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September 7, 1984

United States Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Mr. George W. Knighton, Chief
Licensing Branch 3
Office of Nuclear Reactor Regulation

SUBJECT: Beaver Valley Power Station - Unit No. 2
Docket No. 50-412
PSB Electrical Outstanding Issues

Gentlemen:

This letter forwards responses to the issues listed below which were provided by PSB in a draft SER on June 8, 1984. FSAR Changes described in these responses are intended to be incorporated upon acceptance by PSB. The following items are attached:

Attachment 1: Response to Outstanding Issue 182 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.2.2.3.

Attachment 2: Response to Outstanding Issue 183 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.2.2.4.

Attachment 3: Response to Outstanding Issue 186 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.1.1.

Attachment 4: Response to Outstanding Issue 187 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.1.3, 8.3.1.8, 8.3.1.9, and 8.3.1.10.

Attachment 5: Response to Outstanding Issue 191 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.1.12.

Attachment 6: Response to Outstanding Issue 192 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.1.14.

Attachment 7: Response to Outstanding Issue 193 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.1.15.

Attachment 8: Response to Outstanding Issue 194 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.1.16.

Attachment 9: Response to Outstanding Issue 195 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Sections 8.3.1.17, 8.3.1.18, and 8.3.1.19.

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Attachment 10: Response to Outstanding Issue 196 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.3.1.2.

Attachment 11: Response to Outstanding Issue 197 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.3.3.1.

Attachment 12: Response to Outstanding Issue 197 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.3.3.2.

DUQUESNE LIGHT COMPANY

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

GLB/wjs
Attachments

cc: Mr. H. R. Denton, Director NRR (w/o attachment)
Mr. D. Eisenhut, Director Division of Licensing (w/o attachment)
Mr. J. Knox (w/attachment)
Ms. M. Ley, Project Manager (w/attachment)
Mr. E. A. Licitra, Project Manager (w/o attachment)
Mr. G. Walton, NRC Resident Inspector (w/o attachment)

COMMONWEALTH OF PENNSYLVANIA)
) SS:
COUNTY OF ALLEGHENY)

On this 5th day of September, 1984, before me, a Notary Public in and for said Commonwealth and County, personally appeared E. J. Woolever, who being duly sworn, deposed and said that (1) he is Vice President of Duquesne Light, (2) he is duly authorized to execute and file the foregoing Submittal on behalf of said Company, and (3) the statements set forth in the Submittal are true and correct to the best of his knowledge.

Anita Elaine Reiter
Notary Public

ANITA ELAINE REITER, NOTARY PUBLIC
ROBINSON TOWNSHIP, ALLEGHENY COUNTY
MY COMMISSION EXPIRES OCTOBER 20, 1986

ATTACHMENT 1

Response to Outstanding Issue 182 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.2.2.3: Independence of Offsite Power Circuits Between the Switchyard and Class 1E System

The Beaver Valley design provides two immediate access offsite circuits between the switchyard and the 4.16 KV Class 1E busses. It is the staff position that these two circuits be physically separate and independent such that no single event can simultaneously affect both circuits in such a way that neither can be returned to service in time to prevent fuel design limits or design conditions of the reactor coolant pressure boundary from being exceeded. The physical separation and independence of these two circuits had not been described or analyzed in the FSAR.

By Amendment 3 to the FSAR, the applicant, in response to a request for information, has provided a description of the routing or physical separation and independence of these two circuits. Based on the description, the staff concludes that these circuits are physically separated, meet the above staff position, the requirements of GDC 17, and are acceptable.

In regard to physical separation and independence of controls and protective relaying associated with these circuits, the applicant, in response to a request for information, addressed controls and relaying for 138 KV circuit breakers, the station service transformers, and the 5 KV cable bus. Control and relaying for 5 KV circuit breakers and Busses 2A, 2B, 2C, and 2D were not addressed in the applicant's response. This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to their report.

The description of physical separation of offsite circuits has not been included in Section 8.2 of the FSAR in accordance with the guidelines of Regulatory Guide 1.70, Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

At the closest point, the 5 KV cable bus routed between System Station Service Transformer (SSST) 2A and 4 KV bus 2A (which may feed emergency bus 2AE), is approximately 14 ft away from the 5 KV cable bus routed between SSST 2B and 4 KV bus 2D (which may feed emergency bus 2DF). At the closest point, the 5 KV cable bus routed between SSST 2A and 4 KV bus 2A, is approximately 2 ft away from the 5 KV cable bus routed between SSST 2A and 4 KV bus 2B. The same is true for the 5 KV cable bus routed between SSST 2B and 4 KV buses 2C and 2D, the two 4 KV buses which it supplies. (Refer to the attached drawing 12241-RE-29A which indicates cable bus routing.)

The feeder cables which connect emergency 4 KV bus *2AE with bus 4A and emergency 4 KV bus *2DF with bus 2D are routed in physically separate, dedicated conduits. All 4 KV buses are located in the Service Building, with 4 KV buses 2A and 2D on elevation 745'-6", and emergency 4 KV buses *2AE and *2DF on elevation 730"-6". At the closest point, the conduits between 2A and *2AE are approximately 14 ft from the conduits between 2D and *2DF. (Refer to attached drawings 12241-RE-42A, B, C, and D which indicate cable/conduit routing between Class 1E/non-Class 1E 4KV buses.)

Separate dedicated protective relaying and control circuits are provided for each of the 4 KV buses. Each 4 KV bus main circuit breaker is provided with a separate primary and backup trip for electrical faults, with each of the trip circuits supplied from a different DC source.

