GULF STATES UTILITIES COMPANY

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March 5, 1984
RBG- 17198
File No. G9.5, G9.8.6.1

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commisson
Washington, D. C. 20555

Dear Mr. Denton:

River Bend Station Unit 1
Docket No. 50-458

Enclosed for your review are Gulf States Utilities Company (GSU) responses to Request for Additional Information identified by the Nuclear Regulatory Commission's Power Systems Branch (PSB). This letter supplements information contained in docketed correspondence from J. E. Booker to H. R. Denton dated December 30, 1983 and February 10, 1984. Attachment 1 of this letter summarizes the Staff request identified in meeting between GSU and PSB dated February 15, 1984. The following enclosures contain the actual written changes to the FSAR text including all tables and figures. These changes will be incorporated into the FSAR in a future amendment.

Sincerely,

William J Reed

for J. E. Booker
Manager-Engineering
Nuclear Fuels & Licensing
River Bend Nuclear Group

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A T T A C H M E N T   1

Listed below are responses to requests for additional information as discussed at our February 15, 1984 meeting.

1. Diesel Generator Operations Training - This item was addressed in the Licensing Review Group - II (LRG-II) position 1-PSB, which was endorsed in our December 30, 1983 letter. A copy of LRG-II Position 1-PSB is provided as Enclosure 1.

2. Surveillance Testing and No Load/Light Load Operation - This item was addressed in the LRG-II position 1-PSB (see Enclosure 1), which was endorsed in our December 30, 1983 letter.

3. Diesel Generator Controls Mounting - This item was addressed in revisions to Sections 8.3.1.1.3.6.1.1 and 8.3.1.1.3.6.2.1 in Amendment 3.

4. Fuel Oil Storage Tank Internal Corrosion - The response to this request is provided in Enclosure 2. In addition, vendor product information on additive SDI-35 has been included as Enclosure 3.

5. Fuel Oil Storage Tank Sediment - The response to this request is provided in Enclosure 4. In addition, a drawing has been provided as Enclosure 5 for your information describing the location and size of filters between the fuel oil storage tank and the diesel generator.

6. Diesel Generator Qualifications - FSAR revisions are provided in Enclosure 6 to address this concern.

7. Standby Diesel Generator Heat Exchanger Data - The response to this request is provided in Enclosure 7.

8. HPCS Diesel Generator Cooling Water System (DGCWS) Corrosion - The response to this request is provided in Enclosure 8. In addition, vendor product information on the corrosion inhibitor used in the HPCS DGCWS is provided as Enclosure 9.

9. HPCS Keep Warm System - The response to this request is provided in Enclosure 10.

10. Diesel Generator Cooling Water System I&C - The response to this request is provided in Enclosure 11.

11. HPCS Diesel Generator Cooling Water System Piping - A comparison of RBS design to ASME III is provided as Enclosure 12.

12. Diesel Generator Air Start System I&C - The response to this request is provided in Enclosure 11.

13. Diesel Generator Air Start System Air Dryers - The response to this request is provided in Enclosure 13.

14. HPCS Diesel Generator Air Start System Filter - The response to this request is provided in Enclosure 14.

15. A. HPCS Diesel Generator Air Start System Piping - A comparison of RBS design to ASME is provided as Enclosure 12.

    B. Standby Diesel Generator Unloading Line - A discussion of this line is provided in Enclosure 15.

16. HPCS Start Capability - Clarifications of this discussion are provided as Enclosure 16.

17. HPCS Diesel Generator Start System Compressor Redundancy - Clarification of this discussion is provided in Enclosure 17.

18. HPCS Pre-lube Capability - This item was addressed in the LRG-II position 1-PSB, which was endorsed in our December 30, 1983 letter. Additionally. FSAR revisions to address this request are provided as Enclosure 18. Also a copy of GM-EMD MI-9644 is provided as Enclosure 19.

19. Diesel Generator Lubrication System I&C - The response to this request is provided in Enclosure 11.

20. HPCS Diesel Generator Lubrication System - A comparison of RBS design to ASME III is provided as Enclosure 12.

21. Standby Diesel Generator Lubrication System Relief Valves - FSAR revisions to clarify this discussion are provided as Enclosure 20.

22. Diesel Generator Panel Dust Protection - This concern was addressed in LRG-II position 1-PSB (see Enclosure 1), which was endorsed in our December 30, 1983 letter.

23. Diesel Generator Drip Lube of Turbocharger Thrust Bearing - FSAR revisions to address this concern are provided in Enclosure 21.

24. HPCS Lubrication of Turbocharger - The 6 gpm lubrication flow is split into 2 gpm for the turbocharger gears and the remainder for the lube oil cooler. Through operational experience, the 6 gpm lubrication flow has been shown to be adequate (Note: This may be slightly modified by the new lube oil modification as described in Item 18 above).

25. HPCS Lube Oil Return Line - Enclosure 22 provides FSAR revisions to address this concern.

26. Response to FSAR Question 430.89 - Enclosure 23 provides FSAR revisions to address Question 430.89.

27. Transfer Scheme Analysis - Clarification to the transfer of sources of power to 1NNS-SWG1C is provided in Enclosure 24.

28. HPCS DG Annunciators - Clarification to the "HPCS SYSTEM NOT READY FOR AUTO START" annunciators is provided in Enclosure 25.

29. IEEE 384 - Clarification to our letter response dated February 10, 1984 on the use of one inch separation is provided in Enclosure 26.

30. HPCS Battery Discharge Alarm - The setpoint for the undervoltage alarm will be revised to be approximately the battery open circuit voltage (approximately 120 VDC). This information will be incorporated into the FSAR in a future amendment.

31. Branch Technical Position PSB-1 - (1) Clarification to what types of 1E electrical loads are tripped on undervoltage and to what level they are tripped is provided in revised paragraph 1(c) of the response (see Enclosure 27). (2) A brief description of how undervoltage relay settings are tested during plant operation is provided in revised paragraph 1(d)(5) of the response (see Enclosure 27). (3) Results of the voltage profile calculation are provided in Enclosure 28. This summary is based on calculations which rely upon general assumptions concerning bus loading conditions.

32. HPCS DG Comparison: A comparison of the RBS HPCS DG and LaSalle DG auxiliary systems are provided in Enclosure 29.

33. Backup Battery Charger Interlock - A padlock will be installed to assure that CB-10 (for the back-up battery charger) will remain open at all times, except for when actually required. The use of this padlock will insure that no single failure will jepordize the HPCS DC bus from operating. This information will be incorporated into the FSAR in a future amendment.

ENCLOSURE 1

LRG-II Position Paper
March 12, 1982

1-PSB
DIESEL GENERATOR RELIABILITY

ISSUE

The NRC issued specific recommendations on increasing the reliability of nuclear power plant emergency diesel generators via the document NUREG/CR-0660, "Enhancement of Onsite Emergency Diesel Generator Reliability". Information requests concerning these recommendations are routinely transmitted to the applicants during the review process. While a generic issue has not been identified, LRG-II has chosen to address the NUREG/CR-0660 recommendations generically.

LRG-II POSITION

The LRG-II position is to implement the appropriate recommendations of NUREG/CR-0660 as they apply to the onsite emergency diesel generators.

A summary of each recommendation is given below followed by a discussion on how the recommendation will be implemented.

Recommendation 1 - Moisture in Air-Starting System

The air starting system for the diesel generators relied on periodic blowdown of the air receivers for removal of entrained oil and excess water from the starting air. Operating experience has shown that accumulation of water in the starting air system has been one of the most frequent causes of diesel engine failure to start. It is recommended that air dryers be installed upstream of the air receivers.

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LRG-II Compliance

Dessicant or refrigerant type air dryers will be used upstream of the air receivers to ensure a continual supply of dry starting air. Since the dryers are not required during the starting cycle of the diesel generator, they will be designed to ASME Section VIII requirements or 1.5 times system design pressure.

Monthly verification and/or maintenance of air dryer performance will be provided.

Recommendation 2 - Air Quality in Diesel Generator Room

Malfunction or failure of the contacts and relays to function properly is another major cause of diesel engine failure to start. The root cause is usually dust, dirt and grit between the electrical contact surfaces. It is recommended that all contacts and relays be inside dust-tight enclosures and that dust control measures be implemented in the diesel generator rooms.

LRG-II Compliance

In order to protect electrical contact surfaces, diesel generator control panels will be dust-tight and water resistant in accordance with the design requirements for NEMA type 4 cabinets.

In order to control dust in the area of the diesel generators, each unit is placed in its own room. During normal plant operation, the ventilation systems provide filtered air, as a minimum, to areas containing diesel generator electrical controls. Ventilation system filters will be cleaned or replaced periodically.

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Recommendation 3 - Turbocharger Heavy Duty Gear Drive

The scheduling and frequency of surveillance testing can result in excessively long periods of no load and light load running of a diesel generator at full rated speed.

This light loading results in insufficient exhaust gas energy to drive the turbocharger on the General Motors - Electro-Motive Division (GM-EMD) diesel engines. This results in the need to mechanically drive the turbocharger. Mechanically driving the turbocharger will result in a short life expectancy for the standard design turbocharger gear drive. It is recommended that a heavy duty gear drive be installed on the turbocharger.

LRG-II Compliance

A heavy duty turbocharger gear drive will be installed to improve the reliability and availability of the GM-EMD diesel generators.

Recommendation 4 - Personnel Training

There is a particularly difficult problem in developing knowledge and maintaining skills of the operators and maintenance personnel of the diesel generator units. These units normally operate only during surveillance and trouble shooting tests to give assurance of readiness, should an emergency arise. The relatively short exposure to an operating unit makes "on the job" training especially difficult. When a nuclear power plant is put into operation, the operators having the diesel generator responsibilities may have little or no related skills on such units. It is recommended that the training of the operators and maintenance personnel, and especially their immediate supervisors, be an intensive and continuing education program. This would serve to develop knowledge and skills among those less experienced and act as "refresher training" to maintain the familiarity and skills of the qualified personnel.

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LRG-II Compliance

Operators and selected supervisory personnel will receive training on the diesel generators as a part of the cold-license training program. In addition, these personnel will receive training and experience by assisting vendor representatives and/or startup engineers during preoperational testing of the diesel generators. Selected maintenance personnel will receive vendor training that will be incorporated into maintenance department training. Maintenance on diesel generators will be performed or directly supervised by personnel who have received this training. Ongoing training will include the requalification training program required by 10CFR55 for operations personnel and maintenance departmental training for maintenance personnel.

Recommendation 5 - Automatic Pre-Lube

Long periods on standby have a tendency to drain or nearly drain the engine lube oil piping systems. 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 with resultant equipment unavailability.

It is recommended that the engine's electrically driven pre-lube pump be started by the same signal which initiates the cranking of the engine and be stopped when the engine stops cranking. An alternative approach would be to start the pre-lube pumps by the same signal but stop the pump when the pressure in the engine lube oil header has achieved a predetermined level. An electrically driven pre-lube pump accelerates to full speed quite rapidly with full delivery while the engine driven pump accelerates more slowly with the engine. In either case, such modifications should be carried out in close consultation with the engine manufacturer.

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LRG-II Compliance

In order to prevent "dry starting of the diesel engine under emergency conditions", one of the two following actions will be implemented:

A. Modify the diesel lube oil system in accordance with GM-EMD Maintenance Improvement - 9644 and anticipated manufacturer clarification.

B. Manually pre-lube the diesel engine in accordance with the manufacturer's recommendations at least once per week and before each manual diesel engine start.

Recommendation 6 - Testing Loading and Preventative Maintenance

Testing and test loading are the essence of the surveillance test as practiced in the nuclear power plant. The basic function and value of a surveillance test on a diesel generator unit is to demonstrate operability. The following recommendations are provided to guide and standardize the general approach in surveillance testing:

A. No-load and light-load operation causing incomplete combustion should be minimized to reduce the formation of gum and varnish deposits on engine parts and to reduce the likelihood of mechanical failures. Minimum load should be at least 25% of rated load.

B. The surveillance test should be within the NRC guidelines and the frequency of testing, size of test load, and duration should generally follow the recommendations of the engine manufacturer.

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C. Investigative testing, replacement and adjustment should be part of the preventative maintenance program. Testing, per se, is not a corrective measure and serves only as confirmation of readiness and operability, or as an indication of the need for corrective action.

D. A "check off test" should be the final step after any corrective action. An actual start, run, and load test would help to determine if mistakes were made during a corrective action.

LRG-II Compliance

The LRG-II position on the above recommendations are as follows:

A. For no-load and light-load operation, the following conditions will be satisfied.

(1) Implement the manufacturer's recommendations for no-load and light-load operations.

(2) During periodic testing, the diesel will be loaded to a minimum of 25 percent of full load or as recommended by the manufacturer.

(3) During troubleshooting, no-load operation will be minimized. If the troubleshooting operation is over an extended period (that is, 3 to 4 hr or more), the engine shall be cleared in accordance with item 1 above.

B. Surveillance testing of dies . generators will comply with requirements provided in each plant's Technical Specifications. These Technical Specifications will reflect the NRC guidance provided in the BWR/6 Standard Technical Specificatons.

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C. Preventive maintenance will go beyond the normal routine adjustments, servicing, and repair of components when a malfunction occurs. The preventive maintenance program will encompass investigative testing of components that have a history of repeated malfunctioning and require constant attention and repair. Furthermore, industry operating experience from sources such as the nuclear plant reliability data system will be utilized as an aid in evaluating industry history for diesel-generator component failure.

D. Upon the completion of repairs or maintenance and before an actual start, run, and load test, a final equipment check will be made to ensure that all electrical circuits are functional; that is, fuses are in place, switches and circuit breakers are in their proper position, no wires are loose, 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, it will be returned to automatic standby service.

<u>Recommendation 7 - Identification of Root Causes of Failures</u>

Improvement in reliability hinges on identification of the basic problem or "root cause" and the proper choice of corrective action. The effectiveness of all efforts to improve reliability depends on the proper execution in finding the true root cause of problems. This is especially difficult because of the usual chain of related cause and effect relationships.

In order to detect "root causes" of problems, the following guidance should be observed:

A. The obvious cause should always be suspect as the "root cause". To be sure, the obvious is usually the direct cause of failure or malfunction. The possible chain of cause-and-effect may fail to be investigated.

B. Closely spaced component failures should not be accepted unless accompanied by specific assurance of the absence of contributing causes and that alternate improved components are unavailable.

C. The LER system and the records so produced have proven to be the best single source of information on the reliability status of the emergency diesel generators. Continued reliance on this source of information for reliability data should be encouraged.

LRG-II Compliance

In general, the above recommendation are inherent in the philosophy of good engineering and operating judgment. Such a philosophy is difficult to incorporate directly into a maintenance procedure and therefore is best accomplished as a function of an onsite review group. The purpose of such a group is to independently review atypical events, repetitive events and operating data from other stations in order to improve plant safety. LRG-II participants will establish such review groups in compliance with TMI Action Plan Item I.B.1.2 as contained in NUREG-0737.

Recommendation 8 - Diesel Generator Room Ventilation and Combustion Air Inlet

Some installed diesel generator units take their combustion air from the engine room regardless of the extent of airborne dirt and the arrangement of the fire suppression system. Some units have inherent recirculation of hot cooling system air, hot room ventilation air, and even hot exhaust gas. It is recommended that the following design guidance be observed for ventilation and combustion air inlet systems:

A. Engine combustion air should be through piping directly from outside the building and at least 20 feet from ground level through proper filters.

B. Room ventilation air should be filtered and taken from a level at least 20 feet above ground level. The piping for the room ventilation air should be separate from that used for the engine combustion air.

C. Room ventilation air, hot cooling system air and/or engine exhaust gas should not be permitted to circulate back into the diesel generator room, fuel storage area, or into any other part of the power plant.

LRG-II Compliance

The LRG-II position on the above recommendations are as follows:

A. A separate source of combustion air for each diesel engine is taken from the diesel generator building outside air intakes which are located at least 20 feet above ground level. This air is filtered prior to combustion.

B. The diesel generator building ventilation system air is drawn from intakes which are at least 20 feet above ground level. As a minimum, ventilation for areas which house control equipment with electrical contacts is filtered. The piping for the diesel generator building ventilation system is separate from that used for the engine combustion air.

C. Hot cooling systems air and engine exhaust gases are discharged directly from the building. Since engine combustion air is taken from outside air intakes, any recirculation of room ventilation air for temperature control will not degrade intake air quality.

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Recommendation 9 - Fuel Oil Storage and Transfer

In order to assure proper fuel oil storage and handling, the following recommendations are made:

A. Bulk fuel storage tanks should have provisions for water removal. In addition, the fuel outlet pipe should be several inches above the tank bottom to allow some tank volume for settling of any water.

B. Fuel supply pumps for the engine fuel system should be engine driven. The fuel supply to the engine driven fuel pump should either be an assured gravity fed supply or else by a booster pump powered from a Class 1E station battery.

LRG-II Compliance

The LRG-II position on the above recommenoations are as follows:

A. Bulk fuel oil storage tanks have provisions for water removal. Typically water removal is via a drain located at the bottom of the tank.

The suction point in each storage tank is located approximately six inches from the tank bottom to prevent any accumulated water from being transferred to the day tank.

B. Fuel supply pumps for the engine fuel system are engine driven. The fuel supply to these pumps will either be an assured gravity fed supply or else by a booster pump powered from a Class 1E d-c power source.

Recommendation 10 - High Temperature Insulation for Overload Conditions

The nature of the emergency diesel generator duty includes a possibility of large overloads which could extend longer than the time required to start large water pumps, etc. There is a possibility of engine overheating from such extreme emergency overloads causing a generator fire. It is recommended that high temperature rated generator insulation be utilized for the diesel generator units to reduce the generator fire hazard.

LRG-II Compliance

LRG-II participants concur with the NRC staff position that explicit conformance with the consultants recommendation is considered unnecessary in view of the equivalent reliability provided by the design, margin, and qualification testing requirements that are normally applied to emergency standby diesel generators for nuclear power plant application.

Recomendation 11 - Engine Cooling Water Temperature Control

A water thermostat of the "3-way" or bypass-type splits the water flow so that only as much water passes through the coolers or radiator as needed to maintain the proper water outlet temperature. This type of cooling water temperature control is used in most nuclear power plant diesel engine cooling systems and was the only design reviewed which gave no indication of trouble. It is recommended that all engine cooling water temperature control arrangements be by means of the 3-way thermostat design.

LRG-II Compliance

Temperature regulation of the diesel engine coolant will be accomplished through the use of a "3-way" thermostatic valve.

Recommendation 12 - Concrete Dust Control

Concrete floors tend to shed abrasive dust of sufficient particulate size to not only become airborne, but also to enter electrical cabinets and prevent contacts from completely closing. It is recommended that the floors be painted in all rooms which house equipment with electrical contacts.

LRG-II Compliance

The accumulation of dust, including dust generated from concrete floors and walls, on the electrical equipment associated with the starting of the diesel generators is limited by:

A. Concrete floors will be painted in all diesel generator rooms which house equipment with electrical contacts.

B. The diesel generator building ventilation system design and operation which provides filtered air to all diesel generator rooms which house equipment with electrical contacts.

C. Plant design which separates each diesel generator from other plant equipment and areas.

D. Administrative procedures for cleanliness and ventilation system maintenance.

Recommendation 13 - Mounting and Support of Instrumentation to Protect It From Vibration Damage

It is recommended that instruments, controls, monitors, and indicating elements be supported in or on a freestanding, directly floor mounted panel to the extent functionally practical to reduce vibration induced wear.

LRG-II Compliance

Except for sensors and other equipment that must be directly mounted on the engine and associated piping, the controls and monitoring instrumentation for diesel generators used at LRG-II plants are installed on freestanding, floor-mounted panels separate from the engine skids and located in a floor area free of engine-induced vibration.

ENCLOSURE 2

2. System piping is protected against corrosion as follows:

   a) Buried piping is coated with coal tar enamel that conforms to the American Water Works Association Standard C203 (ref 3).

   b) Piping not buried is protected by a zinc-rich primer and a polyurethane finish coat.

3. The exterior surface of the storage tank is shot blasted in accordance with the Steel Structure Painting Council (SSPC) standard SPG (ref 4). The surface is then coated with zinc-rich epoxy primer followed by a top coat of coal tar epoxy that conforms to the SSPC-PA1 standard (ref 5).

4. The storage tank is located in a dry sand-filled, concrete vault and is not exposed to groundwater.

5. A diesel fuel oil stabilizer, such as SDI-35, is added to the fuel oil storage tanks to prevent oxidation of the fuel oil and the formation of gums and tars that could plug fuel lines. The water emulsifier component of SDI-35 keeps any water contamination suspended in the fuel oil and prevents it from settling out in the bottom of the tank. SDI-35 also contains agents to prevent internal storage tank corrosion and biotic growth in the fuel.

6. The tanks are kept normally full to minimize air contact with tank surfaces.

The fuel oil forwarding filters described in Section 9.5.4.2.3 are designed to remove any sediment that might be stirred up during refueling.

Plant operating procedures require staggered refill of the diesel fuel oil storage tanks and the following considerations when filling during required diesel generator operation. The day tank is verified to be full prior to refilling its associated fuel oil storage tank. Refill is at a controlled rate to minimize turbulence in the storage tank and is initiated in sufficient time to allow sufficient settlement prior to refilling the next tank. Confirmation of day tank fill capability without fuel oil filter clogging is required before the next storage tank is refilled. Further, the storage tanks for the standby diesel generators are filled before the HPCS storage tank.

ENCLOSURE 3

TELEX: 138516
CABLE ADDRESS APOLLO

apollo CHEMICAL CORP.

35 SOUTH JEFFERSON ROAD, WHIPPANY, NEW JERSEY 07981 • (201) 386-9400

B.U.,
This is the information I spoke about,
Tom Ott

August 15, 1978
FPR-279/878

Mr. Tom Ott, Project Engineer
Stone & Webster Engineering Corporation
Box 5200
#3 Executive Campus
Cherry Hill, New Jersey 08034

Dear Mr. Ott:

Pursuant to our telephone conversation of today, I am enclosing sales and technical information on Apollo's fuel stabilizer, SDI-35. The recommended treatment rate for the long-term storage of #2 fuel oil is 1:2000, on a volume basis.

SDI-35 is a multicomponent treatment, which prevents oxidation of the fuel oil and the formation of gums and tars that would plug fuel lines and fuel filters. The water emulsifier component keeps any water contamination suspended in the fuel oil and prevents it from settling out in the bottom of the tank, where rusting could occur. SDI-35 also contains agents to prevent storage tank corrosion and biotic growth in the fuel.

For more specific tank corrosion problems, attached is literature describing SDI-3R and SDI-14, Apollo's tank corrosion inhibitors. The application of either of these two products would be made pending the evaluation of a specific fuel oil. Should there be an instance of abnormal tank corrosion, you may wish to consider one of these products.

Should you require additional technical information or information on pricing, please do not hesitate to give me a call.

Very truly yours,

F. Paul Russo

F. Paul Russo
Marketing Coordinator
Fuel Treatments

FPR:ann
Encls.

apollo
CHEMICAL CORP.
35 SOUTH JEFFERSON ROAD
WHIPPANY, NEW JERSEY 07981
(201) 386-9400

SDI-3R and SDI-14
Distillate Fuel Oil Stabilizers - Antioxidants - and Dispersants

THE PROBLEM

Trace amounts of metal contaminants in distillate fuel oils can catalyze an oxidation reaction in the fuel, causing it to develop gums and tar which coat precombustion filters, interrupting fuel flow. These same residues may pass through the filter and end up as carbonaceous deposits on burner tips and turbine blades. Fuel oil oxidation products (tars and gums) are also acidic and "stick" to metal surfaces, to which they are attracted, creating localized corrosion. Pluggage may also occur in fuel transfer lines as build-up occurs.

THE SOLUTION

Apollo's multifunctional precombustion additives, SDI-3R and SDI-14, effectively deal with distillate fuel stabilization requirements in three ways:

1. Their metal deactivator removes dissolved metals like copper which catalyze oxidation.

2. Their antioxidant component serves as a free radical scavenger, picking up OH radicals which occur naturally in fuel from water contamination, dissolved oxygen, and ultraviolet radiation. These "radicals" are the source of continuing oxidation in the oil.

3. Their dispersants maintain uniform flow characteristics preventing accumulation of rust and biological sludges.

SDI-3R represents, then, a comprehensive means to achieve distillate fuel stability and quality maintenance for light oils used for coal unit start-up and on peaking oil-fired boilers.

On gas turbines, SDI-14 is the product of choice. It is an ashless organic equivalent of SDI-3R and is used with the (virtually ashless) high grade turbine fuels such as JPA-4 and kerosene.

Rev. 2

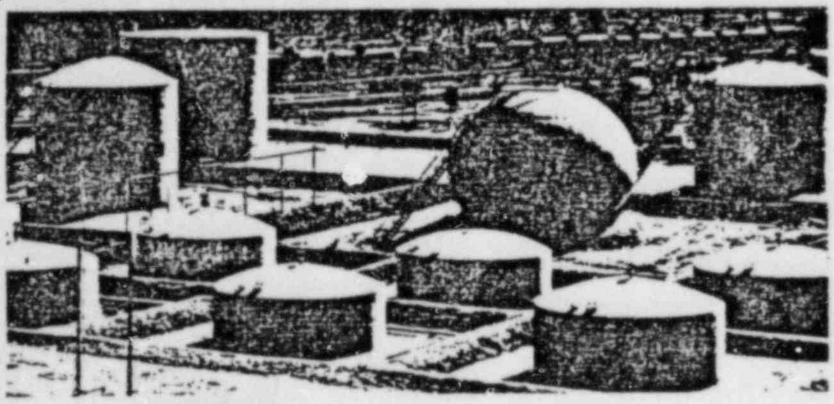
apollo

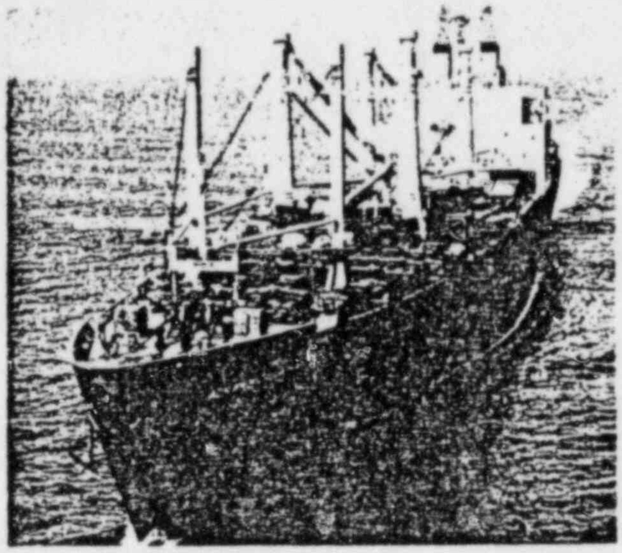
SDI-35

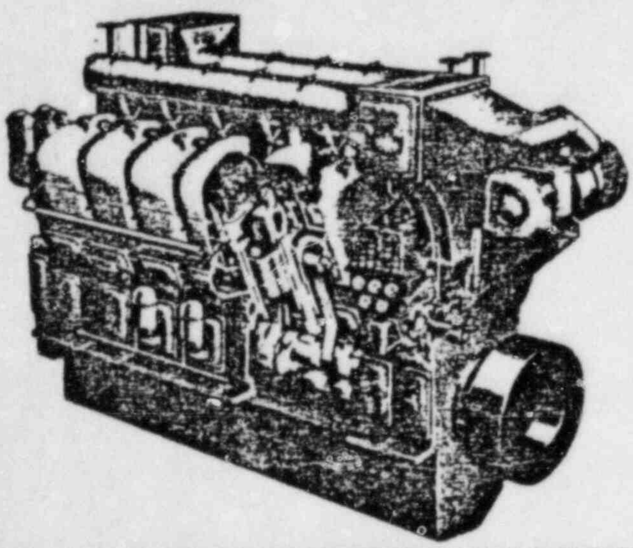
PROBLEMS OF...

- BACTERIA BUILDUP?
- PLUGGED FILTERS?
- CLOGGED SCREENS?
- WATER IN FUEL LINE?
- RUSTING OF FUEL TANKS?
- "NO–HEAT" CALLS?

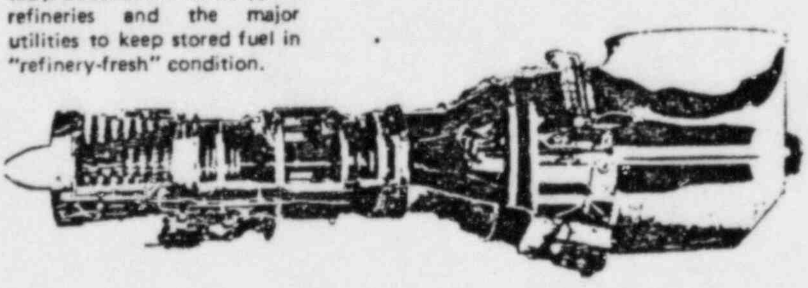
LONG TERM STORAGE FUELS / MILITARY FUELS / MISSILE STATIONS / STANDBY RESERVE FUELS
EMERGENCY DIESELS / GAS TURBINE FUELS / MARINE RESERVE FUELS
INTERRUPTIBLE FUELS / DIESEL FUELS & DOMESTIC FURNACE OILS







APOLLO SDI-35 is the accepted product of the military, the refineries and the major utilities to keep stored fuel in "refinery-fresh" condition.



apollo SDI-35 PROTECTS FUEL STORAGE TANKS AGAINST Corrosion • Bacterial Destruction • Sludged Fuel Oil • Acid Build-up • Water Drop-out

apollo SDI-35 KEEPS STORED FUEL OILS REFINERY-FRESH UP TO 10 YEARS

apollo SDI-35 ASSURES INSTANT START-UP OF EMERGENCY DIESELS, GAS TURBINES and AUXILIARY POWER SOURCES

apollo SDI-35 COMPLETELY ELIMINATES COSTLY WASTAGE PROBLEM OF DUMPING "AGED" FUELS

apollo SDI-35 APPROVED FOR USE IN BELL SYSTEMS NATION WIDE

apollo SDI-35 CURRENTLY IN USE BY MILITARY COMMANDS AND PRIVATE TELECOMMUNICATIONS SYSTEMS

APOLLO CHEMICAL CORP. 250 Delawanna Avenue, Clifton, New Jersey 07014 Tel. (201) 472-5400

apollo
CHEMICAL CORP.
250 Delawanna Avenue
Clifton, New Jersey 07014
(201) 472-5400

APOLLO CHEMICAL SDI-35

MULTIPURPOSE FUEL CONDITIONER

- For Standby Fuels
- For Regularly Burned Fuels

FOR USE WITH: Diesel Fuels, Kerosene, Furnace Oils, Jet Fuels, #4 Oil and Bunker C

A preservative additive to keep the standby fuels in "ready-to-fire" condition. Standby fuels are routinely inhibited with this product on an annual basis to keep the fuels in "refinery fresh" condition. The additive has been proven to have the capability of keeping such fuels stable as long as 10 years, when reinhibited annually.

MULTIFUNCTIONAL COMPONENTS:

(1) Stabilizer - to prevent the formation of organic sludge.

(2) Dispersing agent - to prevent settling out of any sludge.

(3) Rust preventive agent - to protect the storage tanks in the water bottom layer, as well as in the air layer above the fuel oil.

(4) Metal Deactivators and Metal Suppressing Agents - to retard the oxidation and polymerization of the fuel as a result of trace amounts of copper that may be present in the fuel.

(5) Water absorptive agent - to keep trace amounts of water dispersed in the fuel and prevent burner flameout.

(6) Bactericide agent - to prevent bacteria and slime formation and to destroy any existing organisms. The excellent rust protective properties of the fuel conditioner also prevents bacteria from gaining a "foothold" in the fuel storage tanks.

GENERAL PURPOSES OF SDI-35:

Apollo SDI-35 will maintain the fuel oil in refinery fresh condition even for extended periods of time. By proper reinhibition of the fuels, storage stability of as much as 10 years can be obtained. This is particularly important for standby fuels to be used with emergency diesels or gas turbine generators.

