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SYSTEM ENGINEERING AND CONSTRUCTION

RECEIVED
APR 20 1982
US NUCLEAR REGULATORY COMMISSION

April 8, 1982

Mr. A. Schwencer
Chief, Licensing Branch No. 2
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Perry Nuclear Power Plant
Docket Nos. 50-440; 50-441
Response to Draft SER
Power Systems Branch

Dear Mr. Schwencer:

This letter and its attachment is submitted to provided revised responses to the concerns identified in the Draft SER for Power Systems.

It is our intention to incorporate these responses in a subsequent amendment to our Final Safety Analysis Report.

Very Truly Yours,

Dalwyn R. Davidson

Dalwyn R. Davidson
Vice President
System Engineering and Construction

DRD: mlb

cc: Jay Silberg
John Stefano
Max Gildner

B001
S1/1

430.8 (8.3) RSP Periodic testing and test loading of an emergency diesel generator in a nuclear power plant is a necessary function to demonstrate the operability, capability and availability of the unit on demand. Periodic testing coupled with good preventive maintenance practices will assure optimum equipment readiness and availability on demand. This is the desired goal.

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

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

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

3. Preventive maintenance should go beyond the normal routine adjustments, servicing and repair of components when a malfunction occurs. Preventive maintenance should encompass investigative testing of components which have a history of repeated malfunctioning and require constant attention and repair. In such cases, consideration should be given to replacement of those components with other products which have a record of demonstrated reliability, rather than repetitive

repair and maintenance of the existing components. Testing of the unit after adjustments or repairs have been made only confirms that the equipment is operable and does not necessarily mean that the root cause of the problem has been eliminated or alleviated.

4. Upon completion of repairs or maintenance and prior to an actual start, run, and load test a final equipment check should be made to assure that all electrical circuits are functional, i.e., fuses are in place, switches and circuit breakers are in their proper position, no loose wires, all test leads have been removed, and all valves are in the proper position to permit a manual start of the equipment. After the unit has been satisfactorily started and load tested, return the unit to ready automatic standby service and under the control of the control roomoperator.

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

Response

The response to this question is provided in revised Section 8.3.1.1.3.2 item b7 for the standby diesel generators and revised Section 8.3.1.1.3.3b7 for the HPCS diesel generator.

7. Testability

The diesel generators can be tested during normal plant operation or during plant shutdown periods. Administrative controls allow testing of only one diesel generator at a time. Prior to performing the test, all operating functions are transferred to equipment supplied from the bus not affected by the test.

In order to achieve this optimum equipment readiness status, the following requirements should be met:

(a) The surveillance instruction will have a requirement to load the diesel to a minimum of 25% full load for each diesel whenever the diesel is to be operated for more than 3 to 4 hours.

(b) A conflict between NRC guidelines in Regulatory Guide 1.108 and the engine manufacturer does not exist.

(c) The preventative maintenance program will provide methods for data collection and review of any malfunction or discrepancies encountered. This data will be maintained in a computerized equipment history file along with corrective maintenance information. 430.8

The computerized maintenance system will permit ease of access to information for trending and evaluation. These evaluations will then be used to revise preventative and corrective maintenance practices and, as necessary, to initiate equipment repair, modification and replacement.

(d) Upon completion of repairs or maintenance, the applicable valve and electrical line-up sheets for the affected diesel auxiliary systems, diesel starting air, diesel fuel oil, diesel jacket water, diesel lube oil and diesel intake and exhaust, will be completed to return the unit to the correct standby mode.

(c) The preventative maintenance program will provide methods for data collection and review of any malfunction or discrepancies encountered. This data will be maintained in a computerized equipment history file along with corrective maintenance information.

The computerized maintenance system will permit ease of access to information for trending and evaluation. These evaluations will then be used to revise preventative and corrective maintenance practices and, as necessary, to initiate equipment repair, modification and replacement.

(d) Upon completion of repairs or maintenance, the applicable valve and electrical line-up sheets for the affected diesel auxiliary systems, diesel starting air, diesel fuel oil, diesel jacket water, diesel lube oil and diesel intake and exhaust, will be completed to return the unit to the correct standby mode. A final equipment check will be made to assure that all electrical circuits are functional and all valves are properly positioned to permit a manual start of the equipment. After a satisfactory manual startup and load test of the diesel generator unit, it will be placed in automatic standby service.

430.8

alternate preferred power source circuit breakers from being closed at the same time. However, the diesel generator can be manually paralleled with either the preferred or alternate preferred power sources.

5. Permissives

Permissive conditions which must be satisfied for automatic HPCS diesel generator start are as follows:

(a) Maintenance-test-auto switch must be in auto position.
(b) Starting air supply pressure must be greater than 150 psig.
(c) Engine-generator lockout relay must be reset.
(d) HPCS diesel generator circuit breaker must be open.

6. Load Shedding Circuits

Load shedding circuits are discussed in Section 8.3.1.1.2.8.

7. Testing

Periodic surveillance testing will be performed in accordance with Regulatory Guide 1.108 and the manufacturer's operating manual, between which there are no conflicts. It is not anticipated that the DG should experience no load or light load operation for extended periods during periodic testing (Section 8.3.1.1.3.3 a). Normal operating procedures will include a precaution that the diesel generator be loaded to at least 25 percent of full load and run for a minimum of 30 minutes 430.8
whenever a non-surveillance start occurs that is not terminated within 2 minutes. Normal preventative maintenance will be performed in accordance with the manufacturers and Regulatory Guide recommendations. Equipment failures will be monitored by a maintenance history and periodically reviewed for failure rates and trends by the Plant Staff, as described in Section 8.3.1.1.3.2, item b.7.

430.9 (8.3) RSP The availability on demand of an emergency diesel generator is dependent upon, among other things, the proper functioning of its controls and monitoring instrumentation. This equipment is generally panel mounted and in some instances the panels are mounted directly on the diesel generator skid. Major diesel engine damage has occurred at some operating plants from vibration-induced wear on skid mounted control and monitoring instrumentation. This sensitive instrumentation is not made to withstand and function accurately for prolonged periods under continuous vibrational stresses normally encountered with internal combustion engines. Operation of sensitive instrumentation under this environment rapidly deteriorates calibration, accuracy and control signal output.

Therefore, except for sensors and other equipment that must be directly mounted on the engine or associated piping, the controls and monitoring instrumentation should be installed on a freestanding floor-mounted panel separate from the engine skids, and located on a vibration-free floor area. If the floor is not vibration-free, the panel shall be equipped with vibration mounts.

Confirm your compliance with the above requirement or provide justification for noncompliance.

<u>Response</u>

Control and Monitoring Instrumentation for the diesel generator are installed on a free standing floor mounted panel separate from the engine skids. In addition, vital shutdown and control functions are performed pneumatically for reliability in a diesel environment. Operational experience has shown the normal vibration enduced by the standby diesel generator has no affect on the accuracy of the instrumentation.

The response to this question for the HPCS diesel generators is provided in revised Section 8.3.1.1.3.3.

