VIRGINIA ELECTRIC AND POWER COMPANY

RICHMOND, VIRGINIA 23261

January 31, 1980

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
Attn: Mr. O. D. Parr, Chief
Light Water Reactors Branch No. 3
Division of Project Management
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Serial No. 1161/121879
LQA/ESG: dbs

Docket No. 50-339

Dear Mr. Denton:

IMPLEMENTATION OF THE RECOMMENDATIONS OF NUREG-0660
ENHANCEMENT OF ONSITE EMERGENCY DIESEL GENERATOR RELIABILITY
NORTH ANNA UNIT 2

We have received and reviewed Mr. Parr's letter of December 18, 1979, which requested our responses to specific recommendations of NUREG-0660. The requested information is attached.

Please contact us should you require additional information concerning these responses.

Very truly yours,

C. M. Stallings

C. M. Stallings
Vice President - Power Supply
and Production Operations

Attachment

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COMMENT 8.14 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. (9.5.6, Part III, item 1).

RESPONSE

Each Emergency Diesel Generator is supplied with a complete starting air system with compressor, air reservoirs, air dryers, relief valves, dual starting air solenoid valves, pressure switches and gauges, etc. The individual systems are interconnected to provide an overlap of air pressure in case of any piece of equipment being inoperable. The air compressors are Quincy two stage units, each having the loadless start features, and are driven by electric motors. The air reservoirs are connected through valves to a common manifold which allows either or both reservoirs to supply the air start solenoid valves for starting the engine. This arrangement provides redundancy in the air start system. A water separator downstream of the compressor after-cooler is installed to remove moisture accumulation along with refrigerant air dryers. Additionally, a pre-filter is installed to remove particulate and oil mist carried in the compressed air stream.

COMMENT 8.15 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).

RESPONSE

Inlet louver dampers along with an aluminum bird screen are used at the combined ventilation and combustion air inlet wall. This prevents the introduction of deliterious material to the emergency diesel generator space. Air filters are provided in the combustion inlet air ducting to prevent dust infiltration into the engine.

All of the diesel generator control cubicles in the diesel generator room are equipped with fully gasketed doors. The cubicle which houses the excitation transformer has unfiltered louvers in the rear for heat removal. However, all interconnecting cables which penetrate the excitation transformer cubicle from the other control cubicles are fully gasketed. There are other controls for the diesel generator which are located in the emergency switchgear room, the main control room, and the normal switchgear room. Since these areas are ventilated with air conditioned air, and there is little or no dust generated, these areas pose no concern for the dust problem.

A description of the diesel ventilation system is presented in Comment S9.93 of the FSAR. A diagram of Diesel Cubicle Ventilation, N1F Fig. S9.93-1, is provided. This diagram depicts the path of outside air as it enters and exits the diesel generator room while the diesel is in operation.

The surface of the ground outside the air intake has been graded with crushed stone. The crushed stone has limited the generation of dust in the diesel generator room.

Unit 2 has been completed so that it does not generate any dust from construction.

Logs are taken every four hours by operations personnel in the diesel generator rooms. While it has always been general policy for operations personnel to note any area of the plant which needs cleaning and initiate corrective action, a note has been added to the diesel generator room logs which will instruct the operator to issue a work order to clean the diesel generator room if it is so required.

COMMENT 8.16 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 (Fairbanks Morse, Inc.) of the North Anna #2 Emergency Diesel Generators states the following with respect to No-Load operation:

"There are no mechanical limitations on running the Model 38TD8-1/8 engine at full speed no load conditions; however, running in an unloaded condition will result in an accumulation of unburned oil residue in the engine exhaust system. If, under this condition, a sudden load were applied, it could result in a "stack" fire. Therefore, it is recommended that the engine be loaded up to 50-75 percent rated continuous load for one hour after any 8 hour period of unloaded operation."

Operating procedures will be modified to insure that the engine is loaded up prior to securing the unit, after extended no-load operation.

COMMENT 8.17 Section 9.5.4.1 emergency diesel engine fuel oil storage and transfer system (EDEFSS) does not specifically reference ANSI Standard N195 "Fuel Oil Systems for Standby Diesel Generators". Indicate if you intend to comply with this standary in your design of the EDEFSS; otherwise provide justification for non-compliance. (SRP 9.5.4, Rev. 1, Part II, item 12).

