel generator system, and the buildings associated with these systems. The RAI included 18 questions for TVA to answer. Furthermore, one of these questions (Question 040.129) identified another 50 previously answered questions that might require updated responses to address any differences or unique aspects of the additional diesel generator and its building in comparison to the other diesel generators and their buildings. The RAI requested a response in a timeframe consistent with WBN's fuel load date.

Our response to each of the 18 questions in the RAI is attached as Enclosure 1. Enclosure 2 contains revised responses, where needed, to the 50 previously answered questions that are identified in Question 040.129. Enclosure 3 is a list of commitments resulting from the responses in Enclosure 1.

Please note that the responses to previously answered questions are not routinely updated as we are now doing in Enclosure 2. Since the RAI specifically requested updated responses for this group of questions, we are providing appropriate updates. However, in the future, we do not plan to update question responses unless an associated issue is under active review by your staff and we are requested to provide current information. TVA considers the licensing basis for the plant to be the Final Safety Analysis Report (FSAR) itself. As such, the FSAR is the only document that will be maintained current. To avoid confusion regarding the use and status of FSAR questions and their associated responses, TVA plans to include instructions in a future FSAR amendment to delete the questions and responses from the FSAR.

A001 1/1

SEP 24 1991

If you have any questions, please telephone G. L. Pannell at (615) 365-1550.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

JHGarrity

John H. Garrity

Enclosures
cc (Enclosures):

NRC Resident Inspector
Watts Bar Nuclear Plant
P.O. Box 700
Spring City, Tennessee 37381

Mr. P. S. Tam, Senior Project Manager
U.S. Nuclear Regulatory Commission
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852

Mr. B. A. Wilson, Chief, Project Chief
U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

50-390 TVA WATTS BAR

ADDITIONAL DIESEL GENERATOR

REC'D W/LTR DTD 09/24/91....9110010034

ENCLOSURE 1

ENCLOSURE 1

REQUEST FOR ADDITIONAL INFORMATION
WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2
DOCKET NUMBERS 50-390 AND 50-391

010.41 (3.4.1.4) Question:

SRP 3.5.1.4 (NUREG-0800) Item III.4 states the following: "Applicants ... shall have the option at the OL stage of showing conformance with either their original commitment [for the Tornado Missile Spectrum] or Rev. 2 (same as Rev. 1) to this SRP Section. Partial compliance with each is not acceptable." Amendment 57 to the FSAR added Table 3.5-17 "Tornado Missile Spectrum D for Additional Diesel Generator Building and Additional Category I Structures after July 1979." Even though the Tornado Missile Spectrum in Table 3.5-17 is in compliance with Tornado Missile Spectrum II of the SRP, it is not in compliance with the Tornado Missile Spectra submitted with the original FSAR and evaluated and accepted by the staff in the Watts Bar SER (NUREG-0847 dated June 1982). Thus, it is not in conformance with SRP criteria stated above. Justify your deviation from your original Tornado Missile Spectrum Criteria.

Response:

The additional diesel generator building was added after the design of the original Category I buildings was essentially complete. The original Category I buildings are in compliance with one of the three previously accepted missile spectra specified in Section 3.5.1.4 of the FSAR and Standard Review Plan (SRP) Section 3.5.1.4, "Missiles Generated by Natural Phenomena," Rev. 0.

SRP 3.5.1.4 was revised (Rev. 1) after the design of the original Category I buildings was complete. This revision added the Spectrum II tornado-generated missile parameters. Since Spectrum II was the latest criteria specified in the SRP at the time the additional diesel generator building was designed, it was designed in compliance with Spectrum II.

SRP 3.5.1.4 states that the applicant has the option of showing conformance with either the original commitment or Spectrum II. Every Category I structure is in complete compliance with either a spectrum from the original commitment or Spectrum II in SRP 3.5.1.4, Rev. 1. Since no building is in only partial compliance with an approved tornado missile spectrum, the buildings are in compliance with the criteria specified in SRP 3.5.1.4, Rev. 1.

010.42 (9.2.1) Question:

Figures 9.2-6 and 9.2-11 of the FSAR show the Essential Raw Cooling Water (ERCW) arrangement to the Diesel Generator (D/G) Heat Exchangers. The arrangements shown in the two figures are not identical to each other, and the arrangements shown in Figure 9.2-6 are not identical between the diesel generators. The typical ERCW arrangement to the D/G heat exchangers seems to be that the cooling water is taken from the ERCW main header (A or B) and flows through a manually operated heat exchanger inlet valve, a motor-operated control valve, a check valve, and then a common header serving both D/G heat exchangers. Furthermore, this heat exchanger header is connected to the other ERCW main header by the same valve arrangement. The discrepancies between the figures and within Figure 9.2-6 are as follows:

1. Figure 9.2-6 shows that the cooling water take-off from the main header for D/G OC-S is located upstream of the manually operated heat exchanger inlet valves, whereas Figure 9.2-11 does not show the heat exchanger inlet valves.

2. Figure 9.2-6 shows the cooling water take-offs for D/G 2A and 2B from the main header. In one case, the take-off is directly from the main header like D/G 1A, 1B, and OC-S. In the other case, the take-off is between the manually operated heat exchanger inlet valve and its associated motor-operated control valve (FCV 67-68 and FCV 67-65). This take-off arrangement is not the same as that for D/G OC-S.

3. No check valves are shown after the motor-operated control valves (FCV 67-72 and FCV 67-73) for D/G OC-S.

Explain these discrepancies in the figures. (SRP 9.2.1, Items II.4, III.2.a, and III.4)

Response:

1. Figures 9.2-6 and 9.2-11 are logic and control diagrams. These diagrams show selected mechanical features, such as manual valves, for reference only. The isolation valves in question are shown in full detail on flow diagram Figure 9.2-4A.

2. Figure 9.2-6 is a logic diagram that is intended primarily to show electrical control logic functions. The schematic representation of the flowpaths on Figure 9.2-6 is accurate, although somewhat obscure. A clear representation of the flowpaths is shown on Figures 9.2-1 and 9.2-4A.

3. Check valves are of little interest on logic diagrams and were sometimes omitted on Figure 9.2-6. The check valves in question are shown accurately on flow diagram Figure 9.2-4A.

010.43 (9.4.5)

Question:

In Section 9.4.5.2.2.4 of the FSAR it is stated that the additional diesel generator building ventilation and heating systems are tested "initially and periodically thereafter." Define "periodically." (SRP 9.4.5, Item III.1)

Response:

There are no specific tests performed periodically on the additional diesel generator building ventilation and heating systems. The affected portion of these systems is verified to operate correctly after any field work is performed by appropriate post-modification or post-maintenance testing.

FSAR Section 9.4.5.2.2.4 will be revised in a future amendment to incorporate the following clarification:

> The Additional Diesel Generator Building ventilating and heating systems are accessible for periodic inspection. This system is tested initially as part of the preoperational test program in Preoperational Test TVA-74C. After maintenance or modification activities that could affect a system or component function, testing is done to reverify proper operation of the system or component.

010.44 (9.4.5) Question:

Figure 9.4-22 of FSAR Amendment 52 and Figure 9.4-22 of Amendment 57 show the muffler room exhaust fans on the roof of the Diesel Generator Building and the Additional Diesel Generator Building (ADGB), respectively. Sections 9.4.5.2.1.1 and 9.4.5.2.2.1 of the FSAR state that "the muffler room is ventilated as required to remove heat during warm weather." Tables 9.4-4 and 9.4-4A do not describe the effects of a muffler room exhaust fan failure or exhaust blockage on D/G operation. Provide this information as well as describe the tornado missile protection provided for the muffler fan exhaust structure. (SRP 9.4.5, Item III.3)

Response:

The muffler room exhaust fans remove radiated heat from their associated diesel exhaust stacks to improve habitability of the muffler rooms during warm weather. They are not safety-related and are not essential for diesel generator operation. FSAR Tables 9.4-4 and 9.4-4A only describe safety-related component failures and are not intended to address these fans or other non-safety-related fans in the diesel generator building. Since the muffler room exhaust fans are not safety-related, their failure, including exhaust blockage, will have no effect on diesel generator operation. Based on this same line of reasoning, no tornado missile protection is provided for the muffler room fan exhaust structure.

010.45 (9.4.5) Question:

Table 9.4-4A of the FSAR states that a blocked fresh air intake to the 480V auxiliary board room will result in failure of the Additional Diesel Generator. Table 9.4-4 has a similar statement for the electrical board rooms in the Diesel Generator Building. Blockage of the air intakes by snow, ice, or debris from tornadoes and heavy winds, could result in the loss of all D/Gs at Watts Bar. Discuss and justify the provisions made to prevent blockage of the air intakes, and the tornado missile protection provided for the air intake structure. (SRP 9.4.5, Items II.1 and II.2)

Response:

The tables referred to in this question are failure modes and effects analyses. As such, they evaluate postulated failures, but do not consider the likelihood of such events. The following discussions address the potential for the events in question and describe the related design features of the fresh air intakes of the diesel generator building (DGB) electrical board rooms and the additional diesel generator building (ADGB) 480V auxiliary board room. These events are: 1) blockage by wind-driven debris, 2) blockage by ice, 3) blockage by snow, and 4) tornado missile protection.

1. The designs of the air intakes are such that it is unlikely that any of the intakes could be blocked completely by debris from tornadoes or heavy winds.

   The airflow area for each of the four DGB electrical board room air intake missile shields is sized sufficiently large to ensure that the required design airflow can be maintained even with a significant percentage of the airflow area blocked. These missile shields are square-shaped steel plates with a support leg at each corner. The missile shields are located on the roof of the DGB directly above their associated air intake openings. Since air enters under each missile shield from all directions, it is highly unlikely that the entire available airflow area on all four sides of the missile shield could be blocked by debris to the extent that cooling of the associated electrical board room is jeopardized.

   A similar situation applies for the ADGB 480V auxiliary board room air intake vent opening. However, in this case the missile shield is located within the board room underneath the intake vent opening. A mushroom-shaped sheet-metal rain hood is mounted on top of the roof directly over the opening. The uppermost part of the air entrance for this rain hood is 22 inches above the roof and air enters from all directions. It is highly improbable that debris could buildup to a height of 22 inches all the way around this rain hood--especially considering that it has a round outside surface with no sharp edges to catch flying objects.

2. Each DGB electrical board room air intake is a square-shaped opening 30 inches on a side in the ceiling of the room with an 8-inch-high concrete curb around its upper perimeter on the roof of the building. The associated missile shield structure on the roof of the DGB directly above this opening is a 1-inch-thick horizontal plate that has 1/4-inch vertical mesh screens on all four sides extending from the plate down to the roof. It is

conceivable that a glazing of ice could begin to form on these mesh screens and restrict the inflow of outside air. However, the amount of ice buildup and airflow restriction would likely be limited to the portion of the screen area directly in the path of prevailing winds.

The ADGB 480V auxiliary board room air intake rain hood is larger (i.e., 55 inches in diameter) than the concrete curb on which it is mounted (i.e., 14 inches in height with a 46-inch square cross-section). Therefore, the rain hood acts as a protective overhang to prevent any accumulation of ice that could block the airflow entrance.

3. The design of the air intakes for both the DGB electrical board rooms and the ADGB 480V auxiliary board room is such that none of these intakes could be blocked by snow to the extent that an intake's safety function would be jeopardized.

   As discussed in FSAR Section 2.3.2.2 and Table 2.3-5, the average annual snowfall for Decatur, Tennessee, was slightly less than 9 inches over a data collection period of more than 40 years. The maximum snowfall in any 24-hour period was 13 inches. This data is very representative of the Watts Bar site and indicates that appreciable snowfall is relatively infrequent. Furthermore, even when a heavy snow does occur, it is extremely unlikely that it would accumulate to a depth that could interfere with adequate airflow through the intake structures.

   The airflow openings on the roof beneath the missile shields covering the DGB electrical board room air intakes are 20.5 inches high. The lower portions of these airflow openings could be blocked by snow accumulation, but it is not credible to postulate a complete blockage. With the previously described maximum snowfall of 13 inches, there would still be an unblocked area with a height of about 7.5 inches. This area would provide sufficient airflow into the board rooms to ensure that their design temperature was not exceeded. It should be noted that with the reduced outside air temperature which would accompany a snowfall, heat transmission from the board rooms would increase and the required ventilation airflow would be less than the system's design requirement.

