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Dalwyn R. Davidson
VICE PRESIDENT
SYSTEM ENGINEERING AND CONSTRUCTION

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March 25, 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 provide draft 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

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430.6 (8.3) RSP Operating experience at certain nuclear power plants which have two cycle turbocharged engines manufactured by the Electromotive Division (EMD) of General Motors driving emergency generators have experienced a significant number of turbocharger mechanical gear drive failures. The failures have occurred as the result of running the emergency diesel generators at no load or light load conditions for extended periods. No load or light load operation could occur during periodic equipment testing or during accident conditions with availability of offsite power. When this equipment is operated under no load or light load conditions, insufficient exhaust gas volume is generated to operate the turbocharger. As a result the turbocharger is driven mechanically from a gear drive in order to supply enough combustion air to the engine to maintain rated speed. The turbocharger and mechanical drive gear normally supplied with these engines are not designed for standby service encountered in nuclear power plant application where the equipment may be called upon to operate at no load or light load condition and full rated speed for a prolonged period. The EMD equipment was originally designed for locomotive service where no load speeds for the engine and generator are much lower than full load speeds. The locomotive turbocharged diesel hardly ever runs at full speed except at full load. The EMD has strongly recommended to users of this diesel engine design against operation at no load or light load conditions at full rated speed for extended periods because of the short life expectancy of the turbocharger mechanical gear drive unit normally furnished. No load or light load operation also causes general deterioration in any diesel engine.

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

430.6 (Pg. 2) Cont'd

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

Response

The HPCS diesel generator presently has the standard GM turbocharger drive gear unit. Replacement with a heavy-duty turbocharger mechanical drive gear assembly will be made before completion of the first refueling outage in accordance with the manufacturers recommendations.

430.7 (8.3) Provide a detailed discussion (or plan) of the level of training proposed for your operators, maintenance crew, quality assurance, and supervisory personnel responsible for the operation and maintenance of the emergency diesel generators. Identify the number and type of personnel that will be dedicated to the operations and maintenance of the emergency diesel generators and the number and type that will be assigned from your general plant operations and maintenance groups to assist when needed.

In your discussion, identify the amount and kind of training that will be received by each of the above categories and the type of ongoing training program planned to assure optimum availability of the emergency generators.

Also discuss the level of education and minimum experience requirements for the various categories of operations and maintenance personnel associated with the emergency diesel generators.

Response

Educational and minimum experience requirements for all categories of operations and maintenance personnel are in accordance with the recommendations of ANSI/ANS 3.1-1978. Section 13.1.3 provides further information.

Personnel from the Perry Plant operation and maintenance departments will be performing the operations and maintenance functions associated with the emergency diesel generators. It is not anticipated that any assistance will be required or requested of nonplant operating or maintenance personnel. Vendor assistance will be requested if needed. These functions will be performed on a nondedicated basis. The number and type of personnel utilized for operations and maintenance of the diesel generator will be based on the complexity and requirements of the task being performed. In all cases, plant personnel utilized will possess the qualifications and training discussed in this response. Supervisors of these functions will be from the respective department.

Training will be provided for the operations and maintenance department personnel including respective supervisors of these groups. The projected training time, directly associated with emergency diesel generators, for each department is expected to be approximately 80 hours.

The proposed training to be received by the Perry Plant staff is as follows:

1. Operations Department Personnel

   a. Basic diesel engines: This segment of training includes theory of operation, application, and basic controls.

   b. Emergency diesel generator, related system training: This segment of training consists of instruction on mechanical, electrical, and instrumentation systems such as diesel fuel oil storage and transfer, intermediate ac distribution, emergency safety features actuation, and air start systems.

   c. Emergency diesel generators: This segment of the training provides the specific information concerning the diesel generator sets installed at the Perry Plant. This instruction includes related plant procedures and technical specifications associated with the emergency diesel generators.

2. Maintenance Department Personnel

   a. Basic diesel engines: This segment of training includes theory of operation, application, and basic controls.

   b. Emergency diesel generator, related systems training: This segment of training consists of instruction on mechanical, electrical, and instrumentation systems such as diesel fuel oil storage and transfer, intermediate ac distribution, emergency safety features actuation, and air start systems.

   c. Emergency diesel generators: This segment of the training provides the specific information concerning the diesel generator sets installed at the Perry Plant. The instruction includes related plant procedures and technical specifications associated with the emergency diesel generators.

In addition to the above training, vendor instruction will be obtained for installation, operation, and maintenance of the diesel generator for selected key operations and maintenance supervisors and maintenance personnel. The proposed format of this course is:

1. Operations Department Personnel

   a. Theory of Operation
   b. Installation and Testing
   c. General Maintenance

2. Maintenance Department Personnel

   a. Theory of Operation
   b. Installation and Testing
   c. Basic Controls
   d. Specific Maintenance
   e. Troubleshooting Techniques

The vendor instruction will occur during the installation and testing of the emergency diesel generators. This instruction will be supplemented prior to fuel load by specific plant procedure instruction once those procedures have been developed. As the instruction provided by the foregoing is already developed and available, the courses shall be repeated by training CEI instructors or vendor personnel on a periodic basis as part of the replacement and requalification programs.

The Perry Training Unit provides for requalification and replacement training to ensure maintenance of proficiency for the operating organization consistent with the recommendations of ANSI N18.1-1971.

430.8 Periodic testing and test loading of an emergency diesel generator in
(8.3) a nuclear power plant is a necessary function to demonstrate the
RSP 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 an extended time period.