RESPONSE

The construction permit for North Anna Unit #2 was granted in February 1971, therefore, compliance with an ANSI standard issued in April 1976 is not considered appropriate. However, N.A. Unit 2 Emergency Diesel Generators do comply with ANSI N195-1976 with the following exceptions:

1. Paragraph 6.1 Tanks

   The overflow line from the day tank is to the ground and not to the supply tank.

2. Paragraph 6.3 Strainer

   In place of a strainer and engine fuel filter a duplex fuel oil filter is provided for each engine.

3. Paragraph 7.5 Other Requirements

   A fill line duplex strainer is provided for N.A. Unit Nos. 1 & 2 Fuel Oil Tank (5000 BBL capacity). This tank then supplies the Emergency Diesel Generator underground Fuel Oil Storage Tanks. No strainer is provided between these fuel oil tanks.

COMMENT 8.18 Assume an unlikely event has occured 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

No special provision is 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. However, the fuel oil suction line from the underground storage tanks is six inches above the bottom of the tank, also, a strainer and foot valve are provided in each Emergency Generator Day Tank (1000 gallon capacity).

COMMENT 8.19 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).

RESPONSE

A description of the fuel oil specifications is presented in Comment S9.101 of the FSAR. The vendor which is presently used to supply fuel oil is contracted to supply oil with the following specifications:

TYPICAL SPECIFICATIONS
NO. 2 FUEL OIL

Gravity API	35 (Maximum of 40)
Viscosity, SUS @ 100 F	33
Flash	150°F (140°F Minimum)
Pour	-20°F (0°F Maximum)
Sulfur	0.18% (0.50% Maximum)
Vanadium	Less than 0.5 PPM
Magnesium	Less than 0.5 PPM
Nickel	Nil
Lead	Nil
Btu's per gallon	139,400

No testing of fuel oil is performed on newly delivered fuel prior to entering the above ground storage tank.

Periodic sampling of the above ground tank, each underground tank, and each day tank is accomplished in accordance with Unit 2 Proof and Review Technical Specification 4.8.1.1.2.b. This sampling is required at least once per 92 days by verifying that a sample of diesel fuel from the fuel storage tank obtained as a DRAIN Sample in accordance with ASTM-D270-65, is within the acceptable limits specified in Table 1 of ASTM D975-74 when checked for viscosity, water and sediment.

The underground tanks and the day tanks are generally maintained full at all times. This limits the formation of condensate from any air vapor in the tank. The fuel oil storage tanks are checked every 92 days for condensation and are cleaned out as required. To date this has not been required.

COMMENT 8.20 Operating experience has shown that accumulation of water in the starting air system has been one of the most frequent causes of diesel engine failure to start 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 NUREG-0660 indicates 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.

Describe your diesel engine air starting system and indicate how your system meets the recommendation stated in NUREG-0660. If there are any differences between your design and the recommendations of NUREG-0660, provide justification for your design or plans for implementation.

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RESPONSE

The air starting system consists of the starting air piping and the engine starting mechanism. Air for the starting system is required at between 150 and 250 psi at the engine and is stored in air storage tanks. Engine starting is accomplished by the action of compressed air on the pistons in their proper firing order. The engine starting mechanism includes the air start control valve, air start distributor, the air header, the pilot air tubing and the air start check valves at the individual cylinders. Regrigerated starting air drye_s are provided between the air compressors and the air storage tanks as recommended by NUREG-CR-0660.

COMMENT 8.21 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 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.

RESPONSE

North Anna Unit #2 Emergency Diesel Generators were manufactured by Fairbanks Morse, Inc. (Colt Industries), and therefore, EMD's turbocharger problem is not applicable.

COMMENT 8.22 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.

RESPONSE

TRAINING OF OPERATIONS PERSONNEL

North Anna Operators are provided with training on the emergency diesels in three (3) programs: 1) Operator Development Program; 2) Operator License Program; 3) Operator Requalification Program.

There are 13 licensed operators and 18 non-licensed operators who are qualified to operate the diesel generator units. The 18 non-licensed operators have demonstrated proficiency in the operation of the diesels by completing the diesel generator qualification program

There are 13 senior reactor operators assigned to operations as supervisory personnel that are qualified to operate the diesel.

The Operator Development Program uses a combination of self-study, practical demonstration and written examinations to accomplish the desired training. A description of this training as it applies to the emergency diesels is attached.