DISPERSANT & PENETRATING SOLVENT:

Apollo SDI-35 is a penetrating solvent and dispersant for gums, varnish and hard carbon buildup. It will:

(1) Disperse sludge in fuel tank.
(2) Prevent layering (sludge-out) in #4, #5 and #6 oils.
(3) Clean fuel preheaters, filters and screens.
(4) Clean burner tips.
(5) Promote uniform atomization.

SDI-35 FOR USE WITH DISTILLATE FUELS:

The petroleum refiners in preparing diesel fuel or #2 furnace oils add sufficient stabilizer to the fuel to protect it during the summer months, or at least until it is delivered to the fuel oil dealer or the consumer. However, the amount of stabilizer added to the fuel oil is limited.

It is even more important to note that the refiner is not primarily concerned with tank rusting or tank failure from long term storage.

Water-soluble inhibitors interfere with the storage stability of the fuel, and should not be used.

In order to keep stored fuel in "refinery fresh" condition, it is necessary that a supplementary inhibitor be added to the fuel.

The advantages of the SDI-35 inhibitor where used routinely with distillate fuels are:

(1) Prevents tank failures due to rusting. It is estimated that an average lifetime for a fuel storage tank for distillate fuel is 5 to 10 years. The additive should extend this period to 10 to 20 years and indefinitely when treatment is started with a fresh tank.

(2) Less maintenance is required since the fuel is always in ready condition for firing. The screens and nozzles require less frequent cleanout on a continually used basis and the lifetime of the Fulflo filters is extended from one year to three years.

(3) Permits savings in fuel costs by making it possible to substitute lower cost #2 fuel oil in place of kerosene or diesel fuel.

To the above directly realizable economic advantages, one should consider the expenses that occur when a furnace is not operating correctly and loss of power results therefrom. Even if the inhibitor is viewed as a preventive protection against potential failures, it provides a significant margin of safety.

USES WITH HEAVY FUEL OILS:

The SDI-35 can also be used with #4 fuel oils and residual fuel oils where advantage can be taken of its dispersing properties. It will prevent sedimentation as well as settle-out.

Residual fuels are manufactured today as a cutback of still bottoms with cutter stock. There are strong tendencies for settle-out to occur. This can be prevented by the use of SDI-35.

POUR POINT DEPRESSANT:

Apollo SDI-35 often functions as a pour point improver for #4, #5 and #6 oils, although its effect is unpredictable. Generally it improves the pumpabilities of the fuels at low temperatures and will stabilize the pour point. In some cases reductions of up to 40° F. pour point have been noted.

DISPERSANT INHIBITOR:

Apollo SDI-35 prevents wax and sludge deposits in storage tanks containing distillate fuels, #4, #5 and #6 oils. It peptizes and disperses sludge deposits.

TREATMENT RATE:

1 gallon/2,000 gallons of fuel oil.

Reinhibit the fuels at yearly intervals at the same rate of 1 gallon per 2,000 gallons.

Any makeup fuel should be reinhibited at the same rate, i.e. each 1,000 gallons of makeup fuel will require 2 quarts of SDI-35.

Overtreating will not adversely affect either the storage, the flow, or the burning properties of the fuel oil.

CLASSIFICATION & CONTAINER:

NOIB - 55 and 30 Gallon containers, 5 Gallon Pails, 1 Gallon Cans (6 per case), 1 Quart Cans (12 per case), and 1 Pint Cans (24 per case).

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ENCLOSURE 4

2. System piping is protected against corrosion as follows:

   a) Buried piping is coated with coal tar enamel that conforms to the American Water Works Association Standard C203 (ref 3).

   b) Piping not buried is protected by a zinc-rich primer and a polyurethane finish coat.

3. The exterior surface of the storage tank is shot blasted in accordance with the Steel Structure Painting Council (SSPC) standard SPG (ref 4). The surface is then coated with zinc-rich epoxy primer followed by a top coat of coal tar epoxy that conforms to the SSPC-PA1 standard (ref 5).

4. The storage tank is located in a dry sand-filled, concrete vault and is not exposed to groundwater.

5. A diesel fuel oil stabilizer, such as SDI-35, is added to the fuel oil storage tanks to prevent oxidation of the fuel oil and the formation of gums and tars that could plug fuel lines. The water emulsifier component of SDI-35 keeps any water contamination suspended in the fuel oil and prevents it from settling out in the bottom of the tank. SDI-35 also contains agents to prevent internal storage tank corrosion and biotic growth in the fuel.

6. The tanks are kept normally full to minimize air contact with tank surfaces.

The fuel oil forwarding filters described in Section 9.5.4.2.3 are designed to remove any sediment that might be stirred up during refueling.

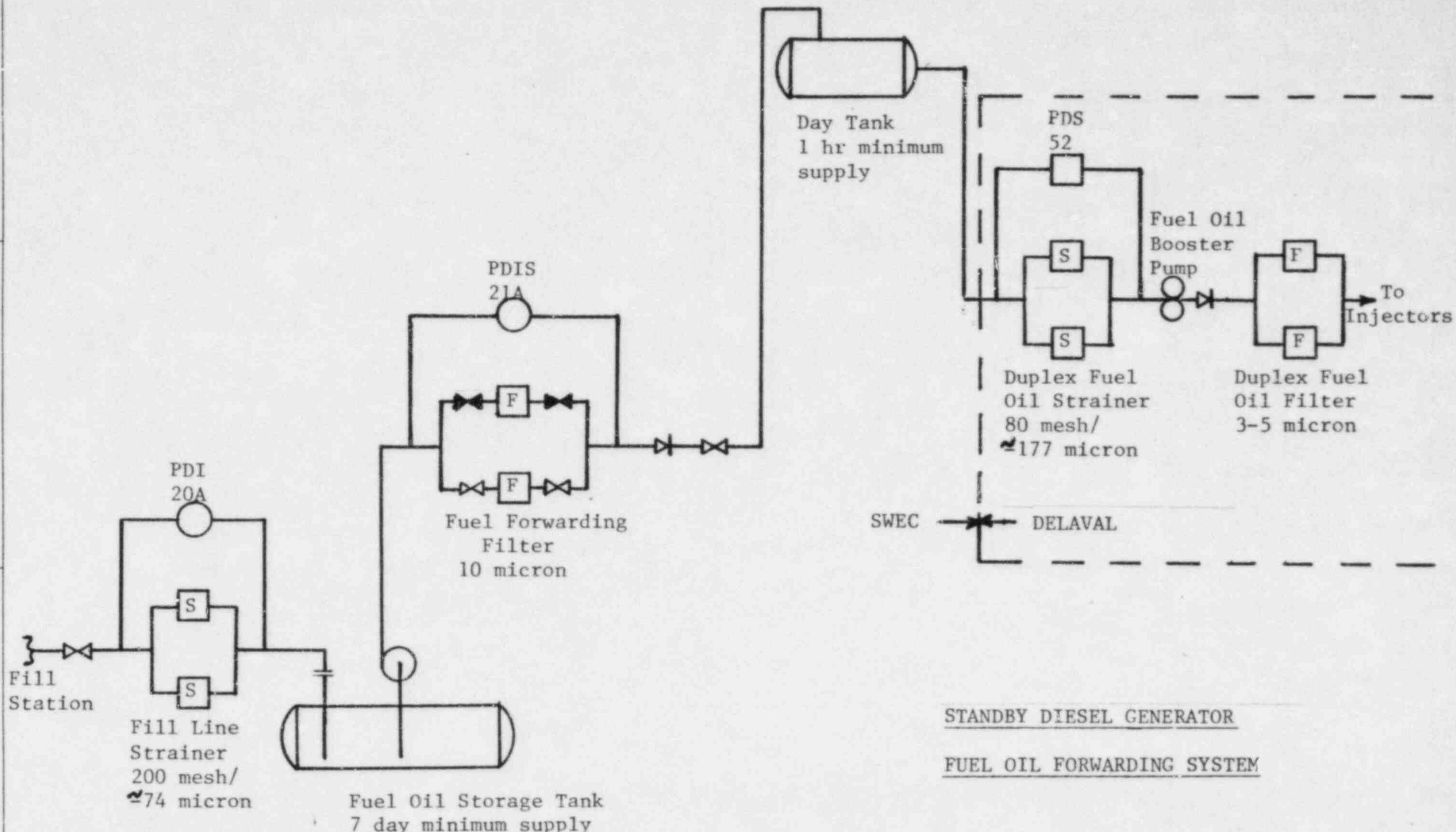
Plant operating procedures require staggered refill of the diesel fuel oil storage tanks and the following considerations when filling during required diesel generator operation. The day tank is verified to be full prior to refilling its associated fuel oil storage tank. Refill is at a controlled rate to minimize turbulence in the storage tank and is initiated in sufficient time to allow sufficient settlement prior to refilling the next tank. Confirmation of day tank fill capability without fuel oil filter clogging is required before the next storage tank is refilled. Further, the storage tanks for the standby diesel generators are filled before the HPCS storage tank.

Water levels in the fuel oil storage tanks are checked periodically. Water-finding paste may be introduced through the sounding tube as a visual method of measuring the water level. In addition, the diesel fuel oil is sampled periodically as described in Section 9.5.4.4. Should the water level be excessive, water is removed through a drain line located in the bottom of the tank.

The diesel generator fuel oil storage tank is located in a dry sand-filled, concrete vault on the lowest level of the diesel generator building, as shown in Fig. 1.2-28. The diesel generator building is protected against the effects of groundwater and flooding. The design provides for all vents, fill lines, and manholes to be above the PMF elevation or properly sealed against any possible water leakage.

With a monthly testing of each diesel generator, it is expected that a maximum of 400 cu ft of air could be present at any time during the month in each fuel oil storage tank. The location and climatic conditions are such that the temperature of the storage tanks can be expected to be relatively high with respect to the dewpoint. This results in a negligible amount of water vapor being condensed in the tank. Condensation is estimated at less than 1 gpd.

ENCLOSURE 5



STANDBY DIESEL GENERATOR

FUEL OIL FORWARDING SYSTEM

ENCLOSURE 6

the buses are still connected to either the preferred or normal station service transformers.

Unit 1 has three diesel generators: 1EGS*EG1A, 1EGS*EG1B, and 1E22*S001G1C. Diesels 1EGS*EG1A and 1EGS*EG1B are devoted to safety-related equipment as shown in Fig. 8.1-6. Diesel 1E22*S001G1C is devoted exclusively to the HPCS system, which is described in Section 8.3.1.1.3.6.2.

8.3.1.1.3.6.1 Standby Diesel Generators

8.3.1.1.3.6.1.1 Description

Each standby diesel generator is physically independent, located in a building structure designed to withstand earthquakes and to protect the standby diesel generators against tornadoes, floods, hurricanes, and tornado-generated missiles (Section 3.8). Within the protected structure, each standby diesel generator, including its associated starting equipment and other auxiliaries, is installed in a separate room of a Seismic Category I building so that an incident at one generator will not physically or electrically involve the others. Each standby diesel generator is provided with a separate missile-protected combustion air intake, room air intake and discharge, and diesel engine exhaust opening.

Seismic qualification of the standby diesel generators and associated equipment is discussed in Sections 3.9.2.2A and 3.10A. Environmental qualification is discussed in Section 3.11 and in the separate Environmental Qualification Document (EQD). In addition, the standby diesel generators can provide full rated load when subjected to extreme atmospheric conditions (e.g., due to a hurricane or tornado. The probability of a tornado striking a point on the site is low, about once in 3415 years, as discussed in Section 2.3.1.2.4).

Each standby diesel generator is provided with an independent fuel oil system consisting of a day tank with fuel capacity for 1-hr minimum operation at required load, and one 100 percent capacity Class 1E fuel oil transfer pump for automatically filling the day tank from its respective storage tank. One fuel oil storage tank for each standby diesel generator supplies fuel for continuous operation at its rated capacity for 7 days (Section 9.5.4).

Each standby diesel generator unit is provided with two independent and redundant air starting systems with separately powered air compressors to furnish air for automatic and manual starting. The starting systems for each standby diesel generator includes electrically driven compressors, primary air tanks, reserve air tanks, and necessary gears and valves for cranking the engine. The two starting systems (the HPCS diesel's air compressors are described in Section 8.3.1.1.3.6.2) are arranged so that failure of one will not jeopardize proper operation of the other. Each train of the starting system is capable of at least eight cranking cycles without the assistance of outside power. The time required by each air compressor to recharge its tank from minimum starting air pressure to operating air pressure is approximately 30 minutes. Each standby diesel

engine is provided with cooling by means of a shell and tube heat exchanger cooled by water from the SSW system. Each generator is a self-cooled air-ventilated unit. All necessary auxiliaries directly associated with each standby diesel-generator unit, such as ventilating fans, battery chargers, fuel oil transfer pump, etc, are powered from their associated standby buses. Electrical power for starting and control is supplied from the 125-V dc system associated with that generator. Safety-related piping and valves subject to freezing are electrically heat traced and thermally insulated.

The standby diesels for 1EGS*EG1A and 1EGS*EG1B are Transamerica Delaval Inc. type DSR 48 and provide 4889 bhp in continuous duty. The synchronous generators were manufactured by Electric Products Division Porter.

The rating of each standby diesel generator is determined from plant design and power requirements and has the capability to ensure proper starting and operation of all required motor loads without excessive frequency or voltage drop. The rating of each of the standby diesel generators is based on the maximum required coincident loads during the unit design basis accident (DBA) in accordance with Regulatory Guide 1.9, except for the HPCS diesel. The philosophy applicable to the sizing of the HPCS diesel is defined in Section 8.3.1.1.3.6.2.

The rating of the standby diesel generator sets are as follows:

Standby Diesel Generator 1EGS*EG1A	Standby Diesel Generator 1EGS*EG1B	Time (hr)
3,500 kW	3,500 kW	8,760
3,850 kW	3,850 kW	2

The 8,760-hr rating is on continuous duty under normal maintenance. The diesel generators are capable of supplying 10 percent in excess of their 8,760 hr rating, at rated voltage and frequency for any 2 hours out of any 24 consecutive hours of operation.

No de-rating is required for operation of the standby diesel generators for ambient temperatures up to 125°F or for ambient atmospheric pressures down to 20.58 inches Hg-absolute (10.1 psia).

The standby generator and the 4.16-kV preferred station service system are manually synchronized during periodic testing or upon restoration of preferred power. If any safety-related switching equipment fails to operate automatically, manual operation is possible, remotely in the main control room or at the standby diesel generator control room. Except for sensors and other equipment that must be directly mounted on the engine or associated piping, the controls and monitoring instrumentation are installed on free-standing floor-mounted panels located in a vibration-free floor area.

8.3.1.1.3.6.1.2 Starting and Loading

The standby diesel generator sets are designed for independent operation, but they may be operated in parallel with the plant auxiliary system for exercising and test purposes. Standby buses 1ENS*SWG1A and 1ENS*SWG1B are normally continuously energized from the preferred station service transformers. Standby bus 1E22*S004 is normally continuously energized from the normal station service system. The standby diesel generators are started upon receipt of an undervoltage signal from the standby bus source, upon receipt of a LOCA signal or on manual signal from the main control room. The automatic transfer of each standby bus to its standby generator is done only on loss of voltage measured on the standby 4.16-kV bus. Transfer is accomplished by opening both the normal and preferred station service transformer supply circuit breakers and closing the standby

generator's circuit breaker when the generator is at proper voltage and frequency.

Low voltage on a standby bus automatically disconnects all 4.16-kV motor loads on the bus. Sequencing of loads supplied from the standby diesel generators is required to prevent exceeding the motor starting and load pickup capability of the standby diesel generator. Provisions are made for automatic sequencing of all loads in accordance with Table 8.3-2. Other loads may be connected by the station operators (by manually controlled breakers) when load conditions permit. There is no automatic load shedding of the standby 4.16-kV buses when power is furnished by the standby diesel generator.

The load sequencing control for the onsite and offsite power sources for River Bend Station utilizes individual timers and permissive circuitry for individual feeder breakers being sequenced on standby buses. Although there is a logic which ties the operation of the entire load sequencing scheme together, failure of one or more breaker timers or permissive circuits to operate does not prevent other breaker timers and permissives from performing their intended functions. Timers and permissives are located in qualified switchgear and relay panel enclosures for the breaker they control. There are no credible sneak circuits or common failure modes in the sequencing design that could render either the onsite or offsite power sources unavailable.

An emergency demand start signal overrides all other operating modes including test and returns control of the diesel-generator unit to the automatic load sequencing system.

The standby diesel generator incorporates two modes of control, OPERATIONAL and MAINTENANCE.

a. In the OPERATIONAL mode the diesel starts and comes up to speed when either of the following conditions is present:

   1) A MANUAL START SIGNAL generated from the local control panel and the units entire protective system is reset.

   2) An EMERGENCY START SIGNAL generated by either a LOCA signal or a sustained bus undervoltage or by depressing emergency START push button in the main control room. Except for overspeed and generator differential, no other diesel generator protective device is functional under emergency start conditions. The emergency start overrides all other conditions, such as manual running, test, tripping on fault (other than overspeed or generator differential) and returns the unit to rated speed. (Refer to Section 8.3.1.1.4.1)

b. In the MAINTENANCE mode only the engine ROLL pushbutton on the local panel is operative. This feature permits cranking the diesel without effecting a start.

c. The standby diesel generators may be tested while in the operational mode by manually starting the engines and manually closing the circuit breakers connecting the standby diesel generators to the bus. In this manner, the standby diesel generators can be tested under load while in parallel with the grid.

   Should the grid go to an undervoltage or underfrequency condition, the circuit breakers in the Fancy Point Substation trip and deenergize the circuit feeding the preferred station service transformers. The pilot wire system also initiates a trip of the 4.16-kV circuit breaker between the preferred station service transformer and the bus. With the preferred or alternate supply breakers in the open position, the generator setting would switch from the parallel operation mode to the isochronous mode, and the standby diesel generator picks up the entire load of the standby 4.16-kV bus.

The standby diesel generators are capable of running unloaded for 7 days without degrading the performance or reliability of the engine. The manufacturer has demonstrated this capability with a special no load endurance test.

8.3.1.1.3.6.2 High Pressure Core Spray Power Supply System

8.3.1.1.3.6.2.1 Description

Fig. 8.3-3 shows the HPCS power system simplified one-line diagram electrical arrangement, power distribution, protective relaying, and instrumentation for the HPCS power system.

The HPCS power supply system is self-contained except for the initiation signal source and access to the preferred source of offsite power through the plant ac power distribution system. It has a dedicated diesel generator, 1E22*S001G1C and is operable as an isolated system independent of electrical connection to any other system.

The HPCS diesel 1E21*S001G1C is a Stewart and Stevenson EMD 20645-E4, 20-cylinder, vee type. It provides 3600 bhp in continuous duty. The synchronous generator was manufactured by Ideal. This SM-100 model has an 8,760-hr rating of 2600 kW, and a 2,000-hr rating of 2850 kW.

Seismic qualification of the HPCS diesel generator and associated equipment is discussed in Section 3.9.2.2B and 3.10B. Environmental qualification is discussed in Section 3.11 and in the separate Environmental Qualification Document (EQD).

The standby auxiliary equipment such as heaters, air compressor, and battery charger are supplied from the same power source as the HPCS motor.

Voltage and frequency of the HPCS diesel generator is compatible with that available from the plant ac power system.

ENCLOSURE 7

QUESTION 430.79 (9.5.5)

Section 9.5.5 indicates that the function of the diesel generator cooling water system is to dissipate the heat transferred through the (1) engine water jacket, (2) lube oil cooler, (3) turbocharger after-coolers, and (4) governor lube oil cooler. Provide information on the individual component heat removal rates (btu/hr), flow (lbs/hr) and temperature differential (°F) and the total heat removal rate required. Also provide the design margin (excess heat removal capacity) included in the design of major components and subsystems. (SRP 9.5.5, Part III, Item 1).

RESPONSE

The response to this request ~~for the HPCS diesel generator~~ is provided in revised Section 9.5.5.2 ~~Information for the standby diesel generator will be provided by the end of February 1984.~~ and Tables 9.5-3 and 9.5-6. 11

The heat dissipated by the governor lube oil cooler is insignificant (less than 1% of the total), and is therefore not included in Table 9.5-6.

[Note : The lube oil cooler is described in Table 9.5-3]

bypassing the heat exchanger for fast engine warmup.

3. One water expansion tank (approximate capacity of 84 gallons) for the HPCS DGCWS and one jacket water standpipe (approximate capacity of 225 gallons) for the standby DGCWS.

4. One electric immersion heater, thermostatically controlled to maintain the engine jacket cooling water during periods when the diesel is not running at a temperature which allows easy starting.

5. One ac motor-driven water circulation pump, for moving the water through the jacket cooling water system when the engine is not running for the standby diesel generator only.

6. One heat exchanger suitable for maintaining the engine jacket cooling water at the desired temperature. It is of the shell and tube type with the jacket water flowing through the shell and the plant standby service water flowing through the tubes.

Component data for the standby DGCWS is shown in Table 9.5-6. The standby DGCWS is a completely self-contained loop, with a vertical standpipe located as shown in Figure 9.5-12. The standpipe is not a pressure vessel; it is an atmospheric vessel, vented to atmosphere. The standpipe provides the flooded suction for the jacket water pumps, acts as a system vent point for de-aeration of the jacket water, provides the point for jacket water system heating and control, and is the system fill and drain point.

The standby DGCWS provides a total cooling water capacity of approximately 725 gallons which is adequate to maintain the required pump NPSH. Water leakage from the system is not expected, and thus no makeup needs are anticipated for seven days of continuous operation at full rated load. Any loss of water is noticed through routine checks of the standpipe sight glass. Jacket water low level is alarmed in the standby diesel generator control room, and activates a common trouble alarm in the main control room to alert the operator of abnormal conditions. Makeup water, if needed, is provided from the makeup water system (Section 9.2.3 and Figure 9.2-3b).

The HPCS DGCWS is a completely self-contained closed loop, with an expansion tank. The DGCWS can be vented to ensure that the entire system is filled with water. Surfaces of vent lines in contact with water will resist corrosion

because the water used is demineralized, and treated. Each time the engine is run, all parts of the cooling system are wetted with inhibitor which provides a protective coating inside the pipes. Running the engine once a month will provide adequate corrosion protection, and no decrease in cooling system life is anticipated. This design precludes piping exposure to air and its associated corrosion.

The HPCS cooling water system provides a total cooling water capacity of approximately 318 gallons which is adequate to maintain the required pump NPSH. The system does not require makeup water unless it is lost through seepage, leakage or the pressure relief cap. Any loss of water is noticed through routine checks of the expansion tank sight glass and is manually replaced when necessary through the filler opening at the top of the expansion tank. However, no makeup needs are anticipated for seven days continuous operation of the HPCS diesel engine at full rated load.

The HPCS diesel generator cooling water system has a built-in provision to assure all components and piping are completely filled with water by having two system high point vents, one coming off the manifold, and the other coming off the water side of the lube oil cooler. These high point vents are attached directly to the cooling water expansion tanks to maintain the closed system. In addition, there is a low positive pressure in the system from the engine driven water circulating pump, which helps drive out any entrapped air in the system. Thus, the air is purged from the system piping once the engine is running and attains rated speed.

TABLE 9.5-6

STANDBY DIESEL GENERATOR COOLING WATER SYSTEM COMPONENTS

1. Jacket Water Pumps

Type:	Centrifugal
Quantity:	1 per Diesel Engine (Engine Driven)
Capacity:	900 GPM
NPSH:	15 Feet
TDH:	110 Feet

2. Jacket Water Cooler

Type:	TEMA Class R ASME Section III, Shell & Tube
Duty:	12,030,000 BTU/HR

Design Conditions (Plant)

Tube Side - Cooling Water	
a. Inlet Temperature:	95 F
b. Outlet Temperature:	129 F
c. Flow:	[illegible]0 GPM
Shell Side - Engine Jacket Water (Note)	
a. Inlet Temperature:	175 F
b. Outlet Temperature:	144.9 F
c. Flow:	800 GPM

Heat Removal Design Overload Margin: 110%

3. Jacket Water Standpipe

Quantity:	1 per Diesel Engine
Type:	Vertical
Capacity:	225 Gallons to Fill
Engine:	500 Gallons to Fill from J.W. inlet to J.W. outlet

4. Jacket Water Heater

Type:	Flanged Immersion
Quantity:	1 per Standpipe
Output:	48 KW (3 Phase/60 Hertz/460 Volts)

5. Jacket Water Keepwarm System Circulating Pump

Type:	Centrifugal
Quantity:	1 per Diesel Engine
Capacity:	50 GPM
NPSH:	15 Feet
TDH:	50 Feet

6. Turbocharger After-Coolers

Duty:	3,695,000 BTU/HR
Jacket Water Flow:	450 GPM
Jacket Water Inlet Temperature:	150 F
Jacket Water Outlet Temperature:	165 F

Heat Removal Design Margin: 10%

Note: Data listed is for engine at full load operation, stabilized nominal full load temperature.

ENCLOSURE 8

bypassing the heat exchanger for fast engine warmup.

3. One water expansion tank (approximate capacity of 84 gallons) for the HPCS DGCWS and one jacket water standpipe (approximate capacity of 225 gallons) for the standby DGCWS.

4. One electric immersion heater, thermostatically controlled to maintain the engine jacket cooling water during periods when the diesel is not running at a temperature which allows easy starting.

5. One ac motor-driven water circulation pump, for moving the water through the jacket cooling water system when the engine is not running for the standby diesel generator only.

6. One heat exchanger suitable for maintaining the engine jacket cooling water at the desired temperature. It is of the shell and tube type with the jacket water flowing through the shell and the plant standby service water flowing through the tubes.

Component data for the standby DGCWS is shown in Table 9.5-6. The standby DGCWS is a completely self-contained loop, with a vertical standpipe located as shown in Figure 9.5-12. The standpipe is not a pressure vessel; it is an atmospheric vessel, vented to atmosphere. The standpipe provides the flooded suction for the jacket water pumps, acts as a system vent point for de-aeration of the jacket water, provides the point for jacket water system heating and control, and is the system fill and drain point.

The standby DGCWS provides a total cooling water capacity of approximately 725 gallons which is adequate to maintain the required pump NPSH. Water leakage from the system is not expected, and thus no makeup needs are anticipated for seven days of continuous operation at full rated load. Any loss of water is noticed through routine checks of the standpipe sight glass. Jacket water low level is alarmed in the standby diesel generator control room, and activates a common trouble alarm in the main control room to alert the operator of abnormal condition. Makeup water, if needed, is provided from the makeup water system (Section 9.2.3 and Figure 9.2-3b).

The HPCS DGCWS is a completely self-contained closed loop, with an expansion tank. The DGCWS can be vented to ensure that the entire system is filled with water. Surfaces of vent lines in contact with water will resist corrosion

because the water used is demineralized, and treated. Each time the engine is run, all parts of the cooling system are wetted with inhibitor which provides a protective coating inside the pipes. Running the engine once a month will provide adequate corrosion protection, and no decrease in cooling system life is anticipated. This design precludes piping exposure to air and its associated corrosion.

The HPCS cooling water system provides a total cooling water capacity of approximately 318 gallons which is adequate to maintain the required pump NPSH. The system does not require makeup water unless it is lost through seepage, leakage or the pressure relief cap. Any loss of water is noticed through routine checks of the expansion tank sight glass and is manually replaced when necessary through the filler opening at the top of the expansion tank. However, no makeup needs are anticipated for seven days continuous operation of the HPCS diesel engine at full rated load.

The HPCS diesel generator cooling water system has a built-in provision to assure all components and piping are completely filled with water by having two system high point vents, one coming off the manifold, and the other coming off the water side of the lube oil cooler. These high point vents are attached directly to the cooling water expansion tanks to maintain the closed system. In addition, there is a low positive pressure in the system from the engine driven water circulating pump, which helps drive out any entrapped air in the system. Thus, the air is purged from the system piping once the engine is running and attains rated speed.

ENCLOSURE 9

Item 19

ELECTRO-MOTIVE

M.I. 1748

*Rev. C

MAINTENANCE INSTRUCTION

ENGINE COOLANT

DESCRIPTION

Coolant is circulated throughout the engine to provide the means for heat transfer from the engine components. Water, corrosion inhibitor and, in some applications, antifreeze are used in coolant solutions.

Because the function of the coolant is so necessary to the operating efficiency of the engine, it is important that the selection of a coolant solution be carefully considered.

Failure to meet any *one* of the following requirements will inevitably result in costly system damage. Typical corrosion failures are shown in Figs. 1, 2, and 3.

COOLANT SOLUTIONS

A coolant suitable for use in EMD engine cooling systems must meet four basic requirements:

1. It must adequately transfer heat energy through the cooling system.
2. It must not form scale or sludge deposits in the cooling system.
3. It must not cause corrosion within the cooling system.
4. It must not deteriorate any of the cooling system seal materials.

These requirements are normally satisfied by combining a suitable water with a reliable corrosion inhibitor. Certain operating conditions may dictate the use of antifreeze-coolant. In this case the basic requirements can be satisfied with a combination of suitable water and an ethylene-glycol type antifreeze which contains an adequate corrosion inhibitor. However, the use of antifreeze involves special consideration regarding Items 1 and 3 above. This will be discussed in detail under "Antifreeze."

It should be recognized that coolants which perform satisfactorily in other applications may not be satisfactory for use in EMD engine cooling systems. Differences in coolant volume-to-cooling system surface area ratios, coolant velocities, temperatures, and the types of materials employed make such comparisons meaningless.

The formulation of home made inhibitors and antifreezes is not recommended since such compounds are difficult to monitor and control. The ready availability of suitable proprietary products makes these practices uneconomical and impractical.

Water quality should be evaluated whenever a new water source is to be used, or when changes in existing water sources occur. Likewise, quality of the coolant solution should be tested when a new engine is put into service, and at regular intervals thereafter. The quality of coolant should always be known and should be maintained as required.

WATER

The water used in the cooling system of EMD engines should be of such quality that it does not contain excessive solids, hardness salts, or corrosive elements such as chlorides. Water containing these constituents in undesirable amounts can either be softened or de-ionized to make it suitable for use. Steam condensate is also suitable for use in the cooling system as an equivalent to distilled water.

*This bulletin is revised and supersedes previous issues of this number.

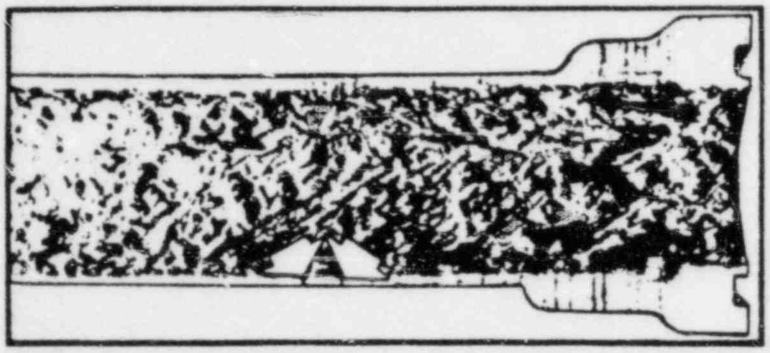
Areas of change are indicated by vertical bars in the margins.

Cooling water radiator tube cut apart and enlarged to show severe corrosion after approximately 1000 hours operation. Coolant consisted of fairly soft well water and an ethylene glycol antifreeze, without additional inhibitor.

This tube was photographed against a black background. The dark black areas show complete penetration of the tube wall.

27144

Fig.1 – Section Of Cooling Water Radiator Tube



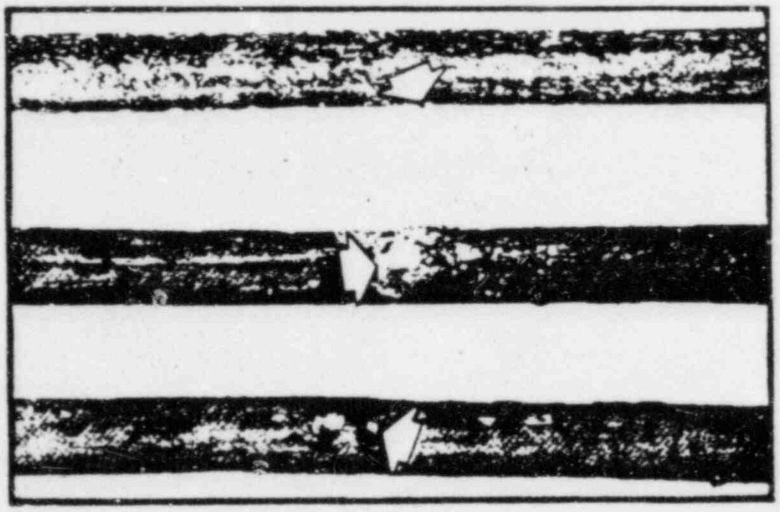
Cylinder liner water jumper sectioned to show corrosion after approximately 5000 hours operation. Coolant consisted of hard water, an ethylene glycol antifreeze and a corrosion inhibitor which obviously did not provide adequate protection.