   The uppermost part of the airflow entrance underneath the rain hood covering the ADGB 480V auxiliary board room air intake vent opening is 22 inches above the roof. Even with a 13-inch snowfall accumulation, the snow would still be 1 inch below the bottom of the airflow opening, which is 14 inches above the roof. Therefore, no portion of the airflow opening (with a total height of 8 inches) would be blocked by the snowfall accumulation and the design airflow would still be maintained.

4. As previously described, the DGB electrical board room air intakes are protected from damage and airflow blockage by tornado-generated missiles by missile shields installed over the intakes.

   The ADGB 480V auxiliary board room air intake has a missile shield installed under the roof inside the board room. This design provides adequate protection against missile penetration into the board room and direct damage to safety-related components within the room. However, the design does not, in itself, prevent external blockage of the air intake by a missile impact. TVA is currently investigating the potential for such blockage and will report its evaluation and any resulting design change in a future submittal prior to fuel load.

In addition to the design features discussed above, the postulated events can also be mitigated by relatively simple operator actions. For instance, snow or ice buildup on the board room air intake structures could be cleared manually. Access to the roof of either the DGB or the ADGB is possible using a permanently installed ladder and hatch within the building. In the extremely unlikely event of total blockage of an intake structure for either building which cannot be corrected by quickly removing the blockage, it is possible to provide continuous airflow to any board room by opening personnel doors to the room. Since these doors are fire doors, applicable administrative controls would have to be satisfied to use the doors in this manner.

010.46 (9.5.1)

Question:

Section C.1.b(1) of Branch Technical Position (BTP) APCSB 9.5-1 states that a detailed fire hazard analysis should be done during initial plant design and that this analysis should be revised before and during major plant modifications. Therefore, provide the fire hazard analysis for the Additional Diesel Generator Building.

Response:

The fire hazard analysis for the additional diesel generator building will be provided in the WBN Fire Protection Report which will be incorporated into FSAR Section 9.5.1 in a future amendment.

010.47 (9.5.1) Question:

BTP APCSB 9.5-1, Appendix A to BTP APCSB 9.5-1, and Appendix R to 10 CFR 50 present staff guidelines for the development of a fire protection program. Accordingly, provide a comparison of the fire protection features of the Additional Diesel Generator Building with the applicable guidelines of each of these documents. Also, identify and justify any deviations from the guidelines presented in these documents.

Response:

The WBN Fire Protection Report will be incorporated into FSAR Section 9.5.1 in a future amendment. This report will provide a revised comparison of the plant fire protection program to Appendix A of BTP APCSB 9.5-1 and to the applicable sections of Appendix R of 10 CFR 50. The remainder of this response is limited to a comparison with APCSB 9.5-1, Appendix A, Section F.9, "Guidelines for Specific Plant Areas - Diesel Generator Areas," and Section F.10, "Diesel Fuel Oil Storage Areas." The ADGB is in compliance with the requirements of these sections as follows:

The additional diesel generator building (ADGB) is a separate building located approximately 50 feet from the diesel generator building. This arrangement provides the required separation for the ADGB. Also, the ADGB is provided with the following fire detection and suppression systems:

1. Diesel Generator Room, El. 742.0 - Cross-zoned thermal detection with a closed-head aqueous film forming foam (AFFF) water sprinkler system.
2. Pipe Gallery, El. 742.0 - Cross-zoned thermal detection with a closed-head AFFF water sprinkler system.
3. Fuel Transfer Pump Room, El. 742.0 - Cross-zoned thermal detection with a closed-head AFFF water sprinkler system.
4. 6.9kV Switchgear Room, El. 742.0 - Cross-zoned ionization detection with a closed-head AFFF water sprinkler system.
5. Transformer Room, El. 760.5 - Cross-zoned ionization detection with a closed-head AFFF water sprinkler system.
6. 480V Auxiliary Board Room, El. 760.5 - Ionization detection with a preaction sprinkler system.

The ADGB is provided with a Class III standpipe and hose system and with portable fire extinguishers. Each diesel engine is equipped with a 550-gallon diesel fuel oil day tank (1100 gallons total for the tandem diesels in the diesel generator room) mounted on the diesel skids. The 7-day diesel fuel oil tanks are embedded in the ADGB foundation.

010.48
(9.5.1)

Question:

General Design Criteria (GDC) 3 of Appendix A to 10 CFR Part 50 states that fire fighting systems shall be designed to assure that their rupture or inadvertent operations do not significantly impair the safety capability of structures, systems, and components important to safety. Verify that the fire fighting systems installed in the Additional Diesel Generator Building meet this GDC.

Response:

The ADGB automatic fire suppression system uses a preaction valve to control flow into the sprinkler piping and closed-head spray nozzles. Unless a fire has been detected and a control signal initiated to open the preaction valve, the sprinkler piping will remain dry and its rupture would not result in the discharge of water from the system. For inadvertent operation, the preaction valve would open and admit water into the system piping, but no discharge of water from the system would occur because the spray nozzle heads would still be closed. (Each head opens only when its fusible link melts in the presence of an actual fire.) Therefore, neither inadvertent activation nor damage to the sprinkler piping would impair the safety capability of structures, systems, and components important to safety. Furthermore, the sprinkler piping is either seismically supported to ensure that its pressure boundary is maintained or spray shields are provided to protect adjacent equipment from damage. The standpipes are also seismically supported in areas of the building where safety-related equipment could be damaged by water spray.

040.129 (8.3) (9.5.2) (9.5.3) (9.5.4) (9.5.5) (9.5.6) (9.5.7) (9.5.8)

Question:

Except as noted in the above requests for additional information (RAIs), verify that the responses to RAI 040.34 through 040.47, 040.74 through 040.111, 040.125, 040.127, and 040.128 are applicable to the Additional Diesel Generator and ADGB. Identify where the RAIs are not applicable, and provide an explanation for this non-applicability. (SRPs 8.3, 9.5.2, 9.5.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, and 9.5.8)

Response:

Responses to the following previously answered FSAR questions are applicable without change for the additional diesel generator and the ADGB. That is, the responses to these questions are identical if either the four original diesel generators or the additional diesel generator is considered.

040.34	040.42	040.84	040.100
040.35	040.43	040.86	040.102
040.36	040.44	040.87	040.105
040.37	040.45	040.93	040.107
040.38	040.46	040.95	040.108
040.39	040.47	040.97	040.110
040.40	040.76	040.99	040.127
040.41			

Responses to the following previously answered FSAR questions have been updated and are included with this letter as Enclosure 2. Most of the updates are related to the additional diesel generator or the ADGB, except as noted.

040.74*	040.83	040.92	040.104*
040.75*	040.85*	040.94	040.106
040.77	040.88*	040.96*	040.109*
040.78	040.89	040.98	040.111
040.79	040.90	040.101	040.125
040.81	040.91	040.103*	040.128
040.82*			

* - The specific information updated in these questions does not relate directly to the additional diesel generator or the ADGB.

The following previously answered FSAR question is not applicable to the additional diesel generator and the ADGB for the reason indicated.

040.80 - This question concerns internal barriers within the diesel generator building and the loss of an additional diesel generator due to various accidents within the building. Since there is only one diesel generator in the ADGB, no other diesel generators can be damaged by these types of accidents.

040.130 (8.3) Question:

Operating experience at two nuclear power plants has shown that during periodic surveillance testing of a standby diesel generator, initiation of an emergency start signal (LOCA or LOOP) resulted in the diesel failing to start and perform its function due to depletion of the starting air supply from repeated activation of the starting relay. (See IE Notice 83-17.) This event occurred as the result of inadequate procedures and from failure to provide a built-in time delay relay in the engine starting and control circuit logic to assure the engine comes to a complete stop before attempting a restart (i.e., during the period that the relay was open, fuel injection to the engine was blocked while the starting air was uninhibited). This condition, with repeated start attempts, depleted starting air and rendered the diesel generator unavailable until the air system could be repressurized.

Review procedures and control system logic to assure this event will not occur at your plant. Provide a detailed discussion of how your system design, supplemented by procedures, precludes the occurrence of this event. Should the diesel generator starting and control circuit logic and procedures require changes, provide a description of the proposed modifications. (Refer to Request 040.135 for control air requirements.) (SRP 8.3.1, Parts II and III)

Response:

IE Notice 83-17 identified a diesel generator (D/G) starting problem that was specifically related to the existence of a time delay feature in the D/G control circuitry. This time delay feature prevented restart of the D/G for 60 seconds after shutdown to allow it to come to a complete stop. However, the time delay feature only blocked the fuel supply to the D/G. It did not inhibit starting air. Therefore, it was possible to deplete the starting air reserve supply during futile attempts to restart the D/G during the 60 seconds when the fuel supply was blocked.

None of the emergency D/Gs at WBN (including the additional D/G) incorporate a time delay feature in their restart logic similar to that described above. Consequently, the type of problem identified in IE Notice 83-17 is not considered to be applicable to WBN.

040.131 (9.5.4)

Question:

The response to RAI 040.81 and 040.87 with regards to tornado missile protection of the fuel oil storage tank fill lines and the procedures used to refill the tanks following damage of these fill lines from tornado missiles and seismic events is unacceptable for the Additional Diesel Generator. The design layout of the ADGB is not the same as the Diesel Generator Building, thus the procedures found acceptable for refilling the D/G fuel oil storage tanks in the D/G building are not applicable to the ADGB. It is also the staff's position that the fuel oil fill line for additional D/G fuel oil storage tanks should be designed to Seismic Category I and be tornado missile protected or justification should be provided for not doing so. Discuss your plans for complying with this position.

Response:

TVA has evaluated the design of the fill lines for the ADGB fuel oil storage tanks and the consequences of damage to these lines due to seismic effects or tornado missiles. Based on this evaluation, TVA believes that the safety function of the ADGB fuel oil system can be ensured without upgrading the seismic design of the fill lines or adding tornado missile protection. The portion of the additional diesel generator fuel oil system necessary to supply fuel for a minimum of seven days is located within the base slab of the ADGB, which is designed to Seismic Category I structural requirements. By virtue of this location, the fuel oil storage tanks and their associated piping to the diesel engine are fully protected from tornado missiles. A truck fill connection is provided on the outside of the building for each embedded storage tank. In the event that these fill lines are rendered inoperable by seismic loads or tornado missiles, the tanks can be filled through the building personnel doors. This can be done by routing the tank truck hose (qualified for this service) through the building north exterior wall personnel door, and then through two nearby interior wall personnel doors leading to the north-end storage tank manway openings. Since this method of filling the tanks requires blocking open fire doors, applicable administrative controls would have to be satisfied to use the doors in this manner.

040.132 (9.5.4)

Question:

Section 9.5.4.2 of the FSAR states in part:

"Level switches are provided on the storage tank assemblies to provide the following functions: ...

4. Provide an interlock with the 200 gpm transfer pumps at the yard storage tanks and in the diesel building fuel oil transfer room, to shut off the pumps automatically on high level. This interlock feature is not employed when using the additional diesel generator building (ADGB) fuel oil transfer pump or in transferring fuel oil to the ADGB fuel oil tanks."

Describe why the pump interlock feature is not employed when using the ADGB fuel oil transfer pump or in transferring fuel to the ADGB fuel oil tanks. (SRP 9.5.4, Item II.4.c)

Response:

The following clarification will be incorporated into FSAR Section 9.5.4.2 in a future amendment:

4. An interlock is provided with the 200 gpm transfer pumps at the yard storage tanks and in the diesel building fuel oil transfer room to shut off the pumps automatically on high level. The interlock feature is not employed when using the additional diesel generator building (ADGB) 7-day fuel oil transfer pump to transfer fuel oil to the diesel generator building (DGB) tanks from the ADGB tank since this will be an infrequent operation. However, the interlock feature is provided between the yard storage tanks and the ADGB 7-day fuel oil tank.

040.133 (9.5.5) Question:

Operating experience indicates that diesel engines have failed to start on demand due to water spraying on locally mounted electronic/electrical components in the diesel engine starting system. Describe the measures that have been incorporated in the diesel engine electrical starting system to protect such electronic/electrical components from such potential environment. (SRP 9.5.5, Parts II and III)

Response:

WBN's diesel generators use a compressed air starting system and, therefore, they have very few essential electronic/electrical components that could be affected by water spray. There are only two locally mounted electrical components within the starting air system that could be affected by water spray: 1) the starting solenoid valve and 2) the pressure switch on the associated compressed air line. The solenoid valve is the same type as those used for outdoor applications such as locomotive engines. The pressure switch is enclosed in a NEMA Type 13 enclosure, which is an indoor enclosure to protect against such conditions as spraying water.

