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United States Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Mr. Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation

SUBJECT: Beaver Valley Power Station - Unit No. 2
Docket No. 50-412
Identification of Backfit Requirement Number 4

Gentlemen:

On April 27, 1973, Duquesne Light Company (DLC) provided a description of the Air Starting Systems for Emergency Diesel Generators in Amendment 4 to the Beaver Valley Power Station Unit 2 (BVPS-2) Preliminary Safety Analysis Report (PSAR). This description is included here as Attachment 1.

On November 9, 1973, the U.S. Atomic Energy Commission issued the Construction Permit stage Safety Evaluation Report (CP-SER). The CP-SER, in review of the proposed Emergency Diesel design (Attachment 2) states, "We have concluded that this design commitment is acceptable."

On September 19, 1983, the NRC staff issued questions 430.97 and 430.100 (Attachment 3). Question 430.100 states, "... we require that compressed air starting system designs include air dryers for the removal of entrained moisture." In this question, the NRC staff directs, "Revise your design of the diesel engine air starting system accordingly ...." Attachment 3 (originally Attachment 3 to DLC letter 2NRC-4-032, dated March 28, 1984) also includes the DLC responses to questions 430.97 and 430.100. In these responses DLC has appropriately addressed the technical aspects of the question. A draf' copy of this response had previously been provided to the staff reviewer. In a telephone conference with DLC (February 22, 1984), the staff reviewer indicated that his concerns were not satisfied and that air dryers would be required. He cited NUREG/CR 0660, "Enhancement of On-site Emergency Diesel Generator Reliability" (the University of Dayton study referenced in question 430.100) as his basis for requiring that DLC install air dryers.

Section 9.5.6 of the Standard Review Plan (SRP), Rev. 2, July 1981, has incorporated the recommendations of NUREG/CR 0660 as guidance in Paragraph II.4. However, Paragraph III of this section states:

> "The procedures below are used during the construction permit (CP) review to determine that the design criteria and bases and the preliminary design as set

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> forth in the preliminary safety analysis report meet the acceptance criteria given in subsection II of this SRP section. For the review of operating license (OL) applications, the procedures are used to verify that the initial design criteria and bases have been appropriately implemented in the final design as set forth in the final safety analysis report."

The requirement to change the system design, after the initial design was approved at the issuance of the CP is a "backfit" as identified in 10CFR50.109. The change in the implementation of the SRP review procedure represents a new position on requirements and is identified as a "backfit" in Generic Letter 84-08 and the implementing NRC procedures.

DLC requests that the proposed requirement be submitted to NRC management for approval, in accordance with the Office of Nuclear Reactor Regulation (NRR) procedure for management of plant specific backfitting, prior to transmittal as a licensing requirement.

DUQUESNE LIGHT COMPANY

By E. J. Woolever
E. J. Woolever
Vice President

RW/wjs
Attachments

cc: Mr. H. R. Denton (w/attachments)
Mr. G. W. Knighton, Chief (w/attachments)
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Mr. G. Walton, NRC Resident Inspector (w/attachments)

Air Starting Systems for Emergency Diesel Generators

Design Basis

Separate air starting systems are provided for the emergency diesel generators. Each diesel generator is isolated from the other diesel generator.

The emergency diesel generator air starting system is shown in Fig. Response 8.12(2)-1. Each diesel engine drive is provided with 2 independent redundant starting systems, both capable of starting the engine without outside power. Each independent starting system includes an ac motor-driven air compressor, air storage tanks, air starting motors, all necessary valves and fittings, and complete instrumentation and control systems. All components will be missile protected, seismic Category I equipment.

The air storage tanks capacity is capable of providing 5 generator engine starts without outside power. The tanks are made of welded steel plate and will conform in all respects to the latest published edition of ASME Boiler and Pressure Vessel Code, Section III, Nuclear Power Plant Components, Class 3.

System Design and Operation

Each diesel engine is supplied with 2 independent air starting systems, both capable of starting the engine. The air starting system is shown in Fig. Response 8.12(2)-3.

A 2 position preferred start selector switch is provided to determine which bank of dual air starting motors will be used for the initial start. Position 1 will engage the starting motors on the left side of the engine (viewing from the generator end) and Position 2 engages air starting motors on the right side of the engine.