NOTE

Severe reduction of tube section. This jumper was removed because of leakage from several holes corroded through the tube wall.

27145

Fig.2 – Section Of Cylinder Liner Water Jumper

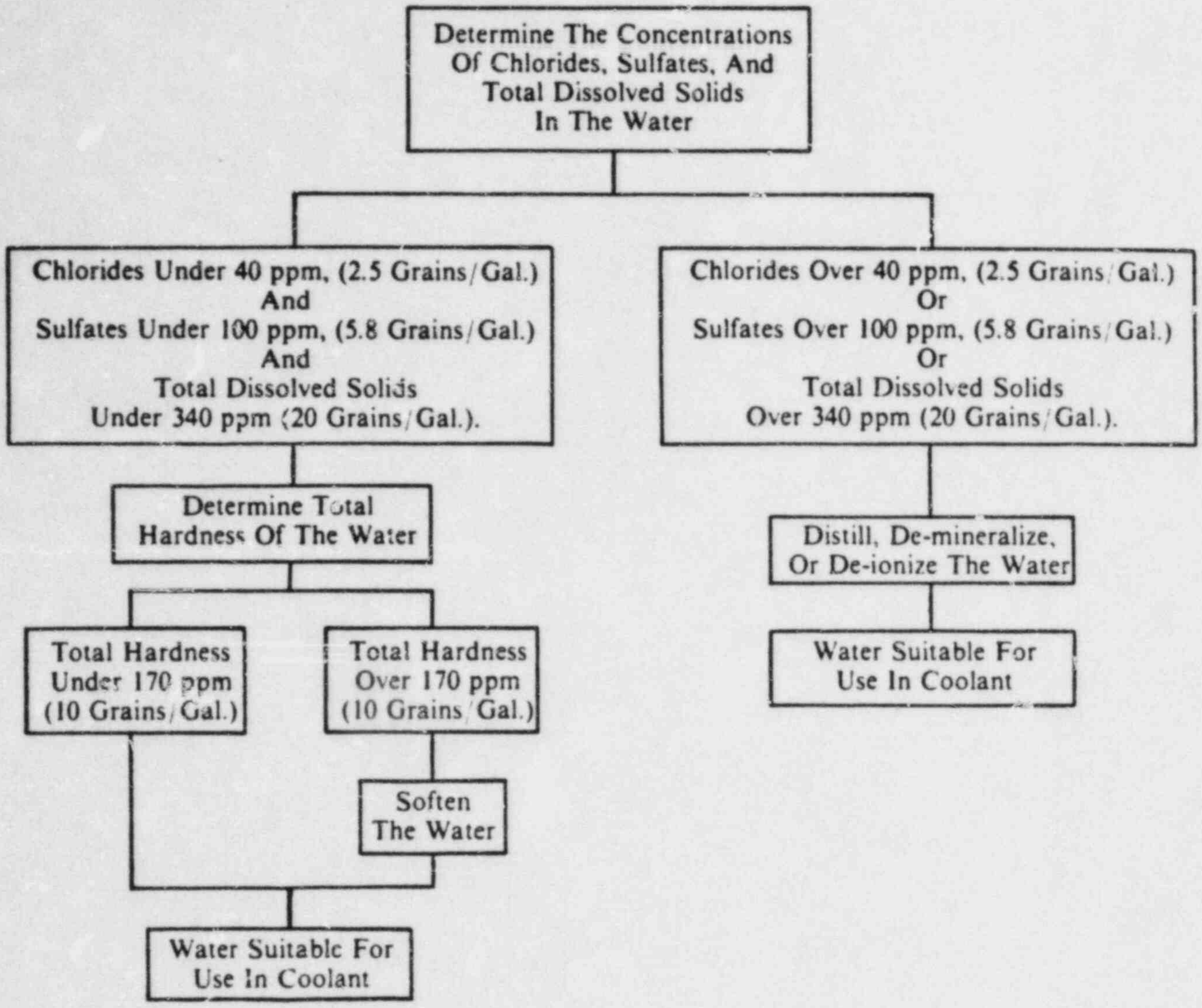


Heat exchanger tubes sectioned to show corrosion failures after approximately 6 months operation. Coolant consisted of untreated brackish water.

27146

Fig.3 – Section Of Heat Exchanger Tubes

TABLE 1



Water exceeding these limits can cause scale and sludge deposits, corrosion, or a combination of these.

INHIBITOR

CAUTION

Uninhibited water should never be used to fill a cooling system (even temporarily) because of the possibility of rapid corrosion and rusting. This applies to all uninhibited water but is especially true for distilled, de-ionized, or demineralized waters, including steam condensate. Prior to application, the water should be mixed with the inhibitor or inhibited antifreeze which is to be used in the coolant. The use of soluble oil type inhibitors is not recommended.

Two basic types of inhibitors, chromate and borate-nitrite, are the most commonly used in EMD cooling systems. Environment restrictions in some localities have led to the development of a non-polluting silicate-nitrite inhibitor. It is considered non-polluting because it does not contain chromium or boron.

Dry Measure:

16 Ounces = 1 Pound = 453.6 Grams

Liquid Measure:

32 Fluid Ounces = 1 Quart = 0.946 Liter

4 Quarts = 1 Gallon = 3.785 Liters

CHROMATE TYPE

Chromate type inhibitors are generally furnished in the form of powder or pellets. The pH of these inhibitors, when mixed with water, ranges from 7.5 to 9.0. The recommended inhibitor dosage for an initial fill is 4.5 grams per liter (0.6 ounce per gallon [4500 ppm]). Thereafter, the inhibitor concentration should be maintained above 3.0 grams per liter (0.4 ounce per gallon [3000 ppm]). Dissolve the inhibitor in water before adding it to the cooling system. When coolant is lost from the system, the makeup coolant should contain inhibitor in the recommended dosage (0.4 ounce/gallon).

Chromate type inhibitors should not be used in cooling systems containing ethylene-glycol type antifreeze. The use of chromate with ethylene-glycol may, under certain conditions, result in an insoluble sludge forming in the cooling system.

BORATE-NITRITE TYPE

Borate-nitrite type inhibitors are furnished in the form of powder, pellets, and liquids. The pH of these inhibitors, when mixed with water, ranges from 8.5 to 10.0. They also contain a dye, which is distinctive in color and stable at 88° C (190° F). The recommended inhibitor dosage for the powder or pellets at the initial fill is 7.5 grams per liter (1.0 ounce per gallon of water [7500 ppm]). Dissolve the inhibitor in water before adding it to the cooling system. Thereafter, the inhibitor concentration should be maintained above 5.6 grams per liter (0.75 ounce per gallon [5625 ppm]).

The recommended dosage of liquid inhibitor for an initial fill is 23.4 cubic centimeters per liter (3.0 fluid ounces per gallon). Thereafter, the inhibitor concentration should be maintained above 15.6 cubic centimeters per liter (2 fluid ounces per gallon). When coolant is lost from the system the makeup coolant should contain inhibitor in the recommended 15.6 cubic centimeters per liter (2 fluid ounces per gallon) dosage.

SILICATE-NITRITE TYPE

Silicate-nitrite type inhibitors are supplied in liquid form. The pH of these inhibitors, when mixed with water, ranges between 9.0 and 11.0. They also contain a distinctive color dye, which is stable at a temperature of 88° C (190° F). The recommended dosage of inhibitor for an initial fill is 23.4 cubic centimeters per liter (3.0 fluid ounces per gallon). Thereafter, the inhibitor concentration should be maintained above 15.6 cubic centimeters per liter (2 fluid ounces per gallon). When coolant is lost from the system, the makeup coolant should contain inhibitor in the recommended 15.6 cubic centimeters per liter (2 fluid ounces per gallon) dosage.

Experience to date has shown that the performance of this inhibitor is more sensitive than chromates and borate-nitrites to fluctuations in concentration levels. Therefore, the concentration of silicate-nitrite solutions must be carefully monitored during service.

Silicate-nitrite type inhibitors are considered non-polluting because they do not contain chromium or boron. However, federal, state, and local pollution restrictions should be investigated before discharging these inhibitors.

INHIBITOR GUIDELINES

WARNING

Safety and hygienic precautions should always be exercised when handling corrosion inhibitors to avoid possible irritation of eyes, nose, and skin. This is especially important when handling chromate inhibitors.

1. The recommended inhibitor concentrations have been found suitable for most corrosion inhibitors. However, the user should always contact the inhibitor supplier for recommendations as to the proper concentration level for his application.

2. When used in EMD systems, inhibitors should contain specific concentrations of a strong tracer element to help determine the degree of water contamination in lube oil analysis.

3. It is important that the inhibitor concentration be determined. Most suppliers are prepared to furnish a kit for this purpose. Instructions for EMD recommended laboratory and field evaluation appear later in this instruction.

4. The chemicals in corrosion inhibitors are slowly depleted in service. The effective life of an inhibitor depends on such factors as the cooling system condition, hours of operations, coolant and metal temperatures, aeration, and rate of contamination of the coolant. As a general rule the coolant should be discarded at least annually, and the cooling system filled with new inhibited coolant.

5. Draining an inhibited coolant from one engine and reusing in another is not recommended. If drained coolant is reused, particular attention should be given to piping and holding tanks to *ensure freedom from dirt and oil.*

6. Most manufacturers advise against mixing of different brands of corrosion inhibitors. This restriction recognizes the fact that some corrosion inhibitors may not be compatible with other brands. This incompatibility may lead to foaming, precipitation, or accelerated corrosion. EMD concurs with the manufacturer's advice in this respect.

7. Prior to fleetwide application of a new inhibitor formulation, it is advisable to test these formulations in a few engines. This will determine whether the inhibitor is compatible with the operating environment to which it will be exposed.

ANTIFREEZE

ALCOHOL TYPE

Alcohol type antifreeze is not recommended for use in EMD engine cooling systems because of the high coolant operating temperatures.

ETHYLENE-GLYCOL TYPE

Where EMD engine cooling systems must be protected from freezing, ethylene-glycol type antifreeze is recommended. This type of antifreeze must contain a balanced blend of inhibitor ingredients to prevent corrosion. This antifreeze also must contain a distinctive color dye that is stable at a temperature of 88° C (190° F).

Ethylene-glycol type antifreeze should be used at concentrations between 33% and 68% by volume, as required to prevent freezing. Antifreeze concentrations below 33% do not provide sufficient inhibitors to give adequate corrosion protection. Using antifreeze concentrations above 68% will raise the freezing point and will not provide good heat transfer. Because antifreeze affects heat transfer rates, it should not be used without prior consultation with EMD Service representatives regarding the specific engine installation and possible engine derating requirements.

The corrosion inhibitors incorporated in antifreeze are slowly depleted in service. How long these inhibitors will remain effective depends on factors, such as, the cooling system condition, hours of operation, coolant and metal temperatures, aeration, and rate of contamination of the solution. Usually the antifreeze manufacturers recommend using their products for only one year.

In special applications involving large capacity systems, such as EMD engines, the antifreeze solutions may be usable for a longer period of time. The customer should contact the manufacturer for instructions which may include periodic tests of the antifreeze solution by the antifreeze manufacturer.

Chromate type inhibitors should not be used in cooling systems containing ethylene-glycol type antifreeze. The use of chromate with ethylene-glycol, under certain conditions, may result in insoluble sludge forming in the cooling system.

Fig. 4 depicts the freezing points of typical ethylene-glycol antifreeze and water solutions. The freezing points of specific brands may vary slightly from prints shown on the graph. However, the graph is sufficiently accurate for use in estimating antifreeze requirements, regardless of brands.

ETHYLENE-GLYCOL TYPE WITH DE-IONIZED WATER

Because hardness, total solids, and corrosiveness of water varies throughout the world, antifreeze

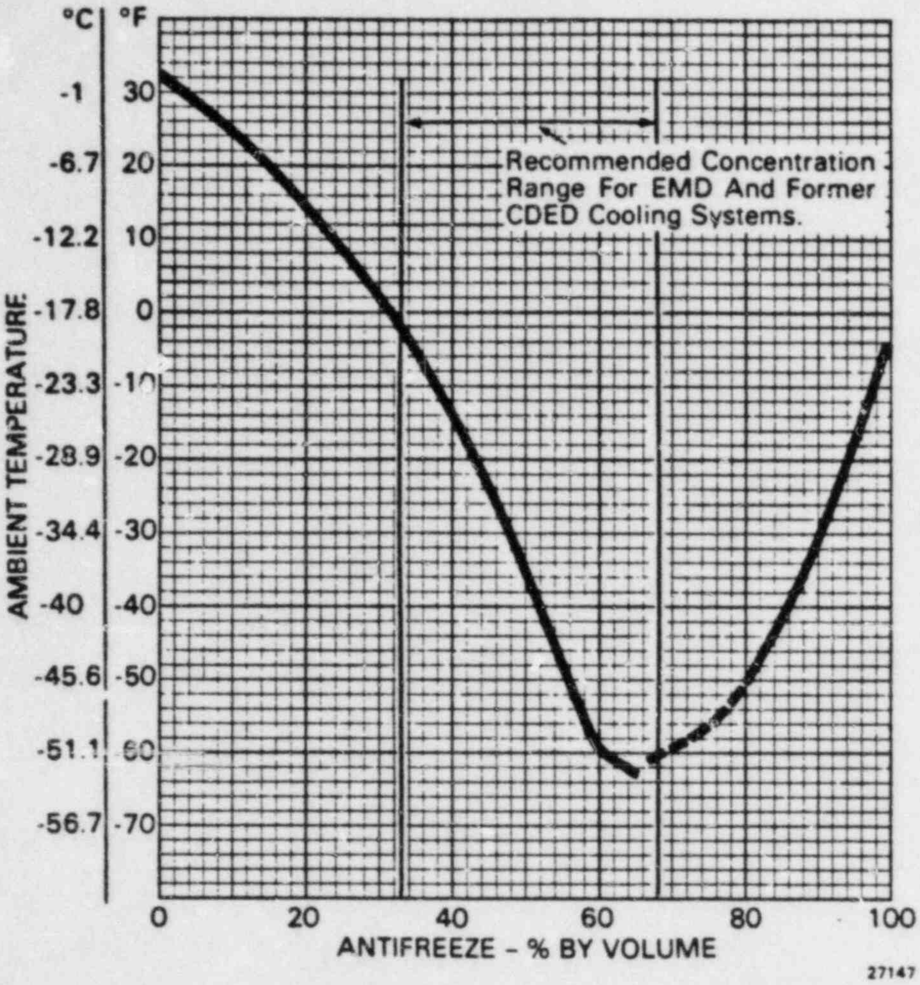


Fig.4 – Freezing Points Of Aqueous Solutions Of Ethylene-Glycol Antifreezes

containing inhibitors and de-ionized water should be used in areas where the water does not meet the standards listed in Table I "Water." This type of antifreeze contains the proper amount of ethylene-glycol to protect the cooling system from freezing to 40° C (-40° F).

METHOXY PROPANOL TYPE

The principal advantage of methoxy propanol is that oil contamination from coolant leaks is minimized. The 50% methoxy-propanol-water mixture, which boils at 98.3° C (209° F), vaporizes out of the hot lubricating oil and thus does not form a sludge as would ethylene-glycol.

The disadvantages of using methoxy propanol are:

1. Corrosion Protection

   Inhibitors commonly used in ethylene-glycol antifreeze have limited solubility in the methoxy propanol.

2. Freezing Protection

   The freezing point depressant characteristics are not as good as ethylene-glycol. For example, a 50% aqueous solution has a freezing point of -28.3° C (-19° F) as compared with -36.7° C (-34° F) for a 50% solution of ethylene-glycol.

3. Fire Hazard

   The flash point of a 50% aqueous solution is 47.8° C (118° F). The flash point of the concentrate is 34.4° C (94° F) as compared with 132° C (270° F) for ethylene-glycol.

GENERAL COMMENTS

Most manufacturers advise against the addition of supplemental inhibitors or additives to either fresh or used antifreeze solutions. They also advise against mixing of different antifreeze brands. These restrictions recognize the fact that some supplemental inhibitors, additives, and antifreeze brands contain

materials which may not be compatible with the corrosion inhibitors initially incorporated in the antifreeze. The addition of these compounds could increase corrosion in the cooling system. EMD concurs with the antifreeze manufacturer's advice.

Some antifreeze manufacturers market inhibitor concentrates specifically designed for reinhibiting their antifreeze. These inhibitors are designed only for their antifreeze and should be added only on their advice.

Some brands of antifreeze contain anti-leak compounds which may cause plugging and eventually reduce the heat transfer qualities of the cooling system. EMD advises against the use of antifreeze containing anti-leak compounds.

FIELD QUALIFICATION TESTS FOR CORROSION INHIBITORS AND ANTIFREEZE CONCENTRATES

Before a cooling system additive is placed in general service, field qualification tests should be undertaken on a sample of both new and old cooling systems.

No inhibitor or antifreeze is considered suitable for use in EMD engine cooling systems unless it passes the laboratory glassware tests described below.

CAUTION

Do not place an unqualified additive in general service. Such additives may cause widespread cooling system damage, and result in very expensive repair.

LABORATORY EVALUATION TESTS

The purpose of the laboratory tests is to ensure complete water solubility of corrosion inhibitor ingredients within an at-use pH concentration of 7.5 to 10. (An engine coolant having a pH factor of approximately 11 will result in erosion-corrosion of the non-ferrous metals in the cooling system.)

All corrosion inhibitors and antifreeze concentrates contain a blend of chemical compounds which protect metals, common to the cooling system, from corrosion. To ensure adequate protection, these compounds must be present in the coolant in proper proportions.

NOTE

It is essential to follow the blending sequence, especially when using liquid concentrated formulations. Improper blending sequence or inadequate reaction time will result in an excessive amount of precipitate in the liquid concentrate and reduce the effectiveness of the inhibitor.

GLASSWARE CORROSION TESTS FOR INHIBITORS AND ANTIFREEZE

The glassware corrosion test will generally differentiate between products having good corrosion inhibiting properties and those which are detrimental to the metal test specimens. This test must conform with the standards set forth in ASTM D1384-80 "Corrosion Test for Engine Coolants in Glassware." However, the glassware corrosion test should be modified to reflect the metals in the EMD cooling system, and the operational characteristics in the field. These modifications are as follows:

1. Do not incorporate aluminum in the coupon bundle, Fig. 5, since it is not present in EMD engine cooling systems. However, red brass (85% copper - 15% zinc) should be included in the coupon bundle since this metal is used in the cooling system.

2. Because some inhibitors react differently, the glassware corrosion test should be performed in both soft and hard waters. Corrosive water obtained by adding sodium salts to distilled water, as specified in D1384, is considered a soft water. Hard water containing calcium and magnesium compounds will often be used in the engine cooling system, but must be limited to 170 ppm. The laboratory sample of hard water should observe the same limitation.

NOTE

Before conducting glassware corrosion tests on unknown products, it is suggested that the user conduct tests on known quality products. Conducting glassware tests on a quality product will familiarize laboratory personnel with the test procedure and the variations which may be encountered.

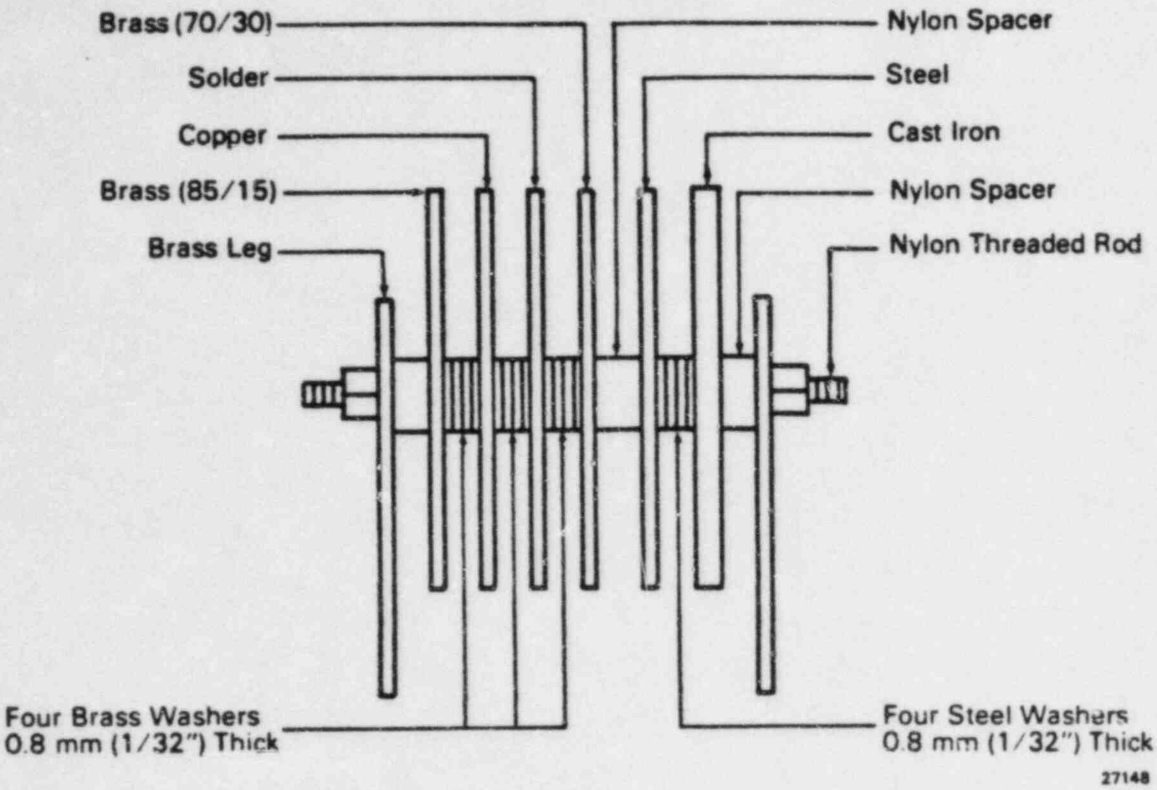


Fig.5 – Arrangement Of Metal Test Specimens

INTERPRETATION OF GLASSWARE CORROSION TEST RESULTS

In general, an inhibitor or antifreeze is considered unsuitable for use in EMD engine cooling systems when the weight loss of the metal test specimens exceeds the following recommended limits:

Cast Iron and Steel	5 milligrams per coupon.
Solder	20 milligrams per coupon.
Brass and Copper	10 milligrams per coupon.

If the weight losses of the metal test coupons do not exceed the above limits but the coupons show signs of pitting or crevice-type corrosion, the corrosion protection properties of the coolant are considered inadequate. Further, an excessive amount of precipitate is undesirable. An excessive amount of precipitate may cause fouling or erosion in the cooling system.

ELASTOMER IMMERSION TEST

The elastomer immersion test determines whether exposure to a corrosion inhibitor or antifreeze solution will have adverse effects on the elastomeric seals used in the EMD engine cooling system. This procedure is a standard compression set determination utilizing excerpts from ASTM D1384, D395 (Method C), and D471 as follows:

APPARATUS

1. Container - D1384
2. Condenser - D1384
3. Oil Bath - D1384
4. Aerator Tube - D1384
5. Air Supply - D1384
6. Two compression set fixtures each consisting of:

   a. Two 60 mm (2-1/4") diameter steel discs with 10 mm (3/8") diameter holes drilled into the center of each disc.

   b. An 8 mm (5/16") threaded bolt for insertion through drilled discs.

   c. An 8 mm (5/16") nut to fit the bolt for compressing discs together upon tightening.

7. Several 13 mm (1/2") square spacers of a thickness necessary to produce a 30% deflection of elastomers as specified below in "Test Specimens" section.

TEST SPECIMENS (Figs. 6 and 8)

Silicone Rubber Seals (See Service Data)

Fluoroelastomer Seals (See Service Data)

TEST SOLUTIONS

The concentration of the engine coolant to be tested shall be as follows:

1. Corrosion Inhibitor

   Corrosion inhibitor shall be mixed with the proper quantity of distilled water to give the resulting solution twice the minimum concentration as specified by the manufacturer.

2. Antifreeze

   Antifreeze shall be mixed with distilled water in the ratio of 50% by volume (1 to 1).

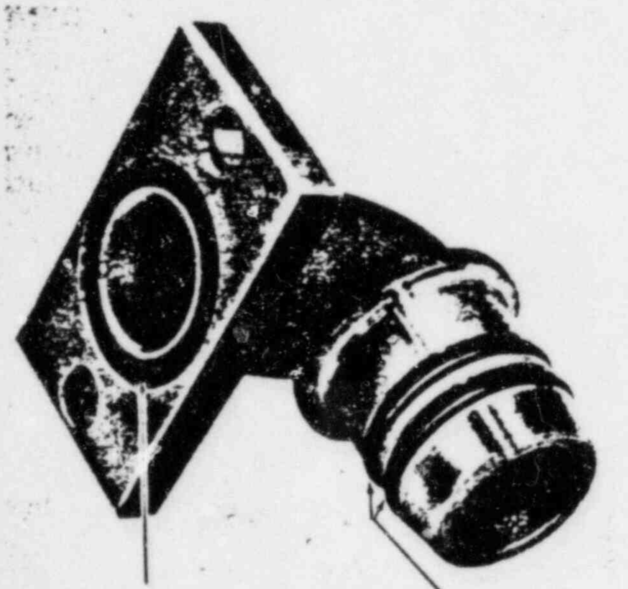


Fig.6 - Usage Reference For Test Sample Seals

PROCEDURE

Cut a 30 mm (1-1/4") length from each of five silicone rubber and fluoroelastomer seals. Use three of each seal type in the test for compression set. The remaining seals will be used for volume change and durometer hardness change determination.

1. Compression set determination (according to ASTM D395, Method C), except as follows:

   Measure initial thickness of three silicone rubber seals. Prepare two sets of spacers of appropriate thickness to obtain a 30% deflection of the seals. Place the spacers on the flat side of a steel disc at the outside edges, diametrically opposed, Fig. 7.

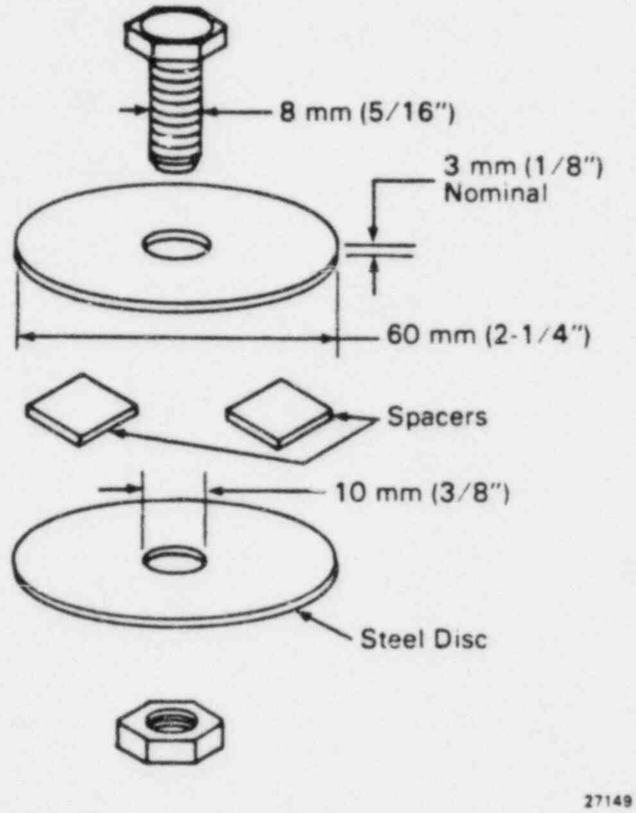


Fig.7 - Compression Set Fixture And Spacers

   Place the silicone seals on the disc allowing sufficient space between samples. Place the second disc on top, and insert bolt through the center holes from the bottom. Carefully tighten the nut with a wrench, using care not to dislodge the spacers. Tighten until solid contact is made between the spacers and steel disc.

   Repeat procedure outlined above for fluoroelastomer seals using the second compression set fixture.

2. Volume Change and Duro Hardness Change

NOTE

Measure the initial durometer hardness and initial weight in air and water of the two silicone seals and the two fluoroelastomer seals per ASTM D471.

Place the two compression set fixtures and all the seals measured for volume change into the glassware corrosion container which has been filled with 600 ml of the test solution and insert the rubber stopper and aerating tube, as outlined in D-1384. Place the container in the oil bath heated to 88° C (190° F). Adjust air supply at a rate of 100 ml/min. Insert condenser tube into the rubber stopper.

After 70 hours in the heated oil bath, remove the container from the bath. Immediately remove the compression fixtures and disassemble. Remove the seals from the fixture and allow to cool on a thermally non-conducting surface, such as wood, for 30 minutes before measuring thickness and determining the compression set per ASTM D395.

Allow the volume change samples to remain in the container (do not drain any coolant). Place container in a water bath and cool to 25° C (77° F). After 30 to 60 minutes, remove the samples from the container, blot the surface, and quickly weigh in air and then weigh in water. Measure durometer hardness. Determine volume change and hardness change per ASTM D471.

INTERPRETATION OF TEST RESULTS

If the changes in the elastomeric properties after the immersion tests exceed the limits listed below, the inhibitor or antifreeze is considered unsuitable for use in EMD cooling systems:

Volume change for – Fluoroelastomer (EMS 641, Gr .76), Silicone Rubber (EMS 644, Gr .71)	0 to +10%
Duro hardness change for – Fluoroelastomer, Silicone Rubber	0 to -10%
Compression set for – Fluoroelastomer, Silicone Rubber	20% Max.

FIELD QUALIFICATION TESTS FOR CORROSION INHIBITORS AND ANTIFREEZE

The glassware corrosion test should be recognized as a controlled laboratory test. It is possible that a coolant which appears satisfactory in glassware corrosion tests may fail in the field. The glassware corrosion test is conducted statically; the final evaluation of a coolant must be made in the field where the inhibitor will be subjected to the cooling system turbulence, heat, and flow rates.

Whenever possible, the recommended concentration of inhibitor or antifreeze should be tested in five new and five old engine cooling systems. The engines used in the qualification test should be in heavy duty service on the highest horsepower units available. New inlet water jumper lines and inlet deflectors should be installed on the right bank front and rear of the NEW engines tested in order to establish a valid baseline. The engines should be identified as test units. The first inspection of the cooling system components should be made 3 months after the initiation of the tests. This inspection should include the following:

1. Coolant Sample

   Operate the engine for a minimum of 15 minutes before obtaining a representative coolant sample. Purge the sight glass to remove any accumulated sediment by draining a minimum of one quart of coolant. After sediment is purged from the glass, collect one quart in a clear, clean glass bottle. Allow the sample to settle for 24 hours; then inspect the bottom for sediment.

   If sediment completely covers the bottom of the glass bottle, it may indicate that excessive corrosion or inhibitor depletion is occurring. Note the color of both the sediment and the coolant. (The density of the color dye in the coolant should be strong enough to indicate the presence of the inhibitor or antifreeze.) The inhibitor or antifreeze manufacturer should be contacted to analyze the coolant to determine whether there has been excessive depletion of the inhibitor ingredients.

2. Visual Inspection of Jumper Lines and Inlet Deflectors

   Remove two water jumper lines and inlet deflectors from the right bank front and rear of engine. With a strong light, visually inspect the interior of the jumper lines for corrosion as indicated by well defined irregular spots or corrosion products 1 mm (1/32") or more in thickness. (Note that the removal of the solid corrosion products by pickling or abrasion will reveal pitting.)

   Inspect both sides of the deflectors for signs of pitting which may indicate corrosion-erosion or

impingement corrosion. Generally, the surface of the deflectors will have a tarnish coating. If the surfaces are clean and bright, this condition may indicate metal deterioration caused by inadequate inhibitor protection.