Control and relay circuits for the breakers feeding the two emergency 4 KV buses are Class 1E circuits, and are, therefore, independent from each other and from all other 4 KV feeder breaker control and relay circuits.

The above information, as well as our previous response to Question 430.7, which addressed separation of the offsite power circuits, will be added to FSAR Section 8.2.

simultaneously take out all incoming transmission lines or both 138 kV switchyard buses, the unit is designed to continue in operation, supplying station service power from the main generator. In the unlikely event of simultaneous loss of offsite power and unit generator power, the buses supplying the emergency systems are automatically transferred to onsite emergency power. All indoor equipment and circuits required to ensure isolation of the onsite emergency power systems from the offsite power systems are protected by enclosures designed to withstand damage from tornadoes or missiles.

8.2.2.2 Stability Considerations

Load flow and stability studies show that a full load trip of both Beaver Valley units, or a tripping of one unit with the other unit either online or offline, or the tripping of a transmission line, will not impair the ability of the preferred source to provide power to the Class 1E system.

Results of stability studies indicate that three-phase faults on the 345 kV and 138 kV systems will not impair the ability of the preferred source to provide power to the Class 1E system. The conditions studied include those faults which resulted in the loss of single circuits, two circuits, and complete bus sections. Both BVPS bus faults and far-end faults were considered.

For all of the tests that were run, generating units in the area were monitored for internal voltage angles, and non-faulted lines in the area were monitored for both watt and var flows. The unit angle swings, and the level of line flows indicated, preclude any hazard of additional line or unit trippings. For all cases, the BVPS units and the entire system proved stable and free of cascading.

8.2.2.3 Independence of Offsite Power Circuits Between the Switchyard and Class 1E System

ADD ATTACHMENT I HERE
(pgs. 8.2-7A, B, C & D)

NOTED AUG 14 1984 H.Marcus

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Attachment I - Pg 1 of 4

Question 430.7 (SRP 8.2)

~~The Beaver Valley design provides two immediate access offsite circuits between the switchyard and the 4.16 kV Class 1E busses. It is the staff position that these two circuits be physically separate and independent such that no single event can simultaneously affect both circuits in such a way that neither can be returned to service in time to prevent fuel design limits or design conditions of the reactor coolant pressure boundary from being exceeded. The physical separation and independence of these two circuits has not been described or analyzed in the FSAR. Provide the description and analysis and justify areas of noncompliance with the above staff position. The analysis should include separation and independence of control and protective relaying circuits as well as the power circuits.~~

~~Response~~:

¶ The two immediate access offsite circuits being addressed originate within the 138 Kv switchyard and end at the station 4,160 V ac power distribution system (refer to Figures 8.1-2 and 8.3-1 and IEEE Standard 308-1974, Figure 1). As depicted by Figure 8.1-2, and described in Section 8.1.4, the 138 kV switchyard is composed of two separate 138 kV buses, each of which provides power to one of the immediate access circuits (one circuit has sufficient capacity and capability to operate as a minimum the system equipment necessary to attain the performance requirements and affect the station conditions defined in GDC 17).

The principal components composing each of these circuits include a 138 kV switchyard bus, 138 kV disconnect switches, 138 kV circuit breaker, transmission line and supporting structures, a system station service transformer, 5 kV cable bus, and 4,160 volt switchgear.

~~Any analysis of these circuits, which follows, confirms the Staff's position as stated in the question above.~~

The two circuits are physically separated as follows: Within the switchyard, the 138 kV buses are separated 33 feet on center, the 138 kV circuit breaker and disconnect switches are spaced 45 feet on center. Immediately outside the switchyard, the transmission lines and towers are spaced 180 feet apart and the spacing increases from there to the respective destination system station service transformers. Figure 8.3-13 illustrates the independent locations provided in the siting of these two transformers. The transmission line spacing layout was specified such that any component failure in one line would not affect the opposite circuit.

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Pg. 8.2-7A

Attachment I - Pg 2 of 4 1

The 5 kV cable bus circuits, from the station service transformer secondaries to the 4,160 V switchgear buses located in the service building, at el 760'-6", approach the switchgear area destination from opposite directions, as follows. The circuit starting from transformer 2A is routed through the northeast corner of the turbine building (at el 766'-10") directly into the northeast side of the service building (at el 766'-10") and terminates at 4,160 V buses 2A and 2B on the north side of the service building and switchgear.

The alternate circuit, originating from transformer 2B, enters the 755'-6" elevation of the cable tunnel in the northwest area of the auxiliary building, traversing this tunnel from west to east, and passing through the cable vault and rod control area (at elevation 769'-3") and entering into the northwest side of the service building, elevation 773'-6", terminating at 4,160 V buses 2C and 2D.

The four 4,160 V buses are separated at the 760'-6" elevation of the service building such that the two access circuits do not come within ~~17~~ feet of one another.
14

Controls and relaying are provided for these circuits as follows: controls are provided for the 138 kV circuit breakers and the station service transformers. Protective relaying is provided for the 138 kV buses, the transmission lines, the station service transformers, and the 5 kV cable bus. To assure availability of these circuits, primary and backup trips are provided for electrical faults including separate and different dc sources for the protective functions and controls.

Separate cable routings are provided for these circuits, including the controls and protective circuits of the system station service transformers.

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NOTED AUG 14 1984 H.Marcus

PREPARER

REVIEWER NO. 1

REVIEWER NO. 2

LEAD ELECTRICAL ENG.