Upon receiving a start signal, the solenoid valve is energized, allowing air from the tanks to pass through the solenoid valve to the pinion gear end of the lower starting motor. The entry of air moves the pinion gear forward to engage with the engine ring gear. Movement of the pinion gear uncovers a port, allowing air pressure to be released to the upper starting motor, which, in turn, engages its pinion gear with the engine ring gear. With both pinion gears engaged, the air is released from the uncovered port in the upper motor. The released air closes the air relay valve, which, in turn, opens the air starting valve and releases the main starting air supply. Starting air passes through the air line lubricator, releasing an oil-air mist into the starting motors. The multivane motors drive the pinion gears, rotating the ring gear, and cranking the engine.

The engine will start with one bank of dual air starting motors, but if the unit is placed in the standby mode of operation, the starting system will automatically proceed through the following cranking sequence to ensure starting:

1. One bank of dual air starting motors cranks the engine, depending on the selector switch setting. If the engine fails to start within 3 sec, the air starting motors shut down.

2. Following a 1/2 sec pause, both banks of dual air starting motors crank the engine. If the engine fails to start within 3 sec, the air starting motors shut down.

3. Following a 1/2 sec pause, the other bank of dual air starting motors (the bank not used in Step 1) cranks the engine. If the engine fails to start within 3 sec, the air starting motors shut down.

The air compressor arrangement contains an electric motor-driven compressor on one bank and a combination electric motor/design engine-driven compressor on the other bank, with separate air storage tanks provided for each bank.

The air compressors are equipped with a pressure operated control switch that automatically operates the electric motor when the air pressure in the air storage tanks drops to 175 psi and shuts off the electric motor when the air pressure reaches 200 psi. The diesel engine is a manual start engine with an automatic stop when the air pressure reaches 200 psi. Prior to use, the diesel engine also requires a manual belt changeover from the electric motor.

Evaluation

The design incorporates sufficient redundancy to prevent a malfunction or failure of an active or passive component from impairing the ability of the system to start the diesel engine.

Specifically, the air starting system for each diesel is designed to remain operable under any one of the following conditions:

1. Maintenance outage or failure of any one starting air compressor.

2. Maintenance outage or failure of any one bank of storage tanks.

3. Maintenance outage or failure of any one set of dual air starting motors.

4. Maintenance outage or failure of any one starting valve and/or piping.

Tests and Inspections

The air starting system will be hydrostatically tested during construction, and all active system components are functionally tested during startup, and periodically thereafter. The air storage tanks are periodically checked for water, oil, sediment, etc., to determine possible contamination or corrosion. The frequency of the periodic tests is given in Section 16.

Combustion Air Intake and Exhaust Systems for Emergency Diesel Generators

Design Basis

Each emergency diesel generator is supplied with its own separate air intake and exhaust system. The system is designed to supply sufficient combustion air to operate the diesel engine at rated power during worst atmospheric conditions.

Each diesel generator is isolated from the other diesel generator by a missile-proof wall. Each independent intake and exhaust system will be located in the cubicle of the diesel that it serves. This design incorporates sufficient redundancy to prevent a malfunction or failure of an active or passive component from impairing the ability of at least one emergency diesel generator to function properly.

The intake and exhaust systems will be missile protected and designed to seismic Category I requirements.

System Design and Operation

The arrangement of the Diesel Generator Building is shown in Fig. 15.1-23. Each combustion air intake and exhaust system consists of:

1. Two motor-operated inlet dampers

   Consists of missile-protected redundant dampers to allow combustion air into the diesel cubicle.

2. Engine air intake filter assembly

   Consists of 9 panel type oil bath filters that are mounted on the main generator.