3. Visual Inspection of the Oil Cooler

Remove the most accessible oil cooler flexible coupling clamp plate from the oil ring and the water inlet pipe. With a strong light and telescoping mirror, inspect the interior of the oil cooler tubes. Clean bright metal or pitting are indications of corrosion. Also inspect the top of the tubes for erosion (wearing away of the metal).

4. Visual Inspection of the Water Pump

Remove and disassemble one of the water pumps. Inspect the carbon seal for excessive wear, and check the water pump impeller for bright shiny surfaces which may indicate corrosion.

INTERPRETATION OF FIELD QUALIFICATION TEST RESULTS

If there are no indications of corrosion problems after 3 months, the field test may be continued. However, the cooling system should be inspected at 3-month intervals in the same manner as described for the 3-month inspection.

After completion of the 12-month field tests, if the results are considered satisfactory by EMD, the corrosion inhibitor or antifreeze can be considered suitable for use in EMD engine cooling systems.

SERVICE DATA

Silicone Rubber Seals	8305815
Fluoroelastomer Seals	9317972

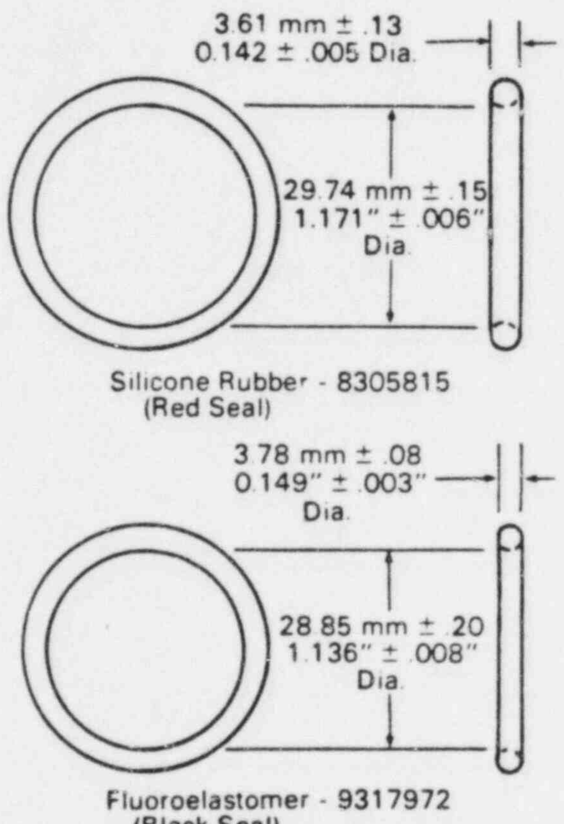


Fig.8 - Dimensional Reference For Seal Applications

No. 6P-78
AUGUST 16, 1978

ELECTRO-MOTIVE

POWER Pointers

NEW DESIGN MAIN BEARINGS AND CAPS

Continued in-service evaluation and EMD Engineering studies have shown minimal advantages, and possible disadvantages, to be realized in the application of the "two-tang" lower main bearing and associated bearing cap. Consequently, we have decided to return to our prior "four-tang" design.

As a result, the article appearing in Power Pointers No. 2P-78 dated March 29, 1978, should be totally disregarded and be so marked.

PURCHASING & MATERIAL MANAGEMENT SEMINAR

On October 2, 3 & 4, 1978, Electro-Motive will present the Fall session of the Purchasing & Material Management Seminar. All Purchasing & Material Management personnel are invited to attend this 3-day seminar held at the La Grange plant.

There is a continuing effort to provide our customers with the most up-to-date information about Electro-Motive and the services we provide. The program includes a close examination of the latest procedures for Parts, Warranty, Component Remanufacture, Packaging, and Material Control, as well as many other Purchasing & Material Management operations.

Plant tours of the key manufacturing areas of Transmission, Engine, and Locomotive Divisions are designed to give a good overview of our manufacturing facilities, as well as follow the complete build-up of equipment. A tour of the Parts Center Warehouse will include a demonstration of improved methods in packaging, boxing, and palletizing.

A visit to the Fabrication Building will enable you to observe a warehouse which is completely automated as to storage and retrieval of stock, and which stores 13,500 items in 6100 locations. The heart of this system is an electric console controlled by one operator.

The seminar concludes on Wednesday, October 4, at 2:00 PM to permit transportation schedules to be met.

All enrollments for this class are to be directed to the Training Center at La Grange, Illinois 60525. Please enroll as soon as possible to ensure adequate accommodations.

ENGINE COOLING WATER QUALITY AND INHIBITORS

Two things are necessary for proper long term, maintenance free, operation of the engine cooling system. The first is an inhibitor to prevent rust and corrosion of the metals of the engine. The second is water of good quality to prevent sediment blockage and scale formation. The use of an inhibitor and good quality water cannot be over-emphasized. EMD's specifications for inhibitors and water quality are stated in M.I. 1748, Rev. B.

Water hardness, namely dissolved compounds of calcium and magnesium, must be closely checked and controlled by treating the water to remove hardness salts. If the hardness salts are not removed they will plate out on the hottest surfaces of the engine. This always happens on the water side of the fire face of the cylinder head assembly.

CONFORMING ANTIFREEZES

The use of antifreeze may require derating of the output of the unit.

Manufacturer	Brand Name	Type of Antifreeze	Dosage Minimum Allowable	 Maximum Allowable	Trace Element
Dow Chemical Co.	Ambitrol CN (Notes 1&3) (Color Green)	Ethylene-Glycol	33% by volume	68% by volume	Potassium
Dow Chemical Co.	Ambitrol FL (Notes 1,2,&3) (Color Red)	Ethylene-Glycol	52% by volume	52% by volume	Potassium

CONDITIONALLY CONFORMING ANTIFREEZES

Manufacturer	Brand Name	Type of Antifreeze	Dosage Minimum Allowable	 Maximum Allowable	Trace Element
BASF Wyandott	Monocol 500 (Sno-Flo) (Note 1)	Ethylene-Glycol	33% by volume	68% by volume	Boron
Union Carbide Corp.	Prestone II (Note 1)	Ethylene-Glycol	33% by volume	68% by volume	Boron
Union Carbide Corp.	Pah-Nol (Note 1)	Ethylene-Glycol	33% by volume	68% by volume	Boron
Dow Chemical Co.	Ambitrol NTC (Notes 3&4)	Propylene-Glycol	33% by volume	68% by volume	Potassium
Dow Chemical Co.	Ambitrol NTF (Notes 2,3,&4)	Propylene-Glycol	33% by volume	68% by volume	Potassium

Note 1: Freezing Point: Determine the freezing point with an ethylene-glycol type antifreeze tester.

Note 2: This material is a full-fill antifreeze, no water is needed.

Note 3: This antifreeze may be reinhibited with Ambitrol Inhibitor.

Note 4: Freezing Point: Ethylene-glycol type tester and Dow furnished conversion table.

CONFORMING CORROSION INHIBITORS

Manufacturers	Brand Name	Type of Inhibitor	Dosage Minimum Allowable	Dosage Initial Fill	Trace Element
Dearborn Chemical Division	Dearborn 517	Chromate	0.5 oz./gal.	0.6 oz./gal.	Chromium
Dearborn Chemical Division	Dearborn 521	Potassium, Nitrite, Silicate	2.0 fl.oz./gal.	3.0 fl.oz./gal.	Sodium, Potassium, Silicon
Dearborn Chemical Division	Dearborn 527	Borate-Nitrite	0.75 oz./gal.	1.0 oz./gal.	Boron
Dearborn Chemical Division	Dearborn 528	Borate-Nitrite	0.75 oz./gal.	1.0 oz./gal.	Boron
Dearborn Chemical Division	Dearborn 537	Borate-Nitrite	2.0 fl.oz./gal.	3.0 fl.oz./gal.	Boron
Dearborn Chemical Division	Dearborn 537 (Special)	Borate-Nitrite	2.0 fl.oz./gal.	3.0 fl.oz./gal.	Boron
Nalco Chemical Co.	Nalco 37 (Available in ball or pulverized form)	Chromate	0.4 oz./gal.	0.6 oz./gal.	Chromium
Nalco Chemical Co.	Nalco 39 (Liquid)	Borate-Nitrite	2.0 fl.oz./gal.	3.0 fl.oz./gal.	Boron
Nalco Chemical Co.	Nalco 40	Borate-Nitrite	0.75 oz./gal.	1.0 oz./gal.	Boron
Nalco Chemical Co.	Nalco 2000	Borate-Nitrite	4.0 fl.oz./gal.	4.0 fl.oz./gal.	Boron
Nalco Chemical Co.	Nalco 2100 (Color Red)	Borate-Nitrite	2.0 fl.oz./gal.	3.0 fl.oz./gal.	Boron
Nalco Chemical Co.	Nalco 2102 (Same as 2100 but Color Blue)	Borate-Nitrite	2.0 fl.oz./gal.	3.0 fl.oz./gal.	Boron

CONDITIONALLY CONFORMING CORROSION INHIBITORS

These corrosion inhibitors have been tested in the EMD Laboratory and found to be satisfactory for field qualification tests.

Manufacturers	Brand Name	Type of Inhibitor	Dosage Minimum Allowable	Dosage Initial Fill	Trace Element
Dearborn Chemical Division	Dearborn 525	Borate-Nitrite	0.6 fl.oz./gal.	1.0 fl.oz./gal.	Boron
Drew Chemical Corp.	Chromate 2000	Chromate (Liquid)	3000 PPM	4500 PPM	Chromium
DuBois Chemicals	IWT-4B	Borate-Nitrite	½ gal./100 gals.		Boron
General Blending Co., Inc.	G.B. No.50	Borate-Nitrite	2 fl.oz./gal.	3 fl.oz./gal.	Boron
Magnus Division of Economics Laboratory, Inc.	Magnus Magnatrol No. 3	Chromate	0.4 fl.oz./gal.	0.6 fl.oz./gal.	Chromium
Mogul Corp.	Mogul WS-141	Borate-Nitrite	2.0 fl.oz./gal.	3.0 fl.oz./gal.	Boron
Nalco Chemical Co.	Nalco 2103	Nitrite, Potassium, Silicate	2.0 fl.oz./gal.	3.0 fl.oz./gal.	Potassium
Nalfloc Limited of England (Nalco Chemical Co.)	Nalfleet 9-131	Nitrite-Silicate	1 part to 125 parts		Sod[illegible]
Norman Chemical Co.	150 Diesel Coolant Treatment	Borate-Nitrite	4.0 fl.oz./gal.	5.0 fl.oz./gal.	Boron
Dearborn Chemical Division	ENDCOR 4709	Borate-Nitrite	2.0 fl.oz./gal.	3.0 fl.oz./gal.	Potassium & Boron

Mineral deposits on the fire face insulate that surface, making it more difficult for the head to transfer heat to the cooling water. With the reduced heat transfer, the temperature of the fire face increases. If the scale thickness becomes great enough and the engine is operated in this condition at high loads, it is likely that the heads will develop cracks in the fire face. Once this occurs, it is likely that all of the heads will eventually have to be replaced due to fire face cracks. Attempts to descale or derust the engine are likely to offer only temporary relief from the cracking problem. Cleaning agents that require neutralization, due to their chemical activity, may also damage other engine components that otherwise may be unaffected by rust.

Water hardness testing kits are generally available from some inhibitor manufacturers and from firms dealing with water softening equipment.

Those customers who operate in areas where water inhibitors or good water quality is difficult to obtain, may use a steel holding tank to store the engine cooling water after it is drained for engine maintenance. For applications where space is at a premium, Goodyear Aerospace Corporation manufactures a utility tank, Fig. 1, that is a rubber bladder that can be rolled up for storage. Engine cooling water that is contaminated with oil, through a head or liner or other fault, should not be reused. The following table indicates sizes that would be most useful to operators of EMD equipment; these and larger capacity tanks are available from Goodyear Aerospace Corporation, Engineered Fabric Division, Rockmart, GA 30153 U.S.A. Telephone 404-684-7855.

DIMENSIONS AND WEIGHT (Nominal)

Tank Capacity Gals.	Size - In. (empty & unrolled)*	Filled Dim. Inches	Wt. Empty Lbs.
60	42 x 56	34 x 48 x 18	20
100	42 x 68	34 x 60 x 18	23
125	56 x 56	42 x 44 x 27	25
150	56 x 68	42 x 58 x 27	30
200	56 x 80	42 x 70 x 27	34
250	56 x 92	42 x 80 x 27	39
300	56 x 104	42 x 94 x 27	44
350	56 x 116	42 x 106 x 27	50
500	68 x 116	49 x 98 x 32	55
750	80 x 128	65 x 120 x 36	70
900	86 x 140	70 x 122 x 36	80

*Add 3" to length and width to allow for seams.

Optional Equipment: Tanks up to 200 gallons are available with two tie-down straps. Tanks with a capacity of 250 gallons or more are available with three tie-down straps.

The following listings are to aid customers in selecting suitable water inhibitors and antifreezes. Customers are reminded that being a conforming product does not constitute an EMD recommendation of that product. It simply meets EMD specifications and has been satisfactorily field tested.

Those products that are "conditionally conforming" should be used only if the customer intends to comply with the field qualification guidelines that have been set by EMD. The customer and the inhibitor manufacturer must assume responsibility for the equipment and the monitoring of the test if they are going to field test the product.

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Fig. 1 – Typical Utility Tank

ENCLOSURE 10

QUESTION 430.86 (9.5.5)

In section 9.5.5.3, you state that on standby service the diesel generator jacket cooling water is maintained at a constant temperature by circulating the water through a separate electric immersion heater. Forced circulation is used on the standby diesel generators, while the HPCS diesel utilizes natural circulation. Expand this section of the FSAR to show that these jacket water heating systems are adequate to maintain recommended jacket water temperature for the coldest temperatures possible in the diesel generator building, assuming a failure of the heating system. If the jacket water heating systems are not adequate for this purpose, describe the measures which will be taken to maintain diesel generator availability in the event the diesel generator building heating system fails.

RESPONSE

11 ~~The response to this request is provided in revised Section 9.5.5.2.~~

A description of the diesel generator cooling water system operation in the standby condition is provided in Section 9.5.5.2.

The RBS HPCS diesel generator is specified to operate at room temperatures ranging from 40 to 122 F. The diesel generator building HVAC systems are designed to maintain the required environmental conditions between the minimum and maximum ambient conditions specified. The design basis thus provides an ambient room temperature ranging from 40 to 122 F. When the ambient temperature of the HPCS diesel generator room drops below (1) declared inoperable as required by Technical Specifications. An engine low temperature condition will be annunciated in the diesel generator control room and in the main control room through a low temperature alarm in the lube oil system.

To address the concern of HPCS diesel generator operability with the room temperature below 65 F, GSU will demonstrate, prior to full power operation, the engine's capability to start and accept load within 10 sec at an ambient room temperature of approximately 40 F. In addition, required monthly surveillance testing will demonstrate engine start tests over a range of room temperatures. Additional parameters that will be monitored prior to the monthly test include: room and engine block temperatures on the day before and the day of

(1) 40° due to loss of the HPCS diesel generator room heater, the HPCS diesel generator will be

the test, and temperatures of the lube oil and cooling systems. An assessment of the impact of ambient temperatures on the diesel generator starting performance will be made by identifying and trending the frequency of test failures at room temperatures below 65 F. Visual inspection for wear will be included in maintenance procedures when the unit is dismantled for overhaul.

NOTE: A failure of a DG start test results in increased test frequency per Regulatory Guide 1.108 and will provide additional data points.

After 24 months of required surveillance testing, an evaluation of the diesel generator performance during these tests will be submitted to the NRC Staff along with justification for continued operation or with proposed design modifications to either the HPCS diesel generator room HVAC system or to the diesel generator cooling water system to assure suitable engine pre-heating and improve starting reliability.

ENCLOSURE 11

QUESTION 430.69 (9.5.4)

Provide a discussion of the testing of the diesel generator fuel oil storage and transfer system controls and instrumentation necessary to maintain and assure a highly reliable system. Define what is meant by "periodically" as it relates to testing of controls and instrumentation.

RESPONSE

The response to this request is provided in revised 5
Section 9.5.4.4.

Additionally, control logic for the diesel generator standby power support systems (fuel oil storage and transfer, cooling water, starting, lubrication, and combustion air intake and exhaust systems) is discussed in Section 7.3.1.1.11. The standby and HPCS diesel generator protection systems are described in Sections 8.3.1.1.4.1 and 8.3.1.1.4.2, respectively. These sections identify those instruments and controls located in the diesel generator control room and in the main control room. 11

Design criteria and regulatory requirements for calibration,
1.22, setpoint selection, and minimum testing (e.g., Regulatory
Guides 1.108 and 1.118) of Class 1E portions of the standby 1.8,
power support systems are identified in Sections 7.1.2, 7.3.2, 8.1, and 8.3.1. Periodic calibration and surveillance of the control and protection systems for standby power support systems will be included in the plant operating procedures. The logic testing will include simulation of abnormal conditions for which the system is required to generate signals, i.e. low water temperature, high pressure setpoints, etc. These signals are shown on Figures 7.3-15, 7.3-16, 7.3-17, 7.3-23 sheets 17 through 28 and 8.3-12.

coordination of protection. Typical I^2t and breaker coordination curves are provided in Figures 8.3-13a through 8.3-13e.

8.3.1.1.4.1 Standby Diesel Generators

The protection system of standby diesel generators is described as follows (see logic diagrams, Figure 7.3-23, Sheets 17 through 28):

1. The standby diesel generator is rendered incapable of responding to an emergency auto start signal during any diesel generator operational condition (including testing and operation from the local control panel) by the following conditions:

    a. Diesel control panel loss of control power

    b. Starting air pressure below 150 psi

    c. Stop solenoid 1EGS*SOV24A or 1EGS*SOV24B, for 1EGS*EG1A or 1EGS*EG1B, respectively, energized. The diesel generator stop solenoid is energized and sealed in whenever the manual stop pushbuttons are operated, or the diesel generator primary or backup protection relays are tripped. The stop solenoid is sealed in to prevent an automatic diesel generator emergency start occurring before all the diesel generator controls and protection devices are reset to normal operating conditions. The local control room or main control room operator can de-energize the diesel generator stop solenoid by operating the STOP RESET push button provided, one in each control room.

    d. Diesel in the maintenance mode (includes barring device engaged)

    e. Overspeed trip device actuated

    f. Generator backup protection lockout relay tripped

    g. Generator primary protection lockout relay tripped

2. The standby diesel generator unit is tripped under the following conditions during both normal and emergency operation:

    a. Engine overspeed

    b. Both STOP push buttons manually operated. For each standby diesel generator unit, two pushbuttons are located at both the main control room and at the local control panel. The two push buttons are arranged such that the operator must use both hands to simultaneously operate both push buttons.

    c. Generator differential relay trip

3. The standby diesel generator unit is tripped under the following conditions during normal operation only:

   a. Generator phase overcurrent

   b. Generator reverse power

   c. Generator loss of field

   d. High jacket water temperature trip

   e. High bearing temperature trip

   f. Low jacket water pressure trip

   g. High crankcase pressure trip

   h. Trip low turbo oil pressure

   i. Trip high vibration

   j. Trip high temperature lube oil

   k. Low lube oil pressure trip

4. Protective functions of each standby diesel generator are annunciated locally in each of the standby diesel generator control rooms.

   The following alarms are separated into subsystem groups. Each subsystem group is provided with a "first out" indication as per Reg. Guide 1.9.

   a. Diesel engine lube oil subsystem (see Fig. 7.3-17)

      1. Lube oil filter differential pressure high

      2. Lube oil strainer differential pressure high

      3. Turbo oil pressure low

      4. Lube oil pressure low

      5. Turbo oil low pressure - TRIP

      6. Lube oil low pressure - TRIP

      7. Crankcase high pressure - TRIP

      8. Lube oil outlet temperature high

9. Lube oil inlet temperature high

10. Lube oil outlet temperature low

11. Lube oil inlet temperature low

12. Lube oil tank level high

13. Lube oil tank level low

14. Lube oil outlet high temperature - TRIP

b. Diesel engine fuel oil subsystem (see Fig 7.3-15)

1. Fuel oil storage tank level low

2. Diesel engine fuel oil strainer differential pressure high

3. Fuel oil day tank level extreme low

4. Fuel oil day tank level extreme high

5. Fuel oil filter differential pressure igh

6. Fuel oil pump-overspeed drive failure

7. Fuel oil pressure low

c. Diesel engine jacket water subsystem (see Fig 7.3-23, Sheet 22)

1. Jacket water pressure low

2. Jacket water low pressure-TRIP

3. Jacket water outlet temperature high-TRIP

4. Jacket water outlet temperature high

5. Jacket water inlet temperature high

6. Jacket water outlet temperature low

7. Jacket water inlet temperature low

8. Jacket water level low

d. Diesel engine air start subsystem (see Fig. 7.3-16)

1. Start air receiver pressure low

2. Control air pressure low

3. Diesel start air pressure low

e. Diesel generator subsystem (see Fig. 7.3-23, Sheets 22 and 28)

1. Standby generator differential TRIP

2. Standby generator fault TRIP

3. Standby generator ground fault

4. Standby generator loss of field

The following standby diesel generator protective functions are annunciated individually.

a. Control panel space heater failure

b. Generator space heater failure

c. Emergency exhaust fan trouble

d. Auxiliary systems not in auto

e. Main bearing oil high temperature TRIP

f. Fuel oil strainer differential pressure high

g. Fuel oil booster pump running

h. After cooler water inlet temperature high

i. Bearing device engaged

j. Diesel start air pressure high

k. Unit start failure

l. Vibration - TRIP

m. Overspeed - TRIP

n. 4160 Standby bus distribution breakers auto - TRIP

o. Diesel Generator potential circuit blown fuse

p. 4160 Standby bus undervoltage

In addition to the above listed annunicators the following standby diesel generator conditions are also indicated in each diesel generator control room.

9.5.4.4 Inspection and Testing Requirements

The diesel generator fuel oil supply piping is hydrostatically tested during construction. All active system components, instrumentation, and controls are functionally tested during startup and periodically thereafter, as defined in Regulatory Guide 1.108, Revision 1. The diesel fuel oil is sampled monthly to determine possible contamination or deterioration of the oil in the storage tank. The cause of any identified contamination or deterioration is identified and corrected as necessary to assure proper operation of the diesel generators. This may include using an algae inhibiting additive such as biocides to prevent the growth of algae and fungi. The diesel fuel oil inventory is also periodically checked. The water level in the diesel generator fuel oil storage and day tank is checked monthly and after each operation of the diesel when the period of operation is 1 hr or longer, and excessive accumulated water is removed immediately.

9.5.4.5 Instrumentation Requirements

Control and protection logic for the diesel generator fuel oil storage and transfer system is shown in Fig. 7.3-15 (standby and HPCS diesel generators), Fig 7.3-23, Sheets 17 through 28 (standby diesel generators), and Fig. 8.3-12 (HPCS diesel generator). Diesel generator protective functions are further discussed in Section 8.3.1.1.4.

Control switches are provided in each diesel generator control room for either automatic or manual operation of the diesel generator fuel oil transfer pumps. Local indicators are provided for measuring the fuel oil pump discharge pressure and the fuel oil strainer differential pressure. A high strainer differential pressure condition activates an alarm in the diesel generator control room, as well as a trouble alarm in the main control room.

The level of each diesel generator fuel oil day tank is monitored in the main control room from a level transmitter which provides both level control and alarm functions. During operation in the automatic mode, control logic is provided for starting and stopping the fuel oil transfer pump in order to maintain the level inside the day tank within limits. Failure of either the alarms or the control function of the level signal annunciates either a "gross-failure" or a "card out" alarm in the main control room. In either case, the fuel oil transfer pump can still be manually operated from the diesel generator control room, thus ensuring continuous fuel oil supply for the diesel. A low day tank level condition activates an alarm in the main control room. High and low day tank level alarms are provided in each diesel generator control room. A high day

tank level condition also activates a trouble alarm in the main control room.

Alarms are provided in each diesel generator control room for any abnormal condition that occurs in the diesel

9.5.5.3 Safety Evaluation

Each DGCWS is designed to meet Seismic Category I requirements and is housed inside a Seismic Category I structure. The DGCWS is designed so that failure of any one component on one diesel generator results in the loss of cooling water supply to only one diesel generator. There are no interconnections between the DGCWS of any diesel generators. The loss of one diesel generator and its associated load group does not prevent safe shutdown of the unit (Section 8.3.1.2.1).

9.5.5.4 Inspections and Testing Requirements

The DCCWS is designed to permit periodic testing and inspection of all components.

The DGCWS operability, including its associated instrumentation and controls, is demonstrated during the regularly scheduled tests of the diesel generators. The DGCWS is hydrostatically tested prior to startup. The cooling water is sampled and analyzed monthly to verify that its quality meets the diesel manufacturer's recommendations.

The testing of the DGCWS simulates, where practicable, the parameters of operation (automatic start, load sequencing, load shedding, operation time, etc.) and environments (temperature, humidity, etc.) that would be expected if actual demand were placed on the system.

Periodic surveillance testing and inservice inspection programs for the DGCWS components, instrumentation, controls and alarms are in accordance with Regulatory Guide 1.108, Revision 1 and engine manufacturer recommendations.

The system is designed such that testing can be accomplished on a diesel generator with the plant in normal operation or shutdown without impairing the reliability or redundancy of the remaining diesel generators.

The water chemistry program involves maintaining proper alkalinity levels using a corrosion inhibitor such as sodium nitrite, ensuring proper chloride levels and adding EPA approved biocides should the need arise. These measures significantly reduce long-term corrosion and problems related to organic fouling.

9.5.5.5 Instrumentation Requirements

Control and protection logic for the DGCWS is shown in Fig 7.3-23, Sheets 17 through 28 (standby diesel generators), and in Fig 8.3-12 (HPCS diesel generators). Control panels located in each diesel generator control room accommodate instruments and controls for operation of the diesel generator cooling water system. Alarms are provided

The performance of the DGSS filters and strainers for the standby diesel generators is monitored by a pressure sensor located in each of the air starting lines just upstream of the solenoid valves which admit air to the air header on the engine. The pressure sensors detect pressure downstream of the final strainer in the system and signal an alarm on the engine control panel when the starting air pressure is low.

There is no air filter for the HPCS diesel generator. The air strainer is located on the engine at the inlet point. A pressure switch is provided at the entrance of the air motor downstream of the strainer.

9.5.6.4 Testing and Inspection Requirements

The system is operated and tested initially with regard to flow path, flow capacity, and mechanical operability in accordance with requirements given in Chapter 14. To ensure continued integrity of the DGSS, scheduled inspection and testing of equipment including associated instruments and controls, are performed as part of the overall engine performance checks at regular intervals. Filters and strainers are checked for cleanliness during routine testing and inspection.

Testing of the DGSS simulates, where practicable, the parameters of operation (automatic start, load sequencing load shedding, operation time, etc.) and environments (temperature, humidity, etc.) that would be expected if actual demand were placed on the system.

Periodic surveillance testing and inservice inspection programs for the DGSS components, instrumentation, controls, and alarms are in accordance with Regulatory Guide 1.108, Revision 1, and enginer manufacturer recommendations. All start failures are analyzed and reported pursuant to Regulatory guide 1.108 and the Technical Specifications, respectively. The system is designed such that testing can be accomplished on a diesel generator with the plant in normal operation or shutdown without impairing the reliability or redundancy of the remaining diesel generators.

Proper operation of the standby diesel generator starting air desiccant air dryers is verified through periodic inspection and maintenance performed in accordance with the manufacturer recommendations. This includes checking of the dryer timer controls and inspection of the desiccant at least every six months for signs of deterioration. Should evidence of desiccant deterioration appear (e.g., breakdown into fine particles, a drop of disiccant level in the

tower, desiccant that is wet to the touch, or discoloration caused by the presence of oil) the desiccant will be replaced. In addition, the air receiver will be checked on a weekly basis for the presence of moisture.

Proper operation of the HPCS diesel generator starting air refigerant type air dryers is verified through periodic inspection and maintenance performed in accordance with the manufacturer's recommendations. This includes checking of the dryer temperature controls and inspection of the refrigerant at least every six months for signs of loss of pressure. Should evidence of loss of refrigerant appear (e.g. abnormal readings of the HP (110 to 120 psig) or LP (30 psig) pressure gauges), the refrigerant will be restored to proper pressures. In addition, the air receiver will be checked on a weekly basis for the presence of moisture.

9.5.6.5 Instrumentation Requirements

Control and protection logic for the DGSS is shown in Figs. 7.3-16 and 7.3-23, Sheets 17 through 28 (standby diesel generators), and in Fig. 8.3-12 (HPCS diesel generator).

Control switches are provided in the diesel generator control room for either automatic or manual operation of the diesel generator air starting compressors.

In the automatic mode, the standby diesel generator compressors start whenever the air receiver pressure reaches the low set point, and stop when the pressure returns to

The testing of the DELS simulates, where practicable, the parameters of operation (automatic start, load sequencing, load shedding, operation time, etc.) and environments (temperature, humidity, etc.) that would be expected if actual demand were placed on the system.

Periodic surveillance testing and inservice inspection programs for the DELS components, instrumentation, controls and alarms are in accordance with Regulatory Guide 1.108, Revision 1 and engine manufacturer recommendations.

The system is designed such that testing can be accomplished on a diesel generator with the plant in normal operation or shutdown without impairing the reliability or redundancy of the remaining diesel generators.

9.5.7.5 Instrumentation Requirements

Control and protection logic for the DELS is shown in Figs. 7.3-17 and 7.3-23, Sheets 17 through 28 (standby diesel generators), and in Fig. 8.3-12 (HPCS diesel generator).

Control switches are provided in each diesel generator control room for either automatic or manual operation of the diesel generator motor-driven lube oil circulating pumps and associated lube oil heaters.

In the automatic mode of operation, the following conditions exist:

1. Standby Diesel Generators

    a. Lube oil circulating pump starts whenever its associated diesel generator is not running.

    b. Lube oil heater is energized when the lube oil temperature drops below its set point, while the associated pump is running.

    c. Lube oil circulating pump stops whenever its associated diesel generator is running.

    d. Lube oil heater is deenergized when the lube oil temperature rises above its set point

Control logic is provided for deenergizing a lube oil heater when its lube oil circulating pump is not running.

2. HPCS Diesel Generator

    a. Lube oil circulating pump runs continuously.
    b. When lube oil circulating pump is not running the soak back pump (dc) operates.

ENCLOSURE 12

ASME SECTION III, CLASS 3 vs. ANSI B31.1

The HPCS Diesel Generator auxiliary systems have been designed as described in FSAR text Section 9.5 and Table 3.2-1. Specifically, the components and piping systems are designated Seismic Category I and are designed either to ASME Section III Class 3 or ANSI B31.1 requirements. Utilization of the codes described above meets Regualtory Guide 1.26 which requires the design and associated quality requirements be based on the importance to safety of the plant. There are few technical differences between ANSI B31.1 and ASME Section III, Class 3 as reflected in the following table. Specifying all safety class auxiliaries as Seismic Category I and requiring qualification and pre-operational testing further reduces these differences. Conservative design pressures were utilized in the auxiliary systems piping design. Verification that correct piping and component materials were used (material certification) during the manufacturing process should eliminate the need for actual mill test reports for piping. The discussion following the table specifically delineates the differences between the two codes and River Bend Station's specific design for each of the diesel engine auxiliary systems.

RBS considers that an acceptable alternative, which provides an equivalent level of design and quality as ASME Section III Class 3 requirements, has been provided in its HPCS diesel generator auxiliary systems design.

ASME Section III, Class 3	ANSI B31.1
1) Requires ASME materials and mill test reports for piping.	1) Requires only material certifications.
2) Requires seismic design in addition to the B31.1 requirements.	2) Requires design for pressure, temperature, and normal operating loads.
3) Requires liquid penetrant examination for welds over 4" IPS.	3) Requires only visual inspection of welds for design pressure and temperatures of the auxiliaries.
4) Requires hydrostatic test to 1.25 x design pressure.	4) Requires initial service leak test.

The diesel generator auxiliaries are separated into three different segments for design and manufacture, as described in FSAR Section 9.5.

a) The auxiliaries that are supplied as a part of the diesel engine skid and diesel starting air skid.

b) The fuel oil storage tanks and day tanks (provided by a tank fabricator).

c) The piping that connects the DSA skid with the engine skid, fuel oil storage tanks and day tank to the engine skid, the cooling service water to the cooling water heat exchanger and the diesel engine air intake and exhaust.

