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Docket Nos. 50-440
and 50-441

Mr. Dalwyn R. Davidson
Vice President - Engineering
Clevcland Electric Illuminating Company
P. O. Box 5000
Cleveland, Ohio 44101

Dear Mr. Davidson:

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION - POWER SYSTEMS

In the performance of the Perry licensing review, the staff has identified concerns in regard to power systems. The information that we require is identified in the enclosure. These questions concern Chapters 8, 9 and 10 of the FSAR and were generated by the staff's consultant. The staff has indicated that they will have additional questions on Chapter 8 to submit by the end of July.

We request that you provide the information not later than October 1, 1981. If you require any clarification of this request, please contact M. D. Houston, Project Manager, (301) 492-8593.

Sincerely,

Original signed by
Robert L. Tedesco

Robert L. Tedesco, Assistant Director
for Licensing
Division of Licensing

Enclosure:
Request for Additional
Information

cc w/enclosure:
See next page

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REQUEST FOR ADDITIONAL INFORMATION
PERRY UNITS 1 AND 2
DOCKET NUMBERS 50-440 AND 441

NOTE: Unless otherwise specified in the question, questions pertaining to the diesel generators and their auxiliary systems apply to both the emergency standby diesel generators and the HPCS diesel generator.

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

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

To assure optimum availability of emergency diesel generators on demand, Applicant's who have 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.

430.7 (8.3) Provide a detail 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.

430.8
(8.3)
ESP

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

To achieve this optimum equipment readiness status the 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 room operator.

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

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 senstive 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 free standing 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.

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 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.

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.

430.12 (9.5.4) (9.5.5) (9.5.6) (9.5.7) (9.5.8) (9.5.9) You state in Section 9.5.9 "High Pressure Core Spray Diesel Generator" that the descriptions for the auxiliary systems (fuel oil, cooling water, lubrication and air starting) are contained in Reference 1 and/or 3 of Section 9.5.11 - "Fire Protection Evaluation Report" and NEDO-10905 "HPCS System Power Supply" respectively. Reference 1 does not provide any descriptive information and Reference 3 provides only a brief general description with no specific details on how the air starting, lubricating oil and fuel oil systems operate or the system design characteristics. No description is provided for the cooling water and combustion air intake and exhaust systems. An adequate review of the HPCS diesel engine cannot be performed without this information.

430.13 (9.5.4) Describe the instruments, controls, sensors and alarms provided for monitoring the diesel engine fuel oil storage and transfer system and describe their function. Discuss the testing necessary to maintain and assure a highly reliable instrumentation, controls, sensors and alarm system and where the alarms are annunciated. Identify the temperature, pressure and level sensors which alert the operator when these parameters are exceed the ranges recommended by the engine manufacturer and describe what operator actions are required during alarm conditions to prevent harmful effects to the diesel engine. Discuss the system interlocks provided. (SRP 9.5.4, Part III, item 1).

430.14 (9.5.4) The diesel generator structures are designed to seismic and tornado criteria and are isolated from one another by a reinforced concrete wall barrier. Describe the barrier (including openings) in more detail and its capability to withstand the effects of internally generated missiles resulting from a crankcase explosion, failure of one or all of the starting air receivers, or failure of any high or moderate energy line and initial flooding from the cooling system so that the assumed effects will not result in loss of an additional generator. (SRP 9.5.4, Part III, Item 2).

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.

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 water proof protective coatings. (SRP 9.5.4, Part II and Part III, item 4).

430.17 (3.2) (9.5.4) (9.5.5) (9.5.6) (9.5.7) (9.5.8) The FSAR text and Table 3.2-1 states that the components and piping systems for the diesel generator auxiliaries (fuel oil system, cooling water, lubrication, air starting, and intake and combustion system) that are mounted on the auxiliary skids are designed seismic Category I and are ASME Section III Class 3 quality. The engine mounted components and piping are designed and manufactured to DEMA standards, and are seismic Category I. This is not in accordance with Regulatory Guide 1.26 which requires the entire diesel generator auxiliary systems be designed to ASME Section III Class 3 or Quality Group C. Provide the industry standards that were used in the design, manufacture, and inspection of the engine mounted piping and components. Also show on the appropriate P&ID's where the Quality Group Classification changes from Quality Group C.