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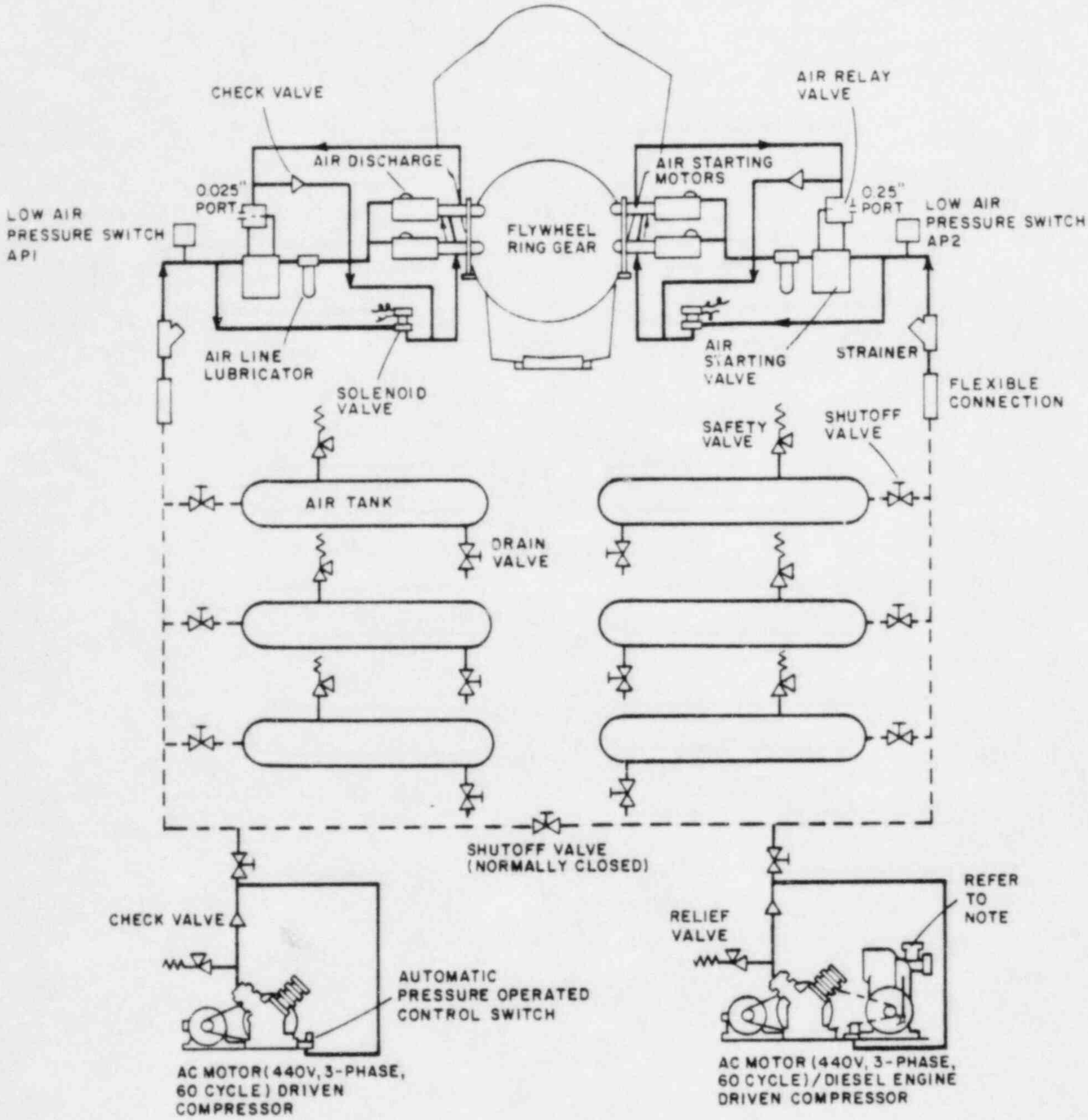

NOTE:
To drive compressor with engine, belt must be changed over manually.

FIG. RESPONSE 8.12(2)-3

AIR STARTING SYSTEM

BEAVER VALLEY POWER STATION-UNIT 2
PRELIMINARY SAFETY ANALYSIS REPORT

The safety loads for Beaver Valley Unit 2 will be distributed evenly between the two distribution systems with the exception of those loads that provide extra redundancy, such as the high pressure injection pump and service water pump. Each of these loads can be powered from either distribution system through separate breakers and one isolating transfer switch which aligns the load to the selected distribution system bus. The selection of the power feed will be accomplished manually through key-interlocked bus-transfer switches which prevent interconnection of the power supplies.