A discussion of each segment follows:

a) Diesel Engine and Diesel Starting Air (DSA) Skid

The engine-mounted piping and components of the fuel oil, engine cooling water (except heat exchangers - ASME Section III, Class 3), starting air and lubricating oil systems are seismically qualified to Seismic Category I requirements as part of the diesel engine skid. These systems, furnished with the engine, are the standard systems developed by the engine manufacturer in accordance with DEMA standards, and have a long history of service and reliability. These systems, piping, and components, are designed, fabricated, inspected, installed, examined, and tested in accordance with the guidelines and requirements of ASNI B31.1.

It should be also noted that it is not possible to obtain all auxiliary components to ASME Section III, Class 3 requirements. For example, the diesel oil pump, lubricating oil pump, filters and flex hoses could not be purchased to ASME Section III, Class 3, since they are unique to engine component manufacturers, which do not manufacture to ASME Section III, Class 3 requirements.

For the engine skid and DSA-skid, the technical differences between ANSI B31.1 and ASME Section III, Class 3 are reduced by the specification of Seismic Category I and RBS's intent to perform a system pressure test in accordance with the hydrostatic test parameters specified in ASME Section III, Class 3. The technical differences are delineated in the following paragraph, formatted consistent with the above table. (Technical differences are distinguised from the Section III, Class 3 administrative requirements in that a technical difference will result in a difference in construction, whereas an administrative requirement provides additional paper evidence the work was done in accordance with the Code.)

1) By invoking ANSI B31.1, RBS has received material certification (certificates of compliance) for the skid-mounted piping components and piping. Mill test reports for piping as required by ASME Section III cannot be obtained.

2) By specifying the skids to be Seismic Category I, the skids and auxiliaries on them will withstand a seismic event.

3) The only piping on the diesel engine skids that is over 4" are the 6" lines between the cooling water heat exchanger, expansion tank, and engine block. These have not been liquid penetrant examined, but will be prior to preoperational testing.

4) The engine auxiliary systems will be at operating pressure for a considerable period of time throughout plant startup testing and thus, will provide a good test of their leak tightness before the

systems are put into operation. Because of the overspecified design pressure of the components and piping, the chance for leakage at other than mechanical joints is low. The expansion tank will be hydrostatically tested at 1.5 times its design pressure.

b) Diesel Oil Storage Tank, Day Tank Supplied by Fabricator

These components are ASME Section III, Class 3.

c) Piping and Components Connecting Skids

The fuel oil piping up to the diesel engine skid, and the cooling water system's piping and components up to the diesel engine heat exchanger, are designed, fabricated, inspected, installed, examined, and tested in accordance with ASME Section III, Class 3 requirements.

The piping connecting the diesel fuel oil storage tank and day tank, is ASME Section III, Class 3. The piping connecting the DSA skid to the engine skid are designed, fabricated, inspected, installed, examined, and tested in accordance with ANSI B31.1 and is designated Seismic Category I. Performance of hydrostatic testing to 1.5 times design pressure will also be accomplished during onsite testing of the auxiliary systems.

Essential components of the starting air system are designed in accordance with the requirements of Section III of the ASME Code. The system is classified Safety Class 3 and Seismic Category I from the check valve upstream of the reciever tanks.

The air intake and exhaust system, except for the crankcase vent lines and exhaust silencers is also classified Seismic Category I Safety Class 3. Piping and components up to the diesel engine interface, are designed in accordance with ASME Section III Class 3 requirements. For both systems, the time at operating pressure during preoperational testing will be as likely t expose a leak as would occur during operation at the higher, but shorter duration test time of 10 minutes required by ASME Section III, Class 3. Therefore, the technical differences between ANSI B31.1 and ASME Section III, Class 3 are largely closed.

ENCLOSURE 13

QUESTION 430.98 (9.5.6)

In NUREG CR-0660, air dryers in diesel generator air start systems are described as being safety significant. In your FSAR, you discuss using desiccant and refrigerant type air dryers in the standby diesel generator and HPCS diesel generator air start systems, respectively. Expand your FSAR to discuss the procedures that will be followed to ensure the dryers are working properly, and the frequency of checking/testing.

RESPONSE

11 ~~The response to this request will be provided by the end of February 1984.~~

The response to this request for the standby and HPCS diesel generators is provided in revised Section 9.5.6.4.

The performance of the DGSS filters and strainers for the standby diesel generators is monitored by a pressure sensor located in each of the air starting lines just upstream of the solenoid valves which admit air to the air header on the engine. The pressure sensors detect pressure downstream of the final strainer in the system and signal an alarm on the engine control panel when the starting air pressure is low.

There is no air filter for the HPCS diesel generator. The air strainer is located on the engine at the inlet point. A pressure switch is provided at the entrance of the air motor downstream of the strainer.

9.5.6.4 Testing and Inspection Requirements

The system is operated and tested initially with regard to flow path, flow capacity, and mechanical operability in accordance with requirements given in Chapter 14. To ensure continued integrity of the DGSS, scheduled inspection and testing of equipment including associated instruments and controls, are performed as part of the overall engine performance checks at regular intervals. Filters and strainers are checked for cleanliness during routine testing and inspection.

Testing of the DGSS simulates, where practicable, the parameters of operation (automatic start, load sequencing load shedding, operation time, etc.) and environments (temperature, humidity, etc.) that would be expected if actual demand were placed on the system.

Periodic surveillance testing and inservice inspection programs for the DGSS components, instrumentation, controls, and alarms are in accordance with Regulatory Guide 1.108, Revision 1, and enginer manufacturer recommendations. All start failures are analyzed and reported pursuant to Regulatory guide 1.108 and the Technical Specifications, respectively. The system is designed such that testing can be accomplished on a diesel generator with the plant in normal operation or shutdown without impairing the reliability or redundancy of the remaining diesel generators.

Proper operation of the standby diesel generator starting air desiccant air dryers is verified through periodic inspection and maintenance performed in accordance with the manufacturer recommendations. This includes checking of the dryer timer controls and inspection of the desiccant at least every six months for signs of deterioration. Should evidence of desiccant deterioration appear (e.g., breakdown into fine particles, a drop of disiccant level in the

tower, desiccant that is wet to the touch, or discoloration caused by the presence of oil) the desiccant will be replaced. In addition, the air receiver will be checked on a weekly basis for the presence of moisture.

Proper operation of the HPCS diesel generator starting air refigerant type air dryers is verified through periodic inspection and maintenance performed in accordance with the manufacturer's recommendations. This includes checking of the dryer temperature controls and inspection of the refrigerant at least every six months for signs of loss of pressure. Should evidence of loss of refrigerant appear (e.g. abnormal readings of the HP (110 to 120 psig) or LP (30 psig) pressure gauges), the refrigerant will be restored to proper pressures. In addition, the air receiver will be checked on a weekly basis for the presence of moisture.

9.5.6.5 Instrumentation Requirements

Control and protection logic for the DGSS is shown in Figs. 7.3-16 and 7.3-23, Sheets 17 through 28 (standby diesel generators), and in Fig. 8.3-12 (HPCS diesel generator).

Control switches are provided in the diesel generator control room for either automatic or manual operation of the diesel generator air starting compressors.

In the automatic mode, the standby diesel generator compressors start whenever the air receiver pressure reaches the low set point, and stop when the pressure returns to

ENCLOSURE 14

The air supply train with a diesel driven air compressor thus provides a backup for the electric motor driven air compressor train. Additional discussion of instrumentation requirements for the air compressors is provided in Section 9.5.6.5. The air receivers are equipped with safety/relief valves which operate at 270 psig. Both air compressors are provided with intake air filters.

Each air starting system has two rotary vane air motors. On receipt of the engine start signal, a normally closed solenoid valve opens and air flows to the piston for the pinion gear of the lower motor. The entry of air moves the pinion gear forward to engage with the engine ring gear. Movement of the pinion gear uncovers a port, allowing air pressure to be released to the upper motor pinion gear piston which, in turn, engages its pinion gear with the engine ring gear. Full engagement of the upper pinion gear permits air flow to the air valve which, in turn, opens the air starting valve and releases the main starting air supply. Starting air passes through the air line lubricator, releasing an oil/air mist into the starting motors. The motors drive the pinion gears, rotating the ring gear and cranking the engine. The engine can be started with one bank of dual air starting motors. However, to ensure positive starting, both solenoids are energized simultaneously and both banks of dual starting motors crank the engine.

The compressed air is dehydrated by a non-cycling refrigerated-type dryer. The dryers are complete with hermetric refrigeration system, self regulating hot gas bypass valve, chiller section and separator. The dryers maximum operating pressure is 300 psig. Dehydrators are capable of producing a constant pressure dew point of 35°F. Dryers have an capacity of 500 scfm when dehydrating at 100 psig with 100°F saturated inlet air temperature at 110°F ambient temperature to obtain a 35°F outlet dew point.

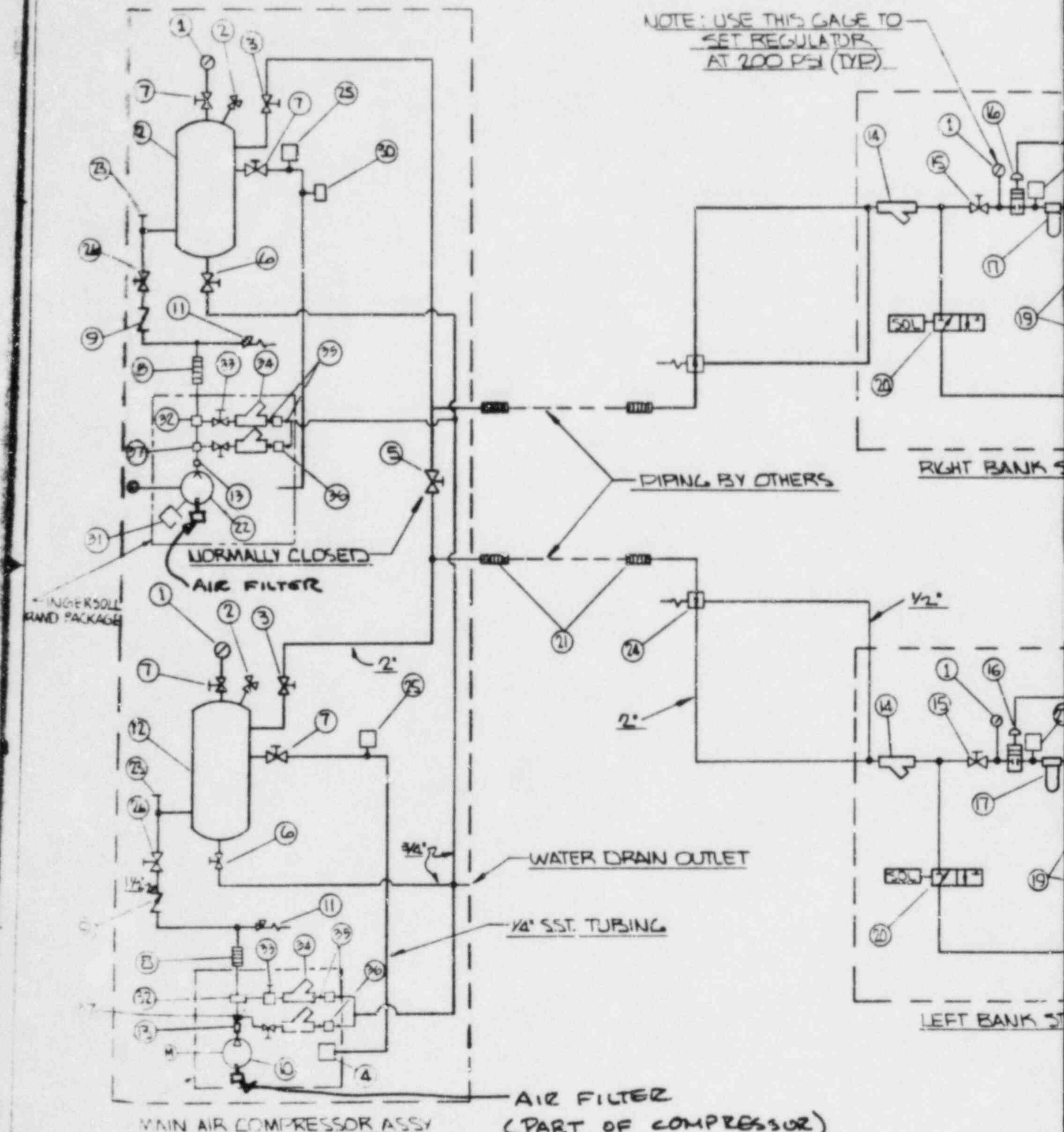
9.5.6.3 Safety Evaluation

Each DGSS is capable of supplying a sufficient quantity of air from its associated air receivers to ensure a successful starting operation of the diesel generator independent of normal plant power sources.

The air starting systems for each diesel generator unit are physically and electrically separated to ensure that no single failure can cause malfunction of two divisions of standby ac power. The starting air manifold is energized by a dc solenoid. The single-failure criterion is enhanced by having a dual-train air starting system for each diesel generator. The consequences of failure of active components

8 7 6 5

Also Available On
Aperture Card



4	3	2	1

REVISIONS

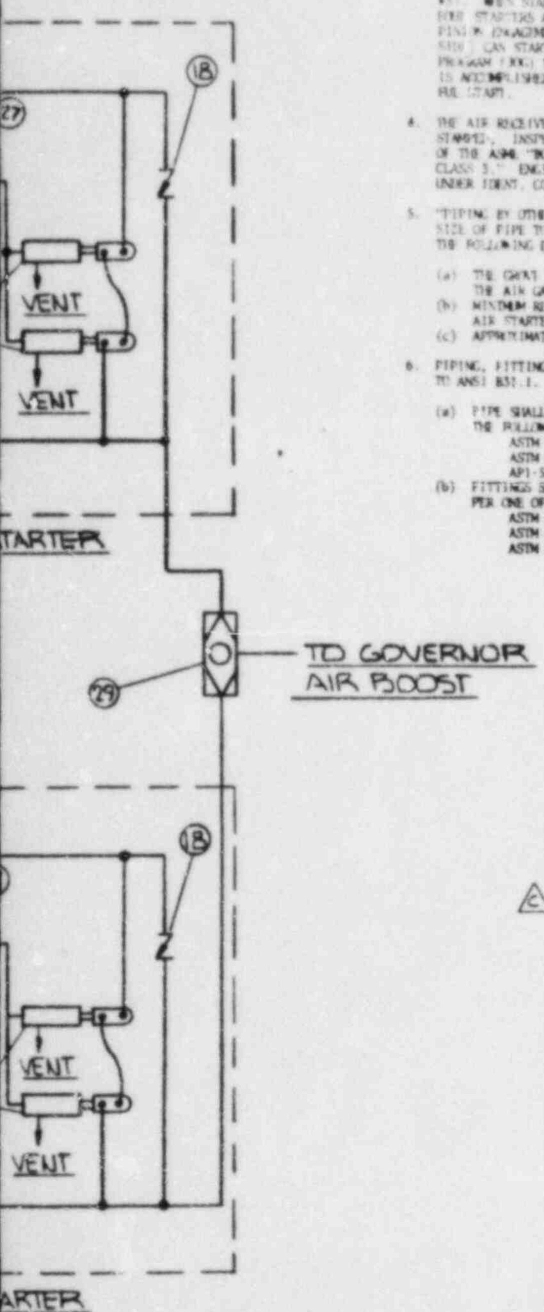
ZONE	LTR.	DESCRIPTION	DATE	APPROVED
	A	ADDED ALL PNEUMATIC, AUTOMATIC DESICCANT TYPE AIR DRYER. ADDED ITEM 33, 34, 35, 36, 37, AND [illegible] CHANGED QUANTITY [illegible] ITEM 32. ADDED NOTE #. AND NOTE [illegible]	4/14/80	[illegible]
	B	DELETE REV. A PER CUSTOMER REQUEST CHANGED MFR. ITEM 22. ADDED ITEMS 33, 34, 35, 36 AND 37 AS PART OF INGERSOLL RAND PACKAGE	6/16/80	[illegible]
	C	CHANGED ENGINE, WAS ST1A, WAS REV. 2	2-25-81	[illegible]

NOTES:

1. AIR STORAGE CONSISTS OF TWO [illegible] RECEIVERS CHARGED TO 250 PSIG. RECEIVER CAPACITY IS SUFFICIENT TO [illegible] 5 NORMAL STARTS.
2. AIR COMPRESSOR IS TWO STAGE AIR COOLED, 20 CFM RATING, CAPABLE OF RECHARGING A RECEIVER FROM MINIMUM OPERATING PRESSURE, 150 PSIG, TO MAXIMUM OPERATING PRESSURE, 250 PSIG, IN LESS THAN 30 MINUTES.
3. TWO REDUNDANT SETS OF ENGINE STARTING EQUIPMENT ARE FURNISHED. THE SETS ARE TIED TOGETHER BY THE NORMALLY CLOSED VALVE (ITEM #5). WHEN STARTING THE ENGINE, BOTH AIR RECEIVERS AND THE FOUR STARTERS ARE ALL ACTIVATED SIMULTANEOUSLY. NOTE THAT PINION ENGAGEMENT OF ONLY ONE PAIR OF STARTERS (ON EITHER SIDE) CAN START THE ENGINE. ELECTRIC RELAYS WILL AUTOMATICALLY PROGRAM (JOG) STARTERS EVERY 3/4 SECONDS UNTIL PINION ENGAGEMENT IS ACCOMPLISHED THEN CRANKING WILL BE CONTINUOUS UNTIL A SUCCESSFUL START.
4. THE AIR RECEIVERS (ITEM 12) SHALL BE DESIGNED, FABRICATED, ERECTED STAMPED, INSPECTED, AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF THE ASME "BOILER AND PRESSURE VESSEL CODE, SECTION III, CLASS 3." ENGINE MANUFACTURER EQUIPMENT IS DESIGNATED IN P/M UNDER IDENT. CODE NO. 72915.
5. "PIPING BY OTHERS" BETWEEN ENGINE SKID AND AIR COMPRESSOR SKID—SIZE OF PIPE TO BE BASED ON PRESSURE DROP CALCULATIONS USING THE FOLLOWING DATA:
   (a) THE GROVE AIR REGULATOR SHOULD BE SET FOR 200 PSIG AT THE AIR GAUGE JUST UPSTREAM OF THE AIR STARTERS.
   (b) MINIMUM RECOMMENDED CRANKING PRESSURE 100 PSIG AT THE AIR STARTERS.
   (c) APPROXIMATE FREE AIR FLOW IS 39 CU. FT. PER SECOND.
6. PIPING, FITTINGS & VALVES FURNISHED BY S&SS SHALL CONFORM TO ANSI B31.1.
   (a) PIPE SHALL BE SEAMLESS, SCHEDULE 80, AND PER ONE OF THE FOLLOWING SPECIFICATIONS:
   ASTM A-53, GR. A OR B
   ASTM A-106, GR. A, B, OR C
   API-5L, GR. A, OR B.
   (b) FITTINGS SHALL BE CARBON STEEL, 3000# RATING MINIMUM, PER ONE OF THE FOLLOWING SPECIFICATIONS:
   ASTM A-105
   ASTM A-181, GR. I OR II
   ASTM A-234, GR. WPA, WPB, OR WPC

NOTE: This drawing is the source for FSAR Fig. 9.5-4b which will be updated in a future amendment.

TI APERTURE CARD



ITEM NO.	ZONE	NOMENCLATURE OR DESCRIPTION	IDENT. CODE	PART OR IDENTIFYING NO.	QTY. REQD
37		SEPARATOR, CARBON STEEL 3/8" NPT CONNECTIONS 1000 PSI	WRIGHT-AUSTIN	TYPE T	2
36		WATER DRAIN TRAP, FLOAT OPERATED 5/64" ORIFICE 3/8" NPT	WRIGHT-AUSTIN	995 TYPE AC	4
35		½" NPT UNIONS, CARBON STEEL -PART OF I.R. PACKAGE			8
34		Y-STRAINER, ½" NPT WITH 20 MESH (1/32" OP.) SCREEN	MCALEAR	STYLE 5	4
33		BALL VALVE, ½" NPT	WHITEY	NO. 80	4
32		REFRIGERATED AIR DRYER-MODEL NO. 3	I.R.	PART OF ITEM 10 & 22	2 REF
31	S48	OIL PRESSURE STARTER DISCONNECT	SQ.D	9012-ACW5	1
30	S49	SWITCH, AIR PRESSURE, DIESEL ENG. ELECT. STARTER CONTROL	SQ.D	9012-ACW2	1
29		VALVE, SHUTTLE, 3/8 NPT	VERSA	SS-4	1
28		FITTINGS, CARBON STEEL, ASME-SA-105, GR. A OR B		AS REQUIRED	
27	S56	SWITCH, AIR PRESSURE, "CRANK-JOG," SET AT 100PSI	SQ'D	9012-ACW-2	2
26		VALVE, SERVICE, 1½" NPT BALL VALVE	SMITH	FIG. 411T	2
25	S13A	SWITCH, LOW AIR PRESSURE (ALARM), 160 PSI CLOSE & 180 PSI OPEN	SQ'D	9012-ACW-9	2
24		REGULATOR, 250/200 PSI, 2" NPT SCREWED ENDS WITH NO. 11082 PILOT	GROVE	114"3NK	2
23		PIPE PLUG (SERVICE CONNECTION) 1½" NPTM			2
22		COMPRESSOR ASS'Y., DIESEL DRIVEN, ELEC START, 125V, LISTER ST2A, I.R. MODEL 253.	I.R.	HP-0115-REV. 3	1
21		FLEX CONNECTIONS, 2" X 18" OAL, MAX. LIVE LENGTH, WITH 2" NPTM NIPPLES	81381	P-25367	4
20	L1 2	VALVE, SOLENOID, 125 V-DC	72915	8393333 or 9081135	2
19		STARTERS, INGERSOLL-RAND P/N 150 BMP, D89RH-46	72915	8367694	4
18		VALVE CHECK, KEPNER 106C-1	72915	8394052	2
17		LUBRICATOR, NORGREN 10-003-074	72915	8322644	2
16		VALVE, AIR-RELAY, GRAHAM WHITE, P/N 853-3	72915	8393335	2
15		VALVE, SHUT-OFF, 2" BALL	72915	8375934	2
14		STRAINER, Y-TYPE	72915	5315830	2
13		AFTER-COOLER (PART OF COMPRESSOR ASSEMBLY) AIR-TO-AIR	I.R.	9GS (PART OF ITM. 10 ITM. 22)	2 REF
12		AIR RECEIVERS, 480 GAL 250 PSI, SECT. III C.L. 3 ASME	81381	25131	2
11		VALVE RELIEF, 1/2" NPTM SET AT 270 PSI, SECT. VIII STAMPED	KINGSTON	FIG. 105C	2
10		COMPRESSOR, ASSEMBLY, MOTOR DRIVEN, 7½ HP, 460V, 3Ø, 60HZ I.R. MODEL 253	I.R.	HP-0114 REV. 1	1
9		VALVE CHECK, 1½" NPT	VOGT	SERIES #2191	2
8		CONNECTION, FLEXIBLE, 1" X 12" OAL WITH MAXIMUM LIVE LENGTH COUPLED WITH CARBON STEEL 2" NPTM NIPPLES EACH END.	81381	P-25366	2
7		VALVE, SERVICE, ½" NPT BALL	SMITH	FIG. 411T	4
6		VALVE, DRAIN, 3/4" NPT, BALL	SMITH	FIG. 411T	2
5		VALVE SERVICE, 2" NPT, BALL	SMITH	FIG. 411T	1
4	S38	SWITCH, PRESSURE, AIR COMPRESSOR CONTROL (ON AT 225 OFF AT 250)	SQ'D	9012-ACW9	1
3		VALVE, SERVICE, 2" NPT BALL	SMITH	FIG. 411T	2
2		VALVE, RELIEF, ½" NPTM, SET AT 270 PSI, SECT. VIII STAMPED	KINGSTON	FIG. 105C	2
1		GAUGE, PRESSURE, 0-300 PSI 2½" DIAL	MARSH	CAT NO. J-4838	4

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY.	14497
USED ON	
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± DECIMALS ± ANGLES ±

MATERIAL

TREATMENT

FINISH

CONTRACT NO.

DATE		
PREPARED	EGJ	9-7-78
CHECKED	[illegible]	12-8-78
ENGINEER	[illegible]	12-8-78
DESIGN ACTIVITY APPROVAL	Robert Malcher 12/4/78	
	Roger L. Huffman 12/8/78	

STEWART & STEVENSON SERVICES
P. O. BOX 1637 HOUSTON, TEXAS, U.S.A.

TITLE: GENERAL ELECTRIC CO. AIR START SCHEMATIC 2600 KW & 2000 KW GEN SETS

SIZE	CODE IDENT NO	DRAWING NO	REV
D	81381	D-63820	C

SCALE NONE | ACT CALC WT | SHEET 1 OF 1

8403210069-01

ENCLOSURE 15

A starting system, consisting of two redundant trains, is provided for each diesel engine.

The major system components are located external to the diesel generator skid in the diesel generator building.

Each standby diesel generator is provided with two separate 250 psig airl.0cooled, motor-driven compressors. Each compressor is designed to recharge an air receiver in 30 min from a minimum starting pressure of 235 psig to a maximum starting pressure of 250 psig. Each compressor discharges to two starting air receivers which are connected in parallel. The air compressor is provided with non-1E power.

An air-to-air type aftercooler is provided on the downstream side of the air starting compressors to cool the compressed air prior to entering the air dryer. The compressed air passes on the tube side of the cooler, and cooling air is fan-blown over the finned tubes. Each aftercooler operates continuously when its respective compressor is operating.

A compressor unloading line is provided between each compressor and air receiver tank set to load and unload the compressor at predetermined pressures while the motor continues to operate. This pressure regulation maintains the air receivers between the minimum starting pressure of 235 psig and maximum starting pressure of 250 psig.

A 1/8 inch restrictive orifice is installed in the compressor unloading line to limit the loss of air from the air receiver tanks should the unloading line fail at the connection to the compressor during a seismic event. The operator has in excess of 30 minutes following receipt of a loss of starting air alarm to isolate the failed line before the starting air pressure falls to 150 psig, below which the diesel generator will not start automatically. The loss of starting air alarm is located in the main control room. Low starting air pressure is also alarmed locally in the diesel generator control room.

Each air starting dryer assembly consists of a prefilter, two dehydrator towers, an afterfilter, and the interconnecting piping and valves which control the air flow to each tower. This type of dryer provides moisture-free air to the air receivers. Each air dryer assembly processes 76 scfm of air through one of the two available dehydrator towers which contain desiccant to remove moisture. While one tower dries the air, the other tower is purged with a portion of the dried air in order to reactivate the desiccant. An automatic control system provided with the air dryer assembly reverses the modes of the towers on a timed basis, thus ensuring that the air is dried with

freshly regenerated desiccant. The air dryer reduces the air starting dew point to -40°F at 250 psig. The prefilter removes entrained water and oil from the air entering the air dryer, and the air filter removes any desiccant which may become airborne during drying.

The on-engine portion of the air starting system includes a header, two solenoid control valves, two gear-driven distributors, and a pilot-operated air starting valve for each cylinder. During engine starts, starting air is admitted to the header when the solenoid valves are opened. There is a solenoid valve at either end of the header, each provided with a check valve on the header side to prevent pressure loss should either supply be low or inoperative. Pressure in the air starting header is supplied to the air starting valves in each cylinder, and to each of the two air starting distributors. Dual air starting distributors are mounted on the camshaft so that if, for any reason, one distributor fails to properly energize the air starting

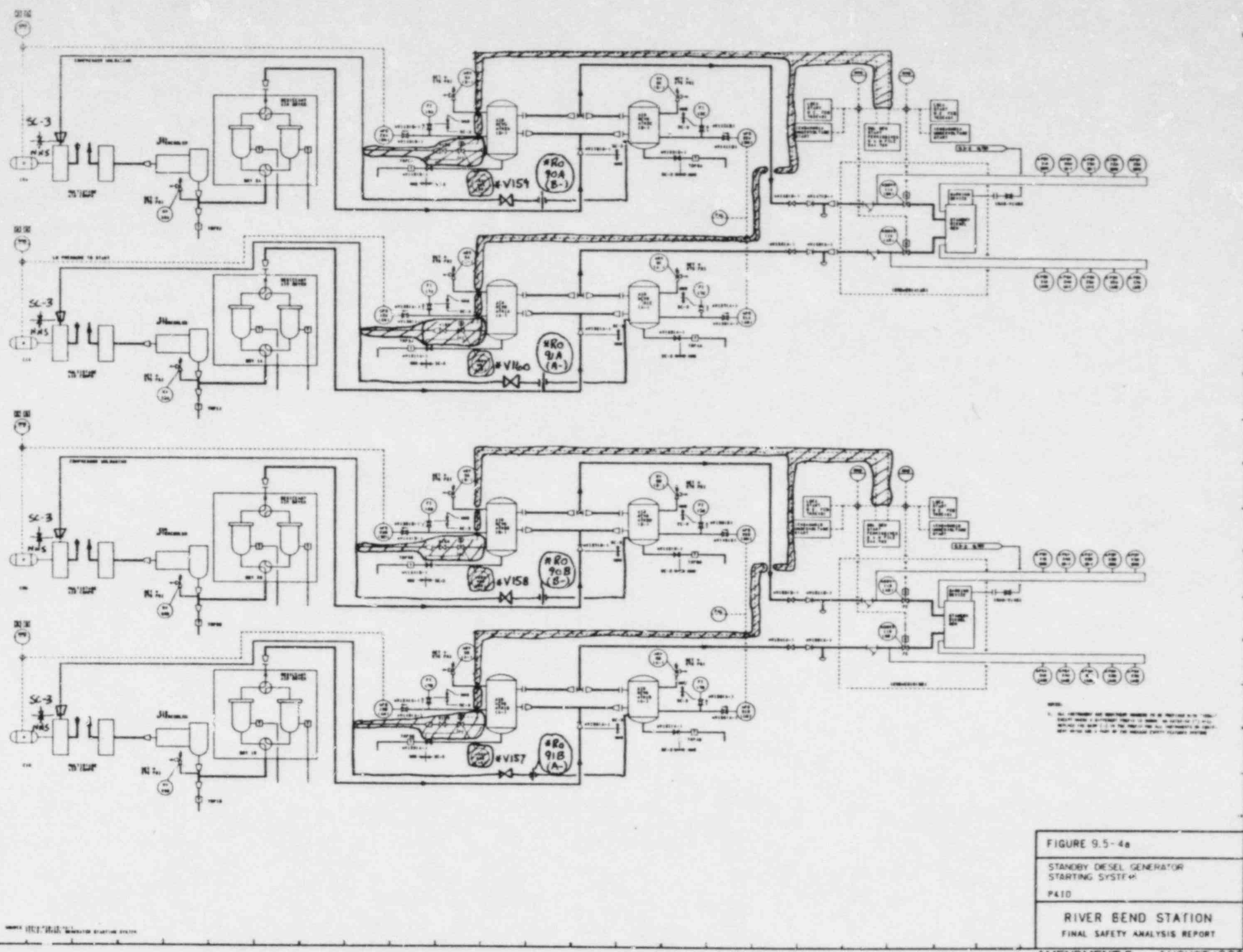


FIGURE 9.5-4a

STANDBY DIESEL GENERATOR STARTING SYSTEM

P&ID

RIVER BEND STATION

FINAL SAFETY ANALYSIS REPORT

AMENDMENT 5 AUGUST 1982

ENCLOSURE 16

3. The DGSS is designed so that a single failure of any active or passive component, assuming a loss of offsite power, cannot result in the loss of more than one diesel generator starting system train.

4. Piping which forms integral part of the diesel engine is designed in accordance with ANSI Piping Code B31.1. The remainder of the piping is designed in accordance with ASME III, Class 3. The air receivers associated with the DGSS are designed and constructed in accordance with the requirements of ASME Code, Section III, Class 3.

5. Each redundant DGSS train is capable of providing the standby diesel generator with eight starts (five of them are 10 sec starts) from two air receivers without recharging the associated air receivers.