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 travelled 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).

430.19 (9.5.4) Discuss what precautions have been taken in the design of the fuel oil system in locating the fuel oil day tank and connecting fuel oil piping in the diesel generator room with regard to possible exposure to ignition sources such as open flames and hot surfaces. (SRP 9.5.4, Part III, Item 6).

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.

430.21 (9.5.4) Discuss the precautionary measures that will be taken to assure the quality and reliability of the fuel oil supply for emergency diesel generator operation. Include the type of fuel oil, impurity and quality limitations as well as diesel index number or its equivalent, cloud point, entrained moisture, sulfur, particulates and other deliterious insoluble substances; procedure for testing newly delivered fuel, periodic sampling and testing of on-site fuel oil (including interval between tests), interval of time between periodic removal of condensate from fuel tanks and periodic system inspection. In your discussion include reference to industry (or other) standard which will be followed to assure a reliable fuel oil supply to the emergency generators. (SRP 9.5.4, Part III, items 3 and 4).

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 9.54, Part III, item 5(c).)

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.

430.24 (9.5.4) Provide the source of power for the fuel oil storage tank motor driven fuel oil transfer pumps and diesel engine motor driven fuel oil booster pump and the motor characteristics, i.e., motor hp., operating voltage, phase(s) and frequency. Also include pump capacity and discharge head. Revise the FSAR accordingly.

430.25 (9.5.7) Expand your description of the diesel engine fuel oil system. The FSAR text should include a detail system description of what is shown on figures 9.5-8 and 9.5-15. The FSAR text should also describe; 1) components and their function, and 2) a diesel generator starting sequence for a normal start and a emergency start. Revise your FSAR accordingly.

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 (but/hr), flow (lbs/hr) and temperature differential (^{O}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).

430.27 (9.5.7) Expand your description of the diesel engine cooling water system. The FSAR text should include a detail system description of what is shown on figures 9.5-9 and 9.5-16. The FSAR text should also describe; 1) components and their function, and 2) a diesel generator starting sequence for a normal start and a emergency start. Revise your FSAR accordingly.

430.28 (9.5.5) Indicate the measures to preclude long-term corrosion and organic fouling in the diesel engine cooling water system that would degrade system cooling performance, and the compatability of any corrosion inhibitors or antifreeze compounds used with the materials of the system. Indicate if the water chemistry is in conformance with the engine manufacturers recommendations. (SRP 9.5.5, Part III, Item 1c.)

430.29 (9.5.5) Describe the instrumentation, controls, sensors and alarms provided for monitoring of the diesel engine cooling water system and describe their function. Discuss the testing necessary to maintain and assure a highly reliable instrumentation, controls, sensors, and alarm system, and where the alarms are annunciated. Identify the temperature, pressure, level, and flow (where applicable) sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer and describe what operator actions are required during alarm conditions to prevent harmful effects to the diesel engine. Discuss the systems interlocks provided. (SRP 9.5.6, Part III, item 1c).

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

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).

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 shafts seals, valve stems and other components, and to maintain required NPSH on the system circulating pump. Provide the size of the expansion tank and location. Demonstrate by analysis that the expansion tank size will be adequate to maintain required pump NPSH and make up water for seven days continuous operation of the diesel engine at full rated load without makeup, or provide a seismic Category I, safety class 3 make up water supply to the expansion tank.

430.33 (9.5.5) Provide the source of power for the diesel engine motor driven jacket water keep warm pump and electric jacket water heater. Provide the motor and electric heater characteristics, i.e., motor hp., operating voltage, phase(s), frequency and kw output as applicable. Also include the pump capacity and discharge head. Revise the FSAR accordingly.

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

430.35 (9.5.6) Provide a discussion of the measures that have been taken in the design of the standby diesel generator air starting system to preclude the fouling of the air start valve or filter with moisture and contaminants such as oil carryover and rust. (SRP 9.5.6, Part III, item 1).