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

Preventative Maintenance on the diesel will be performed under the guidelines of a Preventative Maintenance Program Procedure. Included in this maintenance program will be cleaning and servicing, inspections, lubrication, overhauls, periodic testing, and vibration analysis. Repetitive failures will be analyzed by use of the Perry Plant Maintenance Information System (PPMIS) which will provide an equipment history of the diesel. Included in its history will be type of failure, effect on the system, status at the time of failure detection method, effect on the plant, priority, and corrective action. In addition, the Perry Stock Information System (PSIS) will help keep track of spare part usage. Other utilities' diesel generator histories will be reviewed for potential problems through use of NPRDS (Nuclear Plant Reliability Data System), and NOMIS (Nuclear Operations and Maintenance Information Service). 430.8

(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. 430.8

(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.

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 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.

430.8

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.

Response

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.

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

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.

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

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.

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.

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.

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

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.

The lighting systems dealing with these areas and their accessibility are the normal lighting, essential lighting and emergency lighting systems.

The normal lighting system is fed from non-Class 1E 120/208 V, 3Ø, 4W lighting panels which are powered by 480V MCC's. Reference Section 9.5.3.2.1.

The essential lighting system is fed from 120 Vac essential lighting panels which are powered from diesel backed non-Class 1E 480 V MCC's. Reference Section 9.5.3.2.2.

The emergency lighting system is fed from the 125 Vdc non-Class 1E batteries. Reference Section 9.5.3.2.3. For emergency lighting requirements in the event of a fire, fixed self-contained lighting with 8-hour battery supplies will be provided in area that must be manned for safe shutdown and for access and egress routes.

AREA	LIGHTING SYSTEMS IN ADDITION 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.

430.15 (9.5.4) (RSP) You state in Section 9.5.4.3 and in Figure 9.5.8 that the diesel fuel oil storage and transfer system vents, overflows, fill, dipstick, and water removal lines are non-safety lines, and are therefore non-seismic. A seismic event or a tornado missile with or without a single active failure would cause degradation of the fuel oil due to water entering the system or potential loss of fuel due to tank overflow. We require that these lines be design seismic Category I, ASME Section III, Class 3, and be protected from tornado missiles. Comply with this position.

Response

All underground fuel oil lines and lines which extend above grade outside the diesel generator building will be changed to ASME Section III, Class 3 and Seismic Category I up to the first 6 inches above grade. These 6 inch sections of pipe above grade will be missile protected. These lines include the day tank overflow lines, the water removal lines, the dipsticks, the normal vent lines and the fill lines.

There are two vent paths for each Diesel Fuel Oil Storage tank. The normal vent which runs up the side and is external to the diesel generator building will be changed to ASME Section III, Class 3, Seismic Category I and missile protected for the first 6 inches above grade as mentioned above.

The alternate vent path, which is off the fill line at the fill box, will be changed along with the fill lines to ASME Section III, Class 3, Seismic Category I and will be entirely missile protected above grade.

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.

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." The standby diesel generator fuel oil storage tanks are coated internally with a one coat, 2 mil-thick coating of Rustoleum orange primer #9373, an epoxy-based coating which is completely resistant to fuel oil. 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 Class A bedding; this will avert the threat of possibly lifting the storage tanks due to hydrodynamic forces from a buildup of water around the tanks. (See Figures 9.5-21 and 9.5-22.)

The storage tanks are designed so that all openings are above the ground water and PMF levels to prevent the entrance of water. The only anticipated source of water into the tanks will result from moisture being carried with air that enters the tank through the vent. The maximum rate of this accumulation would occur during a prolonged run of the standby diesel generator when air is drawn into the tank to displace fuel used. Under the worst possible conditions on a

430.18 (9.5.4) In Section 9.5.4.1 you state that diesel fuel oil is available from local distribution sources in the Cleveland area. Identify the sources where diesel quality fuel oil will be available and the distances required to be traveled from the source(s) to the plant. Also discuss how fuel oil will be delivered onsite under extremely unfavorable environmental conditions. (SRP 9.5.4, Part III, Item 5b).

Response

The response to this question is provided in revised Section 9.5.4.1.

In the event of extreme environmental conditions, special arrangements will be made as necessary to ensure fuel oil delivery. Under such conditions, suppliers would be notified immediately if prolonged diesel operation is anticipated. CEI equipment could be utilized, if necessary to assure delivery and maintain ample diesel fuel oil supplies.

430.20 (9.5.4) Section 1.8 and 9.5.4.1, "Emergency Diesel Engine Fuel Oil Storage and Transfer System (EDEFSS)" references ANSI Standard N195, "Fuel Oil Systems for Standby Diesel Generators" and Regulatory Guide 1.137, "Fuel Oil Systems for Standby Diesel Generators" with certain exceptions. Adequate justification for items 1a, 2a, 2b and 2c in Section 1.8 regarding conformance to Regulatory Guide 1.137 is not provided. Provide your justification for the above or comply with those positions in Regulatory Guide 1.137.

Response

Justification relative to the positions of Regulatory Guide 1.137 is as follows:

Item 1a. See response to question 430.23.

Item 2a. Conformance to Regulatory Guide 1.137 is not required by the "Implementation" section of the guide. For the normal control range for operating the primary supply pump, the level in the day tank at wh the primary supply pump is automatically turned on provides a 34 minute supply of oil. However, should the primary supply pump fail to start, a back-up supply pump is provided which starts automatically at a day tank oil level three inches below the primary supply pump start setpoint. There is a 31 minute supply of oil at the level at which the back-up supply pump starts. Either pump is capable of refilling the tank to its normal full 68 minute supply of oil within 3.7 minutes.