6. The HPCS diesel generator air start subsystem has sufficient capacity to start the diesel generator within 10 seconds five times without recharging, when operated in its normal configuration using both redundant trains through all air start motors, and when initially charged to 250 psig. The air start system has sufficient air supply to start the engine 3 times at receiver pressure of 215 psig. At this pressure the diesel driven air compressor is automatically operated to replenish the air supply to 250 psig.

7. The DGSS will be evaluated for the consequences of moderate energy line breaks in accordance with the guidelines given in Section 3.6. The moderate energy lines installed in the diesel generator room are the air start piping and compoents, and the standby service water piping and components. There are no high energy lines which could affect the system.

9.5.6.2 System Description

9.5.6.2.1 Standby Diesel Generators

Each DGSS for each standby diesel generator consists of the following major components and associated piping, valves, and controls:

1. Two starting air compressors (nonsafety-related)
2. Two starting air aftercoolers (nonsafety-related)
3. Two starting air desiccant air dryers with filters (nonsafety-related)
4. Four air receivers, 76 cu ft each.

ENCLOSURE 17

The air supply train with a diesel driven air compressor thus provides a backup for the electric motor driven air compressor train. Additional discussion of instrumentation requirements for the air compressors is provided in Section 9.5.6.5. The air receivers are equipped with safety/relief valves which operate at 270 psig. Both air compressors are provided with intake air filters.

Each air starting system has two rotary vane air motors. On receipt of the engine start signal, a normally closed solenoid valve opens and air flows to the piston for the pinion gear of the lower motor. The entry of air moves the pinion gear forward to engage with the engine ring gear. Movement of the pinion gear uncovers a port, allowing air pressure to be released to the upper motor pinion gear piston which, in turn, engages its pinion gear with the engine ring gear. Full engagement of the upper pinion gear permits air flow to the air valve which, in turn, opens the air starting valve and releases the main starting air supply. Starting air passes through the air line lubricator, releasing an oil/air mist into the starting motors. The motors drive the pinion gears, rotating the ring gear and cranking the engine. The engine can be started with one bank of dual air starting motors. However, to ensure positive starting, both solenoids are energized simultaneously and both banks of dual starting motors crank the engine.

The compressed air is dehydrated by a non-cycling refrigerated-type dryer. The dryers are complete with hermetric refrigeration system, self regulating hot gas bypass valve, chiller section and separator. The dryers maximum operating pressure is 300 psig. Dehydrators are capable of producing a constant pressure dew point of 35°F. Dryers have an capacity of 500 scfm when dehydrating at 100 psig with 100°F saturated inlet air temperature at 110°F ambient temperature to obtain a 35°F outlet dew point.

9.5.6.3 Safety Evaluation

Each DGSS is capable of supplying a sufficient quantity of air from its associated air receivers to ensure a successful starting operation of the diesel generator independent of normal plant power sources.

The air starting systems for each diesel generator unit are physically and electrically separated to ensure that no single failure can cause malfunction of two divisions of standby ac power. The starting air manifold is energized by a dc solenoid. The single-failure criterion is enhanced by having a dual-train air starting system for each diesel generator. The consequences of failure of active components

ENCLOSURE 18

QUESTION 430.101 (9.5.7)

In section 9.5.7.2, you discuss the HPCS diesel generator soak back pump, and state that this pump is used to pre-lube the HPCS diesel engine. Expand your discussion of this pump and its function to demonstrate that the entire engine has adequate pre-lubrication. Use P&IDs, and/or any other drawings and diagrams, as required, to demonstrate there is adequate pre-lubrication.

RESPONSE

The response to this request is provided in revised Section 9.5.7.2 and Fig. 9.5-5b. 5

A description of the automatic prelube modifications consistent with LRG-II Item 1-PSB ~~will be~~ is provided ~~by the end of January 1984~~ below. 11

INSERT HERE

INSERT (for Pg. Q&R 9.5-43)

The HPCS lube oil system piping and connections will be modified to implement diesel manufacturer's recommendation MI-9644. Lube oil flows to the preheat system and to the turbocharger will be separated. The AC motor driven circulating pump will provide 6 gpm flow to the preheat system and the VDC motor driven soakback pump will provide 3 gpm flow to the turbocharger. Both of these pumps will have the capability to operate continuously. Vent lines with orifices will be added to the lube oil filter and lube oil cooler to bleed off any entrapped air and the vents will be connected to the engine camshaft housing to discharge any oil flows back to the engine. A vent will also be added to the lube oil cooler discharge pipe to prevent a syphon effect that would draw oil out of the cooler into the engine strainer box. Two new sight glasses will be added for visual monitoring of the oil level during standby.

In addition, the cooler discharge pipe will be changed to form an inverted 'U" connection to the oil strainer tank. An additional piping connection will be made from the bottom of the cooler to the pressure pump discharge line via a check valve and then to the gallery. This will flood the main oil gallery which supplies oil to the main bearing, the accessory drive, the turbo and the top deck. This will minimize the time for oil to reach these components during a fast start, as well as maintain lubrication of the main bearings.

ENCLOSURE 19

CREATORS OF ELECTRICAL
POWER SUPPLY SYSTEMS

POWER SYSTEMS
A MORRISON-KNUDSEN DIVISION

101 GELO ROAD / POST OFFICE BOX 1948
ROCKY MOUNT, NORTH CAROLINA 27801
PHONE (919) 977-2720 / TWX (510) 929-0725
TELEX 802500 PSO RYMO

April 28, 1981

SUBJECT: MI 9644 (EMD Lube Oil Modification)
Immersion Heater - Lube Oil Circulating Pump System for
Emergency Fast Start Installations

1. Figura 1A - Schematically shows the standard EMD Lube Oil System:

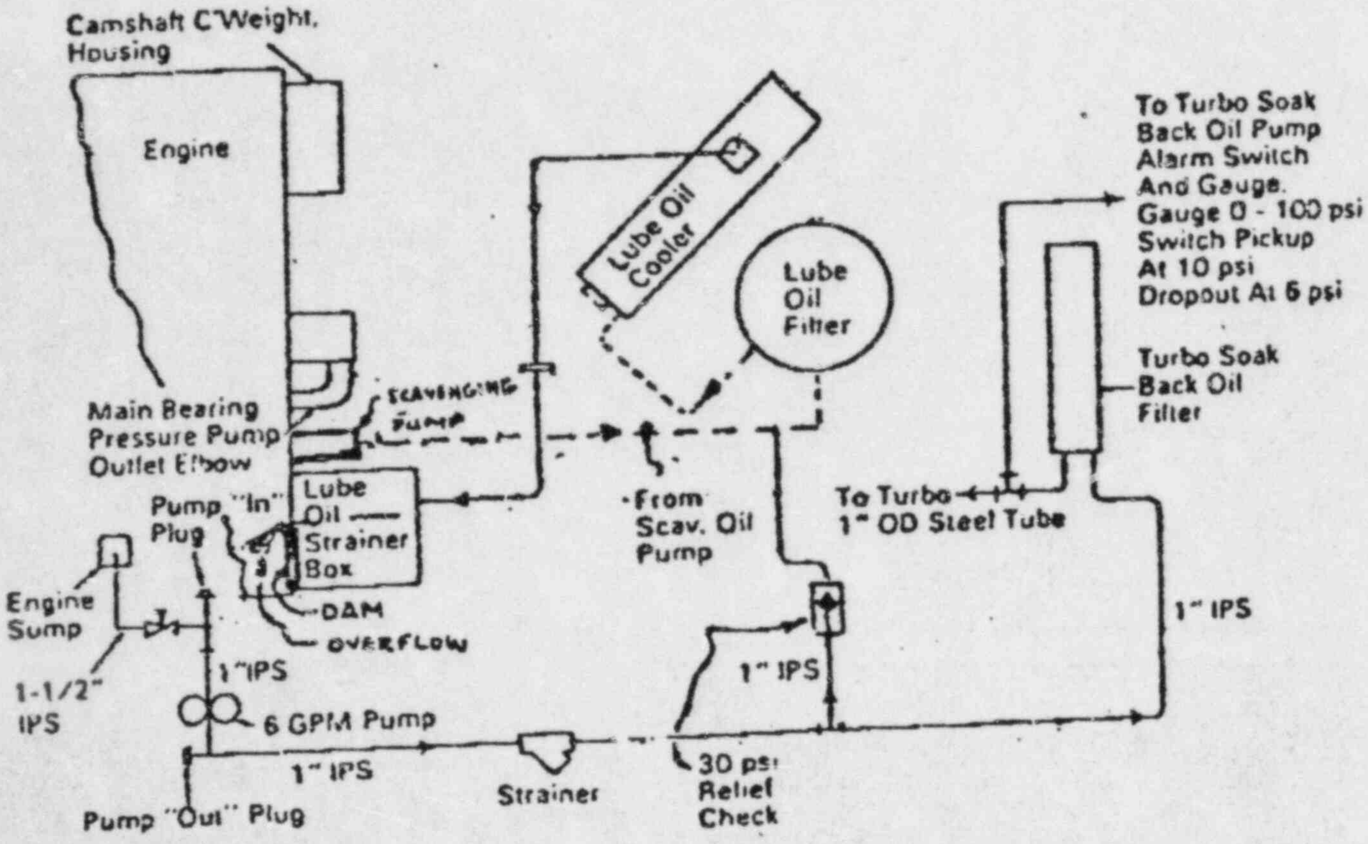


Fig.1A System Schematic Diagram. "S" Units

UNMODIFIED

(a) Lube oil is drawn from the engine sump by a 6 gpm soakback motor driven pump which pumps lube oil through a line strainer to a point where the flow divides (at standby oil temperatures) approximated equally into two systems. Part of the oil flow goes to the preheat system through a 30 psi spring loaded check valve and the other part of the oil flow goes through the soakback filter to the turbocharger for turbo bearing lubrication. The part that goes to the preheat system is discharged into a pipe connection between the scavenging pump and the main lube oil filter. The scavenging pump is a gear type and acts as a check valve so the lube oil does not flow back into the engine oil pan. The lube oil then flows thru the filter and then thru the lube oil cooler where the oil picks up heat from the water and then back into the strainer mounted on the engine. The strainer has a dam so that it contains a supply of oil and excess oil overflows back into the oil pan.

(b) During extensive test conducted by EMD and PSD, it was found that when the oil was close to operating temperature (hot):

(1) The scavenging pump no longer acted like a check valve and oil would flow back thru it into the oil pan at a rate of approximately 3 gpm due to the lower oil viscosity.

(2) The pressure required to pump oil thru the turbo was reduced to about 10 psi so now all the 6 gpm went to the turbo and none to the preheat system.

(3) It was found that during engine operations, the lube oil picked up air which when under pressure was not noticeable. But when the engine stopped, the pressure went essentially to atmospheric and the air expanded inside the lube oil filter and the lube oil cooler displacing the oil. This air could not escape and therefore, these components were only 3/4 full of oil which had to be filled during the next engine start.

(c) The conditions stated in 1(b-2) above caused EMD to issue MI 9644. The net result is that during a fast start after 15 minutes of a shutdown and prior to 3 hours after shutdown, the delivery of lube oil to the turbocharger was delayed for 8 to 10 seconds and this could cause a loss of the turbo bearings, particularly the thrust bearing.

2. Figure 1B schematically shows the EMD modification per MI 9644 designed to overcome the conditions in 1(b-2).

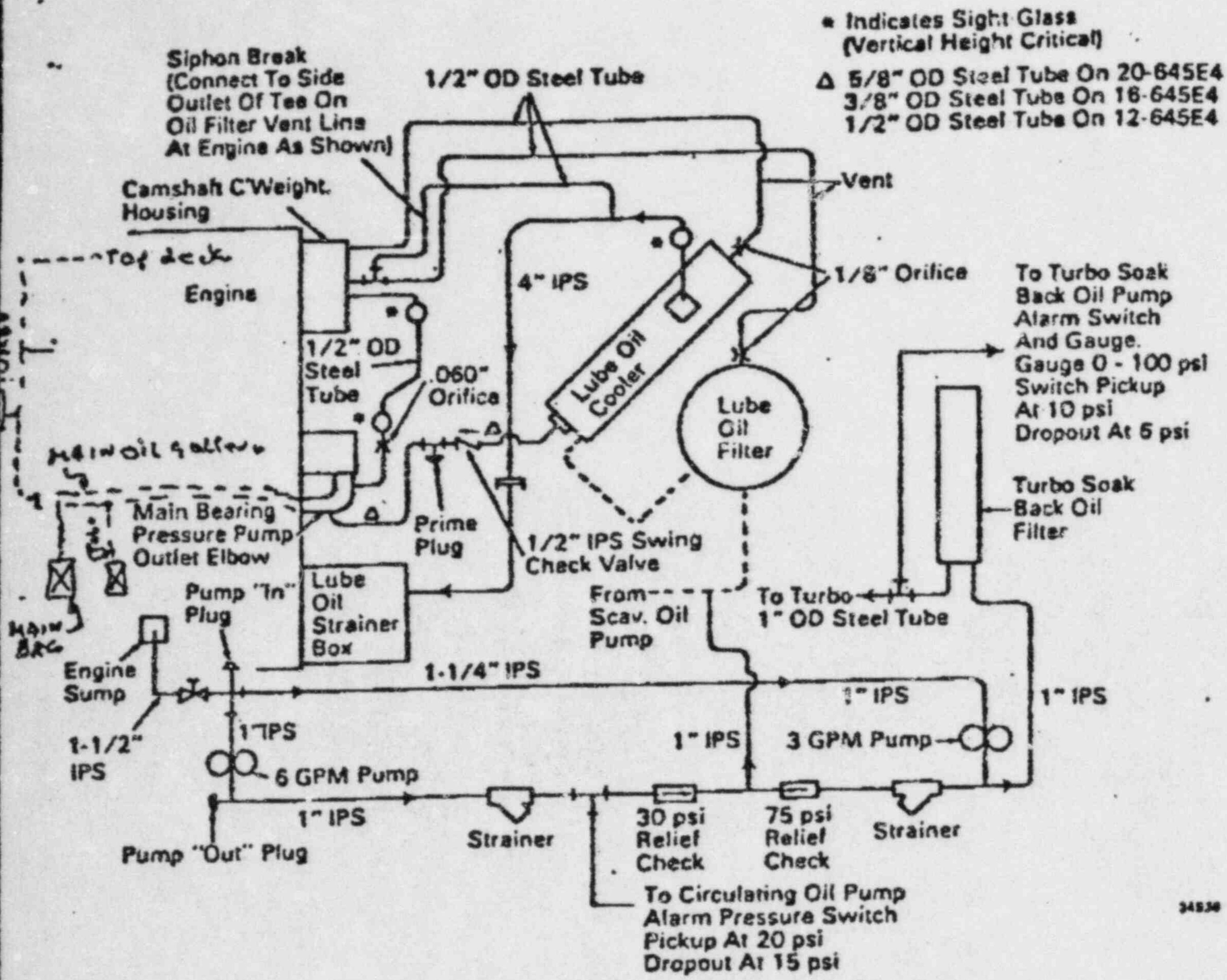


Fig. 1 B System Schematic Diagram, "S" Units

MODIFIED

(a) First the flow to the preheat system and to the turbocharger now pass thru separate pumps insuring 6 gpm to the preheat system and 3 gpm to the turbocharger. The 30 psi spring loaded check-valve is there to furnish a pressure level for monitoring purposes since the pressure during standby is around 3 to 5 psi. The check valve also prevents back flow during engine operation (30-50 psi) should the 6 gpm not be operating.

The 75 psi spring loaded check valve is to provide a relief valve for

the turbo pump. It discharges into the preheat system but also could have been taken back to the oil pan.

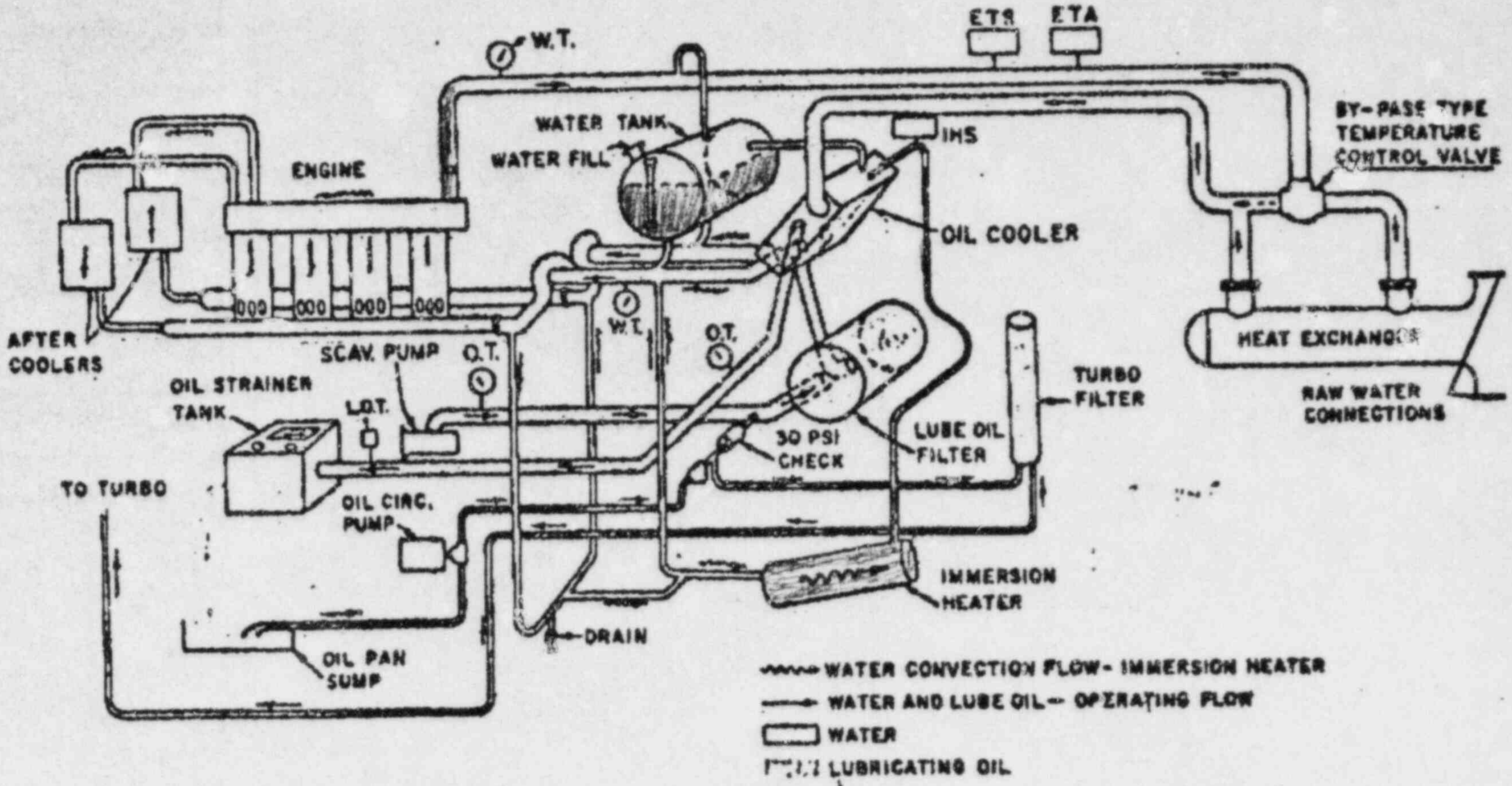
(b) Vents with orifices were added to the lube oil filter and lube oil cooler to bleed off entrapped air and the vents were connected to the engine camshaft housing and discharged whatever oil flowed back into the engine. A vent was also added to the lube oil cooler discharge pipe to prevent a syphon effect that would draw oil out of the cooler into the strainer.

(c) Another improvement is to flood the main oil gallery which supplies oil to the main bearing, the accessory drive, the turbo and the top deck. This would also minimize the time for oil to reach these components during a fast start as well as maintain lubrication of the main bearings.

To accomplish this, the head of oil in the cooler is used as the pressure to fill this system. First, the cooler discharge pipe was changed and now forms an inverted "U" connection to establish the height of oil in the cooler and therefore the pressure head. The head is sufficient to flood the gallery, but not high enough to get to the top deck. A small pipe is connected to the bottom of the cooler to permit oil flow from the cooler thru a check valve to the pressure pump discharge connection and then into the gallery. The check valve prevents back flow when the engine is in operation.

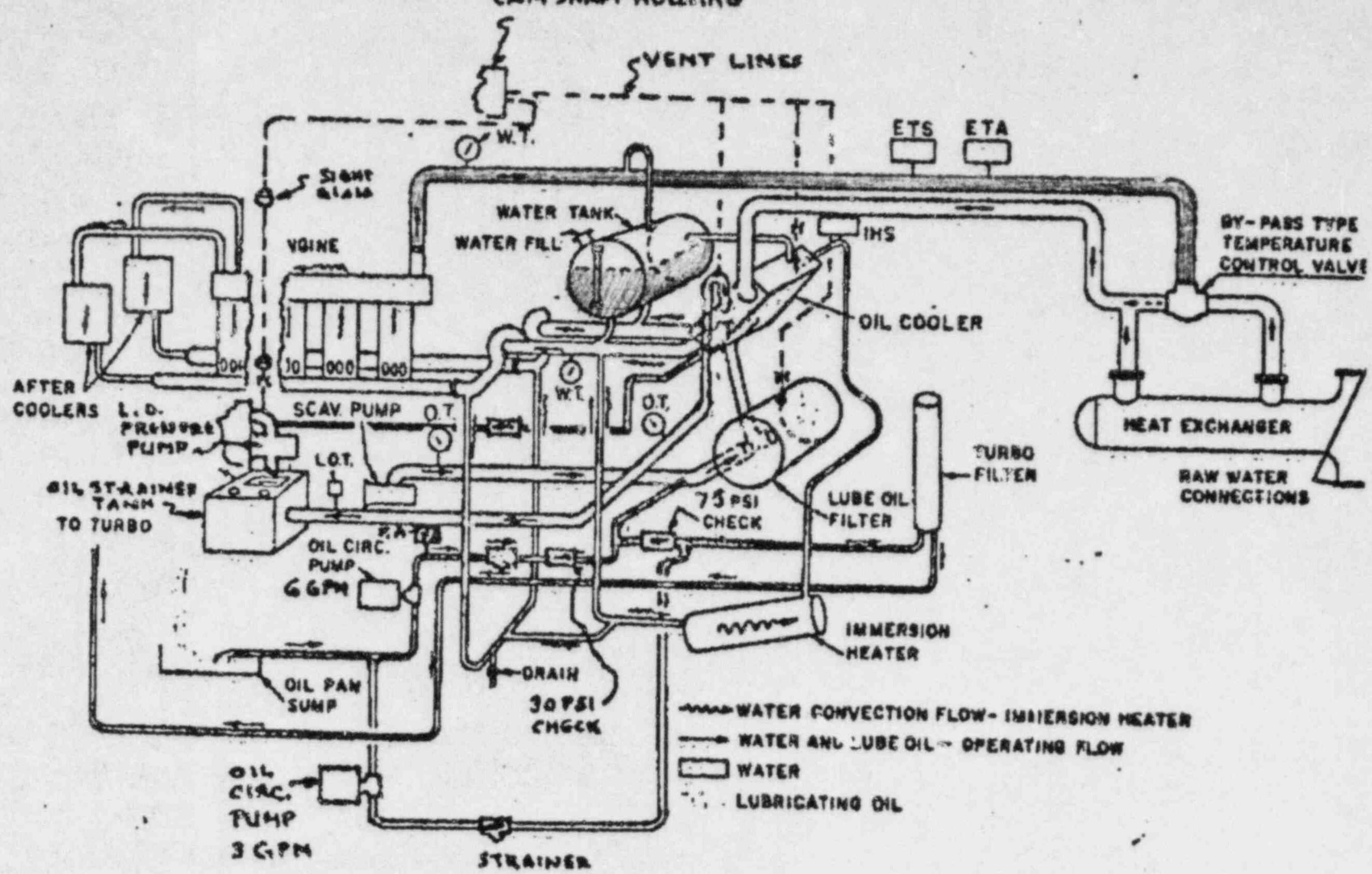
Two bulls-eye sight glasses are added for visual monitoring of the oil level during standby. The lower bulls-eye should be full and the upper should empty. If there is oil in the upper bulls-eye, oil is getting to the top deck and the cause must be found.

3. Figures 2A and 2B show the systems in an illustrative manner and may provide a better visualization.



UNMODIFIED LUBRICATING OIL SYSTEM
AND ENGINE COOLING WATER SYSTEM
WITH IMMERSION HEATER SYSTEM - TURBOCHARGED UNITS

FIG 2A



MODIFIED LUBRICATING OIL SYSTEM
AND ENGINE COOLING WATER SYSTEM
WITH IMMERSION HEATER SYSTEM - TURBOCHARGED UNITS

FIG 2B

ELECTRO-MOTIVE

MAINTENANCE INSTRUCTION

MODERNIZATION RECOMMENDATION

IMMERSION HEATER — LUBE OIL CIRCULATING PUMP SYSTEM FOR EMERGENCY FAST START INSTALLATIONS

PURPOSE: To provide an improved immersion heater lube oil circulating system, Figs. 1 and 10, that will consistently supply oil to the turbocharger and crankshaft in anticipation of an emergency start.

APPLICATION: All turbocharged "S", "999", and MP45 emergency fast start installations.

DISCUSSION: Wear is minimized if lube oil is supplied to engine and turbocharger bearings prior to and during high speed emergency starts.

EMD's original immersion heater system provided a parallel lube oil circuit whereby oil is supplied to the turbocharger bearings via one path and the oil cooler and filters are flooded via another path. However, following a load run, the branched oil flow is unbalanced because of the thinner viscosity of hot oil. As a result, the oil level in the cooler and filter is not replenished to the full level until the oil cools sufficiently (approximately 3 hours following shutdown). High speed starts during this period do not have the wear minimizing benefits of continually abundant oil supply.

Owners of EMD nuclear standby units have previously been notified of the unnecessary wear caused by equipment exercise or test schedules that routinely call for restarting engines without first allowing for a cooling interval from a previous load run. Although a few random starts under these adverse conditions are not expected to cause difficulty, the cumulative wear from repeated routine starts is likely to affect equipment reliability. EMD recommended that exercise and test schedules be revised to avoid restarting engines until they have had a three hour cooling period following shutdowns.

The primary benefit to be gained from this modification is continual oil replenishment of the oil cooler and filters to the full level regardless of oil temperature and viscosity. It would also remove restart restrictions imposed on exercise or test schedules.

Page 7 of 9

However, other benefits provided by this improvement make this modification attractive even when exercise or test schedules can be carefully controlled. Oil systems modified in accordance with this instruction provide consistent oil circulation through the engine crankshaft bearings in addition to the turbocharger. As a result, engines very rapidly approach operating oil pressures following start up. Trapped air which may impede oil flow is vented from the system.

Proper performance of this improved system depends on operation of AC motor driven oil pumps. If start-ups are delayed for more than 5 seconds after loss of AC power, we recommend that DC backup pumps be provided with suitable protection against reverse flow through the use of check valves.

Although oil flows through the crankshaft bearings, the standby oil level in the engine is kept below the camshafts and valve rocker arm assemblies. Sight glass indicators, Fig. 2, are used so that the operator can visually ascertain if the system is operating properly under standby conditions.

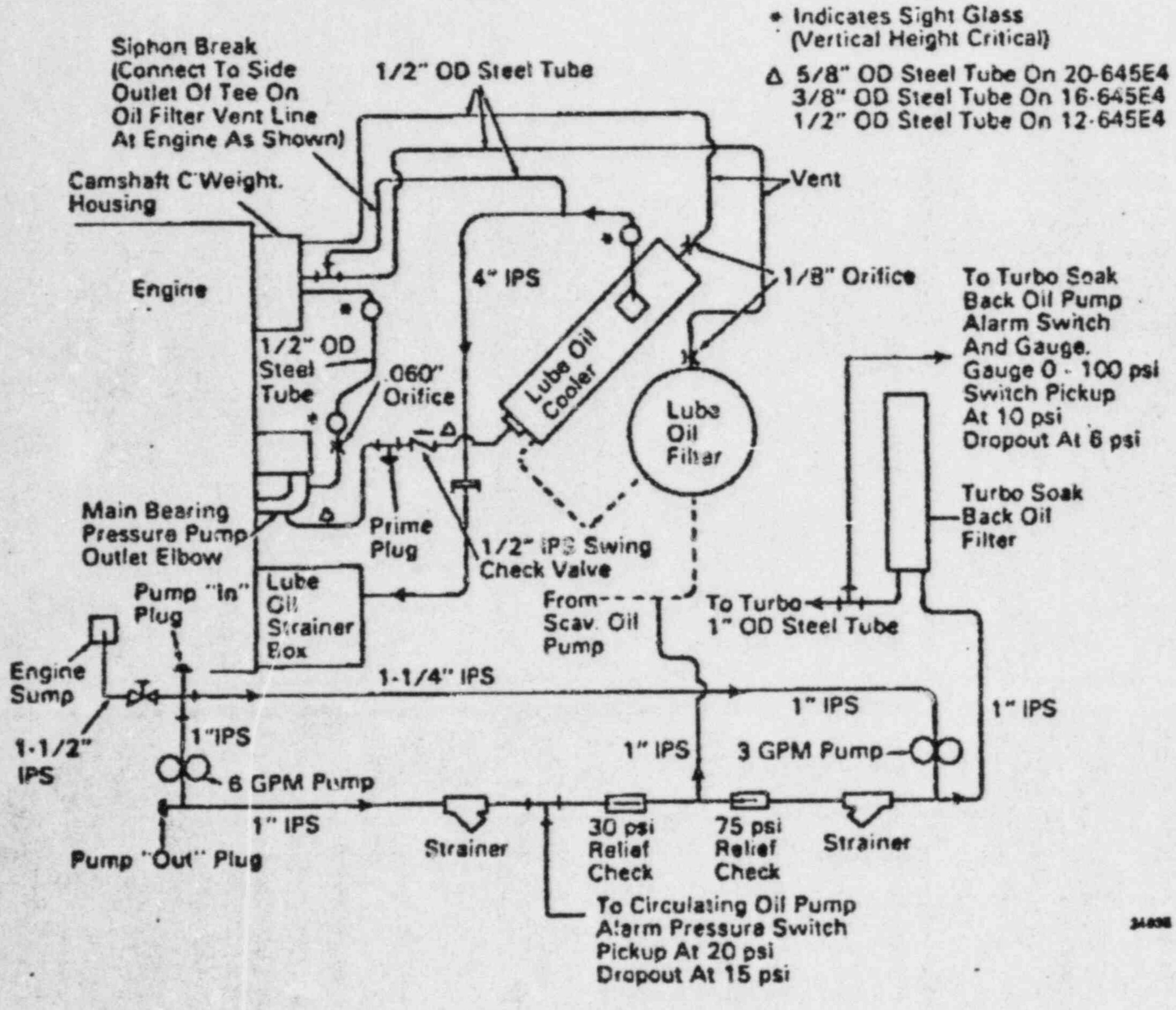


Fig.1 – System Schematic Diagram, "S" Units

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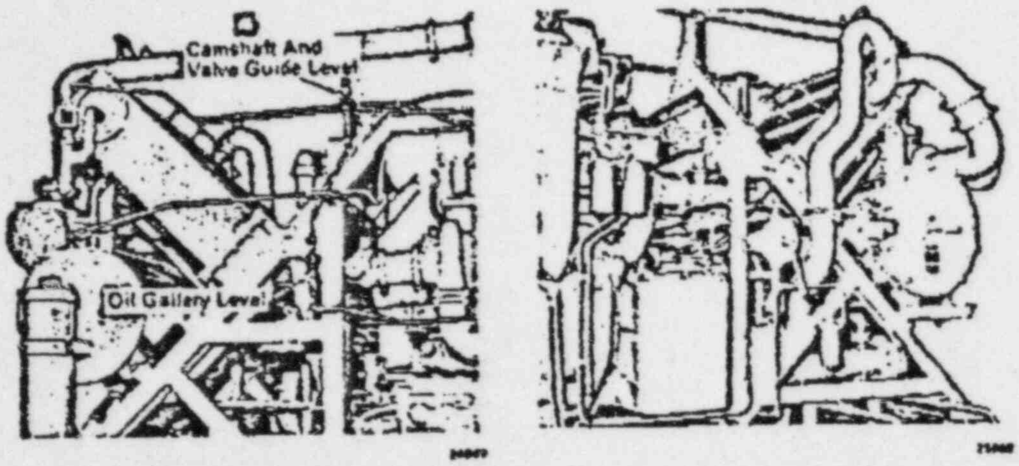


Fig 2 – Vent And Sight Glass Piping, Typical Installation

Twenty Cylinder Unit Only: In addition three stiffeners 9325479 must be added to the lube oil cooler tanks, as shown in Fig. 4. Existing stiffeners can remain in place.