TRAINING ON EMERGENCY DIESELS FOR OPERATOR LICENSE PROGRAM

TOPICS COVERED BY LECTURE DURING OPERATOR LICENSE PROGRAM ON THE EMERGENCY DIESELS

(4 HOUR LECTURE)

1. Purpose of system and design criteria.
2. General description of the engine.
3. Start sequence, signals and reasons.
   - A. Exercise start
   - B. Emergency start
   - C. Local start/CRE
5. Function of all switches and controls. Including the effect on operability and start sequences.
6. Generator and electrical controls and interlocks.
7. Shutdown features, setpoints and reasons.
   - A. Emergency shutdown
   - B. Normal shutdowns
   - C. Reset and interlocks associated with shutdown features
8. Loading sequence on loss of voltage.
   - A. Degraded Voltage Protection
   - B. With Safety Injection
   - C. With Containment Depressurization Actuation
   - D. Output and supply breaker interlocks
9. Technical specifications for emergency diesels.
   - A. Unit 1
   - B. Unit 2

Additional training on Emergency Diesels during Operator License Program is included in some aspects of the following:

1. Lecture on Fuel Oil System.
2. Lecture on Fire Protection.
3. On-Shift Qualification Card for RO and SRO License Training Requires:
   A. Perform or simulate 1-PT-82A or 82B. (Diesel start/surveillance checks.)
   B. Simulated actions for:
      1. Station Blackout
      2. Loss of D Transfer Bus
      3. Loss of E Transfer Bus
      4. Loss of F Transfer Bus
      5. Safety Injection
4. Trainees are continually examined on the Emergency Diesels during license training, on their final audit examination, audit oral examinations and during the NRC examinations.

DESCRIPTION OF TRAINING ON EMERGENCY DIESELS FOR OPERATOR REQUALIFICATION PROGRAM

The 1979 Operator Requalification Program included the following training on Emergency Diesels:

1. Lecture on Degraded Voltage Protection (1 hour).
2. Simulator training on the following malfunctions:
    A. Loss of vital power
    B. LOCA's
    C. Main Steam Line Breaks
    D. Steam Generator Tube Rupture
    E. Station Blackout
3. Each licensee is expected to document diesel engine starts in the training log.

TRAINING OF ELECTRICAL MAINTENANCE PERSONNEL

At present no specific number or type of electrical maintenance personnel are dedicated to maintaining the emergency diesel generators. Electrical maintenance personnel receive general electrical training in an 11 step program based on experience and written tests. Electricians receive no specific training concerning maintenance of the emergency diesel generators. Normal prevention maintenance consisting of test measurements, general inspection, and cleaning of the emergency diesel generator is performed by the electricians. Normal one or two senior electricians, 9 steps or above, and one journeyman electrican are assigned to electrical maintenauce work on the emergency diesel generator. Any electrical maintenance other than minor external repairs is normally performed under the direction of the manufacturers representative. At present, no specific emergency diesel electrical maintenance training program is planned. Most electricians have graducated from high school or have passed GED examinations.

TRAINING OF MECHANICAL MAINTENANCE PERSONNEL

At present no specific number or type of mechanical maintenance personnel are dedicated to maintaining the emergency diesel generators. Mechanical maintenance personnel are trained as general mechanics and receive no specific training concerning maintenance of the emergency diesel generators. Mechanics are trained in a twelve step program. Mechanics are promoted from one step to another based on experience and written tests. Normally two senior mechanics, 9 steps or above, and one lower level mechanic are assigned to trouble shoot the diesel. Any mechanical maintenance which is performed on the diesel is normally performed under the direction of the manufacturers representative except for routine maintenance replacement and/or adjustments to minor parts. At present no specific emergency diesel generator mechanical maintenance training program is planned. Most mechanics have graduated from high school or have passed a GED examination.

TRAINING OF QUALITY CONTROL PERSONNEL

At present no specific number or type of quality control personnel are dedicated to maintaining the emergency diesel generators. Quality control personnel receive general on the job training to read codes and specifications and are familiar with maintenance procedures. All QC personnel have graducated from high school or passed GED examinations and many hold college degrees. The on site Quality Control Engineer and a member of the on site QC staff received speake U.S. Navy training on diesels of the same class as those used at North Anna. Normally major repairs to the emergency generators are given full coverage by QC and usually one shift of the coverage is provided by the on site QC staff member with the applicable U.S. Navy training mentioned above. Minor repairs to the diesel generators are subject to and often are spot checked on site QC. An on site in house QC general training program which includes specific training on the emergency diesel generators was recently formulated and is now in progress.