Item 2b. The underground storage tank fill line is capped at all times except when the tank is being refilled. The cap provides a sealed barrier to the environment. A strainer is provided in the transfer pump suction line.

Item 2c. An abnormally high oil level would not adversely affect system operation. This condition could occur only during the tank filling operation which is administratively controlled. A central oil unloading/tank fill station is provided with a roadside pulloff for the tank truck. The area surrounding the pulloff is suitably drained so that spills or overflows are drained to an oil inerceptor tank.

430.22 (9.5.4) Discuss the design considerations that have determined the physical location of the diesel engine fuel oil day tanks at your facility. Assure that the selected physical location of the fuel oil day tanks meet the requirements of the diesel engine manufacturers. (SRP 9.5.4, Part III, Item 5(c).)

Response

The design considerations which determined the physical location of the day tank for the standby diesel generators included the requirements of the diesel engine manufacturer that the tank be located at an elevation to flood the suction of the motor driven fuel oil booster pump and the engine driven fuel pump. The fuel oil level in the day tank at the low-low alarm level is 632'-0½". At the low-low alarm level, both fuel oil transfer pumps which supply oil to the day tank from the underground supply tank are turned off. The elevation of the suction of the motor driven fuel oil booster pump is 621'-7-5/8". The elevation of the suction of the engine driven fuel pump is 628'-9-11/16". Therefore, the location of standby diesel generator fuel oil day tank is acceptable.

The design considerations which determined the physical location of the HPCS diesel engine fuel day tank included the requirements of the diesel engine manufacturer. These requirements were:

a. There should not be a positive fuel head on the engine injectors.
b. Suction of the fuel oil booster pump and the engine driven fuel pump should remain flooded.

The normal high level pump shutoff is at elevation 629'-11". Fuel injector elevation is at 629'-11-5/8" which ensures no static positive head on the injectors. The motor driven oil booster pump and the engine driven fuel pump are both skid mounted with suction elevations at 621'-6" nominal, some 3 feet below the day tank discharge at the tank bottom so their suction remains flooded.

Fuel oil transfer pumps shut off at low level in the day tank at elevation 627'-2", which ensures that a positive static head will exist on the booster pump and the fuel pump. Therefore the location of the HPCS day tank meets design requirements of the system and the manufacturer.

430.23 (9.5.4) Assume an unlikely event has occurred requiring operation of a diesel generator for a prolonged period that would require replenishment of fuel oil without interrupting operation of the diesel generator. What provision will be made in the design of the fuel oil storage fill system to minimize the creation of turbulence of the sediment in the bottom of the storage tank. Stirring of this sediment during addition of new fuel has the potential of causing the overall quality of the fuel to become unacceptable and could potentially lead to the degradation or failure of the diesel generator.

Response

The design of each standby diesel fuel oil storage tank is such that a minimum amount, if any, of entrained sediment would be drawn into the eductor inlet (which conveys fuel oil from the storage tank to the day tank). This can be seen by description of the fill process, the configuration of the tank and internal piping arrangement.

The fill line terminates 3-5/8 inches off the bottom of the tank. During fill, the fuel oil flows vertically downward and strikes the tank perpendicular to its bottom which will cause a local disturbance of the sediment in a small area around the discharge of the fill line. This area will not increase in size beyond the initial disturbed region as the fill rate will remain constant at 90 gpm.

The fuel oil storage tank is 82'-9" long and 13'-10" in diameter. At the time of fill, there will be a minimum of approximately 10,000 gallons of fuel oil in the tank. The flow currents in this large volume, beyond a few feet from the fill discharge point, caused by the new oil entering the tank will be very low and are unlikely to disturb sediment in the remainder of the tank. There will be no stirring action throughout the tank except at the point of discharge from the fill pipe.

The eductor inlet is 18 inches off the bottom of the tank and is 46 feet away from the fill pipe. The disturbed particles around the fill pipe would have to travel this 46 feet before entering the eductor inlet. The horizontal velocity of the fuel oil in the bottom of the tank will be so low that the probability of a significant amount of particles remaining entrained (not settling out) and entering the eductor is very low.

In addition, the diesel generator fuel oil supply system is provided with redundant pump strainers with high ΔP alarms in the transfer loop from the underground storage tank to the day tank as well as duplex filters with alarms from the day tank to the diesel engine.

For these reasons any sediment disturbance caused by filling the tank during diesel operation could not decrease the fuel oil quality to a point that would cause ultimate failure of the diesel generator.

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. 430.28

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. 430.33

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 430.32

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. 430.26 430.17 430.33

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

TABLE 9.5-8

STANDBY DIESEL GENERATOR COOLING WATER SYSTEM

Jacket Water Heat Exchanger

Quantity	1 per diesel engine
Duty, Btuh	24,500,000
Design Conditions:	
Tube Side - Emergency Service Water:	
a. Inlet temp, F	80.0
b. Outlet temp, F	129.0
c. Flow, gpm	1000
Shell Side - Jacket Cooling Water:	
a. Inlet temp, F	175.0
b. Outlet temp, F	147.8
c. Flow, gpm	1800

Lube Oil Cooler

Quantity	1 per diesel engine
Duty, Btuh	3,224,100
Design Conditions:	
Tube Side - Jacket Cooling Water:	
a. Inlet temp, F	147.8
b. Outlet temp, F	154.9
c. Flow, gpm	900
Shell Side - Lube Oil:	
a. Inlet temp, F	185.0
b. Outlet temp, F	156.4
c. Flow, gpm	500

430.26

430.26 (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, and (3) engine air water coolers. Provide information on the individual component heat removal rates (Btu/hr), flow (lbs/hr) and temperature differential ($^{\circ}$ 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 question is provided in revised Table 9.5-3 and revised Section 9.5.5.2, Information on the HPCS diesel generator cooling water system is not available at this time.

