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February 2, 1981

Director of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Attn: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing
Washington, DC 20555

Reference: Beaver Valley Power Station, Unit No. 1
Docket No. 50-334, License No. DPR-66
NUREG-0737 Response - Items II.E.1.2 and II.E.3.1

Gentlemen:

In accordance with our letter of December 31, 1980, we are providing the information required for Items II.E.1.2 and II.E.3.1. Attached is the documentation required for:

II.E.1.2 - Auxiliary Feedwater System Automatic Initiation and Flow Indication

II.E.3.1 - Emergency Power Supply for Pressurizer Heaters

If you have any questions concerning this submittal, please contact my office.

Very truly yours,

C. N. Dunn
Vice President, Operations

Attachment

cc: Mr. D. A. Beckman, Resident Inspector
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Washington, DC 20555

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II.E.3.1 - Emergency Power Supply For Pressurizer Heaters

System Description

The four pressurizer heater back-up groups are supplied from the emergency buses. Emergency buses 1N and 1P each supply a group of 270 KW heaters. The buses are normally supplied by the offsite power, but are supplied by the emergency diesel generators on loss of offsite power. Emergency diesel generator No. 1 supplies buses 1N and 1N1, with buses 1P and 1P1 being supplied by emergency diesel No. 2. A Containment Isolation Phase B (CIB) signal automatically sheds the 1N1 and 1P1 stub buses from the onsite emergency power supplies. Power is supplied to the heaters from safety grade equipment.

The control circuitry for the heaters power supply is designed to prevent the heaters from being automatically shed from the buses on a safety injection unless it is coincident with a unit trip and loss of offsite power. If a unit trip and loss of offsite power occurs, all loads are shed from the emergency buses and vital loads are reconnected to the buses by the emergency diesel generator sequencing circuit. The pressurizer heaters are not considered vital loads and as such are not in the sequencing circuit and are not automatically reconnected to the emergency buses. The heaters must be manually reconnected to the emergency buses using the control switches located in the control room.

Refer to drawings: RE-1C, RE-1F, RE-1K, RE-21CE, RE-21JR, RE-21JS, 1.11-76B, LSK-25-6J, LSK-25-6H and LSK-25-6K.

Test procedure: BVT-1.36.1

II.E.1.2 - Auxiliary Feedwater System Automatic Initiation and Flow Indication

A. Part 1 Auxiliary Feedwater System Automatic Initiation

The Beaver Valley Unit 1 Auxiliary Feedwater System is discussed below with respect to the paragraphs of IEEE 279-1971 referenced in NUREG-0737, Item II.E.1.2.

4.1 System Description and General Functional Requirement

Automatic initiation of the auxiliary feedwater system when monitored variables reach pre-set levels is provided.

Signals used for automatic initiation are:

1. Safety Injection Signal (SIS)

   a. Low Pressurizer Pressure

   b. Low Main Steam Pressure

   c. High Containment Pressure

2. Main Feed Pump Trip

3. Steam Generator Low-Low Level

4. Reactor Coolant Pump Bus Loss of Power (undervoltage)

The turbine driven auxiliary feed pump is started on a 2-out-of-3 steam generator low-low level in any loop or a 2-out-of-3 reactor coolant pump bus undervoltage.

The motor-driven auxiliary feed pumps are started on a 2-out-of-3 steam generator low-low level in 2-out-of-3 loops, a safety injection signal, or 2-out-of-2 main feed pump trip. The motor-driven pumps also back up the turbine driven pump with automatic start on turbine driven auxiliary feed pump discharge pressure failure. Discharge MOV-FW151A-F, are normally open and presently do not have automatic open signals provided. Technical specification requirements currently require redundant and independent verification of valve position every 31 days. An auto open signal on auxiliary feedwater initiation as well as out of function (i.e., not lined up to provide feedwater to steam generator) annunciation in the control room is being provided for the auxiliary feedwater to steam generator MOV's FW151A-F. Remote manual control for these valves is provided in the control room.

Auxiliary Feedwater A.C. powered equipment is included in the automatic actuation of loads to the emergency buses. Motor driven auxiliary feed pumps are sequenced on "Step 3" of the load sequencing. Although the Auxiliary Feedwater to Steam Generator valves are normally open, power to operate is sequenced on "Step 1" of the load sequencing.

4.1 System Description and General Functional Requirement (continued)

The safety analysis assumes availability of Auxiliary Feedwater within 60 seconds. Response time for the actuation signals for automatic auxiliary feedwater initiation is 1.6 seconds maximum. Response time for auxiliary feedwater pumps and valves required to operate is within the time requirements of the safety analysis.

The ranges of the instrumentation initiating auxiliary feedwater are consistent with the requirements of the safety analysis.