NOTED AUG 14 1984 H.Marcus

Attachment I - Pg 3 of 4

8.2.2.3 Independence of Offsite Power Circuits Between the Switchyard and Class 1E System

At the closest point, the 5KV cable bus routed between System Station Service Transformer (SSST) 2A and 4KV bus 2A (which may feed emergency bus 2AE), is approximately 14 ~~feet~~ away from the 5KV cable bus routed between SSST 2B and 4KV bus 2D (which may feed emergency bus 2DF). At the closest point, the 5KV cable bus routed between SSST 2A and 4KV bus 2A, is approximately 2 FT away from the 5KV cable bus routed between SSST 2A and 4KV bus 2B. The same is true for the 5KV cable bus routed between SSST 2B and 4KV buses 2C and 2D, the two 4KV buses which it supplies. Refer to attached drawing 12241-RE-29A which indicates cable bus routing.

The feeder cables which 2A connect emergency 4KV bus *2AE with bus 4A and emergency 4KV bus *2DF with bus 2D are routed in physically separate, dedicated conduits. All 4KV buses are located in the Service Building, with 4KV buses 2A and 2D on elevation 760'-6", and emergency 4KV buses *2AE and *2DF on elevation 730'-6". At the closest point, the conduits between 2A and *2AE are approximately 14 feet from ~~[illegible] the~~ the conduits between 2D and *2DF. Refer to attached drawings 12241-RE-42A, B, C, D which indicate cable/conduit routing between Class 1E/non-Class 1E 4KV buses.

Separate, dedicated protective relaying circuits are provided for each of the 4KV buses. Each 4KV bus main circuit breaker ~~[illegible]~~ is provided with ~~[illegible]~~ a separate primary and backup trips for electrical faults, with each of the

pg. 8.2-7C

NOTED AUG 1 5 1984 H.Marcus Attachment 1

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trip circuits supplied from a different DC source.

The above information as well as our previous response to Question 430.7 which addressed separation of the offsite power circuits have been added to Section 8.2 by Amendment.

Control and relay circuits for the breakers feeding the two emergency 4KV buses are Class 1E circuits and are therefore independent from each other and from all other 4KV feeder breaker control and relay circuits.

The circuit from each diesel generator (standby onsite circuit) to its class 1E 4KV bus is routed in separate, dedicated embedded conduit. The onsite circuits are routed through the floor from the diesel generator building, elevation 732'-6", to the emergency switchgear rooms in the service building, elevation 730'-6". The service building is directly southwest of, and adjacent to, the diesel generator building. (Refer to attached drawings 12241-RE-37BJ, 37V).

All four circuits (two onsite, two offsite) which feed the 4KV class 1E buses are, therefore, totally independent, with each circuit routed in a dedicated conduit. The circuits from the preferred offsite supply approach the class 1E buses from a higher elevation of the same building (service building, elevation 745'-6") and enter the switchgear at the top ~~above (service~~ [illegible]), while the circuits from the onsite supply approach the class 1E buses from an adjacent building (diesel generator building) through the floor, and enter the switchgear at the bottom.

P4.8.2-9 D

Each one of the circuits is also provided with a separate, independent control and relay circuit.

SEE APERTURE CARDS

*OVERSIZED DRAWINGS

(ADDITIONAL DOCUMENT PAGES FOLLOW)

APERTURE CARD NO# 8409210249

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ATTACHMENT 2

Response to Outstanding Issue 183 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.2.2.4: Independence Between Onsite and Offsite Power Sources

Each of the 4.16 KV Class 1E buses at Beaver Valley is supplied power from preferred offsite and standby onsite circuits. It is the staff position that these circuits should not have common failure modes. Physical separation and independence of these circuits has not been described or analysed in the FSAR.

The applicant by Amendment 3 to the FSAR did not provide a description or analysis that was requested. This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to the response provided for Open Item 182 and drawings 12241-RE-42A, B, C, and D which are attached to the response for a description of cable routing from the preferred offsite supply to each of the 4 KV Class 1E buses (*2AE and *2DF).

The circuit from each diesel generator (standby onsite circuit) to its Class 1E 4 KV bus is routed in separate, dedicated embedded conduit. The onsite circuits are routed through the floor from the diesel generator building, elevation 732'-6", to the emergency switchgear rooms in the service building, elevation 730'-6". The service building is directly southwest of and adjacent to the diesel generator building. (Refer to attached drawings 12241-RE-37BJ, 37V.)

All four circuits (two onsite, two offsite) which feed the 4 KV Class 1E buses are, therefore, totally independent with each circuit routed in a dedicated conduit. The circuits from the preferred offsite supply approach the Class 1E buses from a higher elevation of the same building (service building, elevation 745'-6") and enter the switchgear at the top, while the circuits from the onsite supply approach the Class 1E buses from an adjacent building (diesel generator building) through the floor and enter the switchgear at the bottom.

Each one of the circuits is also provided with a separate, independent control and relay circuit.

The above information will be added to FSAR Section 8.2.

SEE APERTURE CARDS

*OVERSIZED DRAWINGS

(ADDITIONAL DOCUMENT PAGES FOLLOW)

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ATTACHMENT 3

Response to Outstanding Issue 186 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.3.1.1: Voltage Analysis for Safety-Related Loads

The voltage levels at the safety-related loads 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. The applicant was requested to perform a voltage analysis and verification by actual measurement in accordance with the guidelines of positions 3 and 4 of branch technical position PSB-1 (NUREG-0800, Appendix 8A).