430.36 (9.5.6) Describe the instrumentation, controls, sensors and alarms provided for monitoring the diesel engine air starting system, and describe their function. Describe the testing necessary to maintain a highly reliable instrumentation, control, sensors and alarm system and where the alarms are annunciated. Identify the temperature, pressure and level sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer and describe any operator actions required during alarm conditions to prevent harmful effects to the diesel engine. Discuss system interlocks provided. Revise your FSAR accordingly. (SRP 9.5.6, Part III, item 1).

430.37 (9.5.6) RSP You state in Section 9.5.11 (Reference 3) that each HPCS diesel engine is provided with two independent air starting systems each with its own air receiver tank. You also state that this air start system has sufficient capacity for three successful starts. This is not acceptable. We require, as a minimum, the air starting system for each HPCS diesel generator should be capable of cranking a cold diesel engine five times without the use of the air compressor. Revise your design accordingly. (SRP 9.5.6, Part III, item 9b).

430.38 (9.5.6) Expand your description of the diesel engine starting system. The FSAR text should provide a detail system description of what is shown on figures 9.5-10 and 4.1 of Reference 3 of FSAR Section 9.5.11. The FSAR text should also describe: 1) components and their function, and 2) a diesel engine starting sequence. In describing the diesel engine starting sequence include the number of air start valves used and whether one or both air start systems are used.

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 have 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.

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.)

430.41 (9.5.7) What measures have been taken to prevent entry of delitarious materials into the engine lubrication oil system due to operator error during recharging of lubricating oil or normal operation. (SRP 9.5.7, Part III, Item 1c).

430.42 (9.5.7) Describe the instrumentation, controls, sensors and alarms provided for monitoring the diesel engine lubrication oil system and describe their function. Describe the testing necessary to maintain a highly reliable instrumentation, control, sensors and alarm system and where the alarms are annuniciated. Identify the temperature, pressure and level sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer and describe any operator action required during alarm conditions to prevent harmful effects to the diesel engine. Discuss systems interlocks provided. Revise your FSAR accordingly. (SRP 9.5.7, Part III, item 1e).

430.43 (9.5.7) Expand your description of the diesel engine lube oil system. The FSAR text should include a detail system description of what is shown in figures 9.5.11, and 4.4 of Reference 3 of section 9.5.11. The FSAR text should also describe; 1) components and their function, and 2) a diesel generator starting sequence for a normal start and a emergency start and standby operations. Revise your FSAR accordingly.

430.44 (9.5.7) Provide the source of power for the diesel engine prelube and keep warm oil pump, and motor characteristics, i.e., motor hp, operating voltage, phase(s) and frequency. Also provide the pump capacity and discharge head. Revise your FSAR accordingly.

430.45 (9.5.7) RSP Several fires have occurred at some operating plants in the area of the diesel engine exhaust manifold and inside the turbocharger housing which have resulted in equipment unavailability. The fires were started from lube oil leaking and accumulating on the engine exhaust manifold and accumulating and igniting inside the turbocharger housing. Accumulation of lube oil in these areas, on some engines, is apparently caused from an excessively long prelube period, generally longer than five minutes, prior to manual starting of a diesel generator. This condition does not occur on an emergency start since the prelube period is minimal.

When manually starting the diesel generators for any reason, to minimize the potential fire hazard and to improve equipment availability, the prelube period should be limited to a maximum of three to five minutes unless otherwise recommended by the diesel engine manufacturer. Confirm your compliance with this requirement for the HPCS diesel generator or provide your justification for requiring a longer prelube time interval prior to manual starting of the diesel generators. Provide the prelube time interval your diesel engine will be exposed to prior to manual start.

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 engine as much as 5 to 14 or more seconds may elapse from the start of cranking until full lube oil pressure is attained even though full engine speed is generally reached in about five seconds. With an essentially dry engine, the momentary lack of lubrication at the various moving parts may damage bearing surfaces producing incipient or actual component failure with resultant equipment unavailability.

The emergency condition of readiness requires this equipment to attain full rated speed and enable automatic sequencing of electric load within ten seconds. For this reason, and to improve upon the availability of this equipment on demand, it is necessary to establish as quickly as possible an oil film in the wearing parts of the diesel engine. Lubricating oil is normally delivered to the engine wearing parts by one or more engine 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 intregal 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.