430.31 (9.5.5) The diesel generators are required to start automatically on loss of all offsite power and in the event of a LOCA. The diesel generator sets should be capable of operation at less than full load for extended periods without degradation of performance or reliability. Should a LOCA occur with availability of offsite power, discuss the design provisions and other parameters that have been considered in the selection of the diesel generators to enable them to run unloaded (on standby) for extended periods without degradation of engine performance or reliability. Expand your PSAR/FSAR to include and explicitly define the capability of your design with regard to this requirement. (SRP 9.5.5, Part III, Item 7.)

Response

The manufacturer's recommendations for no-load and light load operation will be implemented for both the standby and HPCS diesel generators.

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

During troubleshooting, no load operation will be minimized. If trouble-shooting is extended beyond a 3 to 4 hour period, the engine shall be cleared in accordance with manufacturers recommendations for no-load and light-load operation.

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 diesel is operating, the jacket water cooling pumps will be functioning, supplying water to the diesel at sufficient 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 system leakage during seven days of continuous operation is conservatively estimated at less than one gallon.
The 88 gallon expansion tank is located about 10 feet about the pump elevation. The level in the standpipe after the seven days at full power exceeds the minimum level necessary to provide the required NPSH. Therefore, the pump has the required suction and it provides sufficient head and flow so that the engine will receive the required cooling for seven day operation at full power. See revised Section 9.5.5.2 for additional information.

430.34 Figure 9.5-16 shows an immersion heater in the diesel engine cooling
(9.5.5) 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.

A detailed description of the diesel engine cooling water system is provided in revised Section 9.5.9.2.

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

430.39 (9.5.6) RSP A study by the University of Dayton 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 on demand. Condensation of entrained moisture in compressed air lines leading to control and starting air valves, air start motors, and condensation of moisture on the working surfaces of these components has caused rust, scale and water itself to build up and score and jam the internal working parts of these vital components thereby preventing starting of the diesel generators.

In the event of loss of offsite power the diesel generators must function since they are vital to the safe shutdown of the reactor(s). Failure of the diesel engines to start from the effects of moisture condensation in air starting systems and from other causes has lowered their operational reliability to substantially less than the desired reliability of 0.99 as specified in Branch Technical Position ICSB (PSB) 2, "Diesel Generator Reliability Testing" and Regulatory Guide 1.108, "Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants."

In an effort toward improving diesel engine starting reliability we require that compressed air starting system designs include air dryers for the removal of entrained moisture. The two air dryers most commonly used are the dessicant and refrigerant types. Of these two types, the refrigerant type is the one most suited for this application and therefore is preferred. Starting air should be dried to a dew point of not more than 50° F when installed in a normally controlled 70° F environment; otherwise, the starting air dew point should be controlled to at least 10° F less than the lowest expected ambient temperature.

Revise your design of the HPCS diesel engine air starting system accordingly; describe this feature of your design.

Response

An air dryer will be provided in the HPCS diesel engine air start system prior to fuel load. The FSAR will be revised to describe this design.

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 operator can then take appropriate action to correct the condition. 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.

430.41 What measures have been taken to prevent entry of deleterious materials into the engine lubrication oil system due to operator error during recharging of lubrication oil or normal operation.

Response

The valves and entry points used during recharging of lubrication oil will be color coded and marked to prevent entry of deleterious materials due to operator error.

In addition, new lubricating oil will be stored in a designated lube oil storage facility. The storage of lubricants will be in containers designed to minimize the possibility of contaminati n and to provide safe storage.

Lube oil shall be stored in 55 gallon drums clearly identified as diesel lube oil. The hoses and pumps shall be kept in a designed storage area. These hoses shall be clearly marked. Operators shall be thoroughly trained in the procedures to add diesel lube oil. The drum shall be visually checked to verify its contents.

Training shall be a combination of formal classroom instruction as well as practical application. The training program shall cover these areas:

a. System purpose and basic operation.

b. A system Operating Instruction describing diesel lube oil transfer.

The System Operating Instruction shall include provisions to eliminate entry of foreign material during diesel lube oil transfer. This instruction shall be written in accordance with Perry Plant administrative procedures.

430.46 (9.5.7) RSP An emergency diesel generator unit in a nuclear power plant is normally in the ready standby mode unless there is a loss of offsite power, an accident, or the diesel generator is under test. Long periods on standby have a tendency to drain or nearly empty the engine lube oil piping system. On an emergency start of the eggine as much as 5 to 14 or more seconds may elapse from the start of cranking until full lube oil pressure is attained even though full engine speed is generally reached in about five seconds. With an essentially dry engine, the momentary lack of lubrication at the various moving parts may damage bearing surfaces producing incipient or actual component failure with resultant equipment unavailability.

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

430.46 (Pg. 2) Cont'd

Confirm your compliance with the above requirement for the HPCS diesel generator to provide your justification for not installing an electric prelube oil pump.

Response

The manufacturer's recommendations (GM-EMD-MI-9644) will be implemented to improve the HPCS diesel engine lube oil circulating system. In the event the modification is not implemented prior to fuel load, manual pre-lubrication on a weekly basis and before each manual diesel engine start will be provided in accordance with the manufacturer's recommendations.

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 combustion 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. 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.

430.49 (9.5.8) Show by analysis that a potential fire in the chart storage room or the diesel generator building together with a single failure of the fire protection system (i.e., fire damper fails to close or CO_2 system fails to operate) will not degrade the quality of the diesel combustion air so that the remaining diesel will be able to provide full rated power.