By Amendment 3 to the FSAR, the applicant indicated that the requested analysis would not be completed before March 15, 1984. Review schedule for subimittal of the analysis, verification of the analysis by actual measurement, and justification for voltages (as determined by analysis) not meeting the specific voltage supply tolerances specified by equipment manufacturers, will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

As discussed in the response to Question 430.11 in Amendment 3 to the FSAR, a voltage and load analysis has been completed for the BVPS-2 system (calculation E-68 entitled "Station Service Voltage and Load Analysis"). The analysis examines voltages at 4,160 V and 480 V load center buses, 480 V MCC buses, and at the terminals of 4,160 V and 480 V load center-connected loads for both Class 1E and non-Class 1E equipment. The calculations have been performed for both onsite (unit) power supply, with the unit generator operating at minimum, nominal, and maximum voltage, and for offsite (system) power supply, with the system switchyard at minimum and maximum voltage, in accordance with position 3 of BTP PSB-1, under the following conditions of operation:

a. Normal station load
b. Start of largest station 4,160 V motor
c. Start of largest station 460 V motor
d. Accident load with safety injection signal (offsite supply only)
e. Transfer from normal station load, onsite supply, accident load, and/or offsite supply upon accident with safety injection signal

Refer to the attached "Objective" and "Conclusion" summaries which have been excerpted from the calculation.

A voltage and load analysis for light load cases (cold shutdown and refueling) are now being performed and will be completed by March 15, 1985.

For all conditions as described above, manufacturer voltage tolerance for all Class 1E equipment will be met.

Currently, we are performing voltage analyses for terminal voltages at Class 1E 480 V MCC loads, the Class 1E 120 V AC system, and the Class 1E 125 V DC system in accordance with the following schedule:

1. Terminal voltages at Class 1E 480 V MCC loads -- 12/31/84
2. Class 1E 120 V AC loads -- 3/15/85
3. Class 1E 125 V DC loads -- 3/15/85

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CALCULATION IDENTIFICATION NUMBER				
J.C. OR W.O. NO. 12841	DIVISION & GROUP	CALCULATION NO. E-68	OPTIONAL TASK CODE	PAGE 3 of 311

Objective: To determine the voltage profiles for the Beaver Valley Power Station Unit 2 electrical distribution system for the following operational scenarios for normal and postulated accident conditions:

CASE	OPERATIONAL SCENARIO	COMPUTER RUN ID
Ⓐ	Normal Full Load on USS Transformers; Main Generator Voltage at 1.0 P.U. (22KV)	401
Ⓑ	Normal Full Load on USS Transformers; Main Generator Voltage at 1.05 P.U.(23.1KV)	402
Ⓒ	Normal Full Load on USS Transformers; Main Generator Voltage at 0.95 P.U. (20.9KV)	403
Ⓓ	Start 4.16KV, 6000HP Reactor Coolant Pp. (2RCS-P21A); Normal Full Load on USS Transformers; Main Generator Voltage at 0.95 P.U. (20.9KV)	405
Ⓔ	Start 4.16 KV, 6000HP Reactor Coolant Pp. (2RCS-P21A); Normal Full Load on USS Transformers; Main Generator Voltage at 1.0 P.U. (22KV)	409
Ⓕ	Start 460V, 300HP Containment Circ. Fn. (2HVR*FN201A); Normal Full Load on USS Transformers: Main Generator Voltage at 0.95 P.U. (20.9KV)	—
Ⓖ	Normal Full Load on SSS Transformers; 138 KV Switchyard (SWYD) min (0.983PU, 135.65KV)	420
Ⓗ	Xfer Normal Full Load from USS to SSS Transformers; 138 KV SWYD at Maximum (1.018 P.U., 140.48KV)	421
Ⓙ	Start 4.16KV, 6000HP Reactor Coolant Pp. (2RCS-P21A); Normal Full Load on SSS Transformers; 138KV SWYD at minimum (0.983 P.U., 135.65KV)	423
Ⓚ	Start 4.16 KV, 6000HP Reactor Coolant Pp. (2RCS-P21A) Normal Full Load on SSS Transformers; 138 KV SWYD at maximum (1.018 P.U., 140.48KV)	—
Ⓛ	Containment Isolation Phase A/Safety Injection Signal (CIA/SIS) Accident w/offsite Pwr; Accident Load On SSS Xfmrs w/138 KV SWYD max (1.018 PU, 140.48KV)	450
Ⓜ	CIA/SIS Accident w/offsite Pwr; Accident Load on SSS Xfmrs w/138 KV SWYD min (.983 P.U., 135.65 KV)	451
Ⓝ	CIA/SIS Accident w/offsite Pwr; Xfer from Normal Full Load on USS Xfmrs to Accident Load on SSS Xfmrs w/startup/shutdown of station loads as required; 138 KV SWYD max (1.018 P.U., 140.48KV)	—

OI 186-4

5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 10
12241		E-68		of 311

Conclusion:

For all postulated conditions, with the exception of Case Ⓓ (start of 4.16 KV, 6000 HP Reactor Coolant Pump, generator voltage at 0.95 P.U.), the system provides acceptable voltage profiles in accordance with project voltage criteria as indicated on Page 21 of this calculation. It should be noted that all scenarios postulated represent "worst case" loading of the system; if a load may operate during a postulated scenario, it is assumed to be operating. Also, where there is an "A" load on one bus and a "B" load on another, with only one of the two loads required, the "A" load is always assumed to be running. Since these assumptions correspond to maximum bus loads and maximum imbalance, loads may be somewhat lighter and more well balanced during actual plant operation. The results would be improved voltage profiles over those calculated for the analyzed scenarios.