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

430.47 (9.5.8) Describe the instrumentation, controls, sensors and alarms provided in the design of the diesel engine combustion air intake and exhaust system which alert the operator when parameters exceed ranges recommended by the engine manufacturer and describe any operator action required during alarm conditions to prevent harmful effects to the diesel engine. Discuss systems interlocks provided. Revise your FSAR accordingly. (SRP 9.5.8, Part III, item 1 & 4)

430.48 (9.5.8) You state in section 9.5.8.3 that "there is no storage of gases in the immediate vicinity of the air intakes, accidental release of these gases could affect the minimum quantity and oxygen content requirements for intake combustion air." This statement is contradictory. If there are gases stored on site whose accidental release could cause degradation of diesel generator operation. Respond to the following. 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 prevents developing full engine rated power or cause engine shutdown as a consequence of any meteorological or accident condition. Include in your discussion the potential and effect of fire extinguishing (gaseous) medium, recirculation of diesel combustion products, or other gases that may intentionally or accidentally be released on site, on the performance of the diesel generator. (SRP 9.5.8, Part III, item 3).

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 systems 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.

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 deliterious 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).

430.51 (9.6.7) Expand your description of the diesel engine combustion intake and exhaust system. The FSAR test should include a detail system description of what is shown on figures 1.2-5, 1.2-6, 1.2-13, 9.5.12, 9.5.13 and 9.5.14. The FSAR test should also describe; 1) components and their function, 2) location of equipment (provide clear drawings), and 3) a diesel generator starting sequence for a normal start and a emergency start. Revise your FSAR accordingly.

430.52 (9.5.8) Figure 1.2.5 of the Perry FSAR shows the ESF transformers located near the control/diesel geneator 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 des-gn, etc) which preclude this event from occurring.

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.).

430.54 (10.1) Provide a general discussion of the criteria and bases of the various steam and condensate instrumentation systems in section 10.1 of the FSAR. The FSAR should differentiate between normal operation instrumentation and required safety instrumentation.

430.55 (10.2) Expand your discussion of the turbine speed control and overspeed protection system. Provide additional explanation of the turbine and generator electrical load following capability for the turbine speed control system with the aid of the system schematics (including turbine control and extraction steam valves to the heaters). Tabulate the individual speed control protection devices (normal emergency and backup), the design speed (or range of speed) at which each device begins operation to performs its protective function (in terms of percent of normal turbine operating speed). In order to evaluate the adequacy of the control and overspeed protection system provide schematics and include identifying numbers to valves and mechanisms (mechanical and electrical) on the schematics. Describe in detail, with references to the identifying numbers, the sequence of events in a turbine trip including response times, and show that the turbine stabilizes. Provide the results of a failure mode and effects analysis for the overspeed protection systems. Show that a single steam valve failure cannot disable the turbine overspeed trip from functioning. (SRP 10.2, Part III, items 1, 2, 3 and 4).

430.56 (10.2) Provide the closure times for the quick acting extraction steam and motor operated stop valves installed in the extraction steam lines to the third, fourth, fifth and sixth point heaters. The first and second point heaters steam supply lines are not provided with shutoff and extraction steam valves. Show that stable turbine operation will result after a turbine trip. (SRP 10.2, Part III, Item 4).

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).

430.58 (10.2) In section 10.2.3.6 you discuss in-service inspection and exercising of the main steam turbine stop and control and reheater stop and intercept valves. You do not discuss the in-service inspection, testing and exercising of the extraction steam valves. Provide a detail description of: 1) the extraction steam valves, and 2) your inservice inspection and testing program for these valves. Also provide the time interval between periodic valve exercising to assure the extraction steam valves will close on turbine trip.

430.59 (10.2) Provide a complete list of turbine generator protective trips. Separate these trips into two categories, 1) those that will trip the turbine due to mechanical faults, and 2) those that will trip the turbine due to generator electric faults.

430.60 (10.2) Describe with the aid of drawings, the bulk hydrogen storage facility including its location and distribution system. Include the protective measures considered in the design to prevent fires and explosions during operations such as filling and purging the generator, as well as during normal operations.