In addition, the design will include the capability for disconnecting selected loads from the emergency buses that will not be required to operate during the containment isolation phase B of the accident which encompasses spray actuation. The applicants have stated that this capability will be provided to protect against diesel generator overloading. Since the diesel generators have not been selected, the need for this load shedding capability has not been established. Should this capability be required, we will evaluate it when the characteristics of the diesel generators are known. However, we believe that this capability can be satisfactorily implemented and, thus, satisfies our present evaluation requirements.

The applicants have not selected the diesel generator units for this plant. However, to satisfy our requirements, they have agreed to obtain a diesel generator(s) that has been previously qualified

for use in nuclear power plant applications or to perform qualification tests on a new diesel generator(s) that will demonstrate a 0.99 reliability at 95% confidence level. Further, each diesel generator will be selected and sized in accordance with the recommendations of AEC Regulatory Guide 1.9. We have concluded that this design commitment is acceptable.

Each diesel generator will be automatically started on an undervoltage signal from its respective 4160 volt emergency bus, on a safety injection signal, or on opening of either of the two series isolation breakers through which offsite power is being supplied to the emergency buses. If offsite power is not available, the 4160 volt emergency buses will be automatically isolated from all supply sources and all outgoing feeder breakers will be tripped. The diesel generators will be connected automatically to their respective 4160 volt emergency bus and the safety loads will be automatically connected in a predetermined sequence to their respective diesel generator.

Our review of the proposed a-c emergency onsite power system revealed that the independence of the redundant emergency buses would be compromised through a single bus tie breaker connecting the redundant 4160 volt load center buses. We consider this design arrangement

ATTACHMENT 3

Respone to FSAR Questions 430.97 and 430.100

Question 430.97 (Section 9.5.6)

P-ovide 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).

Response:

Refer to the response to Question 430.100.

Question 430.100 (Section 9.5.6)

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 Electrical 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 diesel engine air starting system accordingly, describe this feature of your design. Also expand your FSAR to discuss the procedures that will be followed to ensure the dryers are working properly and the frequency of checking/testing (SRP 9.5.6, Parts II and III).

Response

The University of Dayton study which concluded that water accumulation was a leading cause of diesel starting failures was based upon analysis of Licensee Event Reports (LER) issued from 1969 through 1977. Improvements in industry practices since that time, and the success of such practices must also be considered. During the first year of operation (1976-1977) at BVPS-1, two failures of the diesel generators to start because of moisture were reported via LER. To prevent further occurrences, a system of periodic blowdown as well as blowdowns prior to testing was implemented. No moisture related start failures have occurred which resulted in LER's in the seven years since (approximately 1/6 of the expected plant life). In addition, a more recent study by the Institute for Nuclear Power Operations used 450 diesel related LER's issued since January 1980 to analyze failure data. this study shows that only 5% of the more recent failures were due to moisture. Improved operation and maintenance practices applied by the industry when the moisture problem first became apparent on an industry-wide basis in the late 1970's is undoubtedly part of the reason for this improvement. Such practices at BVPS-1 have proven to be highly successful.

As described in FSAR 9.5.6, the method of starting the diesels used at BVPS-2 involves admission of air directly into the engine's cylinders. This eliminates the need for air start motors used on some other designs which are, as stated in NUREG/CR 0660, more susceptible to moisture related damage. Another important design feature which allows these diesels to be more tolerant of any starting system failure is the redundancy of the start systems. Each diesel is provided with redundant starting system components to enhance its starting reliability as stated in FSAR 9.5.6.

In accordance with GDC 17, sufficient independence and redundancy is provided to assure performance of safety functions assuming a single failure. Loss of a single diesel generator is considered in the safety analyses. As demonstrated at BVPS-1, loss of a diesel due to moisture is a rarity when appropriate operating and maintenance practices are applied. Coincident loss of both diesels due to moisture would be even less likely and is prevented in part by the independence of the air starting systems.

The use of operating procedures similar to those in use at BVPS-1 should provide diesel reliability similar to that of BVPS-1. Additionally, periodic testing will confirm the availability of the diesels. Thus, it cannot be concluded that installation of the air dryers, as requested by the NRC, would provide substantial additional protection which is required for the public health and safety. Therefore, this proposed backfit is not justified under 10CFR50.109.