There are three water sources in the diesel generator room: 1) the ERCW system which cools the diesel generator, 2) the closed-loop jacket water system that transfers heat from the diesel engine to the ERCW system, and 3) a small potable water line for the eyewash. The piping within the diesel generator building for all three of these water sources is seismically qualified to maintain the integrity of its pressure boundary and, thus, is not expected to produce water spray. In summary, the probability of seismically qualified piping spraying water onto the relatively well-protected essential electrical components in the starting air system in such a way as to cause a malfunction is sufficiently low to disregard as a credible means of causing a diesel failure to start.

The diesel generator room in the additional diesel generator building contains the same water sources as the diesel generator rooms in the diesel generator building and meets the same design criteria. In addition, the additional diesel generator is protected from fire by an aqueous film forming foam (AFFF) system. This AFFF system is seismically supported and uses dry piping with closed heads. Its design and operation are similar to those of most other fire protection systems that use water to protect safety-related equipment.

040.134 (9.5.6) Question:

The diesel generator in many cases utilizes air pressure or air flow devices to control diesel generator operation and/or emergency trip functions such as air-operated overspeed trips. The air for these controls is normally supplied from the emergency diesel generator air starting system. Provide the following:

a) Expand your FSAR to discuss any diesel engine control functions supplied by the air starting system or any air system. The discussion should include the mode of operation for the control function (air pressure and/or flow), a failure modes and effects analysis, and the necessary P&IDs to evaluate the system.

b) Since air systems are not completely airtight, there is a potential for slight leakage from the system. The air starting system uses a non-seismic air compressor to maintain air pressure in the seismic Category I air receivers during the standby condition. In case of an accident, a seismic event, and/or LOOP, the air in the air receivers is used to start the diesel engine. After the engine is started, the air starting system becomes non-essential to diesel generator operation unless the air system supplies air to the engine controls. In this case, the controls must rely on the air stored in the air receiver since the air compressor may not be available to maintain system pressure and/or flow. If the air starting system is used to control engine operation, when the compressor is unavailable, show that a sufficient quantity of air will remain in the air receivers, following a diesel engine start, to control engine operations for a minimum of seven days assuming a reasonable leakage rate. If the air starting system is not used for engine control, describe the air control system provided and provide assurance that it can perform for a period of seven days or longer. (SRP 9.5.6, Part III)

Response:

a) There are no pneumatic engine controls supplied by the starting air system or any other air system whose failure would adversely affect the diesel generator's ability to perform its safety function once it has started. The only pneumatic engine control is a booster servomotor used to position the governor while the air start motors are engaged. However, the air flow path to this servomotor is isolated when the air start solenoid valves close at the completion of the air starting sequence.

   Also, there are no air-operated overspeed trips on any of WBN's diesel generators.

b) In view of the above, leakage from the starting air system during diesel generator operation will not degrade the performance of any diesel generator safety function.

040.135 (9.5.7) Question:

Provide the information requested below related to replenishment of lube oil without interrupting operation of the diesel generator.

a) What are the provisions made in the design of the lube oil system to add lube oil to the sump? Your response should include procedures or instructions available to the operator on the proper addition of lube oil to the diesel generator.

b) Are operating procedures or instructions posted or locally available in the diesel generator rooms?

c) Verify that personnel responsible for the operation and maintenance of the diesel are trained in the use of these procedures.

d) Verify that the color-coded, or otherwise marked, lines associated with the diesel generator are correctly identified, and that the line or point for adding lube oil (when the engine is on standby or in operation) has been clearly identified.

(SRP 9.5.7, Parts II and III)

Response:

a) Lube oil can be added to the sump at any time from 55-gallon drums through the scavenger strainers on the diesel generators. The lube oil level is normally checked each shift by Operations personnel per General Operating Instruction (GOI) 8. Operations personnel initiate a work request (WR) if the lube oil level is not acceptable per the GOI-8 checklist. Mechanical Maintenance completes the WR by adding the correct amount and type of oil as identified on the WR work instructions. System Operating Instructions (SOIs) 82.0 through 82.4 are used when a diesel is operating. These SOIs require monitoring the engine crankcase lube oil level while the diesel generator is operating.

b) SOI-82.0 through 82.4 are available in the main control room 24 hours per day. Operations personnel obtain copies prior to diesel generator operation or alignment. A copy of the GOI-8 checklist is picked up and normally performed once per shift by the Operations personnel assigned to the work station.

c) Operations personnel are trained on the contents and use of the GOIs prior to their initial assignment to shift duties. The GOIs are used daily after this initial training and no retraining is required. Operations personnel are also trained in the use of SOIs. Maintenance personnel work from written instructions that are included as part of each WR.

d) The dip stick on each diesel engine has only low and full marks. The engine sump oil level change between standby and operation is minimal due to continuous operation of the ac lube oil pump. The point for adding lube oil (i.e., the scavenger strainers) is clearly marked on the diesel engine. This marking includes the type of oil to be added. In addition, all subsystems (jacket cooling water, fuel oil, lube oil, and air starting) are color-coded for clear identification.

040.136 Question:

The responses to RAI 040.108 and 040.111 need to be revised.

a) A review of Figures 3.8.4-79, 8.3-1, 8.3-1A, and 9.4-22 of Amendments 52 and 57 indicates that the D/G exhaust stacks and the muffler room exhaust fan discharge vents are in close proximity to the 480V Auxiliary Board Room fresh air intake for the Additional Diesel Generator and the Electrical Board Room air intake vents for the emergency diesel generators. Under the right meteorological conditions, the products of combustion from a fire in the Air Intake/Muffler Room or the D/G exhaust gases could be introduced into the 480V Auxiliary Board Room and/or the Electrical Board Rooms. This could result in the failure of more than one diesel generator, due to the particles of combustion and combustion gases affecting the electrical components in these rooms. Revise your responses to RAI 040.108 and 040.111 to address this concern. (SRP 9.5.8, Items II and III.3)

b) Section 8.3.1.1 of the FSAR describes the connectors used to connect the additional diesel generator to the disabled D/G unit train control and annunciation cables. Revise RAI 040.111 to describe the dust and dirt protection provided for these connectors and their receptacles.

Response:

a) The following information is presented in lieu of revising the responses to Questions 040.108 and 040.111.

The design of the building structural features and ventilation systems for the diesel generator building (DGB) and the additional diesel generator building (ADGB) should preclude the introduction of the products of combustion from a fire in an air intake/muffler room or from diesel generator (D/G) exhaust gases into the DGB electrical board rooms or the ADGB 480V auxiliary board room.

The fire hazard analysis calculation for an air intake/muffler room indicates an extremely small amount of combustible load for this room (i.e., less than 9100 Btu/ft^2). If a fire did occur in an air intake/muffler room when its associated D/G was running, the products of combustion generated by the fire would be diluted by the incoming airflow drawn into the room by the D/G room ventilation suction and the D/G combustion air intake. Most of these diluted products of combustion would then be removed from the air intake/muffler room by the D/G room exhaust fans.

If a fire occurred in an air intake/muffler room when its associated D/G was not running, the room's thermal fire detector would transmit an alarm to the main control room and operations personnel would respond in accordance with appropriate plant procedures. In this case, it is not necessary to prevent completely the entry of smoke into the board room next to the air intake/muffler room where the fire is located. The electrical equipment in this board room is not required to function when its associated D/G is not operating. The board rooms of any adjacent D/Gs that are running would not be adversely affected by products of combustion from the fire because the duration of the fire would be short due to the very limited amount of combustible material in the air intake/muffler room.

In summary for a fire in an air intake/muffler room, smoke and other products of combustion will not adversely affect the electrical components in the DGB electrical board rooms or the ADGB 480V auxiliary board room.

The D/G exhaust stacks are totally surrounded by a 3-foot-high concrete wall. The hot D/G exhaust gases are released vertically into the atmosphere within this concrete enclosure and will continue to rise due to the thermal and dynamic forces affecting them. Under most meteorological conditions, the exhaust gases will form a plume at a higher elevation and eventually disperse into the atmosphere. The minimum distance from a D/G exhaust stack to an air intake vent for either the DGB electrical board room or the ADGB 480V auxiliary board room is 11 feet. Since the maximum entrance height for air into any of these intakes is approximately 22 inches above the roof, the D/G exhaust gases would have to travel both horizontally and slightly downward to enter an intake. This is not considered to be credible since the air intake is multi-directional and low velocity (i.e., it does not produce a significant "suction" effect).

Also, the hot D/G exhaust gases will be diluted as soon as they are discharged into the atmosphere due to thermal expansion and mixing with the outside air. Combustion products will be dispersed randomly. Therefore, it is highly unlikely that any appreciable concentration of combustion products will build up in the air just above roof level where the board room intakes are located. Heavy particles (soot, etc.) in the exhaust gases may settle out on the building roof over a period of time, but they will not enter the board room intakes since the airflow path into these intakes requires several changes in direction.

Based on the reasons presented above, TVA does not believe that it is necessary to perform any further evaluation of the introduction of combustion products or exhaust gases into the board rooms since this should not occur. By extension, it is also not necessary to evaluate any potential adverse effects on electrical components within these rooms and possible resulting D/G failure.

b) In the ADGB in both the control and annunciation distribution panels, all plugs and receptacles that are used to connect the additional diesel generator in place of a disabled diesel generator are equipped with protective caps to prevent the entry of dust and dirt. In the DGB in both the control and annunciation distribution panels, all receptacles are also equipped with protective caps. Protective caps are not required for the plugs in the DGB since they are always plugged into either their normal diesel generator circuits (receptacles) or the additional diesel generator circuits.

The above information has been added to the response for Question 040.111.

040.137 Question:

Figures 8.3-1 and 8.3-1A of the FSAR show that the diesel generator exhaust muffler and associated piping are in the same room as the D/G combustion air intake. By temperature alone, the D/G exhaust system can be considered a high-energy system. The failure of this system by any means (i.e., corrosion, degradation of gasket material, vibration-induced looseness of flange fasteners, etc.) could result in the failure of one or more D/Gs at Watts Bar. Describe inspections, surveillance requirements, and testing that will be performed on the D/G exhaust system to preclude this event. (SRP 9.5.8, Items II.2, II.4, and III.8)

Response:

The intake and exhaust piping components for each diesel generator (D/G) unit are located in their own room separate from the equivalent components of the other four D/Gs. Although the postulated exhaust system failure could propagate to components in the affected D/G's intake system, the net effect on safety would still be only the loss of one D/G. The physical separation and barriers between the D/Gs would prevent any damage to the other four D/Gs. D/G components are also designed to meet Seismic Category I and appropriate environmental qualification requirements to greatly reduce the possibility of common-mode failure. These design provisions are coupled with D/G preoperational testing and monthly visual inspections of each D/G's exhaust system in accordance with plant maintenance instructions to ensure D/G operational availability and plant safety.

040.138 (9.5.8)

Question:

The D/G combustion air intake and exhaust system is designed such that the total air intake and exhaust system pressure losses shall not exceed the maximum pressure losses specified by the diesel generator manufacturer. Recent events have shown that not all aspects in the design of the D/G combustion air intake and exhaust system have been taken into account resulting in the pressure losses through the system exceeding manufacturer's limitations. Verify that the pressure losses through your systems do not exceed manufacturer's recommendations, taking into consideration pipe losses and pressure drops associated with the filters, silencers, and intake and exhaust structure openings. (SRP 9.5.8, Part III)

Response:

The D/G vendor provided pressure switches with alarm functions in the D/G air intake to identify conditions that exceed manufacturer's limitations. Furthermore, preoperational tests determined that the pressure drops in the intake and exhaust systems (5.3" and 2.3" H_2O, respectively) are well below the manufacturer's recommended limits (12" and 5" H_2O, respectively).

ENCLOSURE 2

040.74 <u>Question</u>

Provide a detailed discussion (or plan) of the level of training proposed for your operators, maintenance crew, quality assurance, and supervisory personnel responsible for the operation and maintenance of the emergency diesel generators. Identify the number and type of personnel that will be dedicated to the operations and maintenance of the emergency diesel generators and the number and type that will be assigned from your general plan operations and maintenance groups to assist when needed.

In your discussion identify the amount and kind of training that will be received by each of the above categories and the type of ongoing training program planned to assure optimum availability of the emergency generators. Also discuss the level of education and minimum experience requirements associated with the emergency diesel generators.