See drawings: 11700-RM-18A, LSK-5-13A, B and C, RE-21HE, RE-21HF, RE-21CE-1, RE-21HY and RE-21HD.

4.2 Single Failure

Auxiliary Feedwater Systems are designed so that a single failure will not result in loss of feedwater function.

The safety injection, steam generator low-low level, and loss of power signals are derived out of the redundant reactor protection and engineered safety features instrumentation and control system. The main feed pump trip signal is derived from the main feed pump motor ACB stationary contacts. Each of the two main feed pumps has two drive motors operating in tandem. One train of auxiliary feedwater is initiated by the breaker contacts of one of the tandem motors on each main feed pump and the other train of auxiliary feedwater is initiated by breaker contacts of the second tandem motor of each main feed pump. This creates a redundant initiation signal. Isolation between Class 1E and non-Class 1E circuitry is being provided. The pumps and valves are powered from redundant Class 1E buses. These are two independent electrical sources. Failure of one Class 1E bus will not prevent power from being supplied by the redundant bus. Not only are the initiating circuits redundant but diverse parameters are used.

See drawings: 11700-RM-18A, RE-1F, RE-1S, RE-1T, RE-1U, RE-1Z, RE-1AA, RE-1AB, RE-21PU-3A-1 and RE-21PV-4A-1.

4.3 Quality of Components and Modules

An approved Quality Assurance Program was in effect for the design procurement, fabrication, erection, and testing of component/modules for the Beaver Valley Unit 1 Auxiliary Feedwater System. The QA Program entailed the following:

Conceptual design

Detailed engineering and design

Assembly and maintenance of quality control documentation for shop and field.

Vendor selection

4.3 Quality of Components and Modules (continued)

Surveillance of vendor's shop inspection

Witnessing of key shop tests

Field inspection and quality control of erection

Equipment, installation, and testing specifications

Checkout of mechanical, fluid, and electrical systems

Startup testing

Periodic inservice performance tests

Appendix A of the FSAR discusses in detail the Quality Assurance Program for Beaver Valley Unit 1. The DLC organization is described in Section A.2. The Stone & Webster QA Program is discussed in Section A.3. The Westinghouse Power Systems Division Quality Assurance Program is discussed in Section A.4. Modifications to the automatic initiation system are performed under the Duquesne Light Company Operational Quality Assurance Program.

4.4 Equipment Qualification

Qualification testing for Beaver Valley Unit 1 has been performed on the various protective system equipment. This testing included demonstrating operating of safety functions at elevated ambient temperatures up to 120 F and relative himidity up to 95 percent for control room and electronic equipment room equipment and in full post-accident environment for a specified time for equipment required in the containment. Qualification testing of safety equipment required to operate in the post-accident environment is discussed in "Environmental Testing of Engineered Safety Features Related Equipment (NSS-Standard Scope)" WCAP-7744, Volume I, August 1971.

Temperature in the control room and electronic equipment room is maintained for personnel comfort at 70 F $\pm$ 10 F. Design specifications for this equipment require that no loss of protective function should result when operating in temperatures up to 120 F and himidity up to 95 percent which may occur upon the loss of air conditioning and/or the ventilation system. Thus, there is a wide margin between the design limit and the normal operating environment for the protective equipment.

All Class 1E equipment has been reviewed in accordance with IE Bulletin 79-01B identifying the equipment qualification requirements, documentation justifying equipment qualification, and any equipment qualification deficiencies. The Main Steam Pressure Transmitters, PT-474, 475, 476, 484, 485, 486, 494, 495 and 496, have been identified as requiring replacement. Replacement items for all Class 1E equipment which was found to have qualification deficiencies have been ordered, and will be installed at the first outage of sufficient duration following their delivery and in which plant conditions permit replacement, but no later than June 30, 1982, consistent with the requirements of IE Bulletin 79-01B.

4.6 Channel Independence

The Auxiliary Feedwater System (AFS) initiating signals are powered from emergency power with the exception of the main feed pump trip and the Reactor Coolant Pump (RCP) bus loss of power.

The main feed pumps are not powered from a Class 1E source and their breakers are not Class 1E equipment. The pump trip signals do not require any power to operate, however, as they are only circuit breakers stationary contacts. Isolation between Class 1E and non-Class 1E circuits in the form of auxiliary relays is being added to preclude any degradation of the Class 1E AFS control circuit (see Section 4.17).

The RCP's are also not powered from a Class 1E source. The AFS initiating signal is RCP undervoltage. Upon loss of power, these relays fail in the safe position, the trip condition, and will initiate AFS.

The sensed parameter, RCP bus undervoltage, and the sensing device are powered from the bus voltage being sensed. The signals are processed through the reactor protection logic, creating the redundant train actuation signals. Channel independence is carried throughout the AFS initiating system, from the sensor through the devices actuating the protective function.