In Case Ⓓ, in addition to unacceptably low voltages at certain buses and motors, the voltage at the Reactor Coolant Pump motor itself drops to below 80% of nominal, which indicates that the motor may not start under the conditions postulated. Additional cable will not correct the low motor terminal voltage as the voltage of the bus feeding the motor (BUS 2A) also appears to drop below 80% of 4160 V.

The above scenario anticipates the required restart of an RCS pump while the plant is running at otherwise normal full load conditions, with the generator at 0.95 P.U.. This is the same scenario as postulated in Case Ⓔ, except that for Case Ⓔ the generator voltage is at 1.0 PU. In Case Ⓔ, however, voltages of the system are in accordance with the project guidelines. Therefore, we recommend that DLC consider a procedure to raise the generator voltage to 1.0 PU momentarily whenever it is required to start an RCS pump on a loaded 4160V bus.

OI 186-5

In Case Ⓑ (Normal full load on USST, generator voltage at 1.05 PU), high voltages at certain 480V substation and MCC buses indicate that operation at "light load" conditions may result in excessively high terminal voltages at certain motors. This may require that the generator voltage be limited to somewhat less than 1.05 pu for this condition

ATTACHMENT 4

Response to Outstanding Issue 187 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.3.1.3, 8.3.1.8, 8.3.1.9, and 8.3.1.10: Diesel Generator Testing

SER 8.3.1.3: Load Testing of the Diesel Generator

Section 8.3.1.1.16 of the FSAR indicates that safety related motors are designed with the capability of accelerating the driven equipment to its rated speed with 80 percent of motor nameplate voltage applied at the motor terminals. Section 8.3.1.1.15 of the FSAR indicated that the design of each diesel generator unit is such that at no time during the loading sequence does the voltage decrease to less than 75 percent of nominal.

By Amendment 3 to the FSAR, the applicant, in response to a request for additional information, indicated that data extrapolated from diesel generator load tests implied that 79.3 percent versus 75 percent is the largest voltage drop to be expected during the diesel generator load sequence. Testing of the diesel generator using actual load and loading sequence to demonstrate the voltage will not drop below 80 percent will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response to 8.3.1.3:

Refer to the response provided for Question 430.23, Amendment 3, to the BVPS-2 FSAR. A momentary dip in generator voltage below 80 percent of nominal during load sequencing does not indicate that a motor with 80 percent start capability will fail to accelerate its driven equipment to rated speed. As stated in our response, "This transient voltage dip may delay the start of some motors momentarily. However, since all Class 1E motors have safe stall times considerably longer than the expected transient recovery time, this potential starting delay has no significant effect on the availability or performance of the motors." Furthermore, the extrapolated generator voltage dip to 79.3 percent of nominal applies to the start of the 1,250 hp standby service water pump, which is not a Class 1E load (refer to Open Item No. 195, Section 8.3.1.17).

All of the BVPS-2 Class 1E motors are 900 hp or less. As stated in our response to Question 430.23, actual load tests conducted on the BVPS-2 diesel generator sets using a 1,000 hp motor resulted in a minimum recorded voltage of 85 percent. Therefore, we would anticipate a minimum momentary generator voltage greater than 85 percent of nominal upon the start of any of the BVPS-2 Class 1E loads.

The ability of the BVPS-2 diesel generator sets to start and accelerate all of their required loads in accordance with the established loading sequence will be demonstrated in the field by actual test with plant loads. The voltage at the generator terminals will be monitored with a recording oscilloscope. It will be shown that for any case in which the generator voltage dips below 80 percent of nominal, the recovery time plus the load acceleration time is less than the safe stall time of the load.

SER 8.3.1.8: Diesel Generator Start and Load Acceptance Qualification Tests

Section 6.3.2 of IEEE Standard 387-1977 requires that a series of tests be conducted to establish the capability of the diesel generator unit to start and accept load within the period of time to satisfy the plant design requirements. By Amendment 3 to the FSAR, the applicant documented that the diesel generator voltage and frequency were monitored, recorded, and verified when starting the unit and applying a 50 percent load for each of the 300 start-load tests in full compliance with IEEE Standard 387-1972. In regard to this item, the following items will continue to be pursued with the applicant:

1. Testing to the 1972 versus 1977 versions of IEEE Standard 387
2. Definition for specified frequency, voltage, and required time interval
3. Conformation of test results

The results of the staff review of these items will be reported in a supplement to this report.

Response to 8.3.1.8:

1. The last paragraph of Section 8.3.1.1.15.9.o, Amendment 3, should have stated "full compliance with IEEE Standard 387-1977" not IEEE 387-1972. The FSAR will be amended to incorporate this. Start and Load Acceptance Qualification Testing of the BVPS-2 emergency diesel generators was performed in accordance with the procedure established in Section 6.3.2 of IEEE Standard 387-1977, entitled "Start and Load Acceptance Qualification." A total of 270 starts were performed with the diesel generator set at warm standby jacket water and lube oil temperatures. After application of 50 percent load, the diesel generator set continued to operate until jacket water and lube oil temperatures were within ±5°F of the normal engine operating temperatures for the applied load. This is more severe than the ±10°F tolerance specified by Paragraph 3 of IEEE Standard 387-1977, Section 6.3.2. A total of 30 starts were performed with the diesel generator set, jacket water, and lube oil temperatures within ±5°F of normal operating temperature equilibrium. This is also more restrictive than the ±10°F tolerance specified by Paragraph 4 of IEEE Standard 387-1977, Section 6.3.2. As stated in Section 8.3.1.1.15, the results of this testing were acceptable.