The HPCS diesel generator controls are installed on a free standing floor mounted panel i.e. the DG control panel is separate from the engine skid. The location of this panel and its design is such that it is able to withstand continous vibrational stresses anticipated during operation. Only sensors and other equipment which by their nature require attachment to the engine generator and associated equipment are to be found there. 430.9

11. Qualification Program

The HPCS diesel generator qualification program is discussed in Section 8.3.1.1.6.11.

430.10 (9.5.2) The information regarding the onsite communications system (Section 9.5.2) does not adequately cover the system capabilities during transients and accidents. Provide the following information:

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

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

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

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

1. The page party communications systems, and

2. Any other additional communication system provided to that working station.

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

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

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

Response

Safe shutdown is achievable from either the Control Room or the Remote Shutdown Panel.

The following list is a tabulation of equipment required for safe shutdown and should not be construed to mean this equipment has to be manned to perform its intended function.

(a) and (c): See attached list.

(b) and (d): The maintenance and calibration system uses headsets with integral amplifiers to negate background sound levels.

The PA system utilizes three types of speakers in general plant and outdoor areas. These speakers are;

1. Re-entrant type horn with a 3-½ foot equivalent air column and dispersion angle of 85 degrees.

2. Re-entrant type horn with a 2-1/2 foot equivalent air column and dispersion angle of 95 degrees.

3. Re-entrant type horn with a 1-½ foot equivalent air column and dispersion angle of 105 degrees.

Speaker types 1 and 2 generate a sound pressure of 126 dB while type 3 generates a sound pressure of 123 dB. These levels are adequate to handle the diesel generator area during operation which we consider to be our worst case. The re-entrant type speakers are capable of being oriented in any desired direction after the entire assembly has been permanently mounted and wired. All speaker amplifier sections are equipped with controls for volume and high frequency attenuation to overcome any possible background noise level that could exist.

(e): Each of the onsite working station communication systems will be acceptance tested, demonstrating system performance for the design specification to assure effective communications with the control room or the emergency shutdown panel.

(f) and (g): The Maintenance and Calibration system is powered from a vital AC source (battery backed) yielding an uninterruptible power supply. The 12 channel system has twelve individual power supplies and two spare power supplies mounted in place. Each jack station is separately wired back to the main patch panel.

The plant page/party system is powered from a 120 Vac distribution which is diesel backed. The page system utilizes its own conduit system. The system utilizes a branch circuit arrangement with testing/isolation stations connecting the branches to one of the three trunks. A component failure or short circuit will be isolated from the remaining system. Also, the loss of any one trunk line will only cause the loss of communications in a limited area of the plant.

In the event of the loss of both onsite and offsite power, handy-talkie communication via 2-450 Mhz repeaters will be available to operators and fire fighting personnel in addition to the uninterruptible Maintenance and Calibration System.

During loss of offsite power the page party system remains functional because it is powered from a diesel backed bus. The telephone system (PBX) also has 2 independant feeds which are backed by 2 separate Diesel busses, this system is also battery backed and designed to sustain operation for 4 hours. The backup Telephone System (OPX) is DC backed and will be available for intraplant communications for a period of 8 hours during loss of offsite power. The maintenance and calibration system is powered from an uninterruptible power supply. Based on battery capacity and load, excluding the Process computer, this system will remain functional for 1½ hours.

Two additional 450 MHZ repeaters will be used for radio communications. These are normally fed from the station 120 vac system. Each repeater has an independant battery backup which keeps this system operational for a duration of 4 hours.

Assurance has been provided on the availability of communications during loss of AC power because of the diverse and separate communications systems designed at Perry. The backup power supplies for the communication consistent with worst case design considerations and availability of the Class 1E DC systems. (See FSAR sec. 8.3.2.1.2.2)

Reference Figure 9.5-6 for the layout of the entire page party system, and Figure 9.5-23 for the location for all of the Maintenance and Calibration jack stations.

AREA	COMMUNICATION SYSTEMS AVAILABLE AT EACH STATION
DIESEL GENERATOR BUILDING	
Equipment	
Diesel Generator A Diesel Generator B Diesel Generator High Voltage Exciter Cabinet A Diesel Generator High Voltage Exciter Cabinet B Diesel Generator Engine Control Panel A Diesel Generaor Engine Control Panel B	1. PA system has 8 speakers available in the diesel area. 2. Maintenance and Calibration system has 8 jack stations available in the diesel area.
CONTROL COMPLEX, FLOOR 1 (ELEVATION 574'-10")	
Equipment	
Emergency Closed Cooling/Chilled Water Inst. Rack, A/C Emergency Closed Cooling/Chilled Water Inst Rack B Control Complex Chilled Water Control Panel, A/C Control Complex Chilled Water Control Panel, B	PA system has 4 speakers available in area 1 PBX telephone provided

CONTROL COMPLEX, FLOOR 3 (ELEVATION 620'-6")

Equipment

4.16 Kv Switchgear Bus, Division 1
4.16 Kv Switchgear Bus, Division 2
480 V Switchgear Bus, Division 1
480 V Switchgear Bus, Division 2
Motor Control Centers, Division 1
Motor Control Centers, Division 2
Remote Shutdown Panel

1. PA system has 12 speakers available in the switchgear/MCC area
2. The Maintenance and Calibration system has 18 jack stations in this area.
3. 1 PBX Telephone and 1 OPX Jack (at the Remote Shutdown Panel)

CONTROL COMPLEX, FLOOR 4 (ELEVATION 638'-6")

Equipment

Batteries, A
Batteries, B
Battery Chargers, A
Battery Chargers, B
125 Vdc Switchgear Bus, Division 1
125 Vdc Switchgear Bus, Division 2
125 Vdc MCC, Division 1
125 Vdc Distribution Panel, Division 1
125 Vdc Distribution Panel, Division 2
Neutron Monitor Preamp Panels, SRM/IRM Cabinets, A/D
Neutron Monitor Preamp Panels, SRM/IRM Cabinets, B/C

1. PA system has 18 speakers available in the battery and 125 Vdc switchgear area.
2. Maintenance and Calibration system has 6 jack stations in this area.
3. 1 PBX Telephone (in the Computer Room)

CONTROL COMPLEX, FLOOR 5 (ELEVATION 654'-6")

Equipment

ECCS Benchboard, P601
Auxiliary Relay Panels, P618, P621, P622 P623, P628, P629, P631, P654, P655, P871, P872, P873
Leak Detection Monitoring Panel, P632, P642

1. PA system has 9 speakers in this area. Note: This being the control room, re-entrant horns are not used but recessed

Control Rod Position Panel P651, P652
Neutron Power and Radiation Instrumentation
Panel P669, P670, P671, P672
Unit Control Console, P680
RPS Instrumentation and Auxiliary Relay
Panel, P691, P692, P693, P694
HVAC Control Panel, P800
Analog Loop Instrument Panel, P868, P869
Diesel Generator Benchboard P877
Containment/Drywell Isolation Valve Panel,
P881, P882
Common Analog Loop Instrumentation and
Auxiliary Relay Panel, P969
Common Loop Response Panel, P970
Common HVAC Control Panel, P904

speakers of sufficient sound pressure characteristics are used instead.