Response

See response to Question 430.48 for analysis of potential fire in the chart storage room or diesel generator building and bounding analysis of more severe conditions, i. e., instantaneous release of stored gases.

430.50 (9.5.8) Experience at some operating plants has shown that diesel engines have failed to start due to accumulation of dust and other deleterious material on electrical equipment associated with starting of the diesel generators (e.g., auxiliary relay contacts, control switches, etc.). Describe the provisions that have been made in your diesel generator building design, electrical starting system, and combustion air and ventilation air intake design(s) to preclude this condition to assure availability of the diesel generator on demand.

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

Response

The response to this question is provided in revised Section 9.5.8.3.

The ingestion of dust and other deleterious materials into the combustion air system is precluded by the use of an air filter on the combustion air intake lines of the standby and HPCS diesel generators. The filters will be changed on a periodic basis per the Preventive Maintenance program.

The cabinets in the areas are dust tight Nema type three by design specification. The floors and walls will be coated with S15 which is an epoxy surfacer.

Any concrete dust generated by maintenance will be controlled by the housekeeping procedure PAP 0402 as will all waste, debris, scrap, oil spills, or other combustables resulting from the work activity. These shall be removed from the area immediately following completion of the maintenance activities or at the end of each work shift, whichever comes first. In addition, the areas shall be routinely inspected for proper housekeeping requirements and any discrepancies shall be noted and corrected. 430.50

There will be little concrete dust generated. During construction, the concrete is delivered premixed to the plant and after pouring and curing, the concrete is painted to protect its finish. Any concrete dust generated by hammering, grinding, etc., on already poured concrete will be treated as described above.

9.5.8.4 Inspection and Testing Requirements

Each system is tested in accordance with the manufacturer's recommendations during initial tests and operation. The standby and HPCS diesel generators will be operated every month for periodic testing. Operation of air intake and exhaust system components is verified during this testing. Additional inspection, checkout and maintenance are performed as required.

9.5.8.5 Instrumentation Applications

The diesel generator combustion air intake and exhaust system is instrumented as shown on Figure 9.5-12. A pressure indicator is provided on the local 430.47

diesel generator control panel which displays intake manifold air pressure. Either the left or right bank pressure may be selected for display through use of a manual slide valve. A temperature selector switch and temperature indicator are also located on the local diesel generator control panel. By using the selector switch, one of the following temperatures may be selected for display: intake manifold air temperature, either the left or right bank; exhaust stack gas temperature, either the left or right bank; each individual cylinder exhaust gas temperature. The selector switch and temperature indicator may also be used for local display of jacket water and lubrication oil temperatures.

430.47

The combustion air intake and exhaust system parameters which are displayed on the local diesel generator control panel will be logged during the periodic engine testing. This information is used for engine performance monitoring, trending and engine malfunction diagnostics.

430.52 (9.5.8) Figure 1.2.5 of the Perry FSAR shows the ESF transformers located near the control/diesel generator building complex. An ESF transformer fire with the right meteorological conditions could degrade engine operation by the products of combustion being drawn into the D/G ventilation system which supplies D/G combustion air. Discuss the provisions of your design (site characteristics, ventilation system and building design, etc.) which preclude this event from occurring.

<u>Response</u>

The interbus transformer nearest to the safety related diesel generators is nominally 150 feet away. Review of the combustion process and building configurations if this transformer caught fire indicates that the concentration of combustion products from such a fire which could be drawn into the diesel air intakes is bounded by the analysis of a worst case, combustion of oil in a tank 650 feet from the diesels containing 500,000 gallons of oil, which is included in revised Section 9.5.8.3.

430.53 (9.5.8) You state in Section 9.5.8.3 of the FSAR that "If the carbon dioxide fire extinguishing system is activated for the chart storage room in the control complex, or in a diesel generator room, the fire dampers for the respective room are automatically closed and the area isolated to prevent air, smoke or carbon dioxide from being exhausted. The isolated area will be cleared of these gases using strict administration controls to ensure that no possibility exists for large concentrations of gases to be ejected into the atmosphere and be drawn into the diesel generator air intakes." Describe the administrative procedures for venting the above areas. Include in the description the venting time duration (the time the dampers are open for venting), frequency, the means used to dilute the vented gases, the design criteria used to determine these values, and any design margins included in the procedures (i.e., vent time duration can be exceeded for X amount of time before combustion air becomes degraded, etc.).

Response

If fire breaks out in the chart room of the control complex, the CO_2 fire extinguishing system is activated and the fire dampers close. When the fire is under control, venting of the air and combustion gases will occur to the Unit 1 hallway and through the battery room exhaust. Accelerated purging can be accomplished as needed by use of portable blowers or by connecting auxiliary ducting for exhaust to the lavatory. Restrictions on frequency or duration of venting or requirements for diluting the exhaust combustion products are not needed since excessive concentrations of inert gases at the diesel air intakes will not occur.

If fire occurs in a diesel generator room, activation of the CO_2 fire extinguishing system automatically closes the exhaust louvers (shutting off the fans if they are on, i.e., if the diesel engine is operating). When the fire is under control, louvers are opened and the isolated gases are vented to ambient. Restrictions on frequency or duration of venting or requirements for diluting the exhaust combustion products are not needed since excessive concentrations of inert gases at the diesel air intakes will not occur. (Additional analyses are provided in revised Section 9.5.8.3).

430.57 (10.2) Discuss what protection will be provided the turbine overspeed control system equipment, electrical wiring and hydraulic lines from the effects of a high or moderate energy pipe failure so that the turbine overspeed protection system will not be damaged to preclude its safety function. (SRP 10.2, Part III, Item 8.)