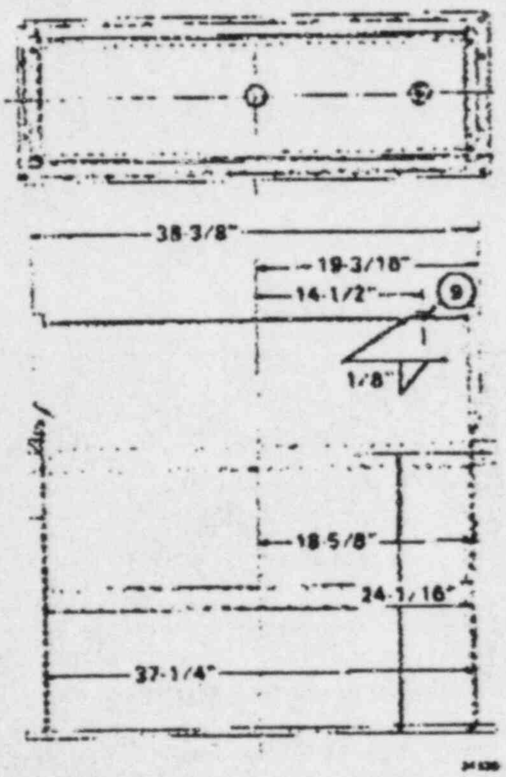


Fig 3 - "S" Unit Oil Cooler Tank Flange Application

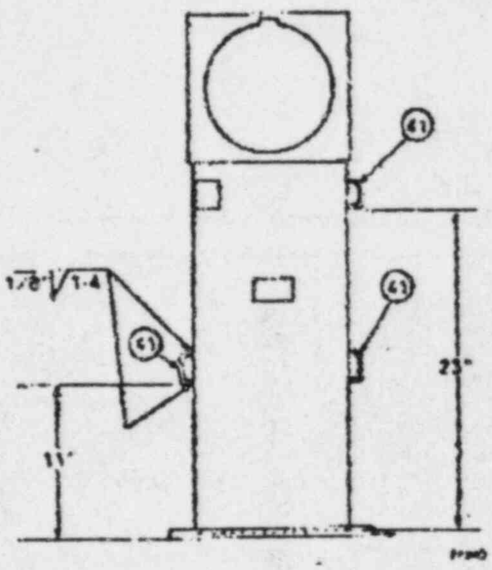


Fig.4 - "S" Unit Oil Cooler Tank Stiffener Application

ENCLOSURE 20

QUESTION 430.103 (9.5.7)

In Fig. 9.5-5, you show two relief valves on the pressure side of the engine drive lube oil pump. One relief valve is piped to the lube oil sump, while the other is piped across the duplex lube oil filters. Provide a discussion of the function of these two relief valves. Show that operation of the relief valve across the duplex filters will not interfere with proper operation of the pressure differential indication and alarm associated with the duplex filters.

RESPONSE

~~The response to this request will be provided by the end of February 1984~~. 11

Figure 9.5-5a has been revised to indicate actual design to deleting the ← (1)
shown on the common discharge pipe from the duplex lube oil filters. The function of the relief valves shown on revised Figure 9.5-5a is described in revised Section 9.5.7.2.

(1) relief valve that was

A separate lube oil pressure source is provided to ensure lubrication of the turbocharger bearings prior to engine start and removal of the residual heat from the turbocharger afer engine shutdown. This pressure source is provided by a continuously running motor-driven circulating pump. There is also a dc motor-driven soak back pump which activates when the circulating pump (ac) is not operating. This assures continuous lubrication prior to engine start and after engine shutdown.

The lube oil circulating pump motor is 1 hp, 460 V ac, 3 phase, 60 hZ fed from the associated Class 1E motor control center. The lube oil circulation pump has a capacity of 6 gpm.

The soak back pump motor is 3/4 hp, 125 V dc fed from the respective Class 1E dc motor control center. The soak back pump has a capacity of 3 gpm.

When the standby diesel engines are in the standby condition, the lube oil is warmed by an electric immersion heater to promote a fast engine start. Each standby diesel engine is provided with a motor-driven pump to circulate the oil during the standby condition.

When the HPCS diesel is on standby, the lube oil is warmed by the warm diesel generator cooling water circulating by natural convection (thermosyphon action) through the lube oil heat exchanger (cooler). The cooling water is warmed by an electric immersion heater (refer to Section 9.5.5). The lube oil is circulated through the engine by the ac motor-driven soak back pump.

The DELS is provided with various filters and strainers to maintain the required quality of the lube oil during engine operation. The filters are changed and the strainers are cleaned periodically to assure an adequate supply of clean oil to the engine. Crankcase pressure relief devices are provided for venting each diesel engine and to prevent overpressurization of the crankcase. The lube oil sump tank for the standby diesel generator contains enough oil for 7 days operation at the rated load, without adding makeup lube oil. The HPCS diesel sump pan also contains enough oil for 7 days of operation without adding makeup lube oil. Makeup lube oil is added to the engine lube oil sump tank or pan as required and in accordance with the manufacturer's recommendations.

The standby diesel generator DELS is provided with relief valves as shown on Figure 9.5-5a. The function of these valves is as follows:

1. Before and After Pump Relief Valve:

This valve is downstream of, and external to, the motor driven before and after pump. The valve acts to protect the before and after system from over pressurization. Relief is to the sump tank.

2. Pressure Control Valve:

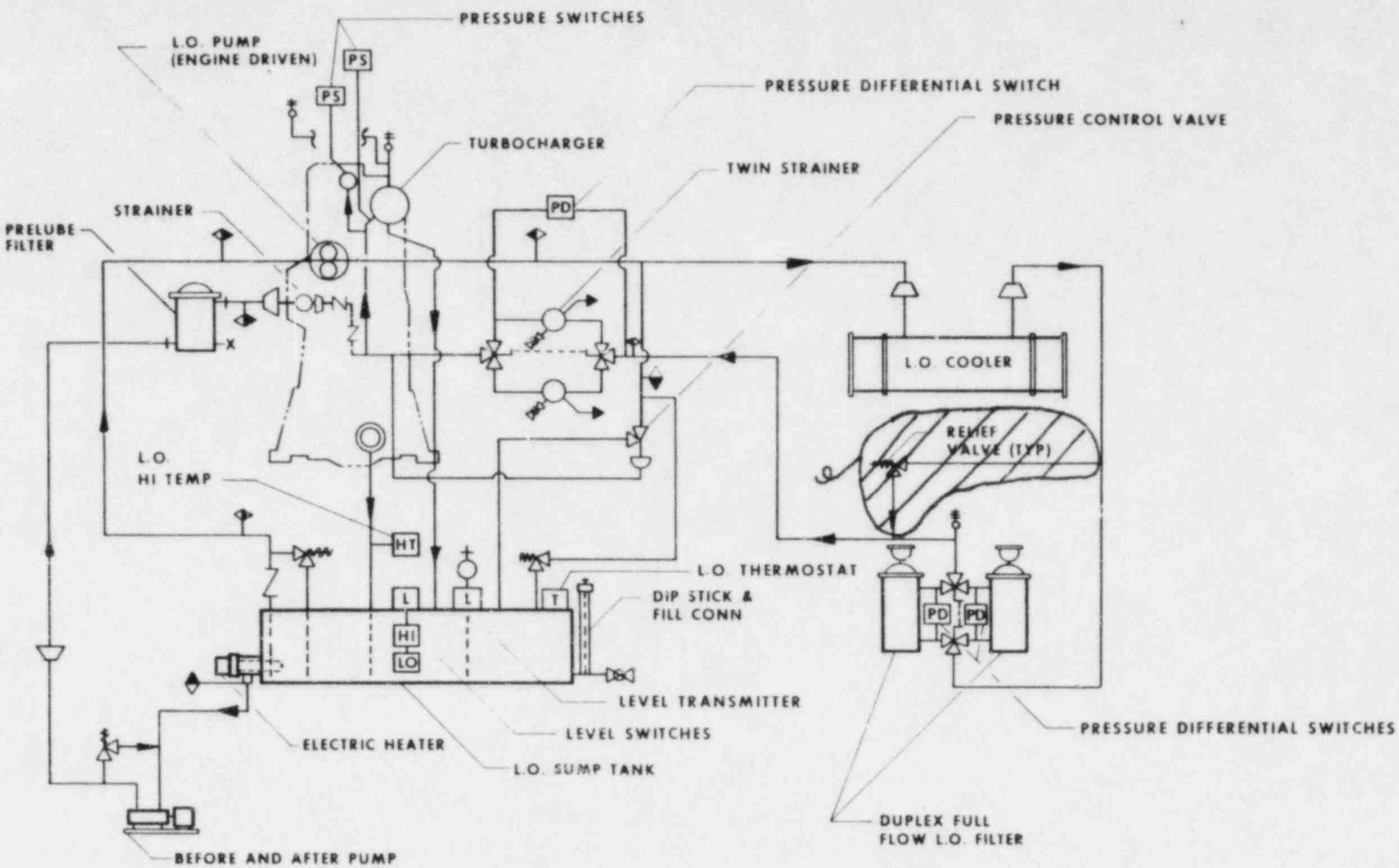
This valve acts to control and regulate engine lube oil header pressure. Header pressure is the actual internal engine oil pressure. The pump has a sensing line connected to the engine lube oil inlet header and one port connected to the lube oil line on the discharge side of the engine driven pump. The other port is the valve discharge to the lube oil sump tank.

3. Engine Driven Pump Relief Valve:

This valve acts in conjunction with the pressure control valve in that it relieves the system of excessive engine driven pump overpressures. Relief is to the sump tank.

4. Roll Back Relief Valve:

This valve protects the engine driven pump and system from reverse rotation pumping when the engine shuts down. When the engine rolls to a stop it will seek a balance point, and for a second or two will, because of the large rotating and reciprocating masses, roll very slightly in both directions of rotation.



NOTE:

INSTRUMENTS ARE SHOWN SCHEMATICALLY

FIGURE 9.5-5a

STANDBY DIESEL GENERATOR
LUBRICATION SYSTEM

RIVER BEND STATION
FINAL SAFETY ANALYSIS REPORT

AMENDMENT 5 AUGUST 1982

ENCLOSURE 21

QUESTION 430.102 (9.5.7)

Several fires have occurred at some operating plants in the area of the diesel engine exhaust manifold and inside the turbocharger housing which have resulted in equipment unavailability. The fires were started from lube oil leaking and accumulating on the engine exhaust manifold and accumulating and igniting inside the turbocharger housing. Accumulation of lube oil in these areas, on some engines, is apparently caused from an excessively long prelube period, generally longer than five minutes, prior to manual starting of a diesel generator. This condition does not occur on an emergency start since the prelube period is minimal. For the River Bend plant, diesel engine prelube will be continuous while the diesel generators are in the standby mode. Therefore, expand your FSAR section on engine prelube to demonstrate that (1) diesel engine prelube is in accordance with manufacturer's recommendations, and (2) that continuous prelube will not result in dangerous accumulations of lube oil that could ignite. In your discussion, consider the basic design differences between the standby diesel generators and the HPCS diesel generator, and provide independent discussions for each.

RESPONSE

7 ~~The response to this request will be provided by June 1983.~~

REPLACE WITH INSERT

INSERT (for Pg. Q&R 9.5-44)

The standby diesel engines have a pre-lube/lube oil system installed by the manufacturer. The pre-lube oil system is electric motor driven and runs continuously while in the standby mode. The turbocharger is drip-fed by the pre-lube system while in the standby mode and pressure-fed by the engine driven lube oil pump while in the running mode.

To minimize the risk of fire in the standby diesel engine turbocharger, accumulations of oil are substantially reduced by the manufacturer's bearing drip lubrication system.

Lubrication of the standby diesel engine turbocharger is clarified in revised Section 9.5.7.2.

The River Bend HPCS diesel engine includes a continuous, recirculating turbocharger lubrication system that operates whenever the diesel is in standby (automatic mode) and will also be in operation during a manual start. Pre-lube of the diesel engine is minimal (only in the turbocharger gears) to prevent any buildup of lube oil on the air side of the turbocharger. There has been no history of oil leakage on the exhaust manifold or turbocharger housing, from operation of this turbocharger prelube system.

6. Two lube oil strainers.

7. Two lube oil full-flow duplex filters.

8. One lube oil immersion heater (standby diesel generators only).

9. One dc motor-driven turbo charger soak back pump (HPCS diesel generator only).

10. Two ac motor-driven circulating pump (HPCS diesel generator only).

The lube oil sump for the HPCS diesel is integral with the engine, and lube oil is warmed through the main lube oil heat exchanger during standby.

Table 9.5-3 contains the applicable data for the above components. The codes and standards applicable to the DELS are listed in Table 3.2-1.

Each standby diesel engine is provided with two lube oil pumps.

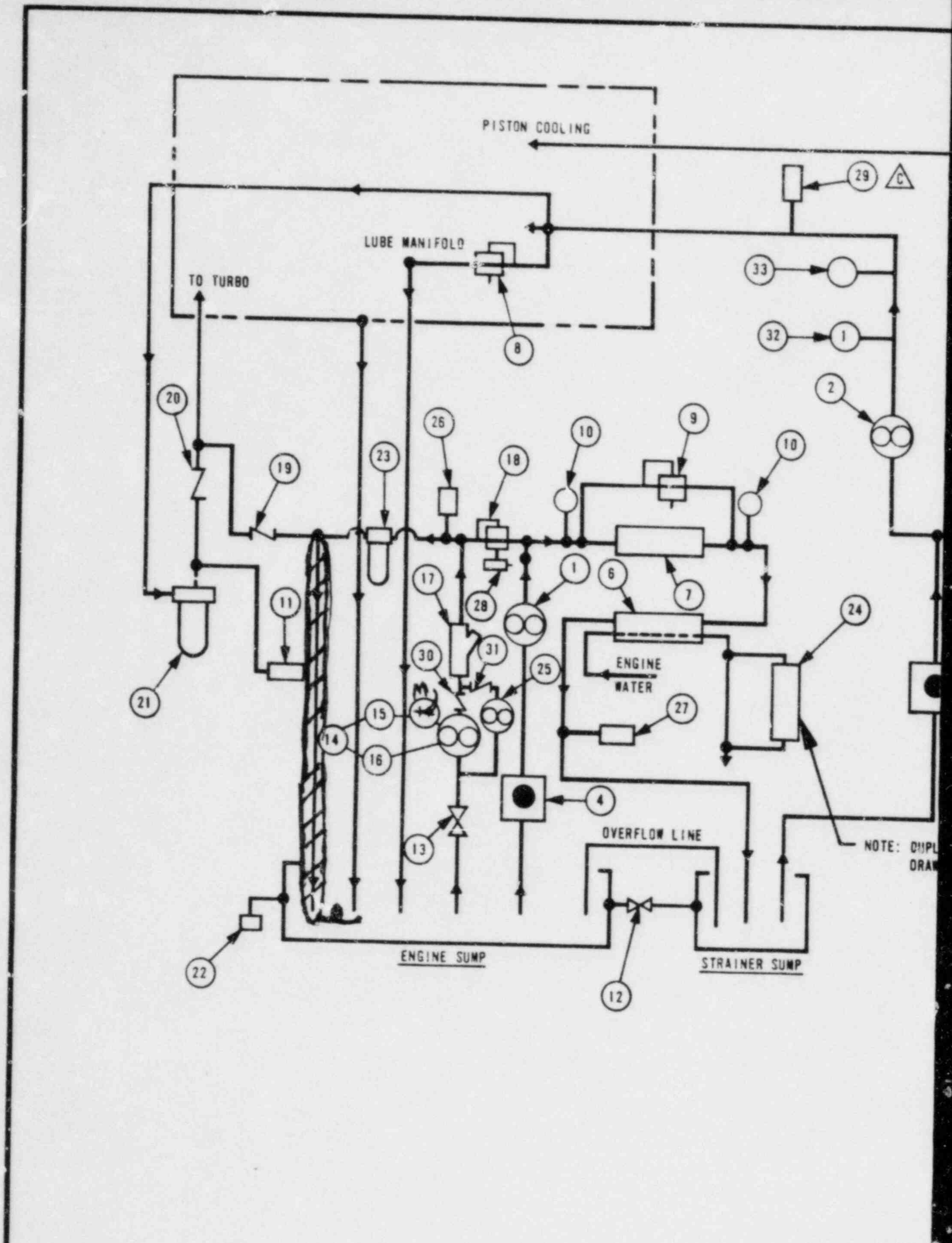
The primary lube oil pump is engine-driven, and the lube oil before-and-after pump is driven by an electric motor. The engine-driven pump draws oil from the sump through a strainer and discharges it through the lube oil cooler directly to the filter. Filtered oil is then passed through a strainer to the engine lube oil header. Oil returns to the sump tank by gravity flow. An integral safety valve on the pump prevents excess discharge pressure, and a pressure-regulating valve controls the pressure in the engine lube oil header. The motor-driven pump provides a means for prelubrication of the diesel engine before starting and to aid in cooling the diesel engine after it has stopped. A keep-warm circuit is provided to maintain the lubrication oil charge, and thereby the diesel engine, in a warm and lubricated condition when in standby status. Immersion heaters at the sump tank heat the oil, which is then pumped by the keep-warm pump to the keep-warm filter and strainer and then to the main diesel engine lubricating oil header.

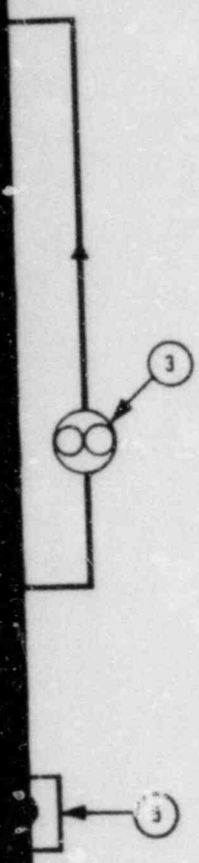
The turbocharger bearings are lubricated by the engine lubricating oil system during normal engine operation. When the engine is in standby status, however, oil is not circulated to the turbocharger. To prevent failure of the bearings during a start, a drip lubrication system is provided. Lubricating oil from the "keep warm" supply is passed through a filter, then through an orifice to a sight glass. The sight glass, one for each turbocharger, provides a means for positive determination of oil flow to the

bearings. This flow is sufficient to provide for proper lubrication of the bearings without flooding the turbocharger.

The HPCS diesel engine has a main lube oil pump, lube oil piston cooling pump, scavenging pump, soak back pump, and two circulation pumps. The main lube oil pump provides oil to the engine bearings, gears and turbocharger, and is in a common casing with the piston cooling pump. All of the pumps, except the soak back and circulation pumps, are driven by diesel engines.

ENCLOSURE 22


PISTON COOLING
29
C
LUBE MANIFOLD
TO TURBO
33
32
1
8
2
20
26
9
10
10
23
18
19
17
1
6
7
11
28
24
21
31
30
25
ENGINE
WATER
15
27
14
16
4
13
OVERFLOW LINE
NOTE: DUPL
DRAW
22
ENGINE SUMP
STRAINER SUMP
12



Also Available On
Aperture Card

NOTE FOLLOWING TRIP & RESET VALUES:

1. ITEM 26-OPENS AT 31 P.S.I., CLOSES AT 26 P.S.I.
2. ITEM 27 ALARM ACTIVATES AT 85°F
3. ITEM 28-CLOSES AT 240°F, OPENS AT 225°F
4. ITEM 29-OPENS AT 20 P.SI., CLOSES AT 16 P.S.I.
5. ITEM 22-CLOSES AT 1" H_2O OPENS AT .8" H_2O
6. ITEM 11-OPENS AT 20 P.S.I., CLOSES AT 16 P.S.I.

ITEM	NOMENCLATURE OR DESCRIPTION	QTY. REQ'D
33	GAUGE LUBE OIL TEMP. 4-1/2" PANEL MTD. 30°F-240°F	1
32	GAUGE MAINLUBE PRESS. 4-1/2" PANEL MTD (0-160 PSI SCALE)	1
31	CHECK VALVE 1/2" STEEL SOCKET-WELD ENDS	1
30	CHECK VALVE 1" STEEL SOCKET-WELD ENDS	1
29	SWITCH CRANK LOCKOUT	1
28	SWITCH, HIGH LUBE TEMPERATURE (ALARM)	1
27	SWITCH, LOW LUBE TEMPERATURE (ALARM)	1
26	SWITCH, LOW LUBE PRESSURE (ALARM)	1
25	SOAK BACK PUMP (MOTOR DRIVEN (125 VOLT DC)	1
24	IMMERSION HEATER 15KW RES. COIL	1
23	FILTER, SOAK BACK	1
22	HIGH CRANKCASE PRESSURE SWITCH	1
21	FILTER, TURBO-ENGINE MOUNTED	1
20	VALVE, CHECK--TURBO CHARGER FILTER	1
19	VALVE, CHECK--SOAK BACK FILTER	1
18	VALVE RELIEF 30 PSI KEPNER PN 316C-1-30	1
17	STRAINER "Y" TYPE	1
16	PUMP, CIRCULATING 67 GPM PART OF ITEM 14	1 REF
15	ELECTRIC MOTOR 1 HP PART OF ITEM 14	1 REF
14	CIRCULATING PUMP ASSY (INCLUDES ITEMS 15 & 16)	1
13	VALVE, BALL 1-1/2	1
12	VALVE, STRAINER BODY DRAIN	1 REF
11	SWITCH LOW PRESSURE-LUBE (SHUTDOWN) 16 PSIG	1
10	GAUGE, PRESSURE (0-100) 3-1/2"	2
9	VALVE, RELIEF--FILTER (WITH ALARM CONTACT)	1
8	VALVE RELIEF--MAIN LUBE--BUILT INTO ENGINE	1
7	FILTER, LUBE OIL	1
6	COOLER, LUBE OIL	
5	STRAINER, MAIN & PISTON COOLING PUMP	2
4	STRAINER SCAVENGING PUMP	1
3	PUMP, PISTON COOLING (ENGINE DRIVEN)	1 REF
2	PUMP, MAIN LUBE (ENGINE DRIVEN)	1
1	PUMP SCAVENGING (ENGINE DRIVEN)	1

LIST OF MATERIAL OR PARTS LIST

TI APERTURE CARD

FIGURE 9.5-5b

HPCS DIESEL GENERATOR LUBRICATION SYSTEM

RIVER BEND STATION
FINAL SAFETY ANALYSIS REPORT

ENCLOSURE 23

QUESTION 430.89 (9.5.5)

You state in section 9.5.5.2 each standby diesel engine cooling water system is provided with an expansion tank to provide for system expansion and for venting air from the system. In addition to the items mentioned, the expansion tank is to provide for minor system leaks at pump shafts seals, valve stems and other components, and to maintain required NPSH on the system circulating pump. Provide the size of the expansion tank and location. Demonstrate by analysis that the expansion tank size will be adequate to maintain required pump NPSH and make up water for seven days continuous operation of the diesel engine at full rated load without makeup, or provide a seismic Category I, safety class 3 makeup water supply in the expansion tank. In the case of the HPCS diesel generator, in addition to the above, any cooling water makeup system must have the capability to add water to the diesel generator cooling water system against this system's operating pressure.

RESPONSE

The response to this request ~~for the HPCS diesel generator~~ is provided in revised Section 9.5.5.2 and new ~~Figure 9.5-3c. Information for the standby diesel generator will be provided by the end of February 1984.~~ 11

Figures 9.5-3c and 9.5-12.

bypassing the heat exchanger for fast engine warmup.

3. One water expansion tank (approximate capacity of 84 gallons) for the HPCS DGCWS and one jacket water standpipe (approximate capacity of 225 gallons) for the standby DGCWS.

4. One electric immersion heater, thermostatically controlled to maintain the engine jacket cooling water during periods when the diesel is not running at a temperature which allows easy starting.

5. One ac motor-driven water circulation pump, for moving the water through the jacket cooling water system when the engine is not running for the standby diesel generator only.

6. One heat exchanger suitable for maintaining the engine jacket cooling water at the desired temperature. It is of the shell and tube type with the jacket water flowing through the shell and the plant standby service water flowing through the tubes.

Component data for the standby DGCWS is shown in Table 9.5-6. The standby DGCWS is a completely self-contained loop, with a vertical standpipe located as shown in Figure 9.5-12. The standpipe is not a pressure vessel; it is an atmospheric vessel, vented to atmosphere. The standpipe provides the flooded suction for the jacket water pumps, acts as a system vent point for de-aeration of the jacket water, provides the point for jacket water system heating and control, and is the system fill and drain point.

The standby DGCWS provides a total cooling water capacity of approximately 725 gallons which is adequate to maintain the required pump NPSH. Water leakage from the system is not expected, and thus no makeup needs are anticipated for seven days of continuous operation at full rated load. Any loss of water is noticed through routine checks of the standpipe sight glass. Jacket water low level is alarmed in the standby diesel generator control room, and activates a common trouble alarm in the main control room to alert the operator of abnormal conditions. Makeup water, if needed, is provided from the makeup water system (Section 9.2.3 and Figure 9.2-3b).

The HPCS DGCWS is a completely self-contained closed loop, with an expansion tank. The DGCWS can be vented to ensure that the entire system is filled with water. Surfaces of vent lines in contact with water will resist corrosion

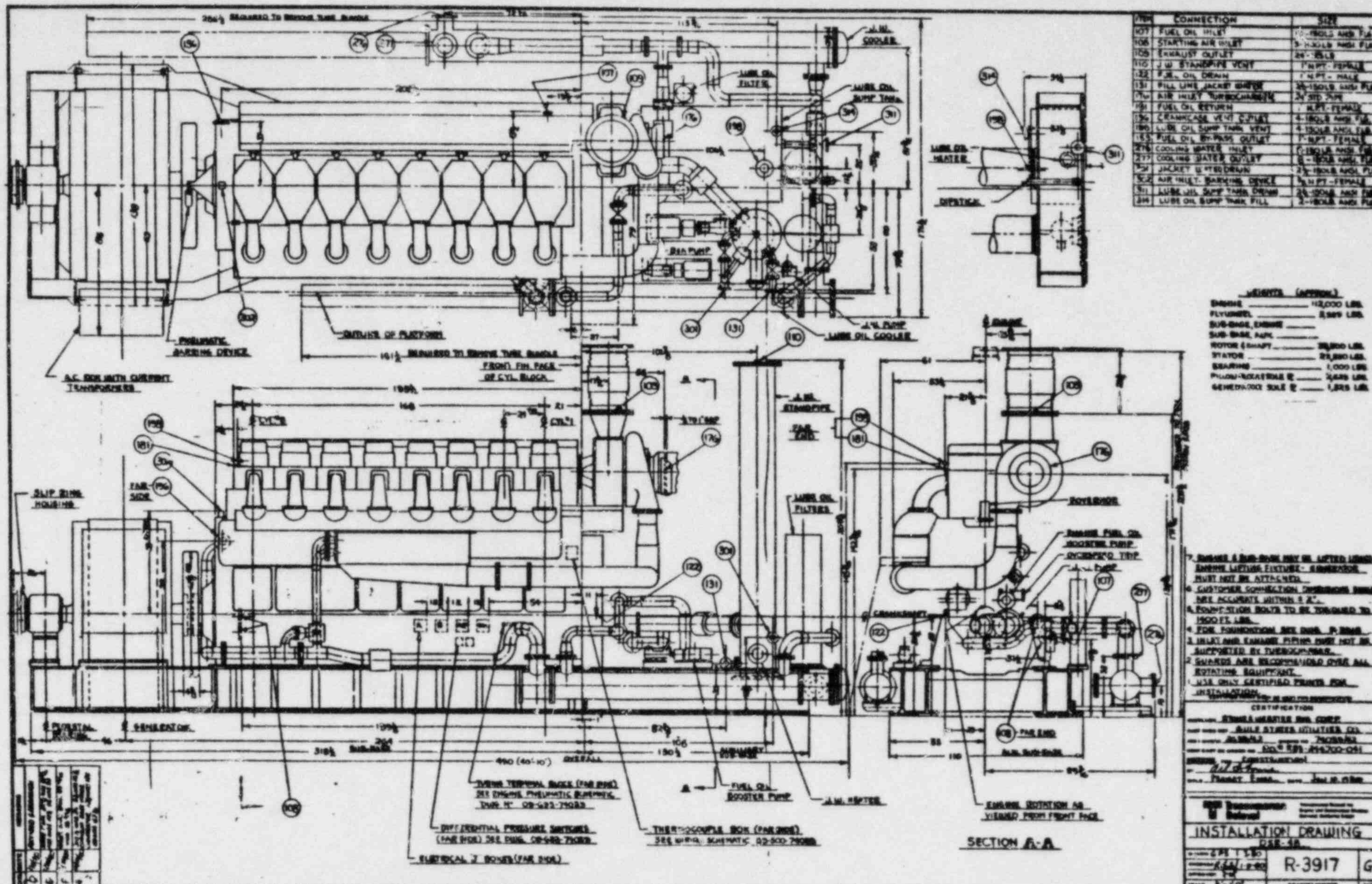


Fig. 9.5-12
Standby Diesel Generator

ENCLOSURE 24

where it is connected to a 750-kVA transformer, and then run to 2.5/3.125-MVA transformer 1STX-XS3A feeding 4.16-kV bus 1NNS-SWG3A, and 500-kVA transformer 1STX-XS4A feeding 480-V motor control center 1NHS-MCC12A. The second feeder 1NPS-ACB26, from 13.8-kV bus 1NPS-SWG1B, is run to disconnecting switch 1YWC-SW2 at the switchyard where it is connected to a 750-kVA transformer, and then run to 2.5/3.125-MVA transformer 1STX-XS3B feeding 4.16-kV bus 1NNS-SWG3B, and 500-kVA transformer 1STX-XS4B feeding 480-V motor control center 1NHS-MCC12B.

8.3.1.1.3.3 4.16-kV Systems (250-MVA Interrupting Capability)

Each of the two normal in-station 4.16-kV buses 1NNS-SWG1A and 1NNS-SWG1B is fed via the normal station service transformer 1STX-XNS1C which has dual secondary windings, one connected to each bus. Alternatively, these buses can be fed from their associated preferred station service transformers, 1RTX-XSR1C and 1RTX-XSR1D, respectively. The above transformers have been sized for all load conditions on buses INNS-SWG1A and INNS-SWG1B.

For buses 1NNS-SWG1A, 1NNS-SWG1B, and 1NNS-SWG1C under normal conditions, the normal supply on each bus is closed and the preferred supply breaker is open. The control logic is identical to that described for buses 1NPS-SWG1A and 1B; except as noted below for bus 1NNS-SWG1C. For bus 1NNS-SWG1C only a manual transfer capability is provided. When a sustained undervoltage on the bus is sensed, all motor circuit breakers are tripped. No automatic transfer is provided.

A 4.16-kV split bus and a 4.16-kV swing bus are energized from the normal 4.16-kV buses. 4.16-kV split buses 1NNS-SWG4A and 1NNS-SWG4B are connected to primary normal buses 1NNS-SWG1A and 1NNS-SWG1B, respectively. 4.16-kV swing bus 1NNS-SWG1C is connected to 1NNS-SWG1A via normally closed circuit breakers and to 1NNS-SWG1B via normally open circuit breakers.

There are three standby 4.16-kV buses: 1ENS*SWG1A, 1ENS*SWG1B and 1E22*S004. Buses 1ENS*SWG1A and 1ENS*SWG1B are energized from the preferred station service transformers 1RTX-XSR1C and 1RTX-XSR1D, respectively. Standby buses 1ENS*SWG1A and 1ENS*SWG1B also have manual access to normal primary buses 1NNS-SWG1B and 1NNS-SWG1A, respectively, if required during a loss of preferred power. There is no automatic fast or slow transfer from the preferred transformers to the normal buses for either 1ENS*SWG1A or 1ENS*SWG1B. The third standby 4.16-kV bus 1E22*S004 is energized from the normal 4.16-kV swing bus 1NNS-SWG1C and has access to the preferred sources via the primary normal 4.16-kV buses, 1NNS-SWG1A and 1NNS-SWG1B, upon loss of normal power.