2. The Maintenance and Calibration System has a jack station at the end of each row of control panels as well as the operators console. This totals 22 jack stations in the control room.

3. 1 OPX Jack(at the Unit Control Console)

   4 PBX Telephones and 3 PBX Jacks(at the Control Room Communication Console)

CONTROL COMPLEX, FLOOR 6 (ELEVATION 679'-6")

Equipment

MCC Switchgear and Battery Room HVAC
Instrument Rack, P164, P166
MCC, Switchgear and Battery Room HVAC
Instrument Rack, P165, P167
Control Room HVAC and Emergency
Recirculation Instrument Rack, P152
Control Room HVAC and Emergency
Recirculation Instrument Rack, P153
HVAC System Control Panel, A
HVAC System Control Panel, B

PA system has 4 speakers in this area.

AUXILIARY BUILDING

Equipment

RCIC Instrument Panel
RHR Instrument Panel, A
RHR Instrument Panel, B

1. PA system has 7 speakers in this area.
2. The Maintenance and Calibration

HVAC Pump Room Cooling Control Panel
Suppression Pool Level Instrumentation Panels

System has 6 jack stations in this area.

REACTOR BUILDING

Equipment

Reactor Level and Pressure Instrumentation Rack, A
Reactor Level and Pressure Instrumentation Rack, B
Reactor Level and Pressure Instrumentation Rack, C
Reactor Level and Pressure Instrumentation Rack, D
Main Steam Flow Instrument Rack, A
Main Steam Flow Instrument Rack, B
Main Steam Flow Instrument Rack, C
Main Steam Flow Instrument Rack, D

1. PA system has 4 speakers at this elevation for the area.

2. There are 13 Maintenance and Calibration jack stations for this area.

EMERGENCY SERVICE WATER PUMP HOUSE

Equipment

Motor Control Centers, Division 1
Motor Control Centers, Division 2
Instrument Racks, DW-1
Instrument Racks, DW-2
Control Panels For Intake Screens, A
Control Panels For Intake Screens, B

1. PA system has 4 speakers in this area.

2. Maintenance and Calibration has 5 jack stations in this area.

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

Response

Safe shutdown is achievable from either the Control Room or the Emergency Shutdown Panel.

The attached list is a tabulation of equipment required for safe shutdown and should not be construed to mean this equipment has to be manned to perform its intended function.

Four separate backup systems are designed in various plant areas to provide lighting under various postulated events. These systems are: the essential lighting, emergency lighting, emergency lighting to meet the requirements in case of fire, and the security lighting system, which is discussed in FSAR Sect. 9.5.3.2.4.

To insure the availability of the lighting system the following features have been incorporated into the design.

1. The essential lighting system is fed from motor control centers which are automatically transferred to the emergency diesel generator upon loss of off-site power. The motor control centers are of the same design and manufacturer as the Class 1E MCC's. The starters have been purchased as part of the Class 1E specification including required documentation. The essential lighting system is routed in separate conduit and the supports for lighting fixtures and conduit in safety related buildings have been designed to withstand the design basis seismic event for safety related buildings.

2. The emergency lighting system is fed from the 2200ah station batteries. The battery charger to these batteries can also be fed from the standby diesel generators. During an accident condition of loss of off-site power, coincident with a LOCA, emergency lighting is provided in the areas identified by the 125V DC emergency lighting system. The batteries which feed this system also supply the power required to re-establish off-site power, and have been designed to provide reliable

(Con't) 2. on-site power. Perry has initiated a 10 point QA program to insure that the procurement, installation and functional integrity of the emergency DC lighting system is completed and installed in accordance with the approved construction drawings, specifications and/or related requirements. The procurement and installation contractor will establish formal procedures which address this limited QA program.

3. To meet the requirements for emergency lighting in case of a fire, a separate system of fixed self-contained lighting packs with 8 hour battery supplies is provided. The lighting units will be seismically mounted to prevent damage to nearby safety related equipment during a seismic event and to provide some assurance of operability. This fixed self-contained lighting will be provided in areas that must be manned for safe shutdown and for access and egress routes. Specific locations will be defined in a future amendment.

Thus, with the diverse and seperate systems for emergency lighting, the present design at Perry provides essential and fixed self-contained lighting in the control room to achieve safe shutdown for a design basis seismic event or emergency DC lighting for safe shutdown for a postulated loss of all AC power. Portable lighting will be available in any event to provide adequate lighting to achieve safe shutdown.

AREA	LIGHTING SYSTEMS IN ADDITION (1) TO THE NORMAL LIGHTING SYSTEMS
DIESEL GENERATOR BUILDING	
Equipment	
Diesel Generator A Diesel Generator B	Emergency Lighting Mainly for Egress
Diesel Generator High Voltage Exciter Cabinet A Diesel Generator High Voltage Exciter Cabinet B	Essential Lighting for Accessibility and Operability
Diesel Generator Engine Control Panel A Diesel Generator Engine Control Panel B	Emergency Lighting Mainly for Egress
CONTROL COMPLEX, FLOOR 1 (ELEVATION 574'-10")	
Equipment	
Emergency Closed Cooling/Chilled Water Inst. Rack, A/C Emergency Closed Cooling/Chilled Water Inst. Rack B Control Complex Chilled Water Control Panel, A/C Control Complex Chilled Water Control Panel, B	Emergency Lighting for Egress Only
CONTROL COMPLEX, FLOOR 3 (ELEVATION 620'-6")	
Equipment	
4.16 Kv Switchgear Bus, Division 1 4.16 Kv Switchgear Bus, Division 2 480 V Switchgear Bus, Division 1 480 V Switchgear Bus, Division 2 Motor Control Centers, Division 1 Motor Control Centers, Division 2	Essential Lighting for Accessibility and Operability
Remote Shutdown Panel	Essential and Emergency Lighting for full Operability

CONTROL COMPLEX, FLOOR 4 (ELEVATION 638'-6")

Equipment

Batteries, A
Batteries, B
Battery Chargers, A
Battery Chargers, B
125 V dc Switchgear Bus, Division 1
125 V dc Switchgear Bus, Division 2
125 V dc MCC, Division 1
125 V dc Distribution Panel, Division 1
125 V dc Distribution Panel, Division 2
Neutron Monitor Preamp Panels, SRM/IRM Cabinets, A/D
Neutron Monitor Preamp Panels, SRM/IRM Cabinets, B/C

There is essential lighting for accessing these areas. There is only normal lighting in the battery rooms.

CONTROL COMPLEX, FLOOR 5 (ELEVATION 654'-6")

Equipment

ECCS Benchboard, P601
Auxiliary Relay Panels, P618, P621, P622, P623, P628, P629, P631, P654, P655, P871, P872, P873
Leak Detection Monitoring Panel, P632, P642
Control Rod Position Panel, P651, P652
Neutron Power and Radiation Instrumentation Panel P669, P670, P671, P672
Unit Control Console, P680
RPS Instrumentation and Auxiliary Relay Panel, P691, P692, P693, P694
HVAC Control Panel, P800
Analog Loop Instrument Panel, P868, P869

The Control Room has a full complement of essential and emergency lighting for operability.