DESCRIPTION OF TRAINING ON EMERGENCY DIESELS FOR OPERATOR DEVELOPMENT PROGRAM

QUALIFICATION RECORD

NAME:	PAGE 2 of 9
SYSTEM: EMERGENCY DIESEL GEN. SYSTEM (1 TYP. ENGINE/GEN. SYST.)	REV. NO. /
UNIT NO. 1 and 2	DATE: 11/03/78

REQUIREMENT	INITIAL
1.0 Engine	
1.1 Model	
1.2 Type	
1.3 Specifications	
1.3.1 No. Cylinders/RPM	
1.3.2 H.P./K.W. Ratings	
1.4 Components	
1.4.1 Governor	
1.4.1.1 Type/Location	
1.4.1.2 Controls	
1.4.1.3 Linkage to fuel rack	
1.4.1.4 Operation Oil/Levels/Type	
1.4.2 Turbochargers	
1.4.2.1 Location/Purpose	
1.4.2.2 Operation	
1.4.2.3 Cooling/Lubrication	
1.4.3 Crankcase Ejector Assy.	
1.4.3.1 Location/Purpose	
1.4.3.2 Operation	
1.4.4 Scavange Air Blower	
1.4.4.1 Location/Purpose	
1.4.4.2 Operation	

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QUALIFICATION RECORD

NAME:	PAGE 3 of 9
SYSTEM: EMERGENCY DIESEL GEN. SYSTEM (1 TYP. ENGINE/GEN. SYST.)	REV. NO. 1
UNIT NO. 1 and 2	DATE: 11/03/78

REQUIREMENT	INITIAL
1.5 Systems	
1.5.1 Fuel Oil Transfer System	
1.5.1.1 Transfer Pumps (L-EG-P-1-A/B) Location/Power Source; Operation	
1.5.1.2 50,000 gal. underground tank	
1.5.1.3 Day Tank	
1.5.2 Engine Fuel System	
1.5.2.1 Engine Driven Fuel Pump; Location/Operation	
1.5.2.2 Aux. Fuel Pump (1-EG-P-01) Location/Power Source; Operation.	
1.5.2.3 Duplex Filters; Location/Purpose	
1.5.2.4 Injection Pumps; Location/Number/Operation Connection linkage to governor.	
1.5.2.5 Injection Nozzle: Location/Operation Number per cylinder.	
1.5.3 Engine Coolant System	
1.5.3.1 Stand by coolant pump (L-EG-P-03) Location/Power Source; Operation; Coolant drain tank line-up.	
1.5.3.2 Jacket Water Heater (1-EG-HT-1) Location/Power Source; Operation	
1.5.3.3 Stand-by Heat Exchanger Location/Purpose	

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QUALIFICATION RECORD

	PAGE 4 of 9
NAME:	REV. NO. 1
SYSTEM: EMERGENCY DIESEL GEN. SYSTEM (1 TYP. ENGINE/GEN. SYST.)	
UNIT NO. 1 and 2	DATE: 11/03/78

REQUIREMENT	INITIAL
1.5.3.4 Engine Drive Coolant Pump ... Location/Operation 1.5.3.5 TCV; Location/Purpose; Operation 1.5.3.6 Radiators 1.5.3.7 Lube Oil Cooler 1.5.3.8 Expansion Tank: Location; Level Indication Chem. Treatment; Filling/Draining System 1.5.3.9 Cooling Fan: Gear Box/Drive System; Air Inlet/Discharge Flow	
1.5.4 Engine Lube System 1.5.4.1 Engine Driven Lube Oil Pump Location/Operation 1.5.4.2 L.O. Filter Location/Type; Internal By-Pass Valves 1.5.4.3 L.O. Cooler Location/Type; Cooling Medium 1.5.4.4 L.O. Strainer Location/Type/Purpose; Cleaning 1.5.4.5 Pre-Lube Pump (1-EG-P-02) Location/Purpose; Operation (Man/Auto) 1876 128	