Response

The response to this question is provided in revised Section 10.2.2.2.

The turbine generator/pressure regulator instrumentation and controls are described in Sections 7.7.1 and 7.7.2. The inservice inspection program for the main steam reheat valves is discussed in Section 10.2.3.6.

A set of seven bypass valves with a total capacity of 35 percent of full load throttle flow is installed immediately upstream of the inlet stop valves. The bypass valves permit rapid load reduction, up to 35 percent capacity, without requiring that the reactor be tripped.

The heat cycle provides for extraction at six pressure stages for feedwater heating as follows:

a. One on the high pressure turbine cylinder (Heater No. 6).

b. One on the moisture separator (Heater No. 5).

c. Four on each of the three low pressure turbine cylinders (Heater Nos. 4, 3, 2 and 1).

10.2.2.2 Electrohydraulic Control System

The turbine-generator uses an electrohyraulic control (EHC) system which, in coordination with the NSSS steam bypass and pressure control system, controls the turbine speed, load, pressure and flow for startup and normal operations. The EHC system operates the turbine stop valves, control valves, and combined stop and intercept valves. Turbine-generator supervisory instrumentation is provided for operational analysis and malfunction diagnosis. 430.55

Automatic control functions are programmed to protect the nuclear steam supply system with appropriate corrective actions. The turbine EHC system combines the principles of solid-state electronics and high-pressure hydraulics to control steam flow through the turbine. The control system has the following major subsystems:

a. Speed-control unit

b. Load-control unit

c. Flow-control unit.

The speed-control unit receives speed signals from the shaft speed pick-ups, which are compared to a speed reference signal, to produce a speed/error signal. The speed-control unit also differentiates the speed signals to produce acceleration signals. These signals are compared to the acceleration reference to produce acceleration error signals that are integrated and combined with the speed/error signal, to produce an output to the load-control unit.

The load-control unit accepts the speed-acceleration error signal from the speed control unit and compares the signal with the preselected load demand signal, which is provided to the NSSS steam bypass and pressure control system. The load-control unit also accepts limit signals (e.g., load limit, pressure limit, power load unbalance limit, etc.) and combines them with the load demand signal to generate flow reference signals, which are provided to the flow control unit. 430.55

The flow control unit positions the turbine steam control valves at the required position to satisfy each valve flow reference signal from the load-control unit. It consists of the individual valve positioning units, which essentially are electrohydraulic, closed-loop, servo-mechanism valve position-control systems.

10.2.2.3 Turbine Overspeed Protection System

The turbine overspeed control system is not safety related. The system has no direct function in the safe shutdown of the reactor in the event of accident. However, a reliable, redundant, fail-safe turbine overspeed system is incorporated for the safety of plant personnel and equipment and to ensure that there is no mitigation of engineered safety systems employed for safe, orderly shutdown of the reactor system. 430.57

To meet the specific requirements of GDC 4 a redundant turbine overspeed control system is provided in addition to the normal speed control function provided by the turbine electrohydraulic control system. Redundancy is achieved by using at least two independent channels from the signal source to the output device which controls the emergency trip system, fluid pressure, which actuates the turbine steam valves. Figure 10.2-3 is a block diagram of the turbine protection system. No specific valve failure can disable the turbine overspeed trip from functioning.

The mechanical overspeed trip is an unbalanced ring which is held concentric with the shaft by a spring. When the speed reaches the trip speed (110 percent to 111 percent of rated), the centrifugal force of the ring overcomes the force of the spring, and the ring snaps to an eccentric position. The ring then strikes the trip finger which operates the mechanical trip valve. This releases the fluid pressure on the disk dump valves for main stop and control valves and intermediate stop and intercept valves, thereby closing the turbine steam valves. The overspeed trip device may be tested by tripping it at normal speed by the application of oil through the oil trip valve.

The electrical backup overspeed trip device consists of a speed trip relay (set at 0.5 percent above the mechanical trip setpoint) that is operated by a signal from a magnetic pickup from the turbine shaft. The signal from the speed trip relay will energize the master trip relay which will deenergize both coils of the electrical trip solenoid valve. When both coils are deenergized, the electrical trip valve operates to release the fluid pressure on the actuator of the steam valves. Each compartment of the mechanical and electrical overspeed protection systems will be tested during normal operation, on a weekly basis, by the following tests: 430.57

a. A mechanical overspeed trip test at the EHC Panel to test for operation of the overspeed trip device and mechanical trip valve.

b. A mechanical trip piston test at the EHC panel to test for electrical activation of the trip mechanism.

c. An electrical trip test at the EHC panel to test for operation of the electrical trip valve.

d. A backup overspeed trip test at the EHC panel to test the 2 out of 3 logic circuits.

An air relay dump valve is provided which actuates on turbine trip. The valve controls air to the extraction steam check valves which limit contributions to turbine overspeed from steam and water in the extraction lines and feedwater heaters. The total energy in these steam lines down to the check valves has been included in the turbine overspeed analysis. The extraction steam lines from the turbine to the No. 1 and 2 feedwater heaters are located within the main condensers and do not have any non-return valves provided in them. The turbine overspeed analysis takes into account the total energy in these extraction lines to the No. 1 and 2 heaters down to and including the water and steam in the heater and subcooler shells. This data has been used by General Electric to calculate the maximum potential overspeed assuming turbine load is suddenly reduced from maximum to zero, with no restraint of reverse flow in the extraction lines being considered, but assuming that all other turbine control and extraction non-return valves operate normally. This General Electric analysis demonstrates that these bottled-up volumes of steam and water within the turbine and extraction steam system will not cause the turbine speed to rise above a certain maximum value (as established by General Electric steam turbine design rules and code requirements) after a full load rejection or trip. 430.57

The closing time for all extraction non-return valves is less than two seconds. The motor-operated stop valves in the extraction steam lines from the turbine are not relied on to provide overspeed protection, but have been included to prevent water damage to the turbine, so their closure times are not relevant to overspeed protection.