2. Generator voltage and frequency requirements upon loading are as defined in Regulatory Guide 1.9, Section C.4. Load step time intervals are as required by the NSSS supplier. Load step times are as defined on the last page of Table 8.3-3.

3. All testing specified in Sections 6.2 and 6.3 of IEEE Standard 387-1977 was performed with the exception of the 2 hour short time/22 hour continuous rating test specified in Section 6.3.1 of the Standard. Test requirements met or exceeded those stated in IEEE Standard 387-1977 (refer to 1 above and to Open Item No. 187, Section 8.3.1.10). All test results were in conformance with test requirements. The 2 hour short time/22 hour continuous rating test will be performed on site, as stated in Section 8.3.1.2, and reconfirmed by our response to Open Item No. 187, Section 8.3.1.9.

SER 8.3.1.9: Diesel Generator Load Capability Qualification Test

Section 6.3.1 of IEEE Standard 387-1977 requires that one test be conducted to demonstrate the capability of the diesel generator to carry and reject rated loads. By Amendment 3 to the FSAR, the applicant, in response to a request for information, indicated that these tests were not performed by the manufacturer but will be performed after installation of the diesel generators at the plant site. Confirmation of these test results will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response to 8.3.1.9:

The load rejection portion of the Load Capability Qualification Test, as specified in IEEE Standard 387-1977, has been performed by the manufacturer of the diesel generator sets, as stated in Section 8.3.1.1.15, Item e. The load carrying portion of the test will be performed on site as stated in Section 8.3.1.2, entitled "Compliance with Regulatory Guide 1.9." Loading will be applied in the order specified in Section C.14 of Regulatory Guide 1.9 (2 hour short-time load capability run followed by 22 hour full load test) rather than the order specified in Section 6.3.1 of IEEE Standard 387-1977 (22 hour full load test followed by 2 hour short-time load). This information will be added to Section 8.3.1.1.15 of the FSAR.

SEI 8.3.1.10: Margin Qualification Test

Section 6.3.3 of IEEE Standard 387-1977 requires at least two margin tests to demonstrate diesel generator capability to start and carry loads that are greater than the most severe step load change within the plant design loading sequence. By Amendment 3 to the FSAR, the applicant did not provide the requested description as to how the Beaver Valley testing meets the margin test requirements of Section 6.3.3 of IEEE Standard 387-1977. This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response to 8.3.1.10:

Margin testing of the BVPS-2 diesel generator units was performed as stated in Section 8.3.1.1.15 of the BVPS-2 FSAR. For the motor starting test portion of the margin test, it was demonstrated that the unit could successfully start a 1,750 hp motor while the unit was carrying a load equal to 50 percent of its rated load. For the BVPS-2 load sequence, the largest single load step block in the loading sequence is approximately 1,300 hp total step load. The 1,750 hp motor used for the margin test represents a 35 percent margin above the most severe single step load within the design load sequence. This exceeds the requirements of IEEE Standard 387-1977 Section 6.3.3, which requires only a 10 percent load test margin. Section 8.3.1.1.15, Paragraph m, of the FSAR is being amended to include this information.

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8. Control system

The diesel generator starting mode selector switch has auto/local positions and is normally in the auto mode position. It is in the local position for local manual starting during maintenance and non-routine testing. If the switch is not returned to the remote position, an alarm in the main control room persists until the switch is returned to the automatic mode. Other manual controls of the auxiliary systems of the diesel generator are also alarmed if failure to return to their auto-start position would inhibit automatic operation of the diesel generators.

Dc power required by each diesel generator for controls, alarms, protective relays, air starting solenoid valves, and generator field flashing is supplied by the Class 1E dc system of the associated train.

9. Prototype qualification testing

Diesel generator units supplied for BVPS-2 are similar to those previously qualified by Alabama Power Company; however, qualification by similarity was not pursued. Verification of suitability of the diesel generator units was made by performing the following tests, which meet the requirements of the engine qualification and load acceptance tests of IEEE Standard 387-1972 and Regulatory Guide 1.108.

387-1977

Each diesel generator unit has successfully passed the following series of system acceptance tests performed at the factory as part of the manufacturer's extensive test program:

a. Fast start capability

This test requires the engine be capable of accelerating to rated speed and full voltage and be ready to accept load in its rated capacity within 10 seconds.

Performance of the diesel generator units met the acceptance criteria.

b. Sequential step load acceptance capability test

This test requires the diesel generator unit accelerate to rated speed and voltage and be ready to accept load within 10 seconds from receipt of start signal. When loaded in accordance with the loading table, the voltage was not less than 75 percent of nominal and frequency was not less than 95 percent of nominal for motor loads up to 1,670 hp. The largest motor

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Performance of the diesel generator units met the acceptance criteria.

m. Motor starting test portion of margin test

This test requires the diesel generator unit be capable of accepting the resistive and motor loads:

1) Without experiencing instability resulting in generator voltage collapse or significant evidence of the failure of the voltage to recover, and

2) Demonstrate that there is sufficient torque available to prevent engine stall and to permit engine speed to recover.

Performance of the diesel generator units met the acceptance criteria.