QUALIFICATION RECORD

NAME:	PAGE 5 of 9
SYSTEM: EMERGENCY DIESEL GEN. SYSTEM (1 TYPE. ENGINE/GEN. SYST.)	REV. NO. /
UNIT NO. 1 and 2	DATE: 11/03/78

REQUIREMENT	INITIAL
1.5.4.6 L.O. Circulation System	:
Pump (OPM); 3-Way Valve; Stand-By Heat Exch.	
Lube Oil Fill Connection; Operation.	
1.6 Starting Air System	
1.6.1 Air Compressors (1-EG-C-1A/B)	
1.6.1.1 Type/Operating Pressure	
1.6.1.2 Elec. Motor	
Power Source; Operation	
1.6.1.3 Diesel Engine	
Operation; Belt Re-alignment	
1.6.2 Air Dryers	
1.6.2.1 Type	
1.6.2.2 Operation	
1.6.3 Air Receivers	
1.6.3.1 Relief Valves	
1.6.3.2 Volume (Number of starts)	
1.6.4 Solenoid Valves (AS-1 & AS-2)	
1.6.4.1 Location/Purpose	
1.6.4.2 Vent Valve (AV)	
1.6.5 Air Start Distributor	

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QUALIFICATION RECORD

NAME:	PAGE 6 of 9
SYSTEM: EMERGENCY DIESEL GEN. SYSTEM (1 TYP. ENGINE/GEN. SYST.)	REV. NO. 1
UNIT NO. 1 and 2	DATE: 11/03/78

REQUIREMENT	INITIAL
1.7 Instrumentation/Controls/Alarms	
1.7.1 Engine	
1.7.1.1 Overspeed Trip Mechanism	
1.7.1.2 Local Control Panel Controls	
1.7.1.3 Crankcase Press.	
1.7.1.4 Engine Operating Modes	
Auto Remote, Man. Remote; Man. Local	
1.7.1.5 Governor Control Syst.	
Normal opns.; Shutdown SOV action	
1.7.1.6 Auto Shutdown Features	
1.7.2 Fuel Oil Transfer System	
1.7.2.1 Level Control/Indications	
1.7.2.2 Local Control Panel Controls	
1.7.3 Engine Fuel System	
1.7.3.1 Press./Temp.	
1.7.3.2 Indication/Alarms	
1.7.3.3 Local Control Panel Controls	
1.7.4 Engine Coolant System	
1.7.4.1 Press./Temp.	
1.7.4.2 Indications/Alarms	
1.7.4.3 Local Control Panel Controls	

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QUALIFICATION RECORD

NAME:	PAGE 7 of 9	
SYSTEM: EMERGENCY DIESEL GEN. SYSTEM (1 TYP. ENGINE/GEN. SYST.)	REV. NO. 1	
UNIT NO. 1 and 2	DATE: 11/03/78	
REQUIREMENT		INITIAL
1.7.5 Engine Lube System		
1.7.5.1 Press./Temp.		
1.7.5.2 Indications/Alarms		
1.7.5.3 Local Control Panel Controls		
1.7.6 Starting Air System		
1.7.6.1 Press. Control(s)		
1.7.6.2 Alarms		
1.7.7 Start circuits 1 and 2		
1.7.8 Auto. Engine Shutdown		
2.0 Generator		
2.1 Type/Ratings		
2.2 Lubrication (Bearings)		
2.2.1 Level Indication		
2.3 Protection (Relaying)		
2.3.1 Phase Differential (87)		
2.3.1.1 Location		
2.3.1.2 Trip Actions		
Gen. Output Breaker; Emerg. Engine Stop		
2.3.1.3 Light Indication		
2.3.2 Phase Overcurrent		
2.3.2.1 Trip Action (Bkr)		
2.3.2.2 Location		

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QUALIFICATION RECORD

NAME:	PAGE 8 of 9
SYSTEM: EMERGENCY DIESEL GEN. SYSTEM (1 TYP. ENGINE/GEN. SYST.)	REV. NO. 1
UNIT NO. 1 and 2	DATE: 11/03/78