Thus, since the turbine overspeed control system equipment, electrical wiring and hydraulic lines are not required for safety related shutdown of the reactor, protection against the effects of high or moderate energy pipe failure is not a design requirement. In the event of a high or moderate energy pipe rupture, failure of the electrohydraulic control system and the hydraulic lines could be postulated. This failure, singly or in combination would not adversely affect the mechanical overspeed trip or the hydraulic speed control systems. Either the mechanical trip or the pressure loss in the ruptured hydraulic lines would result in closure of the turbine stop valves eliminating any probability of turbine overspeed from any credible source. 430.57

10.2.2.4 Turbine Protection System

In addition to overspeed trip signals discussed above, the emergency trip system closes the main stop and control valves and the intermediate stop and intercept valves, shutting down the turbine on the signals listed in Section 10.2.2.4.1 and 10.2.2.4.2.

The sequence of events and response times following a turbine trip are given in Section 15.2.3, Figures 15.2-2 through 15.2-5, and Tables 15.2-2 through 15.2-5.

10.2.2.4.1 Turbine Trip Signals Due to Mechanical Faults

The turbine is shut down due to the following mechanical fault signals:

a. Loss of vacuum trip;

b. Excessive thrust bearing wear;

c. Prolonged loss of generator stator coolant at loads in excess of a preset value;

d. External trip signals, including remote manual trip on the control panel;

e. Loss of hydraulic fluid supply pressure (loss of emergency trip system fluid pressure automatically closes the turbine valves and then energizes the master trip relay to prevent a false restart);

f. Low bearing oil pressure;

g. Loss of both speed signals when turbine is not in standby control;

h. High exhaust hood temperature;

i. High shaft vibration;

j. Loss of 125 volt d-c electrohydraulic control power supply when turbine is operating at greater then 75% rated speed;

k. Loss of 24 volt d-c electrohydraulic control power supply;

l. High level in moisture separators;

m. High reactor water level;

n. Low shaft pump discharge pressure when turbine is operating at greater than 75% of rated speed;

o. Operation of the manual mechanical trip at the front standard; or

p. Low bearing oil pressure to the trip piston.

10.2.2.4.2 Turbine Trip Signals Due to Generator Electrical Faults

Generator electrical fault signals that trip the turbine are as follows:

a. 345 KV breaker failure;

b. Main transformer differential;

c. Main transformer sudden pressure;

d. Main transformer 345 KV neutral overcurrent;

e. Unit 345 KV bus differential;

f. Unit auxiliary transformer neutral overcurrent "X";

g. Unit auxiliary tranformer neutral overcurrent "Y";

h. Unit auxiliary transformer sudden pressure;

i. Unit auxiliary transformer differential;

j. Generator volts/Hz;

k. Manual operation of exciter when generator is not connected to system;

l. Underfrequency;

m. Negative sequence overcurrent;

n. Generator loss of excitation with no voltage balance;

o. Generator out of step with no voltage balance;

p. Low load generator loss of excitation when both generator lockout relays are reset and no voltage balance;

q. Generator neutral overvoltage;

r. Generator differential No. 1;

s. Generator differential No. 2;

t. Unit overall differential; or

u. Zero sequence overvoltage with no voltage balance.

430.70 Provide the results of an analysis indicating that failure of the turbine bypass system high energy line will not have an adverse effect or preclude operation of the turbine speed control system.

Response

The steam bypass system is a primary power generation system in that its operation is essential to the power production cycle. The system is not a safety system and a rupture of the high energy bypass line will not adversely affect essential systems or components, i.e., those necessary for safe shutdown or accident prevention or mitigation.

The turbine bypass system consists of seven bypass lines with automatically operated valves connected to the main steamlines upstream of the main turbine stop valves. Capacity of the bypass lines is 35 percent of rated reactor steam flow. Steam is bypassed to the condenser hot well. Since the seven bypass lines are of equal size, a failure of one of the high energy bypass lines should not be considered as cause for failure of the other bypass lines. During normal plant operations, the bypass system can assist in shutdown by bypassing steam to the main condenser eliminating use of the turbine generator system or safety systems which are available for emergency use. If the turbine bypass system high energy line ruptures, failure of the non-safety electrohydraulic control system and the hydraulic lines of the overspeed control systems could be postulated. These failures, singly or in combination would not adversely affect the mechanical overspeed trip or the hydraulic speed control systems. Normal function of the steam bypass system and the speed control function provided by the turbine electrohydraulic control system could be lost. However, either turbine trip or the pressure loss in the postulated ruptured hydraulic lines would result in closure of the turbine stop valves eliminating any probability of a turbine overspeed condition. (See response to 430.57 for details of effects of a general high or moderate pressure pipe failure.)

430.76 (8.3) Concerning the emergency load sequencers which are associated with the offsite and onsite power sources, we require that you either provide a separate sequencer for offsite and onsite power (per electrical division) or a detailed analysis to demonstrate that there are no credible sneak circuits or common failure modes in the sequencer design that could render both onsite and offsite power sources unavailable. In addition, provide information concerning the reliability of your sequencer and reference design detailed drawings.