<u>Response</u>

TVA's Division of Nuclear Power (NUC PR) is taking advantage of the vendor's maintenance training classes for training of the maintenance crews and engineers who work on diesel generator sets.

Engineers, electricians, and gas/diesel mechanics from the Watts Bar Nuclear Maintenance sections have attended diesel engine and governor vendor classes. In addition, there are engineers in the ~~central Nuclear Maintenance Branch (NMB)~~ corporate engineering department to provide additional support to the plants as needed. These ~~NMB~~ engineers have also attended ~~the~~ vendor classes. ~~and have an equal responsibility for identical engines at Browns Ferry and Sequoyah Nuclear Plants which broadens their background in this area.~~ The minimum level of education for the engineers is a bachelor's degree in engineering or its equivalent in work experience. NUC PR has ~~is in the process of~~ developed ~~developing~~ a training program to satisfy the requirements of the Sequoyah Safety Evaluation Report, Supplement 2, Section 8.3.1. ~~This, or~~ A ~~a~~ similar program has been developed and is being used ~~is being evaluated for use~~ at Watts Bar Nuclear Plant. 44

Operations employees are extensively trained in the operation of electrical systems including all facets of diesel generators. Education and experience are specified in the Nuclear Operations Training Program. Also, additional knowledge will be gained during the preoperational and startup testing phase.

Work performed on these systems is required to be in accordance with written approved work instructions. The Quality Assurance Staff is responsible for reviewing these instructions to ensure compliance with quality assurance requirements and inclusion of applicable quality control (QC) hold points.

Required QC hold point inspection operations are performed and documented by QC inspection employees who are certified as defined in TVA's ~~Topical Report TR 75-1A.~~ Nuclear Quality Assurance Plan.

The overall training and qualifications of plant supervisors and quality assurance and maintenance employees are already addressed in Chapter 13 of the 44
FSAR. Organization and staffing are also addressed in Chapter 13. Employees will meet the guidelines established in ANSI, N18.1-1971, 'Qualification and Training for Nuclear Power Plant Personnel.' Plant employees will be augmented as necessary by other staff specialists and employees in TVA outage, central office, and design organizations.

Periodic formal classes onsite will be conducted regarding equipment changes and identified improved maintenance methods. Other employees will receive training on system operation and functions necessary to enable them to perform their function.

Watts Bar Nuclear Plant (WBN) maintains a training program that has been accredited by the Institute of Nuclear Power Operations. For the diesel generators (D/Gs), this program consists of classroom and laboratory training, along with on-the-job training for electrical and mechanical craft personnel. Since the D/Gs use relatively straightforward types of instrumentation, no D/G-specific training is required for instrument mechanics. All craft personnel must be qualified prior to performing work independently on a D/G. Nonqualified craft personnel may only work on a D/G under the direct control of a qualified craftsperson of the same discipline. The personnel actually assigned to work on the D/Gs will vary depending on what other work activities are in progress and current plant staffing levels.

The D/G system engineer in WBN's plant organization and the person assigned as backup for this position are required to have, as a minimum, a bachelor's degree in engineering or its equivalent in work experience. The system engineer must complete training on WBN's procedural requirements for conducting tests prior to being assigned as a test director. Also, a comprehensive training program has been established for system engineers to ensure a fundamental knowledge of plant systems design, equipment operating characteristics, and typical work processes used at WBN. Each system engineer is required to complete this training program within a prescribed time period. However, there is no restriction on the types of work assignments the system engineer may perform prior to completing the training program. The current system engineer for the D/Gs has additional expertise based on completing the same training program as craft personnel and attending various vendor schools and industry seminars on D/Gs.

Operations employees are extensively trained in the operation of electrical systems including the routine and emergency uses of the D/Gs. Details of their required education, training, and experience are specified in the nuclear operations training program.

Work performed on the D/Gs is required to be done in accordance with written, approved instructions. The quality assurance (QA) staff at WBN reviews these work instructions to ensure their compliance with the requirements of 10CFR50 Appendix B and their inclusion of appropriate quality control hold points. In view of the general nature of these reviews, no specific D/G training is required for the QA personnel who perform them.

The overall training and qualifications for key plant management positions and for QA and maintenance employees are addressed in Chapter 13 of the FSAR. This chapter also describes plant organization and staffing.

040.75 Question

Periodic testing and test loading of an emergency diesel generator in a nuclear power plant is a necessary function to demonstrate the operability, capability, and availability of the unit on demand. Periodic testing coupled with good preventive maintenance practices will assure optimum equipment readiness and availability on demand. This is the desired goal.

To achieve this optimum equipment readiness status, the following requirements should be met:

1. The equipment should be tested with a minimum loading of 25 percent of rated load. No load or light load operation will cause incomplete combustion of fuel resulting in the formation of gum and varnish deposits on the cylinder walls, intake and exhaust valves, pistons and piston rings, etc., and accumulation of unburned fuel in the turbocharger and exhaust system. The consequences of no load or light load operation are potential equipment failure due to the gum and varnish deposits and fire in the engine exhaust system. 46

2. Periodic surveillance testing should be performed in accordance with the applicable NRC guidelines (RG 1.108) and with the recommendations of the engine manufacturer. Conflicts between any such recommendations and the NRC guidelines, particularly with respect to test frequency, loading, and duration, should be identified and justified.

3. Preventive maintenance should go beyond the normal routine adjustments, servicing and repair of components when a malfunction occurs. Preventive maintenance should encompass investigative testing of components which have a history of repeated malfunctioning and require constant attention and repair. In such cases consideration should be given to replacement of those components with other products which have a record of demonstrated reliability, rather than repetitive repair and maintenance of the existing components. Testing of the unit after adjustments or repairs have been made only confirms that the equipment is operable and does not necessarily mean that the root cause of the problem has been eliminated or alleviated.

4. Upon completion of repairs or maintenance and prior to an actual start, run, and load test a final equipment check should be made to assure that all

electrical circuits are functional, i.e., fuses are in place, switches and circuit breakers are in their proper position, no loose wires, all test leads have been removed, and all valves are in the proper position to permit a manual start of the equipment. After the unit has been satisfactorily started and load tested, return the unit to ready automatic standby service and under the control of the control room operator.

Provide a discussion of how the above requirements have been implemented in the emergency-diesel generator system design and how they will be considered when the plant is in commercial operation, i.e., by what means will the above requirements be enforced.

Response

1. Operating instructions are, in general, written to minimize no-load or low-load operation and contain precautions against these conditions as their effects are recognized by the plant staff. The Watts Bar Nuclear technical specifications, which will be generally based on NRC standard specifications, have not been approved; but they may contain requirements for very brief no-load testing to verify starting capability in response to various action statements.

2. The Watts Bar Nuclear technical specifications have not been approved by the NRC; but they will be based, in general, on NRC standard specifications and Sequoyah technical specifications with some operability differences based on diesel generator loading differences between Sequoyah and Watts Bar Nuclear. The Watts Bar Nuclear technical specifications will incorporate the requirements of NRC Regulatory Guide 1.108; however, this is not in direct agreement with the manufacturer's guidelines which suggest weekly operation. Note, however, that technical specifications require increased surveillance frequency when diesel surveillance criteria are not satisfied. 44

3. TVA is actively involved and dedicated to a preventive maintenance program. Common areas of component problems are transmitted among plants for information. Publications, such as Nuclear Power Experience, Nuclear Plant Reliability Data System, and NRC IE circulars and information notices are closely followed for identification of possible generic problems.

4. Preventive maintenance programs on diesels involve performance of approved maintenance instructions on a scheduled periodic basis. These are not done as a result of a malfunction but to prevent malfunctions and ensure equipment operation.

An equipment history program for the diesels addresses the concerns expressed in your questions. The equipment histories are kept by use of ~~trouble~~ maintenance requests ~~reports~~ and special maintenance reports. These histories are readily retrievable and can be surveyed to determine the type of malfunction and the resultant repairs on any piece of equipment relative to the diesel generator.

When equipment, parts, or components are repaired, the cause is investigated. Should problems occur repeatedly in an unsuitable time frame, further investigation is initiated. This investigation may include increased testing and consulting with the corporate ~~Division of~~ Engineering department and ~~Design or~~ the manufacturer and maintenance specialists within TVA. This investigation will ensure that the cause, if identified to be generic and repetitive to the particular component, will lead to corrective action to increase the equipment's reliability and decrease maintenance repair and downtime.

Maintenance instructions addressing the concerns expressed in the question are prepared by plant forces in accordance with the TVA Operational Quality Assurance Manual.

The instructions, which are prepared by the plant's staff, reviewed by the Plant Operations Review Committee, and approved by the ~~power~~ plant Manager superintendent, provide steps for return to service and post maintenance testing commensurate with the maintenance and repairs performed. 44

1. Operating instructions are written to minimize diesel generator (D/G) operation at no-load or low-load and contain precautions against these conditions to the extent that they can be anticipated by the plant staff. WBN's Technical Specifications have not yet been issued, but they are being developed in accordance with draft NUREG-1431 (Westinghouse Standard Technical Specifications). Similarly to this draft NUREG, they are expected to contain surveillance requirements for brief (approximately 5 minutes) no-load testing of the D/Gs to verify their starting capability in response to various required actions when limiting conditions for operation are exceeded.

2. WBN's Technical Specifications have not yet been issued, but they are being developed in accordance with draft NUREG-1431 (Westinghouse Standard Technical Specifications). Similarly to this draft NUREG, they are expected to incorporate the guidelines of applicable NRC regulatory guides for periodic surveillance testing of D/Gs. These guidelines are not in direct agreement with the diesel engine manufacturer's recommendation to operate the diesel weekly. However, the manufacturer does sanction limited deviations from their recommendation to suit individual customer needs, such as standby service for nuclear plants.

3. TVA has established both corrective maintenance and preventive maintenance programs for the equipment at its nuclear power plants. For D/Gs, these programs involve the performance of various approved maintenance instructions that contain provisions for appropriate types of testing. The testing related to preventive maintenance is scheduled on a periodic basis to ensure D/G operability and to detect incipient malfunctions. The post-maintenance testing associated with corrective maintenance is also intended to ensure D/G operability, while specifically verifying that the corrected malfunction will not recur.

   WBN uses an equipment history program to identify components that tend to experience repeated failure. At present, this program is based on the use of component failure reports and review of D/G test logs by the system engineer. WBN plans to expand the program prior to commercial operation to include information from additional sources such as the Nuclear Plant Reliability Data System, which provides equipment history from other plants and industry averages for times between equipment failures. When the equipment history program identifies a component experiencing repeated failure, the situation is investigated further using the technique of cause analysis. Corrective action and recurrence control plans are then developed and implemented. If a major equipment failure is involved, plant management would assign an event investigation team to determine all pertinent issues and resolve them expeditiously. The above program and resulting actions are intended to improve equipment reliability and reduce equipment repairs and downtime.

   TVA also has established a nuclear experience review (NER) program along the guidelines suggested by the Institute of Nuclear Power Operations (INPO) to review a wide-range of industry documents for their applicability to WBN and its other nuclear power plants. Routine reviews of information provided by INPO's Nuclear Network and vendor Power Pointers supplement this NER program to identify potential generic equipment problems and to evaluate recommendations for avoiding or mitigating such problems.

4. The procedures used for D/G repairs and preventive maintenance include steps for returning the D/G to service and post-maintenance testing. These steps are commensurate with the extent and complexity of the repair or preventive maintenance that was performed. Before a D/G is actually started and load tested, the alignment checklist in the appropriate system operating instruction is performed by operations personnel. This ensures that all associated valves and electrical controls are functional and properly positioned to support D/G operation.

40.77 <u>Question</u>
(9.5.2)

The information regarding the onsite communications system (Section 9.5.2) does not adequately cover the system capabilities during transients and accidents. Provide the following information:

(a) Identify all working stations on the plant site where it may be necessary for plant personnel to communicate with the control room or the emergency shutdown panel during and/or following transients and/or accidents (including fires) in order to mitigate consequences of the event and to attain a safe cold plant shutdown.

(b) Indicate the maximum sound levels that could exist at each of the above identified working stations for all transients and accident conditions.

(c) Indicate the types of communication systems available at each of the above identified working stations.

(d) Indicate the maximum background noise level that could exist at each working station and yet reliably expect effective communication with the control room using:

1. the page party communications system, and

2. any other additional communication system provided that working station.