REQUIREMENT	INITIAL
2.4 Static Exciter 2.4.1 Field Flashing	
2.4.1.1 Source of D.C. 2.4.1.2 Operation Auto/Manual	
2.4.2 Normal Excitation 2.4.2.1 Power Source 2.4.2.2 Starting/Stopping Excitation 2.4.2.3 Emergency Shutdown 2.4.2.4 Over excitation	
2.5 Gen. Output Breakers (15-H/J-2) 2.5.1 Operation 2.5.1.1 Auto/Manual 2.5.2 Relaying (86) 2.5.2.1 Actions/Permissives	
3.0 D.C. Control Power System 3.1 Batteries 3.1.1 Ratings 3.1.2 Controls/Indications 3.2 Batt. Charger 3.2.1 Power Source 3.2.2 Operation 3.2.3.1 Controls/Indications	

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QUALIFICATION RECORD

NAME:	PAGE 9 of 9
SYSTEM: EMERGENCY DIESEL GEN. SYSTEM (1 TYP. ENGINE/GEN. SYST.)	REV. NO. 1
UNIT NO. 1 and 2	DATE: 11/03/78

REQUIREMENT	INITIAL
4.0 Operation	
4.1 Have knowledge of applicable Tech. Specs.	
4.2 Using the control panel in the control room, should be able to explain operation of all controls and instrumentation.	
4.3 Should be able to perform and/or explain synchronizing, loading, and unloading of the diesel gen.	
4.4 At the respective diesel, should be able to point out and explain major system components, and explain their operation as well as the operations of all local control panels.	
4.5 Should be able to perform applicable PT's.	
4.6 Demonstrate the ability to perform the operations in accordance with OP-6.	
5.0 Abnormal and Emergency Procedures	
5.1 Understand and explain system line-up and operation during abnormal or emergency conditions.	

We certify that ______________________ has demonstrated the ability and knowledge to safely operate and control this system.

DATE

SHIFT SUPERVISOR ______________________ ____________

OPERATING SUPERVISOR ______________________ ____________

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VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION

QUALIFICATION RECORD

NAME:	PAGE 1 OF 9
SYSTEM EMERGENCY DIESEL GEN. SYSTEM	REV. NO. 1
UNIT NO. 1 and 2	DATE: 11/03/78

REFERENCES:

1. ACRO Development Program Manual:
2. Valve Operating Diagram(s):
3. Flow Diagram(s):
4. Electrical Diagram(s): FE-21E; 21J
5. Elementary Diagram(s): ESK-11C Sh. 1-7; ESK-8AC;
6. System Description(s): 22-12
7. North Anna FSAR, Sec.: 8.3
8. North Anna Technical Specifications, Sec.: 3/4.8
9. Operating Procedure(s): OP-6; OP-46.4
10. Abnormal Procedure(s) AP-10
11. Emergency Procedure(s) EP-2; EP-6
12. Instrumentation Systems EG
13. PLS Document N/A

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14. Mfg. Literature Colt Industries, Pwr. Systems Div. Products
15. Station Curve Book 1-SC-5.13/16. PT's: PT-82A; Misc.-14

EXAMPLE EMERGENCY DIESEL EXAM QUESTIONS

1. Properly arrange the following components of the Diesel Fuel System into a correct flow path from the 5,000 BBL storage tank to the individual injector (4)

   a. 5,000 BBL Storage Tank
   b. Duplex Filters
   c. Engine Injector Pump
   d. Fuel Oil Transfer Pump(s)
   e. Fuel Pumps, Engine & Motor Driven
   f. 50,000 gal. Underground Storage Tank
   g. Day Tank
   h. Individual Injector

2. The fuel oil transfer pumps for the diesels are physically located in the fuel oil pump house. (3)

   a. What is the power source for these pumps?
   b. Where are the control switches for these pumps physically located?
   c. With the pump control switch in "AUTO", what condition will start and stop the pump?

3. What is used to start the emergency diesels? (1)
4. What is the cooling medium for the emergency diesel lube oil cooler? (1)
5. How does the operator check the engine sump lube oil level? (1)
6. Assume you are operating a diesel generator for <u>test</u> purposes. (3)

   a. Why is it desirable not to run the diesel at less than 75% of full rated load?
   b. List three (3) conditions that will cause the diesel to automatically shutdown while in this running configuration.
   c. Outline the steps you would use to synchronize the diesel generator, and place a load on it in this running configuration.

COMMENT 8.23 Several fires have occured 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, NUREG-0660 recommends that the prelube period should be limited to a maximum of three to five minutes unless otherwise recommended by the diesel engine manufacturer.