X

— Replace with Paragraph F, Pg. 8.3-43A

n. Operation on hydraulic governor test

This test demonstrates that the engine continues to operate and carry load in response to a step load change, without a frequency change in excess of a determined setting on the hydraulic case dial.

Performance of the diesel generator units met the test criteria.

o. Variable load run

This test requires the variable load run be demonstrated according to the following parameters:

Load (%)	bhp	Brake Specific Fuel Consumption (lb/bhp-hr)
50	2,950	0.374
75	4,425	0.366
100	5,900	0.375

Performance of the diesel generator units met the acceptance criteria.

The vendor also performed a series of 270 keep warm starts and 30 hot starts, which were performed on one unit and which met the test criteria for the 300 start test of no more than one failure per 100 sequential starts. The load applied was a single step resistive load equal to or greater than 50 percent of the generator nameplate continuous kW rating. Upon ✓

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Paragraph A

¶ It was demonstrated that the unit could successfully start a 1,750 HP motor while the unit was carrying a load equal to 50 percent of its rated load. For the BVPS-2 load sequence, the largest single load step block in the sequence is approximately 1300 HP total step load. The 1750 HP motor used for the margin test represents a 35 percent margin above the most severe single step load within the design load sequence. This exceeds the requirements of IEEE 387-1977, Section 6.3.3 which requires only a 10 percent load test margin.

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loading, the diesel generator set was allowed to continue to operate until the jacket water and lube oil temperatures were within 5°F of the normal engine operating temperature for the corresponding load.

The diesel generator voltage and frequency were monitored, recorded, and verified when starting the unit and applying a 50 percent load for each of the 300 start-load tests in full compliance with IEEE Standard 387-1972 — 387-1977

← PUT PARAGRAPH B HERE → Pg. 8.3-44A

10. Operating procedures, maintenance, and training

    a. Operating procedures for diesel generators provide assurance that diesel generator reliability and operation will not be degraded. In particular, procedures include appropriate restrictions on no-load operation and adequate provisions for post-maintenance checkout and testing to assure operability and return to required standby service.

    b. A preventive maintenance program for the diesel generators provides for adequate testing, which is generally in accordance with IEEE Standard 308-1971, and replacement of identified malfunctioning components, with particular attention to assuring repeated malfunctioning components are replaced with other components of proven reliability.

    c. A training program for diesel generator operations and maintenance personnel exists to assure an adequate level of personnel experience, which assures a high degree of diesel generator reliability and availability.

8.3.1.1.16 Class 1E Equipment Design Criteria

1. Motor

    a. Motor Size

    Safety-related motors are sized to develop sufficient horse power to drive the mechanical load under runout or maximum flow and pressure, whichever is greater, and to permit the driven equipment to develop its specified capacity without exceeding the temperature rise rating of the motor when operated at the duty cycle of the driver equipment. Safety-related motors are, in general, provided with a 1.15 service factor and sized to handle the driven equipment requirements without encroaching on the service factor during normal operating conditions. Precautions are taken to ensure

Paragraph B

p. Load Capability Qualification Test

This test demonstates the DIESEL engine's ability to accept and reject loads. The test is specified in IEEE STANDARD 387-1977 and Regulatory Guide 1.9.

The load rejection portion of the test has been performed by the manufacturer as stated in Paragraph e above.

The load carrying portion of the test will be IS performed on site. Loading will be IS applied in the order specified in Section C.14 of Regulatory Guide 1.9 (2 hour short-time load capability run followed by 22 hour full load test) rather than the order specified in Section 6.3.1 of IEEE STANDARD 387-1977 (22 hour full load test followed by 2 hour short-time load.)

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ATTACHMENT 5

Response to Outstanding Issue 191 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report

Draft SER Section 8.3.1.12: Design for Power Removal for Selected Safety Related Valves

Table 8.3-5 of the FSAR identifies valves from which power is to be removed in order to meet the single failure criteria. By Amendment 3 to the FSAR, the applicant indicated that removal of a banana plug located in the control room provides the necessary power removal and will prevent inadvertent operation of the valves. Details of the design for power removal will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

As depicted on the attached elementary diagrams, a banana plug scheme will be used by main control room personnel to complete or disconnect the control circuits for the following MOV's:

2SIS*MOV865A (AO)
2SIS*MOV865B (BP)
2SIS*MOV865C (CP)
2CHS*MOV8132A (ZO)
2CHS*MOV8132B (ZP)
2SIS*MOV869B (BP)
2CHS*MOV311 (Z-)
2SIS*MOV869A (AO)
2CHS*MOV8133A (ZO)
2CHS*MOV8133B (ZP)
2SIS*MOV841 (ZP)
2SIS*MOV8889 (ZP)
2SIS*MOV836 (AO)
2HVR*MOD25A (-O)
2HVR*MOD25B (-P)

Additional description for the power removal is provided in FSAR Section 7.6.4.

SEE APERTURE CARDS

*OVERSIZED DRAWINGS

(ADDITIONAL DOCUMENT PAGES FOLLOW)

APERTURE CARD NO# 8409210291

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ATTACHMENT 6

Response to Outstanding Issue 192 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.3.1.14: Automatic Reclosure of 4160 Volt Circuit Breakers After Manual Trip

Section 8.3.1.1.3 of the FSAR implies that when a Class IE 4,160 V circuit breaker is tripped manually while a safety injection signal is present, the breaker control scheme is such that automatic reclosure will occur.