(e) Describe the performance requirements and tests that the above onsite working stations communication systems will be required to pass in order to be assured that effective communication with the control room or emergency shutdown panel is possible under all conditions.

(f) Identify and describe the power source(s) provided for each of the communications systems.

(g) Discuss the protective measures taken to assure a functionally operable onsite communication system. The discussion should include the considerations given to component failures, loss of power, and the severing of a communication line or trunk as a result of an accident or fire.

7. Additional work stations may require communications capability to support the manual actions that are needed in the event of a fire

Response

(a) During or following transients or accidents, communications with the control room or the Auxiliary Control Room from the following listed work stations may be necessary to mitigate the consequences of the event and attain a safe cold plant shutdown:

1. 6900-V Shutdown Board Rooms
2. 480-V Shutdown Board Rooms
3. Diesel Generator Building
4. Reactor MOV and Vent Board Rooms
5. Reactor Coolant Pump Boards
6. CVCS Boron Blender (Elevation 713)

(e) The following two communications systems will be tested in the Preoperational Test program:

1. The sound-powered telephone system (Table 14.2-1, test TVA-11A)

2. The codes alarm and paging system (Table 14.2-1, test TVA-11B)

As specified by Table 14.2-3, these tests will conform to Regulatory Guide 1.68. 53

The PAX system will not be preoperationally tested because it is not a communication system required to mitigate the consequences of an accident (for additional details, refer to the March 28, 1983 letter from L. M. Mills to E. Adensam).

The most comprehensive testing of all plant communications systems results from daily usage and subsequent reports of any trouble encountered by the users.

(c) The general descriptions of the communication systems are already described in FSAR Section 9.5.2.2. In addition, an inplant two-way radio system operating on frequencies in the 160-175 MHz range provides another means of communications. The types of systems available in the control room, Auxiliary Control Room, and at or nearby the working stations are as follows:

Main Control Room
1. Sound Power Systems SP-1, 2, 3, 4, 5, and 6
2. PAX
3. Paging
4. Radio
5. Direct Sound Power to the Diesel Generator Building

Auxiliary Control Room

1. Shutdown Control Center Communications Systems, both Primary and Alternate
2. Sound Power Systems SP-1, 2, 3, 4, 5, and 6
3. PAX
4. Paging
5. Radio

6900-V and 480-V Shutdown Boards

1. Shutdown Control Center Communications Systems, both Primary and Alternate
2. PAX
3. Paging
4. Radio

Diesel Generator BuildingS

1. Shutdown Control Center Communications Systems, both Primary and Alternate
2. PAX
3. Paging
4. Direct Sound Power to the Main Control Rooms (main diesel building only)

Reactor MOV and Vent Board Rooms

1. PAX
2. Paging
3. Radio

Reactor Coolant Pump Boards and CVCS Boron Blender

1. PAX
2. Paging
3. Radio

(b) and (d) The ambient noise level at a working station will vary from station to station during normal plant operation and during an emergency situation. As Watts Bar Nuclear Plant is not an operating plant, the design of communications systems had to be based on estimated noise levels using information and noise levels obtained from operating plants. Estimated sound levels for identified working stations are as follows: 53 47

1. Main Control Room - The normal expected ambient noise level is 62 db, with the noise level reaching 66 db during an emergency situation. This rise could be caused by more personnel present in the room, louder voices, and more movement in and out of the room.

2. Auxiliary Control Room - The estimated sound level is 65 db -68 db. There will be no appreciable rise in this level during an emergency.

3. 6900-V Shutdown Board Rooms - The background noise in these areas is approximately 70 db. It is expected that this sound level would not change during an emergency because of elevation and location of these rooms.

4. 480-V Shutdown Board Rooms - The ambient noise level for similar areas in other plants has measured 68 db - 70 db. There is no reason to expect this level to rise during an emergency.

5. Diesel Generator Building - The noise level here during an emergency is 113-115 db (with units running). There is a shielded room in the Diesel Generator Building designated for the specific purpose of conversing with the control room during emergencies. The ambient noise level in this room is 70-75 db and is equipped with a PAX telephone, sound powered telephone (connected directly to the control room) and a CAP speaker. 47 There are also CAP speakers and a PAX telephone in the corridor. Double receiver headsets can be used with sound powered jacks to receive instructions from the control room in high ambient noise areas in diesel generator rooms.

6. Reactor MOV and Vent Board Rooms - Estimated noise levels for these rooms are 72-75 db. Because of the location of these rooms, there will be no increase in sound levels during an emergency.

7. Reactor Coolant Pump Boards and CVCS Boron Blender - The sound level in this area is approximately 75-80 db. It is not expected to rise during an emergency and could go down slightly because of the shutdown of some motors.

The CAP System which is used throughout the plant for codes, alarms, and paging is capable of producing output signals of 110 db at 10 feet. This level of signal will give the CAP System sufficient range to be adjusted for proper voice and tone signaling in the working stations listed above.

The PAX telephone and the sound powered systems are being used effectively at operating plants in areas where sound levels are as high or even higher than those identified above. 47

(f) ~~The paging (CAP) system is powered by a 24V DC power board which is backed by a 24V battery which has an 8 hr capacity of 1200 AH.~~

Replace with INSERT

~~The sound-powered system requires no external power source.~~

~~The power source for the PAX telephone system is a 48V DC power board which is backed by a 48V battery with an 8 hr capacity of 900 AH.~~

(g) CAP SYSTEM

The paging system (CAP) speaker amplifiers are divided into two groups, designated as 'A' and 'B.' 'A' and 'B' speaker-amplifiers are located in all plant areas so as to assure audible paging from either the 'A' or 'B' speakers. Each group is fed from a different fuse panel with cable to the 'A' group being physically separated from cable feeding the 'B' group. If power is lost to either group of speaker-amplifiers, there is sufficient coverage from the remaining group to maintain the integrity of the system. In the event that a speaker-amplifier fails in such way that the signal input leads become shorted, a fuse blows immediately, isolating it from the rest of the system. The 'A' and 'B' groups form two completely redundant systems. 46

SOUND POWERED SYSTEM

The sound powered system designated for emergency communications with the control room consists of a primary system and an alternate system. These are wired independent of each other with a different cable routing for each system. If an individual telephone is lost because of fire or an accident, that station will be isolated from the system. However, the remaining sound powered telephones will perform in the normal way.

PAX TELEPHONE SYSTEM

The PAX telephone system is designed with a redundant power source. It is also designed so that failure of

INSERT: (f) The CAP system equipment requires power from both the 48V telephone battery and the 24V CAP battery for various functions. Both batteries are capable of providing power to the CAP system for 3 hours after loss of ac power to the battery chargers. Portions of the CAP system use 120Vac preferred power rather than relying on a battery and its associated charger. The use of 120Vac power precludes problems due to voltage drop on long supply cables.

The sound-powered phone system requires no external power source.

The power source for the PAX telephone system is a 48Vdc power board which is backed up a 48V battery with a 3-hour capacity.

a major component (excluding total power loss) will not affect greater than 50% of the system. The equipment is such that if a faulty path is encounter when making a call, the act of hanging up the receiver and again removing it will provide a different path.

0.78 <u>Question</u>
.5.3)

Identify the vital areas and hazardous areas where emergency lighting is needed for safe shutdown of the reactor and the evacuation of personnel in the event of an accident. Tabulate the lighting system provided in your design to accommodate those areas so identified. Include the degree of compliance to Standard Review Plan 9.5.1 regarding emergency lighting requirements in the event of a fire.

<u>Response</u>

The emergency lighting consists of two systems:

(1) the 125V dc emergency lighting system as described in the FSAR, Section 9.5.3, and (2) fixed, self-contained lighting consisting of fluorescent or sealed beamed units with an individual 8-hour minimum battery supply.

The vital areas and emergency light locations are as shown on the following tabulation and the attached lighting drawings:

Vital Areas and Light Locations	Emergency Lights	8-Hour Battery Pack Emergency Lights	Drawing No.
Main Control Room EL 755.0'	X	X	55W416-1 55W416-2 55W416-3 55W416-4
6.9KVShutdown BD Room and 480V Shutdown Bd Room	X	X	45W1418-1 45W2418-1
480V Bd Rooms 1A, 1B 2A, 2B, El 772.0	X	X	45W1419-1 45W2419-1
Aux Bldg El 676.0			
A7, U		X	45W1410-1
A6, T		X	45W1410-1
A9; U-V		X	45W2410-1
A10, S		X	45W2410-1
Aux Bldg EL 692.0			
A2, T-U		X	45W1412-1
A12, S		X	45W2412-1
A3, U		X	45W1412-2
A13, U		X	45W2412-2

A9, U-V	X	45W2412-2
A5, X	X	45W1412-3
Annulus, EL 702' 9-3/8'	X	45W1412-4
Aux Bldg EL 713.0		
A6, T	X	45W1414-1
A1, Q	X	45W1414-1
A2, R	X	45W1414-1
A4, S	X	45W1414-1
A3, T	X	45W1414-1
A10, T	X	45W2414-1
A12, S	X	45W2414-1
A2, U	X	45W1414-2
Annulus Access EL 713.0	X	45W1414-2
Reactor Access Room EL 713.0	X	45W1414-2
Aux Bldg EL 713.0		
A9, V	X	45W2414-2
Aux Bldg EL 737.0		
A4, S	X	45W1416-1
A12, S	X	45W2416-1
A2, U	X	45W1416-2
A3, U	X	45W1416-2
A13, U	X	45W2416-2
A9, B	X	45W2416-2
Additional Equipment	X	45W1416-3
Bldg Access EL 743'-6'	X	45W2416-3
Additional Equipment Bldg EL 786'-6'		
A4-1/2, XA	X	45W1416-5
Additional Equipment Bldg EL 775'-3'		
A5, WC	X	45W1416-5
A3, XA	X	45W1416-5
Additional Equipment Bldg EL 763'-6'		
A5, WA	X	45W1416-5
A3, XA	X	45W1416-5
Additional Equipment Bldg EL 740'-6'		
A4, XA	X	45W1416-5

itional Equipment		
g EL 729'-0'	X	45W1416-5
A5, XA	X	45W1416-5
Accumulater Area	X	45W1416-5
A12, WB	X	45W1416-5
Aux Bldg EL 757.0		
A4, U	X	45W1418-1
A8, Q	X	45W1418-1
A6, R	X	45W1418-1
A3, S	X	45W1418-1
A8, Q	X	45W2418-1
A10, R	X	45W2418-1
A12, U	X	45W2418-1
A13, S	X	45W2418-1
A12, Q	X	45W2418-1
A2, U	X	45W1418-2
A4, U	X	45W1418-2
A13, V	X	45W1418-2
Reactor Bldg Access	X	45W1418-3
Room EL 757.0	X	45W2418-3
Aux Bldg EL 757.0		
A5, X	X	45W1418-3
rth Main Steam Valve Room EL 757.0	X	45W1418-3
Aux Bldg EL 772.0		
A3, R	X	45W1419-1
A13, R	X	45W1419-1
Aux Bldg EL 782.0		
A3, U	X	45W1419-2
A3, V	X	45W1419-2
A4, W	X	45W1419-2
A12, V	X	45W2419-2
A12, W	X	45W2419-2
Aux Bldg EL 782 Pressure Heater	X	45W1419-3
Xfmr Room	X	45W2419-3
Aux Bldg EL 786		
A8, T	X	45W1419-4
Diesel Generator Bldg EL 742		
2 Lights/D.G. Area	X	15W420-1

6 Lights along Access Corridor		X	15W420-1
Diesel Generator Bldg EL 760.5			
1 Light in Access Corridor		X	15W420-2
1 Light in each of the 4 brd rooms		X	15W420-2
Additional Diesel Generator Bldg. El.742			
1 light in pipe gallery		X	15W420-5
1 light in pipe gallery	X		15W420-5
2 lights in 6900V Bd Rm.		X	15W420-5
1 light in 6900V Bd. Rm.	X		15W420-5
3 lights in C-S Rm.		X	15W420-5
2 lights in C-S Rm.	X		15W420-5
2 lights in corridor		X	15W420-5
2 lights in corridor	X		15W420-5
Additional Diesel Generator Bldg. El.760.5			
2 lights in XFMR RM.		X	15W420-5
1 light in Air Exhaust Rm.		X	15W420-5
2 lights in Air Exhaust Rm.	X		15W420-5
1 light in 480V Aux Bd. Rm.		X	15W420-5
1 light in 480V Aux Bd. Rm.	X		15W420-5
1 light in Fire Protection Rm.		X	15W420-5
1 light in corridor		X	15W420-5
1 light in corridor	X		15W420-5
2 lights in air intake Rm.		X	15W420-5
2 lights in air intake Rm	X		

.79 **Question**
5.4)

You described the instruments, controls, sensors, and alarms provided for monitoring the diesel engine fuel oil and transfer system and described their function, but you did not discuss the testing necessary to maintain and assure a highly reliable instrumentation, controls, sensors, and alarm system and where the alarms are annunciated. Provide this information. Also discuss the system interlocks provided. (SRP 9.5.4, Part III, item 1).