Response

Emergency Load Sequencers are not used for loading of the safety busses at Perry. Rather each load has individual timing relays which sequence on to the bus in accordance with Table 8.3-1. Automatic bus loading is discussed in Section 8.3.1.1.2.8. Elementary diagrams for the individual loads give the detailed design of these circuits as shown on the B-208 drawing series. This Individual relay design assures that no credible sneak circuits or common mode failure could render both onsite and offsite power sources unavailable.

430.77 Adequacy of Station Electric Distribution System Voltages

(8.3) 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 setting 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.

Based upon these above events, we have developed the following four-part 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 analysis 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 offiste 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 for 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 analyses 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 analyses cited in item 3 above, and the measured existing grid voltage and bus loading 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 analytical 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 analyses 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 analyses should never be less than the Class 1E equipment rated voltages.

Response

1. The Perry design presently includes the "second level" of under voltage protection with time delay to protect Class 1E equipment from sustained low grid voltage conditions. A primary undervoltage scheme to detect loss of offsite power at each Class 1E bus will also be provided.

430.77 (Pg. 6) Cont'd

2. Load shedding will be prevented during an automatic load sequencing operation, but will be reinstated upon completion of the load sequencing operation.

3. A voltage analysis has been performed to determine the minimum operating voltages at safety related buses. For all of the stated contingencies, the results of the analysis indicate that lowest predicted voltage will still be above the level required for sustained Class 1E equipment operation.

4. Verification testing will be performed prior to full power operation in accordance with the guidelines of the staff position.

430.92 (8.3.2) The specific requirements for DC power system monitoring derive from the general requirements embodied in Section 5.3.2(4), 5.3.3(5) and 5.3.4(5) of IEEE Std. 308-1974, and in Regulatory Guide 1.47. In summary, these general requirements simply state that the DC system (batteries, distribution systems, and chargers) shall be monitored to the extent that it is shown to be ready to perform its intended function. Accordingly, the guidelines used by PSB in the licensing review of the DC power system designs are as follows.

As a minimum, the following indications and alarms of the Class 1E DC power system status shall be provided in the control room:

Battery current (ammeter-charge/discharge)

Battery charger output current (ammeter)

DC bus voltage (voltmeter)

Battery charger output voltage (voltmeter)

Battery high discharge rate alarm

DC bus undervoltage and overvoltage alarm

DC bus ground alarm (for ungrounded system)

Battery breaker(s) or fuse(s) open alarm

Battery charger output breaker(s) or fuse(s) open alarm

Battery charger trouble alarm (one alarm for a number of abnormal conditions which are usually indicated locally)

Response

The following indications and alarms of the Class 1E DC power systems status are provided.

Battery current (ammeter-charge/discharge)	Control room indication will be provided
Battery charger output current (ammeter)	Local indication
DC bus-voltage (voltmeter)	Control room indication
Battery charger output voltage (voltmeter)	Local indication with common Control Room Trouble alarm
Battery high discharge rate alarm	Local indication
DC bus undervoltage and overvoltage alarm	Control room alarm
DC bus ground alarm (for ungrounded system)	Control room alarm
Battery breaker(s) or fuse(s) open alarm	Control room alarms
Battery charger output breaker(s) or fuse(s) open alarm	Local Indication with common Control Room Trouble alarm
Battery charger trouble (one alarm for a number of abnormal conditions which are usually indicated locally)	Common control room alarm

One common Control Room alarm, "Battery . . . DC System Trouble" is provided for charger failure, charger input, or output breakers open and charger DC output undervoltage or overvoltage.

430.94 Concerning Regulatory Guides 1.93 and 1.108, we will require that the final technical specification for this station include the applicable provisions of these regulatory guides. Accordingly, verify that these specifications will include these provisions or, if applicable, explicitly identify any exceptions.

Response

Technical Specifications shall provide for testing in accordance with the applicable sections of Regulatory Guide 1.108 except for position c2a3. The diesel generator units shall demonstrate full-load-carrying capability for an interval of not less than 24 hours at a load equivalent to the continuous rating of the diesel generator. The continuous rating of the diesel generator exceeds the maximum accident load and therefore is an adequate demonstration of diesel generator capability. Maximum loads for each of the diesel generators are identified in Table 8.3-1.

The full-load-carrying capability test shall consist of an interval of not less than 24 hours at a load equivalent to the continuous rating of the diesel generator.

Technical Specifications shall provide for limiting conditions of operation in accordance with the applicable sections of Regulatory Guide 1.93.

430.101 (8.3.1) It is stated on page 8.1-8 that the electrical penetration assemblies are designed and applied in accordance with R.G. 1.63. Your description of the compliance with the above regulatory guide is not adequate. The circuit overload protection system should conform to the criteria of IEEE Std. 279. Provide us with the coordination curves for the electrical penetration and describe in detail, at all voltage levels, how you meet R.G. 1.63.

Response

An analysis of the penetration circuits for compliance with R. G. 1.63 identified that two in series circuit protective devices were provided for each of three kinds of power circuits that penetrate containment.

The first type is the 13,800 volt reactor recirculation pump motor circuit which is actually provided with 3 breakers in series. These include the bus feeder breaker and two ATWS circuit breakers, one of which is sized for interrupting duty.

The second kind of circuit is from the 480 volt unit substation circuit breakers to loads inside the containment. These circuits have an additional fuse between the breaker and the penetration to meet R. G. 1.63.

Finally the circuits from the motor control centers (MCC) to containment loads were provided with two fuses in series, both sized to protect the penetration. Also, the fuses bank for non-safety circuits were located in a safety class structure.

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. revised 3/31/82

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.