Provide the prelube time interval your diesel engine will be exposed to prior to manual start and if this interval does not agree with the recommendations of NUREG-0660 provide justification why your interval time is acceptable.

RESPONSE

The prelube time interval for our diesel engine is two minutes when a remote-manual start is made. This is done automatically. There is no prelube during an emergency start. When the diesel is started locally, prelube must be manually initiated. The procedure for locally starting the diesel limits prelube to no greater than two minutes.

COMMENT 8.24 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 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.

Indicate whether your design includes an electric prelube oil pump. If your design does not include this pump, provide justification why it is not necessary.

RESPONSE

North Anna Unit #2 Emergency Diesel Generators do not employ a D.C. powered L.O. pump. However, a L.O. circulating pump is provided as an integral part of the lube oil preheating system. Additionally, manually started A.C. powered prelube pumps are provided for use during non-emergency starts. Fairbanks Morse recognizes that dry starts will be required in emergency conditions. Our operating procedures require the operation of the prelube pump prior to starting the engine in non-emergency starts.

COMMENT 8.25 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, NUREG 0660 recommends the following:

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 dicussion of whether the recommendations of NUREG-0660 have been implemented in the emergency diesel generator system design and how they will be considered when the plant is in commercial operation, i.e., by what means will the above requirements be enforced.

RESPONSE

1. The diesel generators are load tested at 2.5-2.75 MW. This is equivalent to approximately 90 to 100% of rated load.
2. The Unit 2 diesel surveillance requirements for demonstrating the operability of the diesel generators are in accordance with the recommendations of Regulatory Guide 1.108 "Periodic Testing of Diesel Generator Units Used as Onsite Electric Power System at Nuclear Power Plants", Revision 1, August 1977. This is described in the Bases section of the Proof and Review copy of the Unit 2 Technical Specification.

   Surveillance testing of the diesel generators does not conflict with the recommendations of the engine manufacturer.
3. The preventive maintenance program includes normal routine adjustments and servicing of components. When any part on the diesel needs to be repaired or replaced, a maintenance report (MR) is initiated. After the repair has been finished, the completed maintenance report is logged onto a computer. Therefore if any item is suspected of having a history of repeated malfunctions, it can be "called up" and all MR's will be listed which have been performed with respect to that item.
4. When repairs or maintenance is to be performed on the diesel, operations will release the diesel to the maintenance department after completing the first part of the Maintenance Operating Procedure (MOP). Maintenance personnel will perform all diesel maintenance in accordance with an approved procedure as required by the Nuclear Power Station Quality Assurance Manual (NPSQAM). The approved maintenance procedures require the replacement of equipment removed for repair. Following the repair of the

diesel maintenance personnel would return control of the diesel to operations. The diesel would then be returned to operable status and a functional check completed as required by the second part of the MOP. During the function check maintenance personnel would inspect their work, if required.

COMMENT 8.26 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, NUREG-0660 recommends that the controls and monitoring instrumentation be installed on a free standing floor mounted panel separate from the engine skids, and located on a vibration free floor area or equipped with vibration mounts.

Provide a description of how the controls and monitoring systems are installed and indicate how your design addresses the recommendations of NUREG-0660.

RESPONSE

There are three control cubicles in the diesel generator room. One of these cubicles, which consists of three panels, is floor mounted separate from the engine skid. Two control cubicles are skid mounted. All of the devices in the skid mounted control cubicles, as well as those in the floor mounted cubicle, have been seismically qualified by a combination of static analysis and testing. Since the diesel generator units have been operated over a period in excess of three years without vibration induced failures in the control equipment, it is felt that this equipment is satisfactory.

COMMENT 8.27 Experience at operating plants has shown that a diesel engine that is provided with an engine cooling water temperature control system employing a 3-way bypass-type thermostatically controlled valve have demonstrated consistent trouble free operation over engines provided with other methods of temperature control such as shutter controls radiators. Does your system employ a water thermostat of the 3-way or bypass-type which splits the water flow so only as much water passes through the cooler or radiator as needed to maintain the proper outlet temperature? If your engine cooling water system does not use a 3-way valve, describe your installed system and justify its design as opposed to a design emplcying a 3-way valve.

RESPONSE

North Anna Unit #2 Emergency Diesel Generator engine cooling system employs a AMOT 3-way bypass-type thermostatically controlled valve on all Emergency Diesel Generators, thereby, complying with NUREG/CR-0660.