430.61 (10.4.1) Provide a tabulation in your FSAR showing the physical characteristics and performance requirements of the main condensers. In your tabulation include such items as; 1) the number of condenser tubes, material and total heat transfer surface, 2) overall dimensions of the condenser, 3) number of pauses, 4) hot well capacity, 5) special design features, 6) minimum heat transfer, 7) normal and maximum steam flows, 8) normal and maximum cooling water temperature, 9) normal and maximum exhaust steam temperature with no turbine by-pass flow and with maximum turbine by-pass flow, 10) limiting oxygen content in the condensate in cc per liter, and 11) other pertinent data. (SRP 10.4.1, Part III, item 1).

430.62 (10.4.1) Discuss the effect of main condenser degradation (leakage, vacuum, loss) on reactor operation. (SRP 10.4.1, Part III, Item 1).

430.63 (10.4.1) Indicate and describe the means of detecting and controlling radioactive leakage into and out of the condenser and the means for processing excessive amounts. (SRP 10.4.1, Part III, item 2).

430.64 (10.4.1) Discuss the measures taken for detecting, controlling and correcting condenser cooling water leakage into the condensate stream. (SRP 10.4.1, Part III, item 2).

430.65 (10.4.1) Provide the permissible cooling water inleakage and time of operation with inleakage to assure that condensate/feedwater quality can be maintained within safe limits. (SRP 10.4.1, Part III, item 2).

430.66 (10.4.1) In section 10.4.1.5 you have discussed tests and initial field inspection but not the frequency and extent of inservice inspecation of the main condenser. Provide this information in the FSAR. (SRP 10.4.1, Part II).

430.67 (10.4.1) Indicate what design provisions have been made to preclude failures of condenser tubes or components from turbine by-pass blowdown or other high temperature drains into the condenser shell. (SRP 10.4.1, Part III, item 3).

430.68 (10.4.1) Discuss the effect of loss of main condenser vacuum on reactor operation and operation of the main steam isolation valves (SRP 10.4.1, Part III, item 3).

430.69 (10.4.4) Provide additional description (with the aid of drawings) of the turbine by-pass valves and associated controls. In your discussion include the number, size, principle of operation, construction, setpoints, and capacity of each valve and the malfunctions and/or modes of failure considered in the design of the turbine by-pass system. (SRP 10.4.4, Part III, Item 1).

430.70 (10.4.4) Provide the results of an analysis indicating that failure of the turbine by-pass system high energy line will not have an adverse effect or preclude operation of the turbine speed control system. (SRP 10.4.4, Part III, item 4).

430.71 (10.4.4) Provide the results of a failure mode and effects analysis to determine the effect of malfunction of the turbine by-pass system on the operation of the reactor and main turbine generator unit. (SRP 10.4.4, Part III, item 4).

430.72 (10.4.4) In section 10.4.4.4 you have discussed tests and initial field inspection but not the frequency and extent of inservice testing and inspection of the turbine by-pass system. Provide this information in the FSAR. (SRP 10.4.4, Part II).

040.73 (7.0, 8.0) Incidents have occurred at nuclear power stations that indicate a deficiency in the electrical control circuitry design. These incidents included the inadvertent disabling of a component by racking out the circuit breakers for a different component.

As a result of these occurrences, we request that you perform a review of the electrical control circuits of all safety related equipment at the plant, so as to assure that disabling of one component does not, through incorporation in other interlocking or sequencing controls, render other components inoperable. All modes of test, operation and failure should be considered. Verify and state the results of your review.

Also your procedures should be reviewed to ensure they provide that, whenever a part of a redundant system is removed from service, the portion remaining in service is functionally tested immediately after the disabling of the affected portion. Verify that your procedures include the above cited provisions.

040.74 (8.2) Define the facility's operating limits (real and reactive power, voltage frequency and other) which have been established and provide a brief description as to how these limits were established. Also, describe the operating procedures or other provisions (presently planned) for assuring that the facility will be operated within these limits

040.75 (8.3) Detailed reviews of electrical control circuitry associated with the safety systems of nuclear stations shows that these circuits may differ from station to station, in that, for some stations these control circuits are arranged so that an accident signal will override a test mode condition whereas in other stations (due to those circuits) the test mode condition will take precedence. In this regard, identify any redundant electrically controlled components in the Perry design whereby an accident signal will not override a test mode condition. Also, for each component identified, provide technical information which supports the adequacy of this design feature.