Diesel Generator Benchboard, P877
Containment/Drywell Isolation Valve Panel, P881, P882
Common Analog Loop Instrumentation and Auxiliary Relay Panel, P969
Common Long Response Panel, P970
Common HVAC Control Panel, P904

CONTROL COMPLEX, FLOOR 6 (ELEVATION 679'-6")

Equipment	
MCC Switchgear and Battery Room HVAC Instrument Rack, P164, P166	Essential and Emergency lighting for accessibility only.
MCC Switchgear and Battery Room HVAC Instrument Rack, P165, P167	
Control Room HVAC and Emergency Recirculation Instrument Rack, P152	
Control Room HVAC and Emergency Recirculation Instrument Rack, P153	
HVAC System Control Panel, A	
HVAC System Control Panel, B	

AUXILIARY BUILDING

Equipment	
RCIC Instrument Panel	Essential and Emergency lighting for accessibility and operability
RHR Instrument Panel, A	
RHR Instrument Panel, B	
HVAC Pump Room Cooling Control Panel	Normal lighting only
Suppression Pool Level Instrumentation Panels	

REACTOR BUILDING

Equipment	
Reactor Level and Pressure Instrumentation Rack, A	Essential and Emergency lighting for accessibility and operability

Reactor Level and Pressure
Instrumentation Rack, B
Reactor Level and Pressure
Instrumentation Rack, C
Reactor Level and Pressure
Instrumentation Rack, D
Main Steam Flow Instrument Rack, A
Main Steam Flow Instrument Rack, B
Main Steam Flow Instrument Rack, C
Main Steam Flow Instrument Rack, D

EMERGENCY SERVICE WATER PUMP HOUSE

Equipment

Motor Control Centers, Division 1 Motor Control Centers, Division 2 Instrument Racks, DW-1 Instrument Racks, DW-2	Battery powered units for egress only. This is not part of the emergency lighting system.
Control Panels for Intake Screens, A Control Panels For Intake Screens, B	Essential and Emergency Lighting.

(1) Emergency lighting refers to the Emergency DC lighting system .

430.16 (9.5.4) In Section 9.5.4.3 you state that corrosion protection for the tanks and piping will include providing a corrosion allowance as well as external coatings. This statement is unacceptable. Expand the FSAR to include a more explicit description of proposed protection of underground piping. Where corrosion protective coatings are being considered (piping and tanks) include the industry standards which will be used in their application. Also discuss what provisions will be made in the design of the fuel oil storage and transfer system storage tanks in the use of internal corrosion protection, in addition to external waterproof protective coatings. (SRP 9.5.4, Part II and Part III, item 4).

Response

The response to this question is provided in revised Section 9.5.4.3.

430.16.

Corrosion protection for the tanks and piping will include providing a corrosion allowance to the tank wall thickness and the external use of bituminous coatings applied to thicknesses to assure complete uninterrupted coverage. Cathodic corrosion protection of the buried storage tanks and piping is used to withstand corrosive conditions in the system. The underground yard piping is coated with coal-tar enamel and bonded double asbestos-felt wraps, following the American Water Works Association's Standard C-203, "Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied." **All** diesel generator fuel oil storage tanks are coated internally with a one coat, 2 mil-thick coating of Rustoleum. 430.16

Leakage due to corrosion, allowing water to enter the tank, will be detected by a slow increase in the fuel level; this level will be read and logged at regular intervals. Such a leak would be slow starting and would increase at a slow enough rate to allow pumping the water out of the tank. Corrective action could be taken long before the water accumulates to an amount that interferes with fuel transfer.

The standby diesel generator fuel oil systems are not redundant, since two 100 percent capacity diesel generators are provided.

A program of sampling and periodic replacement of the oil will be conducted to prevent long term deterioration of the fuel oil. Due to fuel consumption during periodic testing, it is anticipated that fuel oil replacement for deterioration will not be required.

Algae growth in the tank will be prevented by routinely removing the water in which it grows, and if necessary, by using an algae inhibiting additive in the oil.

The fuel oil storage tanks are provided with porous Class A bedding and backfill as an extension from the main plant underdrain system.

The Probable Maximum Flood (PMF) level is lowered to a point 10 feet below the bottom of the tanks in this area due to the main plant underdrain system and

430.30 (9.5.5) Describe the provisions made in the design of the diesel engine cooling water system to assure that all components and piping are filled with water. (SRP 9.5.5, Part III, Item 2)

Response

Each standby diesel generator system is vented to ensure that all spaces are filled with water. A jacket standpipe serves as a reservoir and is equipped with a low water level alarm. Whenever the standby diesel is operating, the jacket water cooling pumps will be functioning, supplying water to the diesel at sufficent head and flow to keep all piping and cavities in the flow path filled up to the cooling water outlet manifold header (discharging from the engine to the standpipe).

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 expansior tank 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. The manufacturer has demonstrated through long and extensive use of these engines, in both stationary power plants, and in locomotives, the success of this type of system.

The high-point vents are of adequate size upon startup to remove air in the crossover manifold, above the expansion tank, to prevent the air from reaching the circulating pumps and causing binding.

430.32 (9.5.5) The 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 shaft 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. Demonstate by analysis that the expansion tank size will be adequate to maintain required pump NPSH and makeup 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 to the expansion tank.

Response

Whenever the HPCS diesel is operating, the jacket water cooling pumps will be running, supplying water to the diesel at sufficient head and flow to keep all piping pressurized, thus forcing all the air out of the system into the expansion tank. When the pumps are shut off, the water outlet manifold header (discharge piping from the engine to the standpipe) will drain down into the expansion tank. Operating in this manner will not cause any problems, as shown by operating experience.

The system leakage during seven days of continuous operation is conservatively estimated to be less than one gallon. Capacity of the expansion tank is approximately 88 gallon, therefore sufficient capacity is provided so as not to require a continous make-up source. In addition, the tank provides a constant head source to the pumps and is located approximately 18" above the pumps suction line. Minimum water level is maintained in the tank to provide NPSH requirements under all operating conditions. (See the response for the standby diesel generator which is in revised section 9.5.5.2).

9.5.5 DIESEL GENERATOR COOLING WATER SYSTEM

The sections that follow discuss the cooling water system for the standby diesel generators. This system for the high pressure core spray (HPCS) diesel generator is discussed in Section 9.5.9.2.

9.5.5.1 Design Bases

The standby diesel generator cooling water system is designed to dissipate the heat given up by the engine air intercooler, the lube oil heat exchanger, the governor cooler and the engine water jacket heat exchanger. There are no shared systems or piping interconnections among each of the standby diesel generators cooling systems. The jacket water heat exchanger is cooled with water from the emergency service water system. Cooling for the engine water jackets, the lube oil heat exchanger, governor cooler and the engine air intercoolers are provided with a closed loop cooling system in which treated demineralized water is used. This demineralized water is treated by the addition of antifreeze (ethylene glycol) to prevent long-term corrosion and organic fouling of the jacket water. Antifreeze is one of the materials recommended by the engine manufacturer. The performance and water chemistry of the diesel generator cooling water system is in conformance with the manufacturer's recommendations.