Response

The instruments, controls, sensors, and alarms for monitoring the diesel fuel oil storage and transfer systems are ~~will be~~ calibrated on a routine basis ~~every 18 months~~. All alarms are annunciated on main control room panel 0-M-26 and auxiliary control room panel 0-L-4 with the exception of the 7-day diesel oil storage tank abnormal level alarms which are annunciated on main control room panel 0-M-26 only. The system interlocks are described in FSAR Section 9.5.4.2.

The additional diesel generator uses the control panel for the diesel generator it is replacing.

for the original four diesel generators and the additional diesel generator

040.81 (9.5.4) Question

Describe your design provisions made to protect the fuel oil storage tank fill and vent lines from damage by tornado missiles. (SRP 9.5.4, Part II).

Response

No design provisions have been made on the Diesel Generator Building or Additional Diesel Generator Building fuel oil storage tanks to protect the fill lines from tornado missiles. The diesel generators can be isolated by valving from these tanks. The seven-day tanks are embedded in concrete in the floor slab of the Diesel Generator Building ~~and have~~ for the four original diesel generators and the Additional Diesel Generator Building for the ADGU. Each tank has separate truck fills for each generator. 49

In the event all ~~four~~ fuel oil storage tank fill lines are rendered inoperable by tornado missiles, ~~the tanks can be filled~~ For seismic loads, the tanks can be filled as specified below. For the Diesel Generator Building, the tanks can be filled through the tank manway openings located in the hallway area of the diesel generator building. The hallway area is separated from the four diesel generator rooms. The alternate mode of filling the storage tanks will require routing a hose (qualified for this service) from the delivery vehicle through the CO_2 tank storage room, the lube oil storage room, and into the hallway. 49

For the Additional Diesel Generator Building, the tanks can be filled through the building personnel doors. This can be done by routing the tank truck hose (qualified for this service) through the building's north exterior personnel door, then to two nearby interior wall personnel doors leading towards the north-end storage tank manway openings. Since this method of filling the tanks requires blocking open fire doors, applicable administrative controls would have to be satisfied to use the doors in this manner.

Missile protection ~~will be~~ is provided for ~~the~~ all fuel oil vent lines ~~by ECN 3637 prior to fuel load as previously noted in TVA's letter to NRC (L. M. Mills to E. Adensam) dated March 17, 1982.~~ for the four original diesel generators and the ADGU. 49

040.82 Question

Discuss the means for detecting or preventing growth of algae in the diesel fuel storage tank. If it were detected, describe the methods to be provided for cleaning the affected storage tank. (SRP 9.5.4, Part III, Item 4).

Response

Biological growths will be detected by using ~~Boron~~ Microbe Monitor test kits ~~(Boron Oil Company, Cleveland, Ohio), or equivalent,~~ on oil samples taken periodically from diesel fuel storage tanks in accordance with plant technical instructions. These kits are designed specifically for sensing biological growths in oils.

Commercial biocidal agents have been found to be effective in preventing biological growths. Fuel oils will be purchased with biocides added or the biocides will be added by plant employees ~~as required.~~ in accordance with plant technical instructions. 44
If biological growths are detected in the stored fuel supply, biocides will be added and the fuel circulated for mixup.

Should a fuel oil storage tank require disinfection, it will be acccomplished by removing the fuel, isolating the tank, treating with the appropriate concentration of chlorine (sodium hypochlorite) ~~or other suitable disinfectant solutions~~, thoroughly rinsing, and drying with air. After completing the disinfection, the storage tank can then be returned to service. 44

040.83 **Question**
~~(9.5.4)~~

In Section 9.5.4.2 you state whether materials selected for the diesel fuel oil system assure adequate corrosion protection to minimize fuel oil contamination. Expand the FSAR to include a more explicit description of proposed protection of underground piping. Where corrosion protective coatings are being considered (piping and tanks) include the industry standards which will be used in their application. Also discuss what provisions will be made in the design of the fuel oil storage and transfer system in the use of an impressed current type cathodic protection system, in addition to water proof protective coatings, to minimize corrosion of buried piping or equipment. If cathodic protection is not being considered, provide your justification. (SRP 9.5.4, Part II and Part II, Item 4.) 46

Response

Original Four Diesel Generator Units

The only underground piping exists between the yard storage tanks and the seven-day fuel oil storage tanks. The piping and components are wrapped with polyethylene and all joints are taped. Cathode protection is not used since this part of the system is not safety related. The seven-day fuel oil storage tanks are internally coated with Rustban ~~d~~ 357 as manufactured by Humble Oil Company. The exterior of the tank is coated with a single coat of red lead in oil. All coating was done by the tank manufacturer. 49

Additional Diesel Generator System

The underground piping between the yard storage tanks and the seven-day fuel oil storage tanks is coated with .035" of polyethylene coating by the manufacturer. All joints are primed using a coal-tar base solution and taped with a fabric tape that is saturated with coal tar. Cathodic protection is not used since this part of the system is not safety-related.

The seven-day fuel oil storage tanks are internally coated with Rustban # 357 as manufactured by Humble Oil Co. The exterier of the tanks are coated with

Ameron Dimetcoat # 6 inorganic zinc primer. These coatings were applied by the tank manufacturer.

040.85 Question
(9.5.4)

In Section 9.5.4.3 you state that diesel fuel oil is available from local distribution sources. Identify the sources where diesel quality fuel oil will be available and the distances required to be traveled from the source(s) to the plant. Also discuss how fuel oil will be delivered onsite under extremely unfavorable environmental conditions. (SRP 9.5.4, Part III, Item 5b).

Response

~~At the present time fuel oil for Watts Bar Nuclear is supplied under an IQT contract by Exxon Oil Company from Knoxville, Tennessee. The distance from the terminal to Watts Bar Nuclear is 60 miles. Under the IQT contract other suppliers in Knoxville or Chattanooga may be providing oil in the future.~~

~~Delivery service to the plant from the Exxon terminal has been very dependable in unfavorable environmental conditions.~~ 44

~~Under the present IQT contract other Exxon suppliers in the Knoxville or Chattanooga area may be requested to provide fuel oil if needed. The distance from the Chattanooga area to Watts Bar Nuclear is also approximately 60 miles.~~

At the present time, diesel fuel oil for Watts Bar Nuclear Plant (WBN) is supplied under indefinite quantity term (IQT) agreements with various suppliers. The distance from the closest terminals to WBN is approximately 60 miles.

Delivery service to WBN from these terminals has been very dependable, even in unfavorable environmental conditions.

040.88 (9.5.4) Question

Discuss the precautionary measures that will be taken to assure the quality and reliability of the fuel oil supply for emergency diesel generator operation. Include the type of fuel oil; impurity and quality limitations as well as diesel index number of its equivalent; cloud point; entrained moisture; sulfur; particulates and other deliterious insoluble substances; procedure for testing newly delivered fuel; periodic sampling and testing of on-site fuel oil (including interval between tests); interval of time between periodic removal of condensate from fuel tanks and periodic system inspection. In your discussion include reference to industry (or other) standards which will be followed to assure a reliable fuel oil supply to the emergency generators. (SRP 9.,5.4, Part III, Items 3 and 4).

Response

~~See revised Section 9.5.~~ 44

WBN's Technical Specifications are being developed in accordance with draft NUREG-1431 (Westinghouse Standard Technical Specifications). This NUREG, when finalized, will incorporate the latest NRC guidance on appropriate fuel oil testing requirements, including applicable sections of American Standard Testing Methods (ASTM) Standards. Presently, WBN uses an interim program of tests and inspections to assure the quality and reliability of its fuel oil supply. Engine-mounted tanks are checked for accumulated water and any such water removed every 31 days and after operation of the diesel for 1 hour or greater. The 7-day tanks are also inspected every 31 days. Newly delivered fuel oil is inspected in accordance with ASTM Standard D975, except for sulfur analysis which is performed in accordance with ASTM D1552 or D2622.

040.89 (9.5.4) Question

Assume an unlikely event has occurred requiring operation of a diesel generator for a prolonged period that would require replenishment of fuel oil without interrupting operation of the diesel generator. Identify those provisions made in the design of the fuel oil storage fill system to minimize the creation of turbulence of the sediment in the bottom of the storage tank. Stirring of this sediment during addition of new fuel has the potential of causing the overall quality of the fuel to become unacceptable and could potentially lead to the degradation or failure of the diesel generator.

Response

~~The oil tanks have been designed with baffles in the fill lines to prevent sediment from being stirred up during filling at low level.~~

The 7-day fuel oil storage tanks for the additional diesel generator unit as well as for for the original four units, are equipped with anti-splash deflectors attached to the fill lines to prevent sediment from being stirred up during tank filling.

040.90 (9.5.4) Question

You state in Section 9.5.4.2 that the diesel generator fuel oil storage tank is provided with an individual fill and vent line. Indicate where these lines are located (indoor or outdoor) and the height these lines are terminated above finished ground grade. If these lines are located outdoors discuss the provisions made in your design to prevent entrace of water into storage tank during adverse environmental conditions.

Response

Original Four Diesel Generator Units

The individual fill connections for the original four diesel generators are of the OPW No. 122 type with a quick opening top cover and screw thread inner lock-type cover with gaskets to prevent water leakage and are located in concrete slabs on the outside of the Diesel Generator Building. The individual vent lines are vented to the outside at an elevation of 766'6' which is above the maximum flood level of 743'5'. 46

Additional Diesel Generator Unit

The fill connection for the ADGU is a type OPW No. 122 with a quick-opening top cover and screw-thread inner lock-type cover with gaskets to prevent water leakage. It is located 6" above finished grade on the outside of the additional diesel generator building. The vent line is routed to the outside at an elevation of 775'-6", which is above the maximum flood level of 743'5".

040.91 (9.5.4) **Question**

Provide the source of power for the seven day fuel oil storage tank transfer pumps and the motor characteristics, i.e., motor horsepower, operating voltage, phase(s), and frequency. Also include pump capacity and discharge head. Revise the FSAR accordingly.

Response

Day fuel oil storage tank transfer pump motors for the original four diesel generators and the additional diesel generator unit (ADGU) are rated one horsepower, 460 VAC, 3 phase, 60Hz. The pump capacity for the original four diesel generators and the ADGU is 15 gpm, 30 psi discharge head, 13 ft suction head, 0°-110°F. The pump motors for the original four diesel generators ~~They~~ are powered from the 480V diesel auxiliary boards 1A1-A, 1A2-A, 1B1-B, 1B2-B, 2A1-A, 2A2-A, 2B1-B, and 2B2-B, and are shown connected to 1A1-A and 1A2-A on Figures 8.3-30 and 8.3.-31 respectively of the Watts Bar FSAR. The pump motors for the ADGU are powered from the 480V diesel auxiliary board C1-S, as shown on FSAR Figure 8.3-30A.

040.92 Question

Provide the results of a failure mode and effects analysis to show that failure of a piping connection between subsystems (engine water jacket, lube oil cooler, governor lube oil cooler, and engine air inter-cooler) does not cause total degradation of the diesel generator cooling water system. (SRP 9,.5.5, Part III, Item la).

Response

The ERCW supply piping to any one diesel-generator may be isolated to prevent total degradation of the cooling water system due to a piping failure. The valve numbers to isolate are as follows:

Unit 1A-A:	1-FCV-67-66
	1-FCV-67-68
Unit 1B-B:	1-FCV-67-65
	1-FCV-67-67
Unit ~~1~~ 2A-A:	2-FCV-67-66
	2-FCV-67-68
Unit 2B-B:	2-FCV-67-65
	2-FCV-67-67
ADGU:	1-FCV-67-72
	2-FCV-67-73

040.94 Question
(9.5.5)

Describe the instrumentation, controls, sensors and alarms provided for monitoring of the diesel engine cooling water system and describe their function. Discuss the testing necessary to maintain and assure a highly reliable instrumentation, controls, sensors, and alarm system, and where the alarms are annunciated. Identify the temperature, pressure, level, and flow (where applicable) sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer and describe what operator actions are required during alarm conditions to prevent harmful effects to the diesel engine. Discuss the systems interlocks provided. (SRP 9.5.5., Part III, Item 1c).