Separation of redundant transmitters is achieved by physical separation. Redundant transmitters are powered from separate Class 1E power sources. Wiring separation is achieved by using separate wireways, cable trays, conduit runs, and containment penetrations for each redundant channel. Redundant analog equipment is separated by locating modules in different protection rack sets with each redundant channel energized from separate Class 1E power feeds.

See drawings: 11700-1U, RE-1AB, RE-1AA, RE-1F, RE-1S, RE-1T and RE-1Z.

4.7 Control and Protection System Interaction

The ESF actuation system consists of two discrete portions of circuitry: An analog portion consisting of three to four redundant channels which monitor various unit parameters such as the reactor coolant system (RCS) and steam system pressures, temperatures and flows and containment pressures and a digital portion consisting of two redundant log trains which receive inputs from the analog protection channels and perform the needed logic to actuate the ESF. Each digital train is capable of actuating the ESF actuation system and failure of any one entire train will not prevent system action when required.

The redundant concept is applied to both the analog and logic portions of the system. Separation of redundant analog channels begins at the process sensors and is maintained in the field wiring, containment vessel penetrations, and the analog protection racks, terminating at the redundant groups of the safeguards logic racks. This design meets the requirement of GDC 19.

4.7 Control and Protection System Interaction (continued)

The safety injection, steam generator low-low level, and loss of power signals are derived out of the redundant reactor protection and engineered safety features instrumentation and control system. The main feed pump trip signal is derived from the main feed pump motor ACB stationary contacts. Each of the two main feed pumps has two drive motors operating in tandem. One train of auxiliary feedwater is initiated by the breaker contacts of one of the tandem motors on each main feed pump and the other train of auxiliary feedwater is initiated by breaker contacts of the second tandem motor of each main feed pump. This creates a redundant initiation signal. Isolation between Class 1E and non-Class 1E circuitry is being provided.

The pumps and valves are powered from redundant Class 1E buses. There are two independent electrical sources. Failure of one Class 1E bus will not prevent power from being supplied by the redundant bus.

See drawings: 11700-RE-1U, RE-1AB, RE-1AA, RE-1F, RE-1S, RE-1T and RE-1Z.

4.9/4.10 Capability for Testing

The AFS is designed to permit periodic testing of the analog channel portion of the ESF actuation system during reactor power operations without initiating a protective action unless a trip condition actually exists. This is because of the coincidence logic required for trip.

The operability of the process sensors is ascertained by comparison with redundant channels monitoring the same variables or those with a fixed known relationship to the parameter being checked. The in-containment sensors can be calibrated during unit shotdown and others can be calibrated as required.

Analog channel testing is performed at the analog instrumentation rack set by individually introducing dummy input signals into the instrumentation channels and observing the tripping of the appropriate output bistables. Analog output to the logic circuitry is interrupted during individual channel test by a test switch, which when thrown, deenergizes the associated logic input and inserts a proving lamp in the bistable output. Interruption of the bistable output to the logic circuitry for any cause (test, maintenance, or removal from service) will cause that portion of the logic to be actuated (partial trip) accompanied by a partial trip alarm and channel status light actuation in the control room. Each channel contains the switches, test points, etc., necessary to test the channel.

Refer to the following BVPS Unit No. 1 documents: OST 1.24.2, 1.24.3, 1.24.4 and 1.24.5; MSP 24.01, 24.02, 24.03, 24.04, 24.05, 24.06, 24.07, 24.08, 24.09, 24.32, 24.33 and 24.34.

Actuation of safety injection, which subsequently initiates the AFS, cannot be tested at power by operation of the manual switch. The logic portion of this trip, however, is testable.

Auxiliary feed pumps are exercised monthly and are automatically started by test signal at each refueling cycle.

4.11 Channel Bypass

Present design permits any one ESF actuation channel to be maintained, tested, or calibrated during reactor operation with indication of the bypass condition in the control room (see Section 4.13). Administrative controls require that when any ESF channel is bypassed, its output bistable be put in the trip condition by its trip switch. The trip switch connects the output proving lamp to the bistable and disconnects (thus deenergizing) the bistable output relays in Train A and Train B cabinets. The ESF actuation bistable output relays are deenergized to actuate automatic initiation of the AFS. The ESF actuation circuits for auxiliary feedwater are 2-out-of-3 logic matrices. Placing any one channel in test reduces the logic matrices to 1-out-of-2, and thus continues to meet the single failure criterion.

4.12 Operating Bypass

There are no operating bypasses.