Conformance with applicable GDC's is discussed in Section 3.1. Conformance with regulatory guides is discussed in Section 1.8. Conformance with Branch Technical Positions ASB 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping systems outside containment, is discussed in Sections 3.6.1 and 3.6.2. The guidelines presented in Branch Technical Position ICSB-17 (PSB) have been considered in the design of this system as described in Chapter 8.

9.5.5.2 System Description

The standby diesel generator cooling water system is shown on Figure 9.5-9. The entire cooling water system is supplied as part of the diesel generator auxiliary skid. The system consists of a separate piping network for each engine that circulates lake water from the emergency service water system through the jacket water heat exchanger.

The engine jacket water cooling system consists of a closed loop in which demineralized water is circulated through the engine, the lube oil heat exchanger, and the jacket water heat exchanger with an engine driven centrifugal pump. It then passes through a three-way temperature control valve (R46-F507A,B) which directs the coolant through or around the engine jacket water heat exchanger, as necessary, to maintain the required water temperature. The water then returns to the pump suction and the cycle is repeated.

The 100 percent capacity engine driven cooling water pump has a capacity of 1800 gpm at 43 psig discharge pressure and operates whenever the diesel generator is in operation.

The jacket water heat exchanger is a shell and tube type, with emergency service water on the tube side and jacket cooling water on the shell side. The lube oil heat exchanger is a shell and tube type with jacket cooling water on the tube side and lube oil on the shell side. Table 9.5-8 gives applicable data for the lube oil heat exchanger. 430.26, 430.27

The closed cycle system also includes a jacket water standpipe and a heating system to keep the system warm for standby purposes. The diesel engine cooling water system standpipe (expansion tank) is a 30 inch diameter vertical tank 18 feet 10 1/2 inches high, having a working water volume of 651 gallons with the system at operating temperature. The standpipe is skid mounted and adjacent to the diesel engine. The heating system includes a 75 kW, 460 volt electric heater inside the jacket water standpipe and a motor driven pump to circulate warm coolant at a temperature of approximately 150°F through the engine. A check valve is included in the warmup line to prevent back flow during operation of the engine. 430.32 430.33

The skid mounted cooling water pump, piping, valves and accessories are designed for near zero leakage during continuous operation at full load. The manufacturers estimate that refilling intervals with demineralized water will be approximately six months due to this slight leakage and to a small amount of evaporation through the atmospheric vent. The level decrease over a seven

day period would therefore be approximately 2.17 inches of water height or 6.64 gallons.

The NPSH required for the pump is 11.5 feet. At operating temperature and with the water at the low level alarm point the NPSH available is 20.05 feet. The results of this analysis indicate that the level decrease of 2.17" over a seven day period would not impair pump performance. 430.32

The keepwarm pump is of the horizontal, centrifugal type with a capacity of 50 gpm at 50 ft head with a three horsepower 460 volt, 3 phase, 60 hertz motor. The motor is powered from a safety related Class 1E motor control center. The pump may be operated with a manual control switch; however, with its control switch in AUTO it will operate continuously with the diesel in standby and will de-energize when the diesel comes up to speed. 430.33 430.17 430.26

The standby diesel jacket water heat exchanger will be without emergency service water flow for approximately 70 seconds from the start of the diesel generators. Ten seconds are required to bring the diesel generator up to speed and 60 seconds elapse before the sequential loading process initiates emergency service water system operation. The standby diesel engine cooling water system can operate without emergency service water for 1-1/2 minutes before the maximum allowable cooling water temperature of 190°F is reached. The standby diesel cooling water system is required to remove 21,589,100 Btu/hr, and is capable of removing a maximum of 23,748,000 Btu/hr which is a heat rejection margin of 9 percent. The temperature of the cooling water coming out of the standby diesel during normal operation is approximately 175°F. 430.26

Control of the system is normally automatic during all modes of plant operation.

Details of the diesel generator starting sequence are discussed in Section 8.3.1. The HPCS cooling water system is discussed in Section 9.5.9.2. 430.27

430.34 (9.5.5) Figure 9.5-16 shows an immersion heater in the diesel engine cooling water system attached directly to the lube oil cooler, and to the engine-driven pumps' suction and discharge lines. The FSAR in Section 9.5.9 does not provide a detailed description of how the diesel engine cooling water system operates during standby conditions nor does the design of this system seem to provide for preheating of the jacket water to enhance engine start capability. Provide a detailed description of how the diesel engine cooling water system operates on standby conditions.

Response

The diesel generator building HVAC systems are designed to maintain the required environmental conditions between minimum and maximum ambient conditions as specified by the diesel engine manufacturer. The design basis provides for an ambient room temperature ranging from 40° to 120°F for outside temperature ranging from -5° dry bulb to 95°F. Engine low temperature condition will be annunciated in the control room through a low temperature alarm(85°F) in the lube oil return line to the strainer sump.

A detailed description of the diesel engine cooling water system operation on standby conditions is provided in revised Section 9.5.9.2.2.

system status and operation from the control room. Details of the instrumentation and controls for the HPCS diesel generator fuel oil storage and transfer system are presented in Section 7.3.1.

9.5.9.2 Division 3 HPCS Diesel Generators Cooling Water System

A functional block diagram which shows the relationship between the diesel generator cooling water system and the other parts of the diesel generator is to be found in Figure 9.5-16.

9.5.9.2.1 Design Bases

a. The diesel generator cooling water system (DGCWS) is designed to remove sufficient heat from the diesel generator assembly to permit continuous operation at maximum load. Heat removed from the DGCWS is transferred to the shutdown service water system (see Section 9.2.1).

b. The system is designed to process the capability to provide heat to the engine to maintain it in a standby condition.

9.5.9.2.2 System Description

A separate cooling water system is provided for the HPCS diesel generator.

The diesel generator cooling water system is supplied as a part of the diesel generator structure, and connects to the shutdown service water system. Heat from the diesel generator in the engine jacket water cooling system is dissipated into a closed loop in which demineralized water is circulated through the engine, the lube oil heat exchanger, and the turbocharger after-coolers by means of two engine driven pumps. The closed cooling water system consists of immersion heater, expansion tank, temperature regulating valve and lube oil cooler.

The immersion heater is thermostatically controlled and, in conjuction with the temperature regulating valve, will maintain the jacket water at a steady temperature during standby condition.

The immersion heater is 15 kW, 460 a-c, 3 phase, 60 Hz and is fed from its associated Class 1E motor control center. During engine shutdown conditions, jacket water heated by the immersion heater will circulate through the lube oil cooler by thermosyphon action to warm the lubricating oil which is circulated by an a-c motor-driven pump. This "keep warm" feature will provide the engine with capability of quick start and load acceptance. The engine low-temperature condition will be annunciated in the main control room.