040.76 (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 failures 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.

040.77
(8.3)

Adequacy of Station Electric Distribution System Voltages

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 existance 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, "Criter... for Protection Systems for Nuclear Power Generating Stations:"

1) Class 1E equipment shall be utilized and shall be physically located at and electrically connected to the Class 1E switchgear;
2) An independent scheme shall be provided for each division of the Class 1E power system;
3) The undervoltage protection shall include coincidence logic on a per bus basis to preclude spurious trips of the offsite power source;
4) The voltage sensors shall automatically initiate the disconnection of offsite power sources whenever the voltage setpoint and time delay limits (cited in item 1.b.2 above) have been exceeded;
5) Capability for test and calibration during power operation shall be provided;
6) Annunciation must be provided in the control room 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.

040.78 (8.3) Provide a listing of all switchgear (by bus nomenclature) within the design and specifically address the source of control power to each. This is needed to facilitate an independent review of how your emergency power system design meets the single failure criterion and to determine the extent of loss due to postulated failures.

040.79 (8.3) Provide a listing of all motor operated valves within your design that require power lock out in order to meet the single failure criterion and provide the details of your design that accomplish this requirement.

040.80 (8.3.1) Recent experience with Nuclear Power Plant Class 1E electrical system equipment protective relay applications has established that relay trip setpoint drifts with conventional type relays have resulted in premature trips of redundant safety related system pump motors when the safety system was required to be operative. While the basic need for proper protection for feeders/equipment against permanent faults is recognized, it is the staff's position that total non-availability of redundant safety systems due to spurious trips in protective relays is not acceptable.

Provide a description of your circuit protection criteria for safety systems/equipment to avoid incorrect initial setpoint selection and the above cited protective relay trip setpoint drift problems.

040.81 (8.3.1) Provide a listing of the following for the containment electrical penetrations by voltage Class: I^2t ratings, maximum predicted faults currents, identification of maximizing faults, protective equipment setpoints, and expected clearing times.

Provide a description of the physical arrangement utilized in your design to connect the field cables inside containment to the containment penetrations, e.g. connectors, splices, or terminal blocks. Provide supportive documentation that these physical interfaces are qualified to withstand a LOCA or steam line break environment.

040.82 (8.3) We request that you perform a review of the electrical control circuits for all safety related equipment, so as to assure that disabling of one component does not, through incorporation in other interlocking or sequencing controls, render other components inoperable. All modes of test, operation, and failure should be considered. Describe and state the results of your review.

040.83 (8.3) You state that HPCS system emergency diesel generator unit consists of two diesel engines driving one generator. Expand the FSAR to include a detail description of the duel diesel drive for each generator. Provide justification for the selection of dual diesel drives per generator as opposed to the more conventional single diesel engine driven generator. Demonstrate that the proposed dual diesel engine drive units has an equivalent reliability as a single diesel engine drive unit. In your analysis common mode failures as well as random single failures should be considered.

040.84 (8.3) Section 5.6.2.2(1) of IEEE-387-77 (endorsed by Regulatory Guide 1.9 Revision 2) requires that a start-diesel signal shall override all other operating modes and return control of the diesel-generator unit to the automatic control system. The description of your design is insufficient to assess whether your design meets this requirement. Verify that your design meets this requirement and provide a revised description in sufficient detail to permit independent evaluation of this design capability.

The following discussion and recommendations are presented for your consideration:

A design which does not meet the above cited requirement would necessitate operator action, of varying levels of complexity depending on the circumstances, in order to enable a diesel generator (D/G) in the test mode to respond to a bona fide emergency demand signal such as Loss of Offsite Power (LOOP), Safety Injection (SI), or simultaneous SI and LOOP. The concern here is the high probability of human failure under these stress conditions, and the possible consequent disabling of a D/G or other action which degrades safety margin at a time when it is most needed.

Each D/G must be periodically tested at a frequency as specified in R. G. 1.108. This test frequency is normally once per month but could be as high as once every three days. The duration of each test is one hour. During a normal successful test the D/G would be sequentially in the following states: starting, running disconnected from its bus, running loaded on its bus, tripping and coasting to a stop. However, during almost all of the one hour test period the D/G is loaded on its bus with the governor operating in a droop mode, and the load carried by the diesel engine is a function of governor speed setting and speed droop setting.