4.13 Indication of Bypass

Beaver Valley has an administratively controlled status board to provide control room indication of the availability of the AFS. The indications are in the form of a manually actuated back-lighted display at the system level indicating which auxiliary feedwater train is not operable as a result of bypassed or inoperable equipment.

If any analog channel in the ESF actuation system is taken out of service for any reason, the channel is placed in the tripped mode and a channel tripped status light is illuminated on the control board. When testing or maintenance is performed on the solid state logic protection racks, or on the associated test cabinet, an annunciator one per rack or cabinet, per train is actuated in the control room. Test circuitry prevents two ESF trains being tested at the same time, thus preventing the extension of the bypass condition to the redundant train.

Control room indication is provided for any auxiliary feedwater control valve (MOV-FW151A-F) not in the full open position. Common annunciators, one per train, will be installed during the next scheduled outage, but before July 1, 1981.

See drawings: 11700-RE-21PP, RE-21PS, RE-21PT, RE-21PU and RE-21PV.

4.17 Manual Initiation

Auxiliary feedwater may be manually initiated from the control room and from the shutdown panel. Each pump and valve has its own control switch.

The pump control circuits are wired so that the manual switch contacts at the control room and the shutdown panel are both in parallel with the automatic initiation contacts. Failure of the automatic signals and

4.17 Manual Initiation (continued)

circuits for the AFS will not result in the loss of manual capability to initiate the system from either the control room or the shutdown panel. A single failure, therefore, will not disable manual operation.

The automatic initiating signals enter the final actuated device as contact closures from either the reactor protection rack output relays (which isolate the upstream initiating instrumentation) or from the breaker auxiliary contacts in the case of the main feed pump trip signal.

The main feed pump trip initiating circuit will be upgraded to safety grade with the addition of auxiliary relays to provide isolation between the non-Class 1E main feed pump circuits and the Class 1E auxiliary feedwater pump circuits. The main feed pump trip initiating signal enters the final actuated device as a contact closure from the auxiliary relay which isolates the upstream main feed pump breaker auxiliary contacts. The auxiliary relays will be powered from the same respective Class 1E train as the auxiliary feed pump receiving their signals, but have dc control power circuit independent from the auxiliary feed pump breaker dc control power circuit. Qualified isolation relays will be installed during the next scheduled outage before July 1, 1981.

Remote manual control for the auxiliary feedwater to steam generator discharge valves (MOV-FW-51A-F) is provided in the control room and the shutdown panel. The valve control circuits are wired such that both the control room manual switch contacts and the shutdown manual switch contacts are in parallel with the automatic open contacts. These valves are normally open. Automatic open signals are being provided.

See drawings: 11700-RE-21HD, RE-21HE and RE-21HY.

B. Part 2 Auxiliary Feedwater System Flowrate Indication.

1. One auxiliary feedwater flow indicator and one wide range steam generator level indicator for each steam generator is provided in the control room and also at the shutdown panel.

2. The auxiliary feedwater flowrate indication satisfies the requirements set forth in NUREG-0737 as follows:

   a. Environmental Qualification

      As a result of the Beaver Valley Unit 1 response to IE Bulletin 79-01B environmentally qualified replacements for auxiliary feedwater flow transmitters and the Steam Generator Wide Range level transmitters are being procured. The transmitters will be replaced during the first outage following receipt of sufficient duration at which the plant conditions will permit their replacement but no later than June, 1982 consistent with the requirements of IE Bulletin 79-01B.

B. Part 2 Auxiliary Feedwater System Flowrate Indication (continued)

b. Power Source

Independent vital power supplies are utilized for flow transmitter FT-FW100 A, B, C. Additionally, all cabling has been routed to meet separation requirements. One channel of auxiliary feedwater flow indication is provided for each steam generator in the control room and also at the shutdown panel. The power supply for FT-FW100A is located in secondary process protection Rack A which is powered from 120 VAC vital bus 1 (Red); flow transmitter FT-FW100B is located in secondary process protect Rack D which is powered from 120 VAC vital bus IV (Yellow), and the power supply for flow transmitter FT-FW100C is located in secondary process protection Rack C which is powered from 120 VAC vital bus IV (Blue).

c. Periodic Testing

Auxiliary Feedwater Flowrate indication is periodically tested at each refueling cycle. Flow transmitter channels are calibrated every eighteen months per technical specification requirements.

d. Quality Assurance

Auxiliary feedwater flowrate indication is QA Category I and as such is included in the Duquesne Light Company corporate quality assurance program. (Refer to Part 1, Section 4.3.)

e. Display

Both auxiliary feedwater flowrate indication and steam generator wide range level indication are continuously displayed at the main control board (and shutdown panel) when the auxiliary feedwater system is in operation.

See drawings: 11700-RM-18A, RE-1U, RE-1AB, RE-1AC, and RE-21WS.