The closed loop water cooling system connects to an external heat exchanger which dissipates heat to the emergency service water system.

The engine of the HPCS diesel generator is provided with two 50 percent capacity pumps. Both pumps are driven by the diesel engine. When the diesel engines are in the standby condition, the cooling water is maintained at a constant temperature by circulating it through the separate electric immersion heater. The jacket water heater element is installed near a low point in the diesel generator jacket water supply, and by natural convection circulation, the hot water from the heater, by being less dense, rises causing a natural flow. This flow causes a thermosyphon effect drawing water over the heater, which is set to turn on at 125°F and shut off at 155°F. The heat conduction from the water channels and the engine will keep the lube oil as well as the engine block warm. Operating experience has demonstrated that a motor driven jacket water "keep warm" pump is not necessary. This "keep warm" feature helps to provide the engine with high reliability and enhances its capability of quick start and load acceptance. The immersion heater is thermostatically controlled and operates in conjunction with a temperature controlled regulating valve. Natural circulation of the cooling water is used for the diesel generators.

The HPCS DGCWS also provides a sufficient heat sink to permit a hot HPCS diesel engine to start and operate for 2 minutes without standby service water flow through the DGCWS heat exchanger. Standby service water flow through the HPCS diesel generator DGCWS heat exchangers begins 10 seconds after the generator supplies power to the bus. Power is supplied to the bus 10 seconds after the HPCS generator start signal. Therefore, the additional time during

430.40 (9.5.7) For the diesel engine lubrication system in Section 9.5.7 provide the following information: (1) define the temperature differentials, flow rate, and heat removal rate of the interface cooling system external to the engine and verify that these are in accordance with recommendations of the engine manufacturer; (2) discuss the measures that will be taken to maintain the required quality of the oil, including the inspection and replacement when oil quality is degraded; (3) describe the protective features (such as blowout panels) provided to prevent unacceptable crankcase explosion and to mitigate the consequences of such an event; and (4) describe the capability for detection and control of system leakage. (SRP 9.5.7, Part II, Items 8a, 8b, 8c, Part III, Item 1.)

Response

The following response is applicable to the standby diesel generators:

1. Lube Oil Cooler

	Shell Side (Lube Oil)	Tube Side (Jacket Water)
Flow (gpm)	500	900
Temperature In (^{O}F)	185	148
Temperature Out (^{O}F)	156	155
Heat Removal Rate (BTU/HR)	3,224,100	

2. The diesel engine manufacturer has provided a specification for the lube oil to be used in the engine. The required oil quality is maintained by performing monthly laboratory analysis on a sample of the lube oil. From the results of the analyses, it is determined if the oil quality has degraded and replacement is necessary. In addition, clogged oil filters will be annunciated.

3. The crankcase is fully enclosed and theoretically air tight. To remove gases and vapors from the crankcase and to reduce the possibility of fresh air or oxygen being present, crankcase pressure is maintained at a level slightly below atmospheric, measured in inches H_2O by a

standard U-type manometer. Two motor driven blowers are used to draw directly from the crankcase to each engine, and discharge through oil separators where oil vapors are removed. The discharge is piped outside the engine room to the atmosphere.

Crankcase vacuum readings shall be taken and compared with previous readings. In this way, gradual changes can be detected and investigated so that minor problems can be corrected before they reach major proportions. Should the readings indicate a loss of crankcase vacuum, the cause should be promptly determined and corrected.

Crankcase vacuum readings shall be carefully observed during heavy load operations. Should the pressure go from a vacuum to a positive reading, the engine will be shut down immediately. The engine will not be operated with a positive pressure inside the crankcase since this indicates that the action source for purging the crankshaft has been plugged and/or otherwise obstructed, or that some condition exists that is creating abnormal heat. If a hot spot develops in the engine and the oil flows or splashes over it, a considerable amount of oil vapor will be formed. This vapor is explosive and the engine will be stopped immediately. The engine will be allowed to rest for fifteen minutes to allow fumes and vapors to dissipate before removing any engine covers. The cause will be determined and corrected before continuing operation.

As a further safety measure, doors on the crankcase will automatically open if the pressure inside the crankcase exceeds the pressure of the ambient atmospheric pressure by 0.7 psi. The doors are designed so that only a small amount of vapor will be released to the room. No oil will be released.

4. The following are two methods to detect oil leakage from the system:

   a. Make comparisons of oil levels and the rate of level reduction with previous rates. An increase in the rate of reduction of the oil level could mean a leak in the system.

b. Visually examine the various components in the system during normal preventive maintenance work.

The following response is applicable to the HPCS diesel generator:

1. The diesel engine lube oil cooling system together with the diesel engine cooling water system are integral parts of the diesel engine. The cooling water system is designed to absorb all the heat carried from the engine by the lube oil system. A description of the cooling water and lube oil systems are provided in Sections 9.5.5 and 9.5.9. In particular, Table 9.5-2 summarizes the thermal characteristics of the cooling water system and its design margin. No external cooling is needed for the lube oil system.

2. The diesel engine manufacturer has provided a specification for the lube oil to be used in the engine. The required oil quality is maintained by performing monthly laboratory analysis on a sample of the lube oil. From the results of the analyses, it is determined if the oil quality has degraded and replacement is necessary. In addition, clogged oil filters will be annunciated.

3. A crankcase pressure detector is provided to detect change in the normally negative crankcase pressure to a positive pressure. If the crankcase pressure should become positive the high crankcase pressure alarm annunciates. The oil relief valve is released and lube oil pressure to the oil pressure switches is relieved. Low lube oil pressure at the switches will initiate engine shutdown. The operator can then take appropriate action to correct the condition in accordance with manufacturers recommendations. See revised Section 9.5.9.

4. During the initial start up and periodic testing the lube oil system is checked for leaks. High lube oil temperature, low lube oil level or low lube oil pressure could be partly attributed to lube oil leakage. Excessive oil use may be partly due to oil leakage. This is checked by routine inspection. See revised Section 9.5.9.

430.48 Provide the results of an analysis that demonstrates that the function of your diesel engine air intake and exhaust system design will not be degraded to an extent which (will) prevent developing full engine rated power or cause engine shutdown as a consequence of any meteorological or accident condition. Include in the discussion, the potential effects of fire extinguishing medium, recirculation of diesel combustion products, or other gases which may intentionally or accidentally be released on site on the performance of the diesel generator.

Response

1. Consequence of Meteorological Effects

Each standby and HPCS diesel generator is provided with a completely separate and independent combustion air intake and exhaust system. The essential system components exposed to atmospheric conditions such as ice and snow are protected from probability of clogging during standby or operation by being housed within Seismic Category I structures provided with louvers. The standby and the HPCS diesel generator intake and exhaust systems are safety related from the inlet filter through the exhaust blowoff hatch and are designed to remain operative against missiles, pipe whip and jet impingement as well as the effects of earthquakes, floods, and tornados. The exhaust silencer is non-safety related. However, in the event of exhaust blockage by the silencer, exhaust gases would be automatically bypassed through the blowoff hatch. The blowoff hatch is protected from tornado generated missiles by horizontal and vertical shield barriers.