During any of the above cited test states, a D/G start signal should return control of the D/G to the automatic control system, thereby enabling it to respond automatically to an emergency demand signal (SI or LOOP) without need for any operator action. Designs providing this capability have already been implemented in some nuclear plants. Such designs include the following features:

On receipt of a SI signal:

a) The D/G breaker (if closed) is tripped.

b) The D/G, if running remains running, or is started, and remains operating in the isochronous mode in ready-standby.

c) The D/G protective trips are bypassed per design.

d) The offsite power feed breaker remains closed and ESF loads are connected to the bus per design.

On receipt of a LOOP signal following a SI signal:

a) The offsite power feed breaker is tripped.

b) Loads are shed from the bus per design.

c) The D/G breaker is closed connecting the D/G to the bus per design.

d) ESF loads are sequenced to the bus per design.

On receipt of simultaneous SI and LOOP signals:

a) The D/G breaker (if closed) is tripped (on SI signal).

b) The D/G, if running remains running, or is started, operating in the isochronous mode.

c) The offiste power feed breaker is tripped.

d) Loads are shed from the bus per design.

e) The D/G protective trips are bypassed per design.

f) The D/G breaker is closed connecting the D/G to the bus per design.

g) ESF loads are sequenced to the bus per design.

On occurrence of a LOOP condition while a D/G is on test and connected to its bus, an LOOP signal would probably not be generated because the D/G would attempt to provide power to the bus and to the offsite system through the closed offsite power feed breaker. In this case, the D/G breaker must be relied upon to trip on overcurrent, underfrequency or undervoltage. This would deenergize the bus thereby producing an LOOP signal. In this case:

a) The offsite power feed breaker is tripped.

b) The D/G remains running in the isochronous mode (or if stalled it is automatically started).

c) The D/G breaker is closed connecting the D/G to the bus per design.

d) The shutdown loads are connected to the bus per design.

e) On occurrence of a LOOP condition while a D/G is on test but is not connected to its bus, a LOOP signal will be generated immediately, and this should initiate above actions (a) through (d).

040.85 (8.3) Diesel ge- .ator alarms in the control room: A review of malfunction reports of diesel generators at operating nuclear plants has uncovered that in some cases the information available to the control room operator to indicate the operational status of the diesel generator may be imprecise and could lead to misinterpretation. This can be caused by the sharing of a single annunciator station to alarm conditions that render a diesel generator unable to respond to an automatic emergency start signal and to also alarm abnormal, but not disabling, conditions. Another cause can be the use of wording of an annunciator window that does not specifically say that a diesel generator is inoperable (i.e., unable at the time to respond to an automatic emergency start signal) when in fact it is inoperable fr. that purpose.

Review and evaluate the alarm and control circuitry for the diesel generators at your facility to determine how each condition that renders a diesel generator unable to respond to an automatic emergency start signal is alarmed in the control room. These conditions include not only the trips that lock out the diesel generator start and require manual reset, but also control switch or mode switch positions that block automatic start, loss of control voltage, insufficient starting air pressure or battery voltage, etc. This review should consider all aspects of possible diesel generator operational conditions, for example test conditions and operation from local control stations. One area of particular concern is the unreset condition following a manual stop at the local station which terminates a diesel generator test and prior to reseting the diesel generator controls for enabling subsequent automatic operation.

Provide the details of your evaluation, the results and conclusions, and a tabulation of the following information:

(a) all conditions that render the diesel generator incapable of responding to an automatic emergency start signal for each operating mode as discussed above;

(b) the wording on the annunciator window in the control room that is alarmed for each of the conditions identified in (a);

(c) any other alarm signals not included in (a) above that also cause the same annunciator to alarm;

(d) any condition that renders the diesel generator incapable of responding to an automatic emergency start signal which is not alarmed in the control room; and

(e) any proposed modifications resulting from this evaluation.

040.86 (8.3) It has been noted during past reviews that pressure switches or other devices were incorporated into the final actuation control circuitry for large horsepower safety-related motors which are used to drive pumps. These switches or devices preclude automatic (safety signal) and manual operation of the motor/pump combination unless permissive conditions such as lube oil pressure are satisfied. Accordingly, identify any safety-related motor/pump combinations which are used in the Perry design that operates as noted above. Also, describe the redundancy and diversity which is provided for the pressure switches or permissive devices that are used in this manner.