Each of these standby 4.16-kV buses has a standby 4.16-kV diesel generator capable of supporting it upon loss of normal and preferred power. The 3500-kW diesel generator 1EGS*EG1A supports standby 4.16-kV bus

ENCLOSURE 25

series of qualification tests to verify compliance with the requirements of the above-referenced NRC BTP.

Surveillance instrumentation is provided to monitor the status of the power supply and starting equipment of each standby generator. Instrumentation and control are essential requirements in the design, installation, testing, operation, and maintenance of the standby generator. All conditions which can affect performance or indicate unavailability of each standby generator are annunciated in the main control room. Local indicators and controls of each diesel generator are located within their respective rooms. Remote indicators and controls are located in the main control room on separate sections of the control board. Additional information on instrumentation and controls is presented in Section 7.3.1. The controls and instrument cables are routed to prevent common failure. All control switches on the main control board are clearly identified as to the equipment that each switch controls (Section 7.1.2.3).

8.3.1.1.4.2 High Pressure Core Spray Power Supply System

The protection system of the HPCS diesel generator is described as follows:

1. The following conditions render the HPCS diesel generator incapable of responding to an automatic emergency start signal:

   a. Diesel Generator lockout relays not reset.

   b. Diesel engine mode switch not in "AUTO" position.

   c. Diesel generator output breaker closed before start of diesel.

   d. Diesel generator output breaker in racked-out position.

   e. Diesel generator regulator mode switch not in "AUTO" position.

   f. Insufficient starting air pressure.

   g. Loss of DC power to diesel generator controls or the 4160V switchgear.

   Items d and e do not electrically block diesel generator from emergency starting, however, these conditions are checked, and corrected if necessary, prior to allowing diesel generator to respond to an automatic emergency start signal.

2. The following alarms are provided at the main control room annunciator for above listed conditions.

   a. Items a, b, d, e, f, and g are annunciated as "HPCS SYSTEM NOT READY FOR AUTO START".

b. Item c is indicated by means of breaker status light (RED).

3. The "DIESEL ENGINE TROUBLE" alarm is annunciated by:

   a. Engine failure to start/run
   b. Engine overspeed
   c. Low fuel level
   d. Crank case pressure high
   e. High lube oil temperature
   f. High water temperature
   g. Charger failure
   h. Engine tripped
   i. Main fuel pump failure
   j. Low lube oil temperature
   k. Low expansion tank water level
   l. High stator temperature
   m. Reserve fuel pump failure
   n. Low lube oil pressure
   o. Low cooling water pressure
   p. Low turbocharger lube oil pressure
   q. Restricted fuel oil filter
   r. Restricted lube oil filter

When the HPCS diesel generator is called upon to operate under accident conditions, the only protective devices used are the generator differential relays and engine overspeed trip device. The engine overspeed trip device is mechanical and trips the engine directly. The trips are annunciated in the main control room. Other protective relays, such as loss of excitation, anti-motoring (reverse power), overcurrent with voltage restraint, high jacket water temperature, and low lube oil pressure, are used to protect the machine when it is operating during periodic tests. These relays are automatically removed from the tripping circuits under accident conditions. In addition to these protective relays, a normal time delay overcurrent relay senses generator overload and causes an alarm in the main control room. The generator differential relays and overspeed trip device are retained under accident conditions to protect against what can be major faults which could cause significant damage. All the bypassed protective devices cause alarms in the main control room and the operator will have sufficient information to take necessary corrective action. Because during accident conditions the HPCS diesel generator is performing a safety-related function, these protective devices are insignificant so

ENCLOSURE 26

of service for which the cable will be utilized.

Number - Three characters assigned to specify each individual cable number.

Example: 1ENS AR H307

All scheduled cables are identified by cable identification number at terminal ends and along runs as necessary for nonsafety-related cables, and at intervals not exceeding 5 ft of the run for safety-related cables, except for those cables installed in conduit and H and L cable trays, described in Section 8.3.1.4.4.2, which do not have color identification at 5-ft intervals, as discussed in Table 1.8-1, compliance with Regulatory Guide 1.75.

The raceway identification has the following format:

X	X	X	XXX	X	X	X
Unit	Type	Service	Number	Color	Condu/A	Condu/N

Unit - Identifies the station's unit number.

Type - Character indicating the type of raceway.

Service - An alpha symbol which indicates the service of cable to be carried in the designated raceway.

Number - Three numbers assigned to specify the individual raceway.

Color - An alpha symbol which identifies the cable to be carried in the designated raceway, safety-related or nonsafety-related.

Condu/A - Conduit identifier. It is a letter or blank when not used. When used for sleeves or duct, it is numeric or blank when not used.

All cable trays and conduits are identified by raceway identification numbers at each end, and at entries to and exits from enclosed areas. Tray sections longer than 50 ft have an additional raceway identification number at midspan and at intervals not exceeding 50 ft, while tray sections 15 ft or less have a raceway identification number at midspan. Exposed conduits 8 ft or less have a raceway identification number at midspan except that for those short sections of conduit where the identification will not fit in midspan the conduit is color-coded only (e.g., a short nipple from a junction box to a piece of equipment). Color-coded markers are provided for all Class 1E raceways adjacent to each raceway identification number or the numbers themselves may be painted in the appropriate color and at intervals not exceeding 15 ft.

8.3.1.4 Independence Of Redundant Systems

8.3.1.4.1 General

There are three basic safety-related power supply divisions that originate at the 4,160-V level. The Divisions I, II and III safety-related power supply systems can be energized from either the normal or preferred power source and from their own diesel generator. The systems serve equipment at the 4,160-V, 480-V, and 120/240-V ac levels, and through intervening equipment they power the 125-V dc system.

A dedicated diesel generator serves each division. Each diesel generator with its supporting auxiliaries is in a separate room, as shown in Fig. 8.3-11. The 4160-kV switchgear, 480-V load centers, 480-V motor control centers, a battery charger for each battery, 125-V batteries, and uninterruptible power supplies are located in switchgear rooms within the control building and are separated by division as illustrated by Fig. 8.3-9 and 8.3-10. Safety-related 4.16-kV motor loads, a 480-V load center, 480-V motor control centers, and loads subordinate to the 480-V ac and dc sources are located within the auxiliary building, and are separated by division to ensure independence of safety-related divisions. Additional safety-related loads are within the containment structure and at the standby cooling towers, where separation between divisions is also maintained.

All the preceding equipment items are located within Seismic Category I structures. Fire extinguishing systems are identified in Chapter 9.

8.3.1.4.2 Class 1E Electric Equipment Arrangement

Redundant electrical equipment and wiring for the RPS, nuclear steam supply shutoff system (NSSSS), and ESF functions are physically separated, electrically independent, and are located such that no single credible event is capable of disabling redundant equipment which would prevent reactor shutdown, removal of decay heat from the core, or prevent isolation of the containment in the event of an accident. Separation requirements were applied to control, power, and instrumentation for all systems concerned. Rules governing separation apply equally for Class 1E to Class 1E, and for Class 1E to non-Class 1E systems. In addition, the distance between the electrical portions of the HPCS and RCIC systems is maximized within the space available to insure the functional availability of high pressure water for core cooling immediately following a transient.

Arrangement and/or protective barriers are such that no locally generated force or missile can destroy any redundant RPS, NSSSS, or ESF functions. Arrangement and/or separation barriers are provided to ensure that such disturbances do not affect both HPCS and RCIC.

Arrangement of wiring/cabling is such as to eliminate, insofar as practical, all potential for fire damage to redundant cables and to separate the RPS, NSSSS, and ESF divisions so that fire in one division will not damage another division. In addition, arrangement of wiring and cabling of the HPCS and RCIC systems ensures that both systems are not

disabled by a single fire as described in Chapter 9. The following general rules were followed:

1. Routing of Class 1E control, power, and instrumentation cables through rooms or spaces where there is a potential for accumulation of large quantities (gallons) of oil or other combustible fluids through leakage or rupture of lube oil or cooling systems is avoided. Where such routing is unavoidable, only one division of Class 1E cabling is allowed in any such space.

2. In any room or compartment, other than the cable chases, in which the primary source of fire is of an electrical nature, cable trays of redundant systems have a minimum horizontal separation of 3 ft if no physical barrier exists between trays. If a horizontal separation of 3 ft is unattainable, a fire-resistant barrier is installed, extending at least 1 ft above (or to the ceiling) and 1 ft below (or to the floor) line-of-site communication between the two trays. Totally enclosed metallic raceway is occasionally used in lieu of barriers, at least 1 inch under open cable trays, to a point where the minimum separation is again maintained. Totally enclosed metallic raceway of redundant systems maintains a minimum separation distance of 1 in.

3. In any room or compartment, other than the cable chases, in which the primary source of fire is of an electrical nature, cable trays of redundant systems have a minimum vertical separation of 5 ft between vertically stacked trays of different divisions, or trays of different divisions one above the other; however, vertical or cross stacking of trays is avoided wherever possible. In cases where the redundant trays must be stacked or crossed one stack above the other, and when the trays do not meet the 5-ft vertical separation requirement, a fire barrier is installed between the redundant trays. The barrier extends beyond either side of the tray system, in accordance with IEEE-384.

   Occasionally, totally enclosed metallic raceway (e.g., conduit) is used in lieu of barriers in the following cases:

   a. Class 1E ladder type cable trays are fit with protective metal covers wherever 480 VAC non-Class 1E cabling or 480 VAC Class 1E cabling of a different division than the subject trays is routed in conduit within 1 inch of the subject trays.

   b. Low voltage (120V) power, control, and instrumentation cabling, when routed in close proximity to Class 1E ladder type cable trays is routed in conduit and maintains at least 1 inch separation.

   c. River Bend Station does not route Class 1E or non-Class 1E 4.16kV/13.8kV cabling in conduit that is in close proximity

to Class 1E ladder type tray, except to exit cables from the subject tray.

d. Totally enclosed metallic raceway of different Class 1E divisions maintain a minimum separation distance of 1 inch. Conduits containing cables of different Class 1E divisions which perform the same redundant safe shutdown function are not routed in close proximity to one another.

4. Any openings in fire-rated floors or walls for vertical or horizontal runs of Class 1E cabling are sealed with fire-resistant material of equal fire rating.

The minimum horizontal and vertical separation and/or barrier requirements in the cable chases are as follows (Note: there are no cable spreading rooms in RBS):

1. Where cables of different divisions approach the same or adjacent control panels with vertical spacing less than the 3-ft minimum, at least one division's circuit is run in totally enclosed

Cable trays used for 13.8-kV service are identified as "J" trays and those for 4.16-kV are identified as "H" trays. The "J" and the "H" trays are separate from one another. Trays for 600-V or lower voltage large power cables and some low power cables are designated "L." Trays for 600-V or lower voltage small power cables and some control cables are designated "K." Control cables of 120-V ac or 125-V dc, are run in "C" trays or conduit. Low level analog or digital instrumentation cables are run in "X" trays or in conduit. Segregation in conduit is in a comparable fashion to that employed for trays.

Cables of redundant safety-related systems are isolated from each other and from nonsafety-related cables.

There are no medium or high voltage (480V and above) power cables in the Control Building cable chases.

Electrical cables for the RPS and other safety-related systems located inside the containment structure are designed so that the cable is operable for the required period of usage during all postulated accident environments. Cables in hazardous environments are protected from the environment and against physical or fire damage to the extent required for the service either by selection of cable or by choice of raceway (e.g., cable trays with covers, metallic conduit).

Cables are derated for grouping and spacing in accordance with IPCEA recommendations. Medium voltage cable trays do not have more than a single layer of cables. Instrument and control cable trays may be filled up to the height of the cable tray siderails, assuming cable ampacity factors are not exceeded. Galvarized steel, nonconducting sleeves or blockouts in walls are used to transport cables through concrete walls.

Fire detection and protection systems, either manually or automatically initiated, are provided in those areas required to preserve the integrity of the circuits for safety-related services (Section 9.5.1).

The electrical penetrations, through the reactor containment vessel, are arranged in groups to maintain separation of electrical cables and to comply with the single-failure criteria. The design and fabrication of each type of penetration assembly is in accordance with IEEE-317 for Electrical Penetration Assemblies in Containment Structures for Nuclear Fueled Power Generating Stations. Each electrical penetration is designed to withstand the environment conditions at its location during all postulated DBAs.

Connections between field wires and penetration assembly conductors are made inside Seismic Category I termination cabinets designed to withstand the environmental conditions at its location during all postulated DBAs.

Wire splices are avoided and made only where necessary. All splices are qualified for their intended use as described in the Environemntal Qualification Document (EQD). All splices are made in accordance with the manufacturers recommended procedures and are tested after installation by continuity and insulation resistance measurements. There are no splices made in cabie trays.

ENCLOSURE 27

QUESTION 430.21 (8.3)

BRANCH TECHNICAL POSITION PSB 1
ADEQUACY OF STATION ELECTRIC DISTRIBUTION SYSTEM VOLTAGES

A. BACKGROUND

Events at the Millstone station have shown that adverse effects on the Class 1E loads can be caused by sustained low grid voltage conditions when the Class 1E buses are connected to offsite power. These low voltage conditions will not be detected by the loss of voltage relays (loss of offsite power) whose low voltage pickup settings is generally in the range of .7 per unit voltage or less.

The above events also demonstrated that improper voltage protection logic can itself cause adverse effects on the Class 1E systems and equipment such as spurious load shedding of Class 1E loads from the standby diesel generators and spurious separation of Class 1E systems from offsite power due to normal motor starting transients.

A more recent event at Arkansas Nuclear One (ANO) station and the subsequent analysis performed disclosed the possibility of degraded voltage conditions existing on the Class 1E buses even with normal grid voltages, due to deficiencies in equipment between the grid and the Class 1E buses or by the starting transients experienced during certain accident events not originally considered in the sizing of these circuits.

B. BRANCH TECHNICAL POSITION

1. In addition to the undervoltage scheme provided to detect loss of offsite power at the Class 1E buses, a second level of undervoltage protection with time delay should also be provided to protect the Class 1E equipment; this second level of undervoltage protection shall satisfy the following criteria:

   (a) The selection of undervoltage and time delay setpoints shall be determined from an anlysis of the voltage requirements of the Class 1E loads at all onsite system distribution levels;

(b) Two separate time delays shall be selected for the second level of undervoltage protection based on the following conditions:

(1) The first time delay should be of a duration that establishes the existence of a sustained degraded voltage condition (i.e., something longer than a motor starting transient). Following this delay, an alarm in the control room should alert the operator to the degraded condition. The subsequent occurrence of a safety injection actuation signal (SIAS) should immediately separate the Class 1E distribution system from the offsite power system.

(2) The second time delay should be of a limited duration such that the permanently connected Class 1E loads will not be damaged. Following this delay, if the operator has failed to restore adequate voltages, the Class 1E distribution system should be automatically separated from the offsite power system. Bases and justification must be provided in support of the actual delay chosen.

(c) The voltage sensors shall be designed to satisfy the following applicable requirements derived from IEEE Std. 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations":

(1) Class 1E equipment shall be utilized and shall be physically located at and electrically connected to the Class 1E switchgear.

(2) An independent scheme shall be provided for each division of the Class 1E power system.

(3) The undervoltage protection shall include coincidence logic on a per bus basis to preclude spurious trips of the offsite power source.

(4) The voltage sensors shall automatically initiate the disconnection of offsite power sources whenever the voltage setpoint and time delay limits (cited in item 1.b.2 above) have been exceeded.

(5) Capability for test and calibration during power operation shall be provided.

(6) Annunciation must be provided in the control room by any bypasses incorporated in the design.

(d) The Technical Specifications shall include limiting conditions for operations, surveillance requirements, trip setpoints with minimum and maximum limits, and allowable values for the second-level voltage protection sensors and associated time delay devices.

2. The Class 1E bus load shedding scheme should automatically prevent shedding during sequencing of the emergency loads to the bus. The load shedding feature should, however, be reinstated upon completion of the load sequencing action. The technical specifications must include a test requirement to demonstrate the operability of the automatic bypass and reinstatement features at least once per 18 months during shutdown.

In the event an adequate basis can be provided for retaining the load shed feature during the above transient conditions, the setpoint value in the Technical Specifications for the first level of undervoltage protection (loss of offsite power) must specify a value having maximum and minimum limits. The basis for the setpoints and limits selected must be documented.

3. The voltage levels at the safety-related buses should be optimized for the maximum and minimum load conditions that are expected throughout the anticipated range of voltage variations of the offsite power sources by appropriate adjustment of the voltage tap settings of the intervening transformers. The tap settings selected should be based on an analysis of the voltage at the terminals of the Class 1E loads. The analyses performed to determine minimum operating voltages should typically consider maximum unit steady state and transient loads for events such as a unit trip, loss of coolant

accident, startup or shutdown; with the offsite power supply (grid) at minimum anticipated voltage and only the offsite source being considered available. Maximum voltages should be analyzed with the offsite power supply (grid) at maximum expected voltage concurrent with minimum unit loads (e.g. cold shutdown, refueling). A separate set of the above analyses should be performed for each available connection to the offsite power supply.

4. The analytical techniques and assumptions used in the voltage analysis cited in item 3 above must be verified by actual measurement. The verification and test should be performed prior to initial full power reactor operation on all sources of offsite power by:

   (a) loading the station distribution buses, including all Class 1E buses down to the 120/208 v level, to at least 30%;

   (b) recording the existing grid and Class 1E bus voltages and bus loading down to the 120/208 volt level at steady state conditions and during the starting of both a large Class 1E and non-Class 1E motor (not concurrently);

   Note: To minimize the number of instrumented locations, (recorders) during the motor starting transient tests, the bus voltages and loading need only be recorded on that string of buses which previously showed the lowest analyzed voltages from item 3 above.

   (c) using the analytical techniques and assumptions of the previous voltage analysis cited in item 3 above, and the measured existing grid voltage and bus losing conditions recorded during conduct of the test, calculate a new set of voltages for all the Class 1E buses down to the 120/208 volt level;

   (d) compare the analytically derived voltage values against the test results.

With good correlation between the analytical results and the test results, the test verification requirement will be met. That is, the validity of the mathematical model used in performance of the analysis of item 3 will have been established; therefore, the validity of the results

of the analyses is also established. In general the test results should not be more than 3% lower than the analytical results; however, the difference between the two when subtracted from the voltage levels determined in the original analysis should never be less than the Class 1E equipment rated voltages.

RESPONSE

~~River Bend Station Unit 1 fully complies with NRC Branch Technical Position PSB 1, Adequacy of Station Electric Distribution System Voltages, except for the following:~~

REPLACE WITH INSERT

~~a) There is one time delay on the second level of undervoltage protection. A time delay, a time greater than a motor-starting transient, and subsequent alarm is not provided in the second level undervoltage protection scheme. Furthermore, the occurrence of a loss of coolant accident (LOCA) signal subsequent to actuation of the second level undervoltage time delay device, does not permit transfer of power to the onsite source until the time delay device has completed its cycle. The design will be revised to comply prior to fuel load.~~

~~b) The Class 1E bus load shedding scheme automatically prevents shedding during sequencing of emergency loads. The load shedding feature is reinstated upon completion of the load sequencing action only if offsite power was available prior to the load shedding/sequencing event. When load shedding/sequencing to the onsite source, the reinstatement of the load shedding feature is not permitted~~.

INSERT (For Pg. Q&R 8.3-10)

BRANCH TECHNICAL POSITION

1. Two completely separate schemes of undervoltage protection are provided on the Class 1E buses at the 4.16kV level. The selection of undervoltage and time delay setpoints have been determined from an analysis of the voltage requirements of the Class 1E loads. These setpoints will be verified during the actual system testing.

   (a) The first undervoltage scheme detects loss of power at the Class 1E buses. This undervoltage setpoint is set below any anticipated transient voltage condition, with a time delay of approximately 3 seconds.

   (b) The second level of undervoltage protection is set at approximately 90% and utilizes two separate time delays based on the following conditions:

      (1) The first time delay is approximately 3 seconds which establishes a sustained degraded voltage condition, (i.e., something longer than a motor starting transient). Following this delay, an alarm in the main control room alerts the operator to the degraded condition. The subsequent occurence of a LOCA signal immediately separates the Class 1E distribution system from the offsite power system, starts load shed logic and load sequence timers, starts the diesel generator, and permits auto-close of the diesel generator breaker.

      (2) The second time delay is approximately 50 seconds which ensures that permanently connected Class 1E loads will not be damaged. Following this time delay, if the operator has failed to restore adequate voltages, the Class 1E system is automatically separated from the offsite power system, the load shed logic and load sequence timers start, the diesel generator starts, and permits auto-close of the diesel generator breaker.

   (c) Undervoltage protection is afforded to the AC distribution system down to and including the 480V motor control centers (MCC's) level. The tripping of the 4.16kV air circuit breakers (ACB's) discussed above also results in no voltage at the 480V load centers and MCC's, which in turn will cause motor feeder ACB's and contacts respectively, to open circuit. Subsequent energization of the 4.16kV buses by the diesel generator results in the re-energization of MCC motor loads with the closing of their contacts at approximately 70% voltage.

   (d) The voltage sensors are designed to satisfy the following applicable requirements:

(1) Class 1E equipment is utilized and is physically located at and electrically connected to the Class 1E switchgear.

(2) An independent scheme is provided for each division of the Class 1E power system.

(3) The undervoltage protection includes coincidence logic (2 out of 3) on a per bus basis to preclude spurious trips of the offsite power source.

(4) The voltage sensors automatically initiate the disconnection of offsite power sources whenever the voltage setpoint and time delay limits have been exceeded.

(5) Capability for test and calibration during power operation is provided. Undervoltage relay settings on the Class 1E 4.16kV buses can be checked during plant operation by testing one single phase undervoltage relay at a time. Disconnecting one phase of the three phase system does not impair the operation of the switchgear. Normally a two-out-of-three logic, the removal of one relay results in an effective one-out-of-two logic, i.e., an undervoltage detected by any one of the two remaining relays still in the circuit would initiate an undervoltage tripping sequence. The removed relay can then be checked against a variable voltage test input to verify its intended setpoint.

(6) Annunciation is provided in the control room by any bypasses incorporated in the design.

2. The Class 1E bus load shedding scheme automatically prevents shedding during sequencing of the emergency loads to the bus. The load shedding feature is reinstated upon completion of the load sequencing action.

3. The voltage levels at the safety-related buses are optimized for the maximum and minimum load conditions that are expected throughout the anticipated range of voltage variations of the offsite power sources. The trip settings selected are based on an analysis of the voltage at the terminals of the Class 1E loads. The analyses performed to determine minimum operating voltages considers maximum unit steady state and transient loads for events such as a unit trip, loss of coolant accident, startup or shutdown; with the offsite power supply (grid) at minimum anticipated voltage and only the offsite source being considered available. Maximum voltages are analyzed with the offsite power supply at maximum expected voltage concurrent with minimum unit loads.

4. The analytical techniques and assumptions used in the voltage analysis cited in item 3 will be verified by actual measurement. The verification and test will be performed prior to initial full power reactor operation on all sources of offsite power by:

(a) loading the station distribution buses, including all Class 1E buses down to the 120/208 v level, to at least 30%;

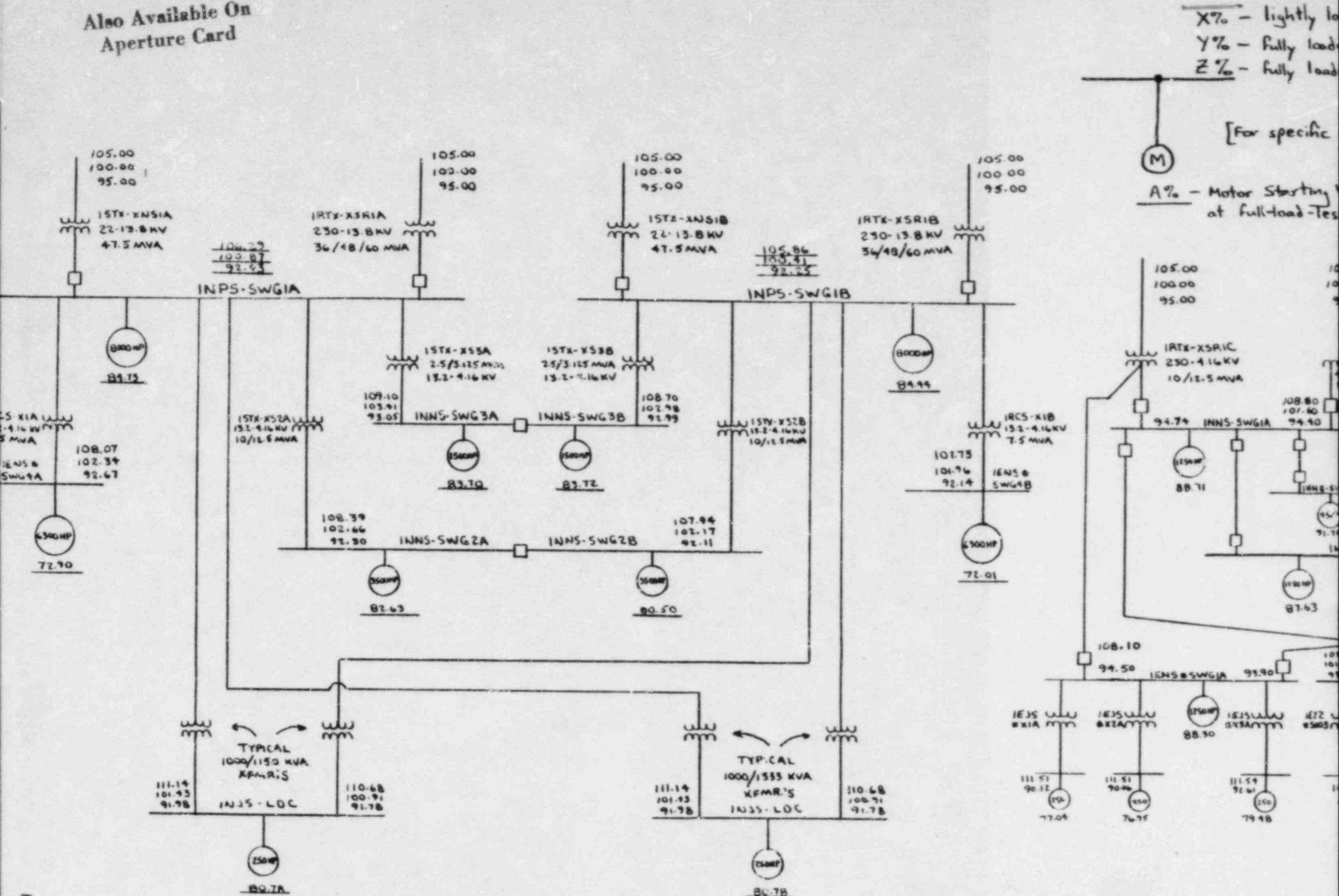
(b) recording the existing grid and Class 1E bus voltages and bus loading down to the 120/208 volt level at steady state conditions and during the starting of both a large Class 1E and non-Class 1E motor (not concurrently);

(c) using the analytical techniques and assumptions of the previous voltage analysis cited in item 3 above, and the measured existing grid voltage and bus losing conditions recorded during conduct of the test, a new set of voltages for all the Class 1E buses down to the 120/208 volt level will be calculated.

(d) The analytically derived voltage values will be compared against the test results.

ENCLOSURE 28

Also Available On
Aperture Card



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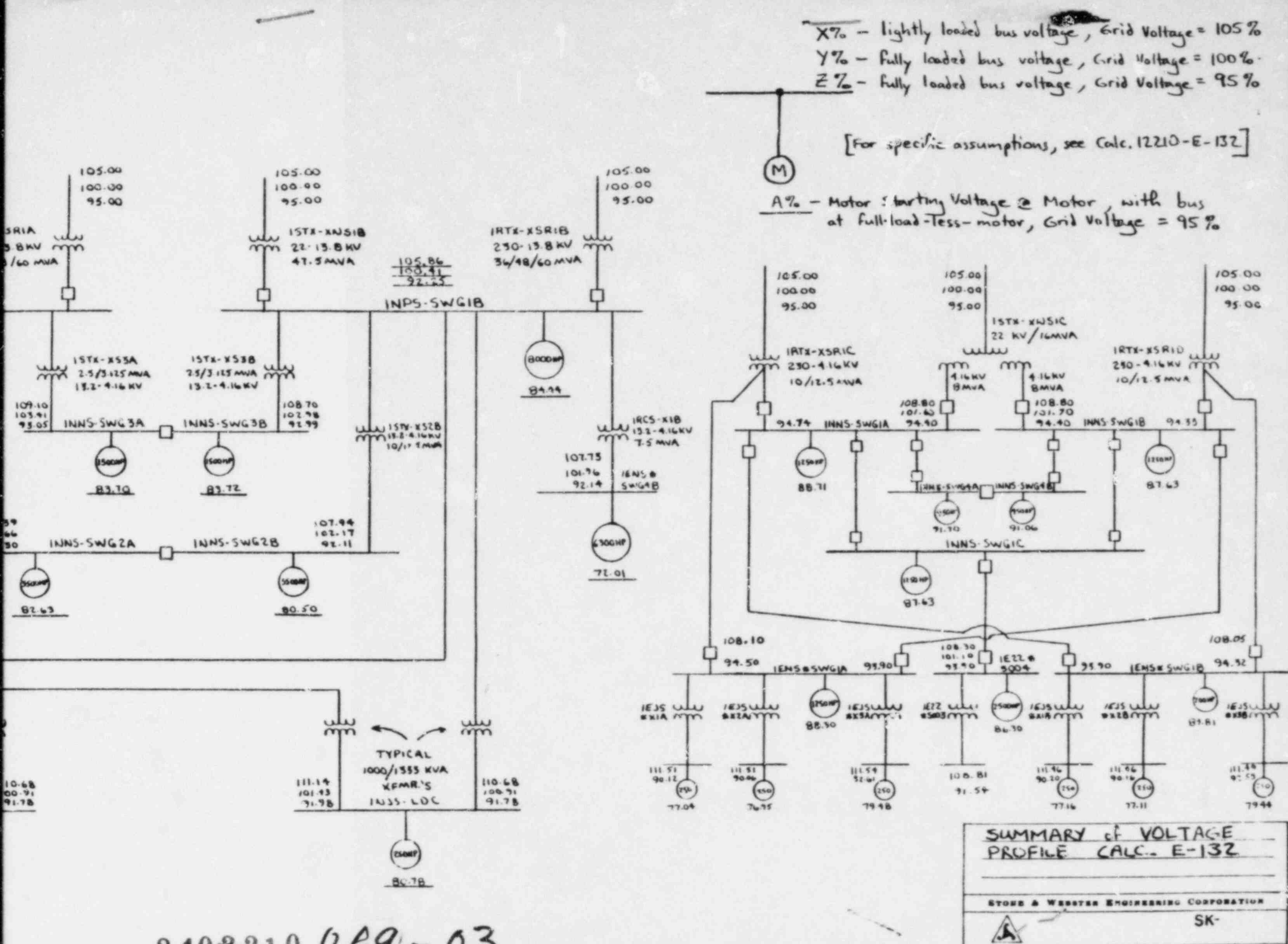

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ENCLOSURE 29

The generator being utilized for River Bend HPCS power supply (Div. 3) is identical to one tested for LaSalle Station.

The following table provides comparison data for these two diesel generators:

ENGINE	LASALLE	RIVER BEND
Make	GM-EMD	GM-EMD
Model	20-645E4	20-645E4
Type	2 Cycle Turbo Charged 45° VEE	2 Cycle Turbo Charged, 45° Vee
BHP (Continuous)	3600	3600
No. of Cylinders	20	20
Speed (RPM)	900	900
Compression Ratio	14.5:1	14.5:1
Lube Oil Consumption (Approx. gal/hr)	0.95	0.95
Cooling Water Capacity (gal)	318	318
Starting Air Receiver Air Press (PSI)	250	250