2. Effects of Fire Extinguishing Mediums

Carbon dioxide fire extinguishing systems which are within the vicinity of the emergency diesel generator air intakes are located within the diesel generator rooms and in the control complex. In the event the CO_2 fire extinguishing system is activated because of fire either in the chart storage room in the control complex or in a diesel generator room, fire dampers for the respective room are closed

automatically and the affected area is isolated. The gases, air combus'ion products and CO_2 are held, contained within the area. The affected area will remain isolated until the fire is under control and is determined that the accumulated gases can be vented safely.

A fire in a diesel generator room would activate the CO_2 fire extinguishing system which would automatically close the louvers that vent the room to ambient. Release of the combustion gases to atmosphere would be controlled and would not degrade the quality of inlet air to the remaining diesel which could impair its full rated performance.

In the event a fire started in the chart storage room, the CO_2 fire extinguishing system would automatically initiate, closing the fire dampers. Combustion products would build up and be isolated in the area by the fire dampers. Controlled release of the combustion products would occur through the vents to the Unit 1 hallyway and to the exhaust to the battery room. If fire dampers failed to close, exhaust of air and combustion products would be to the Unit 1 hallyway where the vented gas would be handled by the control complex habitability system and to the battery room which vents to ambient. In either case, concentrations of inert gases at the diesel air inlets would not degrade diesel performance. (See response for analysis of more severe conditions, i.e., instantaneous release of stored gases.

3. Effects of Recirculation of Diesel Combustion Products

   Combustion air at a rate of 14, 078 scfm for the standby diesel generator is drawn through each of the two air intake filters (28,156 scfm total) located in louvered cubicles on the diesel generator building roof. These filters clean the ambient air which then passes through the inlet

air piping system to the diesel generator. Concentration of oxygen by volume in ambient air is 21 percent. The required oxygen content at the diesel air intake to ensure no degradation of the diesel generator combustion performance is 18 percent by volume. Thus up to 14.3 percent of inert gas, i.e., zero oxygen content, can be mixed with 85.7 percent ambient air on a volume basis without affecting diesel generator performance requirements.

Combustion gases exhuast from the standby diesel engine at a rate of 30,500 scfm. These gases exhuast through a spark arresting type exhaust silencer. It would be necessary for more then 13.2 percent of the exhaust gas (4,026.4 scfm) to be recirculated into the air intakes to deteriorate operation of the standby diesel generator. This same percentage recirculation, 13.2 percent, would apply to the HPCS diesel generator air intake before degradation of performance would occur.

Arrangement and location of the combustion air intakes and exhausts, as shown in Figures 1.2-6 and 1.2-13, are designed to avoid dilution or contamination of intake air by exhaust gases. The exhaust plane of the silencer for the standby diesel generator exhaust system is 44 feet horizontal distance from the air inlet piping and 5'-7" above the high point of the inlet louvers. The exhuast plane of the HPCS diesel exhuast silencer is 29 feet horizontal distance from the air inlet and 6 feet above the high point of the inlet louvers. In both cases, the plume effect and exit velocity of the hot exhaust gases plus the removal distance, with intervening structure blockage, will eliminate recirculation.

The exhaust silencers are not safety related. Because of their elevation above grade impact by large tornado driven missiles should not be postulated.

If any malfunction of the exhaust silencer occurs which prevents normal exhaust through the silencer of diesel combustion gases, the

combustion gases would exhaust through an emergency valve. The valve is safety class three construction, and is protected by a tornado missile barrier. Sufficient vent capability is provided by doorways in the shielding around the emergency valve. Gases exhaust away from the fixed louver inlet plane. An intervening structure blocks the direct path from exhaust to inlet, i.e., exhaust gases would have to rise, be b lown to the lee side of the inlet-containing structure and lower to fixed louver inlet elevation and reverse direction to enter the inlet. Thus, no recirculation of exhaust gases which might degrade diesel performance can occur.

4. Effects of Sudden Release of Stored Gases on Site

On-site stored gases whose accidental (instantaneous) release could result in the gases being drawn into the diesel generator systems intake lines consist respectively of CO_2 and H_2. (See Table 2.2-10). The maximum concentration of these respective gases which could be drawn into the intake lines was calculated in accordance with Regulatory Guide 1.78. Results of the calculation are sumarized below:

Type of Gas	Yard Inventory	Gas Concentration at diesel Air Inlet % by volume (max.)	O_2 Concentration % by volume (max.)
CO_2	4 tons	7.5	19.4
H_2	7,387 $ft.^3$	5.5	19.8

Since the diesel engine combustion performance will show no degradation if oxygen percentages by volume remain above 18 percent, sudden release of stored gas in the yard area adjacent to the diesel generators will not affect the design functions of the diesel systems.

430.102 (8.3.1) Section 8.3.1.4.1.7 "Separation of Class 1E and Non-Class 1E Cables" does not state the separation distance between Class 1E and Non-Class 1E cables. Provide the above information.

Response

For separation of Class 1E and Non-Class 1E cables, the following separation distances are used:

a. A separate tray system consisting of power, control and instrumentation trays is used for non-1E circuits. This tray system is separated from Class 1-E trays utilizing the same criteria as two Class 1-E trays of the different divisions. Refer to FSAR sections 8.3.1.4.1.4 and 8.3.1.4.1.5.

b. For reactor protection circuits in cable tray, the separation distance is 3 foot horizontal and 5 foot vertical. This is reduced to 1 foot horizontal and 3 foot vertical in the cable spreading area.

c. For conduit, the separation is 1 inch minimum.

d. Equipment internal wiring separation is to be a minimum of 6 inches for Class IE and Non Class IE. Areas where this separation can not be maintained, the additional barriers, raceways and/or enclosures shall be utilized.

Provide the analysis to justify the use of Grand Gulf standby diesel generators as the prototype units for the Perry Units for the start and load acceptance test. (300 start test)

<u>Response</u>

As indicated in the D. R. Davidson letter sent to Mr. S. A. Varga, NRC on August 31, 1977, CEI intends to use the results of the 300 start tests done for the Grand Gulf Nuclear Station 1 & 2.

A review and analysis of the Grand Gulf diesel generator sets and the ones used at Perry has been done. The results and conclusions of this review and a description of the tests performed is attached. The results of these tests are available for review.

Our analysis of the differences indicates that their impact on the starting and loading capability of the unit will not be significant. The Perry diesel generator set is within the scope of IEEE-387-1977 sections 5.4.2 and 5.4.3 to take credit for the previous qualification of the Grand Gulf units. The load acceptance portion while a part of the test, can be expected to repeat itself consistently, if the cranking and starting phase of the test are sucessfully accomplished. Therefore, we intend to use the Grand Gulf 300 start and load test data along with our analysis for the Perry Division 1 and 2 diesel generator for start test qualification. In addition 20 start and load tests will be conducted to verify our analysis as previously committed to the NRC.

ATTACHMENT

The following is the results and conclusions of the analysis of the differences between the Grand Gulf and Perry diesel generator sets.