040.87 (6.3, 8.3) Identify all electrical equipment, both safety and non-safety, that may become submerged as a result of a LOCA. For all such equipment that is not qualified for service in such an environment provide an analysis to determine the following:

1. The safety significance of the failure of this electrical equipment (e.g. spurious actuation or loss of actuation function) as a result of flooding.

2. The effects on Class 1E electrical power sources serving this equipment as a result of such submergence, and

3. Any proposed design changes resulting from this analysis.

040.88 (8.3) Provide the results of a review of your operating, maintenance, and testing procedures to determine the extent of usage of jumpers or other temporary forms of bypassing functions for operating, testing, or maintaining of safety related systems. Identify and justify any cases where the use of the above methods cannot be avoided. Provide the criteria for any use of jumpers for testing.

040.89 (8.3.2) Concerning the Class 1E Direct Current Power System address the following:

1. As a result of recent reviews on the adequacy of safety-related dire. current power systems of operating plants the following recommendations applicable to those plants undergoing operating license and construction permit reviews have been proposed. In this regard, state if your design conforms to these recommendations and explicitly identify any exception.

   a. The position of circuit breakers or fused disconnect switches associated with the battery charger, battery and direct current bus supply should be monitored to conform to the recommendations of Regulatory Guide 1.47, "Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems," (May 1973).

   b. The technical specifications should include periodic testing of battery chargers to verify that the current limiting characteristics has not been compromised or lost.

   c. The technical specifications should require that cell-to-cell and terminal connection resistance measurements be made as recommended in IEEE Standard 450-1972, "Recommended Practice for Maintenance, Testing, and Replacement, and Large Stationary Type Power Plant and Substation Lead Storage Batteries."

d. The direct current power system design should include the following monitors and alarms"

(1) An ammeter (directional and dual range) in the battery output to monitor the battery input current while the battery is on floating and equalizing charge and to monitor the battery output current when it is supplying power.

(2) An annunciator to alarm whenever the charger goes into a current limiting condition.

(3) A temperature indicator to measure the battery room ambient temperature.

e. The voltage variation for an associated battery bus during any expected accident mode of operation should be within design specifications.

f. The direct current equipment should be rated and qualified for operation at the equalizing charge voltage and rated discharge voltage (typically 110 to 145 volts for a nominal 125 volt direct current system).

2. State if the battery charger has sufficient capacity to operate all non-accident shutdown loads assuming the battery is not available. Also, state if the stability of the battery charger output is load dependent and if so describe.

040.90 (8.3) Provide a description of the capability of the emergency power system battery chargers to properly function and remain stable upon the disconnection of the battery. Include in the description any forseen modes of operation that would require battery disconnection such as when applying an equalizing charge.

040.91 (8.3) Provide the details of your design of the DC power system that assures equipment will be protected from damaging overvoltages from the battery chargers that may occur due to faulty regulation or operator error.

040.92 (8.3.2) The specific requirements for D. C. 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 D. C. 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 D.C. power system designs are as follows:

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

Battery current (ammeter-charge/discharge)
Battery charger output current (ammeter)
D.C. bus voltage (voltmeter)
Battery charger output voltage (voltmeter)
Battery high discharge rate alarm
D.C. bus undervoltage and overvoltage alarm
D.C. 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)

040.93 (8.3) Explicitly identify all non-Class 1E electrical loads which are or may be powered from the Class 1E a-c and d-c systems (refer to Figures 8.1-1 and 8.3-10). Also, for each load identified provide the horsepower or kilowatt rating for that load and also identify the corresponding bus number from which the load is powered.

040.94 (8.3.1) (16.0) Concerning Regulatory Guides 1.93 and 1.108 we will require that the final technical specifications 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.

040.95 (8.3.1) Regulatory Guide 1.75, C.10 recommends that Class 1E cables, installed in exposed raceways, be marked at intervals not be exceed 5 feet. Indicate whether this requirement will be incorporated in the design; if not, provide justification for your position.