Response

The diesel engine jacket water temperature is monitored and high temperature (195°F) is alarmed on panel O-M-26 in the MCR and panel O-L-4 in the Auxiliary Control Room. During non-accident conditions the engine will shutdown if the water jacket temperature increases to 205°F. There are no other interlocks on this system. Engine water level is monitored locally with low standby and low operating water level alarmed locally. Low engine water pressure in monitored when engine is running and low water pressure is alarmed locally. No immediate operator action is required. These instruments will be tested and calibrated ~~every 18 months.~~ on a routine basis. | 47

(Note: For the Additional Diesel Generator Unit this value is 215°F due to a different location of the temperature sensor.)

040.96 (9.5.5) <u>Question</u>

The diesel generators are required to start automatically on loss of all offsite power and in the event of a LOCA. The diesel generator sets should be capable of operation at less than full load for extended periods without degradation of performance or reliability. Should a LOCA occur with availability of offsite power, discuss the design provisions and other parameters that have been considered in the selection of the diesel generators to enable them to run unloaded (on standby) for extended periods without degradation of engine performance or reliability. Expand your PSAR/FSAR to include and explicitly define the capability of your design with regard to this requirement. (SRP 9.5.5, Part III, Item 7).

<u>Response</u>

Internal combustion engines operate most reliably at the rating for which they are designed. This is true of Electro-Motive Division diesel engines as well as those of other manufacturers.

At extended light load operation, 'souping' can be expected to occur with any diesel engine, including those built by Electro-Motive Division. The term 'souping' refers to an accumulation of lube oil in the exhaust
system due to light load operation. Depending upon the 44
amount of 'souping' that has taken place, an exhaust fire could result when the engine is suddenly loaded.

If an engine has been running lightly loaded it can be 'cleaned out' by following the recommendations listed below:

A.) Operation at synchronous speed at loads between 0 and 20 percent (20%). After four and a half (4 1/2) hours of operation, run the engine at a minimum of 40 percent (40%) load for a minimum of thirty (30) minutes to clean out exhaust stacks.

B.) Operation at idle speed (450 rpm nominal ~~440-560 RPM~~): After 46
five (5) days of operation at a minimum oil into engine temperature of 170 degrees F, run the engine at a minimum of 40 percent (40%)
load for aminimum of thirty (30) minutes to 44
clean out exhaust stacks. It is imperative that during the extended idle period, the air

box drains are allowed to continually drain or are opened periodically to purge oil accumulated in the engine air box.

At synchronous speed and loads less than 20 percent (20%) of rated, a ~~200~~ 3000-hour accumulative time limit has been placed on turbochargers in all nuclear installations. Between 20 percent (20%) and 50 percent (50%) load, there is a ~~n~~ ~~1000~~ 6000-hour accumulative time limit. After the time limit has been reached for a particular load level, this component should be replaced. If a unit is to be run in both the above load ranges, it is recommended that a ~~200~~ 3000-hour time limit be used. 46

Appropriate portions of the above information have been incorporated into FSAR Section 8.3.1.1 to address operation of the diesel generators under low-load or no-load conditions. However, some of the specific numerical values listed in this section for diesel loading percentages and time durations are based on WBN's operating procedures. These are, in some cases, more conservative than the manufacturer's recommendations described above.

040.98 (9.5.5) <u>Question</u>

Provide the source of power for the electric jacket water heater. Provide the electric heater characteristics, i.e., operating voltage, phase(s), frequency and kw output as applicable. Revise the FSAR accordingly.

<u>Response</u>

The electric jacket water heaters for the original four diesel generators and the additional diesel generator unit (ADGU) are rated 15 kw, 480 VAC, 3 phase, 60 Hz. The heaters for the original four diesel generators ~~They~~ are powered from the 480V diesel auxiliary boards 1A1-A, 1A2-A, 1B1-B, 1B2-B, 2A1-A, 2B1-B, and 2B2-B, and are shown connected to 1A1-A and 1A2-A on Figures 8.3-30 and 8.3-31 respectively of the Watts Bar FSAR. The heaters for the ADGU are powered from the 480V diesel auxiliary board C2-S, as shown on FSAR Figure 8.3-31A.

040.101 Question
(9.5.6)

Provide the source of power for the diesel engine air starting system compressors and motor characteristics, i.e. motor hp, operating voltage phase(s), and frequency. Revise your FSAR accordingly.

for the original four diesel generators and the additional diesel generator unit (ADGU)

Response

Air compressor motors are rated 5 horsepower, 480 VAC, 3 phase, 60 Hz. They are powered from the 480V diesel auxiliary boards 1A1-A, 1A2-A, 1B1-B, 1B2-B, 2A1-A, 2A2-A, 2B1-B, and 2B2-B, and are shown connected to 1A1-A and 1A2-A on Figures 8.3-30 and 8.3-31 respectively of the Watts Bar FSAR. The air compressor motors for the ADGU are powered from the 480V diesel auxiliary board C2-S, as shown on FSAR Figure 8.3-31A.

For the original four diesel generators, 040.103 (9.5.7) **Question**

What measures have been taken to prevent entry of deleterious materials into the engine lubrication oil system due to operator error during recharging of lubricating oil or normal operation. (SRP 9.5.7, Part III, Item 1c).

Response

~~When recharging the lube oil system, the oil is pumped from a new sealed drum through clean hoses to the engine.~~ Lube oil is added to the system according to plant maintenance instructions which require new, sealed drums and clean hoses to be used. These instructions also require independent verification to preclude operator error. The point where oil is added is clearly marked on the strainer housing. During normal operation, the lube oil system is a closed system with screens and filters. A periodic sampling or analysis program for the lube oil system will further ensure acceptable oil. 4

040.104
9.5.7

Question

Describe the instrumentation, controls, sensors, and alarms provided for monitoring the diesel engine lubrication oil system and describe their function. Describe the testing necessary to maintain a highly reliable instrumentation, control, sensors, and alarm system and where the alarms are annunciated. Identify the temperature, pressure, and level sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer and describe any operator action required during alarm conditions to prevent harmful effects to the diesel engine. Discuss systems interlocks provided. Revise your FSAR accordingly. (SRP 9.5.7, Part III, Item 1e).

Response

The low lube oil pressure alarms are located on panel 0-M-26 in the MCR, ~~and~~ on panel 0-L-4 in the Auxiliary Control Room, and on the local control panel. Low lube oil pressure will alarm at a pressure below 10 psi whether the engine is operating or on standby. Furthermore, this alarm will activate when the oil pressure is below 6 psi in the turbocharger soakback system. (This feature was added during the lube oil modification.) At idle or low speed the low lube oil pressure will alarm at pressures below 25 psi. When the engine is operating at rated speed, the low lube oil will alarm at pressures below 40 psi. At rated speed the engine will shut down if lube oil pressure drops below 20 psi during non-accident conditions. There are no other interlocks on this system. No immediate operator action is required. These instruments will be tested and calibrated every 18 months. 44

40.106 Question

An emergency diesel generator unit in a nuclear power plant is normally in the ready standby mode unless there is a loss of offsite power, an accident, or the diesel generator is under test. Long periods on standby have a tendency to drain or nearly empty the engine lube oil piping system. On an emergency start of the engine as much as 5 to 14 or more seconds may elapse from the start of cranking until full lube oil pressure is attained even though full engine speed is generally reached in about five seconds. With an essentially dry engine, the momentary lack of lubrication at the various moving parts may damage bearing surfaces producing incipient or actual component failure with resultant equipment unavailability.

The emergency condition of readiness requires this equipment to attain full rated speed and enable automatic sequencing of electric load within ten seconds. For this reason, and to improve upon the availability of this equipment on demand, it is necessary to establish as quickly as possible an oil film in the wearing parts of the diesel engine. Lubricating oil is normally delivered to the engine wearing parts by one or more engine drive pumps. During the starting cycle the pump(s) accelerates slowly with the engine and may not supply the required quantity of lubricating oil where needed fast enough. To remedy this condition, as a minimum, an electrically driven lubricating oil pump, powered from a reliable DC power supply, should be installed in the lube oil system to operate in parallel with the engine driven main lube pump. The electric driven prelube pump should operate only during the engine cranking cycle or until satisfactory lube oil pressure is established in the engine main lube distribution header. The installation of this prelube pump should be coordinated with the respective engine manufacturer. Some diesel engines include a lube oil circulating pump as an integral part of the lube oil preheating system which is in use while the diesel pump may not be needed.

Confirm your compliance with the above requirement or provide your justification for not installing an electric prelube oil pump.

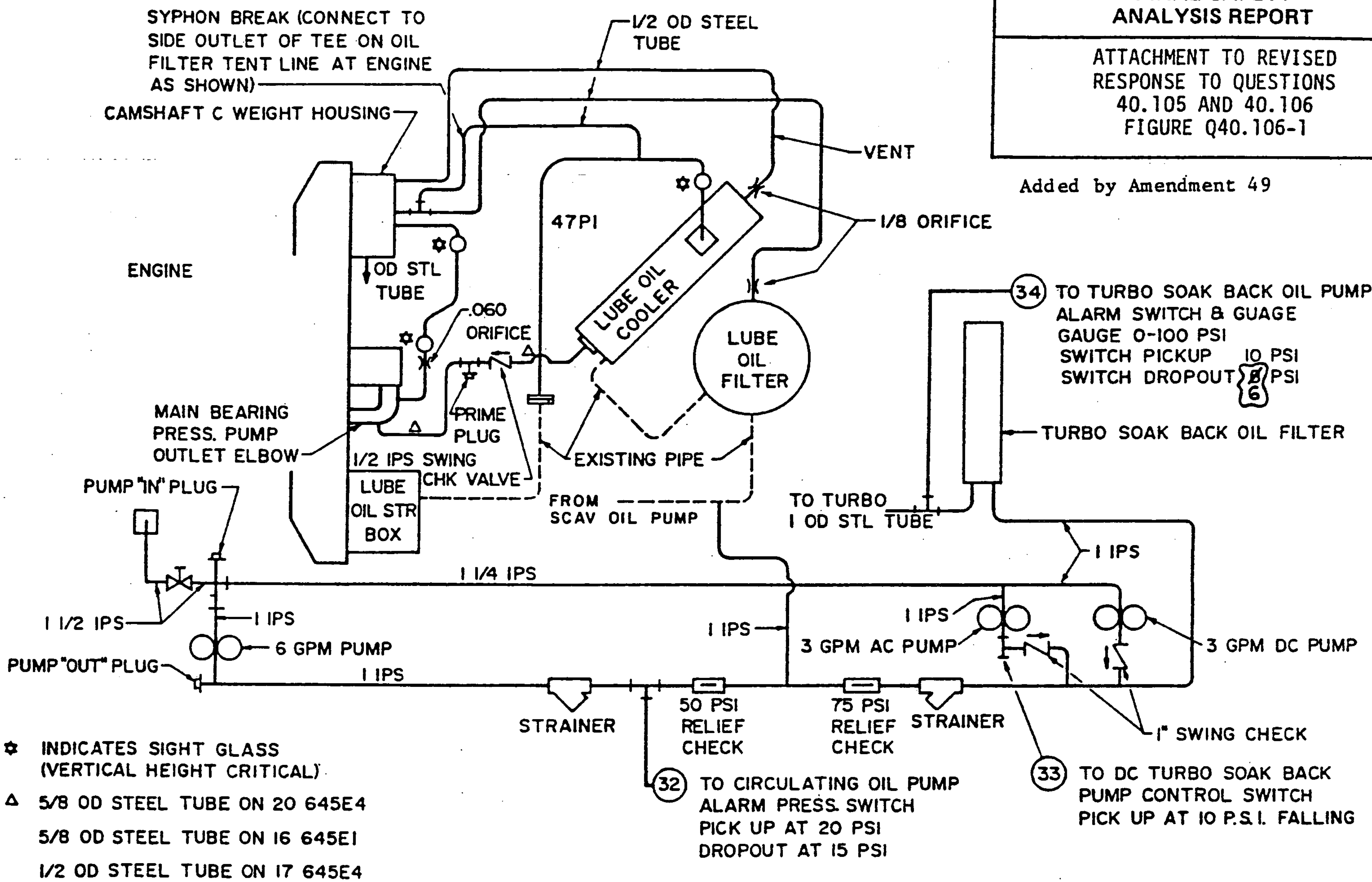
Response

Watts Bar Nuclear Plant has completed ~~The diesel engine manufacturer (EMD/GM) has proposed~~ a modification to the lubricating oil system shown in the attached diagram. Included in this modification are a dc motor-driven pump, an additional ac motor-driven pump, and piping modifications. The dc motor-driven pump supplies oil to the turbocharger if the ac motor-driven pump cannot and provides a method of removing heat from the turbocharger bearings if the engine is shut down without the ac pump operable. The additional ac motor-driven pump ensures proper lubrication of the turbocharger during the start sequence. The piping modifications preclude the draining down of the lubricating oil system and provides warm oil directly to the engine crankshaft bearings during standby, thus providing protection from 'dry' starts and improves standby temperature maintenance. TVA intends to complete this modification prior to fuel loading at WBNP-1. (Note: This lube oil modification has already been incorporated in the additional diesel generator at the factory prior to delivery.) 49

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ATTACHMENT TO REVISED
RESPONSE TO QUESTIONS
40.105 AND 40.106
FIGURE Q40.106-1

Added by Amendment 49



SCHEMATIC DIAGRAM

040.109 (9.5.8) Question

Discuss the provisions made in your design of the diesel engine combustion air intake and exhaust system to prevent possible clogging, during standby and in operation, from abnormal climatic conditions (heavy rain, freezing rain, dust storms, ice and snow) that could prevent operation of the diesel generator on demand (SRP 9.5.3, Part III, Item 5).