1.	Engine	Identical number of cylinders, bore, stroke, BMEP, speed, and diesel generator arrangement.
2.	Governor	Identical model and manufacturer.
3.	Generator	Identical rating, different manufacturer.
4.	Overall System WR^2	Identical for all practical purposes (CEI 340, 669 LB Ft^2, qualified unit 332, 340 Lb. Ft., 2-½% difference).
5.	Excitation Characteristics	Each designed specifically for the application. In our opinion same concept, manufactured by comparable but different manufacturers.
6.	Accessories/ Auxiliaries	Basically identical, minor differences.

After reviewing the differences between the generators, we can offer the following observations. Both Electric Products (Grand Gulf) and Basler (Cleveland Electric Illuminating Company) provide solid state controls with SCR's as the final power device and should have comparable life expectancies.

The Electric Products unit controls the final power by shorting out a portion of the input power through reactors while the Basler unit triggers the power on to control. Therefore the Electric Products unit generates more internal heat and must control heavier current than the Basler unit.

Since most failures of solid state devices occur during the initial burn in and preliminary operation, either unit would have experienced most failures before arriving at the load testing period.

We have also reviewed the entire moments of inertia of the systems and offer the following comments on the differences between the systems and how the starting times are affected.

The Mississippi Power & Light Company DSRV-16-4 engine generators (S/N 74033/36) are rated at 7000 KW at 450 RPM. The total system inertia value or WR^2 is 332, 340 lb. $ft.^2$ with 291, 800 lb. $ft.^2$ in the E.P. generator, and 14,887 lb. $ft.^2$ in the flywheel.

The C.E.I. DSRV-16-4 engine generators (S/N 75051/54) are rated also at 7000 KW at 450 RPM. The generator is G.E. and has a rotor WR^2 of 234,931 lb. $ft.^2$. The flywheel has 79,908 lb. $ft.^2$. The engines are identical. Total WR^2 is 340,669 lb. $ft.^2$.

With identical speed governing devices, air starting system, engine rating and type, the starting time would be increased for C.E.I. over MPL by the percentage difference between the system WR^2 values.

$$\text{Ratio} = \frac{340{,}669}{332{,}340} = 1.025$$

The energy required to accelarate a system from N_1 RPM to N_2 RPM may be expressed as:

$$E = 1/2\ IW^2$$

$$= \frac{\pi^2\ WR^2}{1800\ g}\ (N_2^{\ 2} - N_1^{\ 2})$$

Since the energy available for starting is identical and both have to accelerate from 0 to 450 RPM, the above equation may be written as:

$$E = WR^2 \times C$$

$$HP = \frac{\text{Energy}}{\text{Time}}$$

$$\text{or} \quad \left(\frac{\text{Energy}}{\text{Time}}\right)_{CEI} = \left(\frac{\text{Energy}}{\text{Time}}\right)_{MPL}$$

$$\frac{WR^2\ CEI \times C}{\text{Time CEI}} = \frac{WR^2\ MPL \times C}{\text{Time MPL}}$$

$$\frac{WR^2\ CEI}{WR^2\ MPL} = 1.025 = \frac{\text{Time CEI}}{\text{Time MPL}}$$

Time MPL was between 5 1/2 to 6 seconds.

Time CEI should therefore be 1.025 x 6, or 6.15 seconds.

Twenty-start and load acceptance tests will be performed during pre-operational testing to demonstrate compliance with the requirements of IEEE-387-1977 and verify our analysis.

DESCRIPTION OF GRAND GULF

2.6.5 300 START TEST

PURPOSE

To perform tests as outlined in Qualification Test Procedure, Rev. 2, dated November 30, 1976 for the above engine under Test Method 2.6.1.1.

INSTRUMENTATION

Temperature Recorder, Foxboro S/N 1652300

Frequency Meter, Weston Model 339, S/N 1572

Watt Meter, Weston Model 329, S/N 2851

Voltmeter, Weston Model 341, S/N 25619

Ammeter, Weston Model 370, S/N 8932

Visicorder, Honeywell Model 1508A, S/N 0305J/J71

Transducers

IPAC Series 750, Frequency Transducer

Transdata Inc. Model 10P5101, Voltage Transducer

Transdata Inc. Model 10C5101, Current Transducer

Transdata Inc. Model 20W5101, Kilowatt Transducer

DESCRIPTION OF TEST

Prior to the official start of testing, the engine was run to establish a load of 1750 KW on rheostat "A" and 1750 KW on rheostat "B". Throughout the test these rheostats were kept equal to or greater than 1750 KW. Appropriate test panel timers were then adjusted to achieve the required time for load pickup. The engine was also run for a period of time to establish normal operating temperatures.

2.6.5 300 START TEST
(Cont.)

A "forced cooling" system was used in cooling the engine back to the standby temperatures after each run. The system circulated engine jacket water through its cooler and engine lube oil through an additional cooler and the engine.

The start number, standby and operating temperatures, the starting air pressure before and after the test, and the generator parameters were recorded on data sheet E-236.

The engine lube oil and jacket water out of the engine were recorded on a temperature recorder to show the engine at standby temperature, its rise to normal operating temperature, and its return to standby temperature for each official start.

The visicorder strip charts show that from the time of the start initiation signal until the engine was up to synchronous speed and the 3500 KW load was picked up was no more than seven seconds. The first 270 starts were conducted from the standby keep-warm temperature and the engine was run until the normal operating temperatures of the lube oil and jacket water were reached. This took approximately ten minutes. The engine was then stopped and the lube oil and jacket water were cooled back to their standby keep-warm conditions. This took approximately 15 minutes. Starts No. 270 through 300 were conducted from the normal half-load temperatures of lube oil and jacket water. These starts were conducted on approximately an eleven-minute cycle.

2.6.5

300 START TEST (Cont.)

The 300 start test proceeded on a 24-hour-per-day schedule.

Although the engine successfully started, run #299 was voided because the engine did not reach frequency within the required time. This was because the operator tried to start the unit before the engine shutdown mechanism had had time to reset itself.

Minor maintenance work was done on the air compressor after start 55 and routine engine maintenance was performed after starts #130, 244 and 275.

A total of 305 official starts were made during the test without any failures after initiation of the start signal.

The test as outlined in the Qualification Test Procedure, Rev. 2, dated November 30, 1976 for Test Method 2.6.5 was completed without any failures.

The test was observed, logged and signed by:

H. Henricks, De Laval Senior Research Engineer

H. Schilling, De Laval Senior Research Engineer

D. Reid, De Laval Research Engineer

D. Garton, De Laval Quality Control Engineer

R. Reinsch, Representing Bechtel Corp.

A. G. Watson, Representing Bechtel Corp.

ENCLOSURES

A. Data sheets for 2.6.1.1 - Starts #1 to #305 dated 12/11/76 to 12/16/76

B. Visicorder strip chart recordings - Starts #1 to #305 dated from 12/11/76 to 12/16/76.

C. Temperature recorder charts - Starts #1 to #305 dated from 12/11/76 to 12/16/76