Response

The exhaust system for the original four diesel generator units and the additional diesel generator unit is identical to the design on SNP. ~~and has been complete for six years.~~ Due to the climate in the region, it is not feasible for the 36" diameter exhaust stack to be completely closed by freezing rain or sleet. Any rain, ice, or snow which falls into the stack falls to the bottom of a 90° elbow which is located in a heated room and is carried away by a drain.

40.111 **Question:**
(9.5.8)

Experience at some operating plants has shown that diesel engines have failed to start due to accumulation of dust and other deleterious material on electrical equipment associated with starting of the diesel generators (e.g., auxiliary relay contacts, control switches, etc.). Describe the provisions that have been made in your Diesel Generator Building design, Electrical Starting System, and combustion air and ventilation air intake design(s) to preclude this condition to assure availability of the diesel generator on demand.

Also describe under normal plant operation what procedure(s) will be used to minimize accumulation of dust in the diesel generator room; specifically, address concrete dust control. In your response also consider the condition when unit 1 is in operation and unit 2 is under construction (abnormal generation of dust).

Response:

Combustion air and ventilation air intakes are approximately 20 feet above ground level. Also, the combustion air system includes an oil-bath type filter. These features should restrict introduction of dust into the Diesel Generator Building.

In addition, provisions are made in the control relaying and switches to protect these items from accumulation of dust or other deleterious material by means of dust covers or enclosures.

In the additional diesel generator building in both the control and annunciation distribution panels, all plugs and receptacles that are used to connect the additional diesel generator in place of a disabled diesel generator are equipped with protective caps to prevent the entry of dust and dirt. In the diesel generator building in both the control and annunciation distribution panels, all receptacles are also equipped with protective caps. Protective caps are not required for the plugs in the diesel generator building since they are always plugged into either their normal diesel generator circuits (receptacles) or the additional diesel generator circuits.

040.125 Question

Operating experience at certain nuclear power plants which have two cycle turbocharged diesel engines manufactured by the Electromotive Division (EMD) of General Motors driving emergency generators have experienced a significant number of turbocharger mechanical gear drive failures. The failures have occurred as the result of running the emergency diesel generators at no load or light load conditions for extended periods. No load or light load operation could occur during periodic equipment testing or during accident conditions with availability of offsite power. When this equipment is operated under no load conditions insufficient exhaust gas volume is generated to operate the turbocharger. As a result the turbocharger is driven mechanically from a gear drive in order to supply enough combustion air to the engine to maintain rated speed. The turbocharger and mechanical drive gear normally supplied with these engines are not designed for standby service encountered in nuclear power plant application where the equipment may be called upon to operate at no load or light load condition and full rated speed for a prolonged period. The EMD equipment was originally designed for locomotive service where no load speeds for the engine and generator are much lower than full load speeds. The locomotive turbocharged diesel hardly ever runs at full speed except at full load. The EMD has strongly recommended to users of this diesel engine design against operation at no load or light load conditions at full rated speed for extended periods because of the short life expectancy of the turbocharger mechanical gear drive unit normally furnished. No load or light load operation also causes general deterioration in any diesel engine.

To cope with the severe service the equipment is normally subjected to and in the interest of reducing failures and increasing the availability of their equipment EMD has developed a heavy-duty turbocharger drive gear unit that can replace existing equipment. This is available as a replacement kit, or engines can be ordered with the heavy duty turbocharger drive gear assembly.

To assure optimum availability of emergency diesel generators on demand, applicant's who have on order or intent to order emergency generators driven by two cycle diesel engines manufactured by EMD should be provided with the heavy-duty turbocharger mechanical drive gear assembly as recommended by EMD for the class of service encountered in nuclear power plants. Confirm your compliance with this requirement.

Response

Heavy-duty turbocharger drive gear assemblies are installed on the four existing emergency diesel generators and the additional diesel generator. 53

040.128 <u>Question</u>

Diesel Engine Lubricating Oil System

A. Background - From information supplied to date, the NRC has been able to deterime 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.

LUBRIATING OIL SYSTEM

The engine lubricating oil system is a combination of four (4) separate systems for installation with turbocharged engines. For a detailed schematic of the lube oil system supplied on these engines, refer FSAR Figure 40.128-2. 53

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 separate 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.

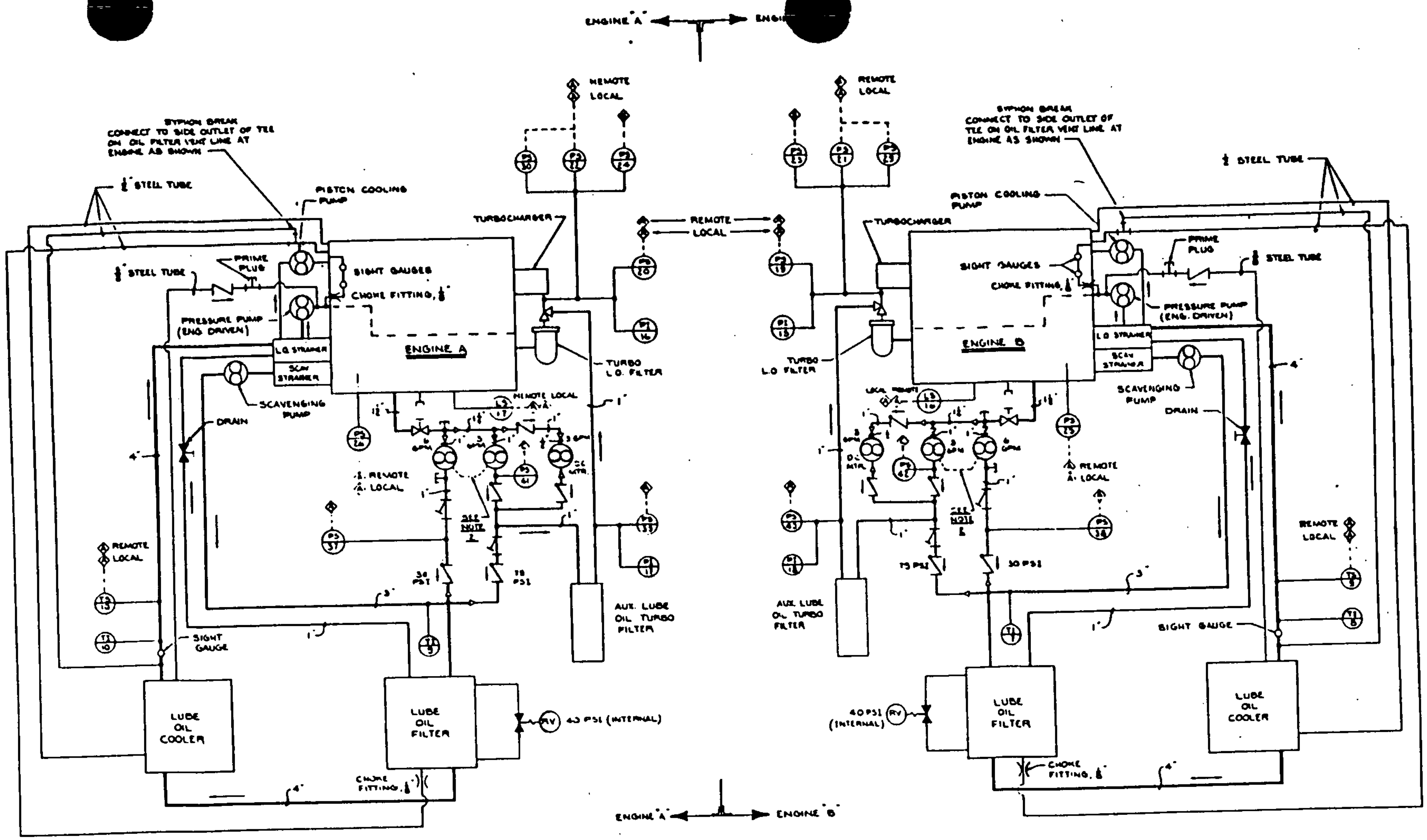
The lube oil circulating pump draws oil from the oil pan and pumps it through a 30 psi check valve, in-line wye strainer, main lube oil filter, lube oil cooler, and is returned to the oil pan through the strainer housing. This system also serves to continously prelube the engine, the main engine oil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

(Note: This lube oil modification has already been incorporated in the additional diesel generator at the factory prior to delivery.)



Revised by Amendment 53

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SCHEMATIC DIAGRAM LUBE OIL
SYSTEM

DRAWING NO. 6036F03001
FIGURE NO. Q40.128-2

ENCLOSURE 3

ENCLOSURE 3

List of Commitments

1. FSAR Section 9.4.5.2.2.4 will be revised in a future amendment to incorporate the clarification presented in the response to Question 010.43.

2. TVA is currently investigating the potential for external blockage of the ADGB 480V auxiliary board room air intake by a missile impact and will report its evaluation and any resulting design change in a future submittal prior to fuel load.

3. The fire hazard analysis for the additional diesel generator building will be provided in the WBN Fire Protection Report which will be incorporated into FSAR Section 9.5.1 in a future amendment.

4. The WBN Fire Protection Report will be incorporated into FSAR Section 9.5.1 in a future amendment. This report will provide a revised comparison of the plant fire protection program to Appendix A of BTP APCSB 9.5-1 and to the applicable sections of Appendix R of 10 CFR 50.

5. Incorporate the clarification presented in the response to Question 040.132 into FSAR Section 9.5.4.2 in a future amendment.

ENCLOSURE 1

NRC-TVA MANAGEMENT MEETING ON

WATTS BAR NUCLEAR PLANT

SEPTEMBER 30, 1991

Attendee	Organization
J. Garrity	Watts Bar Site VP
F. Hebdon	NRC/NRR/PDII-4
R. Huston	TVA Rockville Office
G. Lainas	NRC/NRR/AD for Region II Projects
G. Pannell	TVA Watts Bar Site Licensing
J. Partlow	NRC/NRR/Associate Director, Projects
P. Tam	NRC/NRR/PDII-4
S. Varga	NRC/NRR/DRP I/II

Enclosure 2

AGENDA 9/30/91

NRR Meeting

1:30 P.M.

TVA - John Garrity, George Pannell, Roger Huston

Readiness for Restart John Garrity

- Activity Status
- Restart Management Objectives Review and Closure Process

Licensing Risk Ranking/Performance Measurement George Pannell

- Reason for Development
- Current Use in WBN Licensing Project Plan
- Watts Bar/NRR Performance Measures

NPP Volume 4 George Pannell

- Recent Revision Scope
- CAP and Special Projects Closure (Roles of NRR,Region II,Schedule)
- Expected NRC Action

WBN Completion Plan John Garrity/George Pannell

- Purpose
- Content
- Current Status