In order to understand how this automatic reclosure design may affect operation of other safety systems, the following items will be pursued with the applicants:

a. details of the design for automatic reclosure
b. the extent and purpose of the design
c. justification for bypass of anti-pump design feature
d. design provisions to preclude automatic reclosure during diesel generator operation or analysis which demonstrates that overload of diesel generator will not occur

The results of the staff review will be reported in a supplement to this report.

Response:

The statement: "If a Class 1E 4,160 V circuit breaker is tripped during a DBA while a safety injection signal is present, the breaker control scheme is such that automatic reclosure will occur provided that the automatic trip signal is not present," was not meant to imply that 4,160 V Class 1E breakers are normally tripped on a safety injection signal. The intent of the statement was to indicate that if a Class 1E 4,160 V circuit breaker is tripped by a protective relay, during a DBA with a safety injection signal present, the breaker will reclose automatically only if the fault condition is cleared.

Section 8.3.1.1.3 is being amended to clarify the operation.

(851)

Physical separation of the emergency buses, tie lines, and switchgear is detailed in Section 8.3.1.1.6. Each 4,160 V Class 1E bus supplies one 480 V Class 1E bus through a 1,500/2,000 kVA dry type AA/FA transformer.

There are no manual or automatic connections between redundant Class 1E buses. Physical separation and electrical isolation of redundant safety class buses, including connections to redundant electrical loads, are maintained throughout all voltage levels.

8.3.1.1.3 Loads Supplied From Each Bus

Table 8.3-1 summarizes the principal loads powered from the Class 1E and non-Class 1E buses. All redundant Class 1E loads are powered from separate Class 1E buses (Figure 8.3-1).

All 4,160 V emergency loads are powered via stored energy circuit breakers that provide circuit protection by interrupting an overcurrent condition, as detailed in Section 8.3.1.1.11. Control power for each 4,160 V Class 1E breaker is supplied from the associated Class 1E 125 V dc distribution system. The 125 V dc system is detailed in Section 8.3.2. Selected Class 1E 4,160 V circuit breakers may be operated remotely from the control board in the main control room (el 735 ft-6 in, control building), or from the emergency shutdown panel in the communications room (el 707 ft-6 in, control building). In addition, selected 4,160 V Class 1E circuit breakers, associated with one safety train (Train A - orange), may be operated remotely at the alternate shutdown panel, as further described in Section 9.5.1. Each 4,160 V Class 1E breaker may also be operated manually at the switchgear (el 735 ft-6 in, service building, Figure 8.3-4). If a Class 1E 4,160 V circuit breaker is tripped during a DBA while a safety injection signal is present, the breaker control scheme is such that automatic reclosure will occur provided that the automatic trip signal is not present. All automatic trip signals to 4,160 V emergency loads energize an annunciator in the main control room to alert the control room operating staff.

If a Class 1E 4,160V circuit breaker that is required to operate during an SI is tripped by a protective relay when the safety injection signal is present, the breaker will reclose automatically only if the fault condition is cleared and the lockout relay has been manually reset.

o.K. JRC

The Class 1E 480 V system consists of two independent 480 V unit substations supplied from the 4,160 V Class 1E buses. Each substation in turn powers 480 V Class 1E motor control centers (MCCs), which are conveniently located throughout the station, qualified and protected for their environment. All the 480 V engineered safety systems are powered either directly from the 480 V unit substation or from the 480 V MCCs.

Safety class equipment supplied from the Class 1E 480 V MCCs includes the pressurizer relief and block valves 2RCS*MOV 535, 536, and 537 (Table 8.3-3). Consequently, this equipment is capable of being supplied from either the offsite power source, or the emergency diesel generators when the offsite source is not available, as

ATTACHMENT 7

Response to Outstanding Issue 193 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.3.1.15: Design Provisions for the Use of Replacements for Class 1E Loads

> Section 8.3.1.1.4 and Table 8.3-3 of the FSAR indicates that for a number of Class 1E loads, there is a replacement load provided to allow maintenance to be performed while satisfying the single failure criterion. The Beaver Valley design is such that the Class 1E load and its replacement may be connected to the same Class 1E power supply at the same time. It is the staff concern that this simultaneous connection of loads will exceed the capacity of the Class 1E power supplies. Identification of loads involved and design provisions to preclude simultaneous connection will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to Section 8.3.1.1.4 and Figures 8.3-6, 8.3-7, and 8.3-8 for a description of the use of replacements ("swings") for Class 1E loads and provisions to prevent bus ties.

Cables (green) supplying swing equipment, from the transfer switch to the equipment, are not only routed independently from both safety trains, but also independently from each other. This ensures the indepencence of both safety trains regardless of the trains to which any of the motors are connected.

ATTACHMENT 8

Response to Outstanding Issue 194 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.3.1.16: Connected Accident Loading Exceeds Capacity of the Diesel Generator

> Section 8.3.1.1.7 of the FSAR states that the diesel generator units are designed and manufactured so that the capacity of each diesel generator unit is sufficient to start and accelerate all connected loads to their rated condition in the specified time sequence. Based on the connected loading presented in Table 8.3-3 of the FSAR and the diesel generator rating presented in Section 8.3.1.1.15 of the FSAR, it appears that the connected loading exceeds the rated capacity of 4238 KW. A detailed analysis of the loading and design provisions provided to preclude having the load exceed 4238 KW will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

> Refer to the response provided for Draft SER Open Item No. 189, which revises the diesel generator total loading in Table 8.3-3 to 4,211 KW, which is below its 4,238 KW continuous rating.

ATTACHMENT 9

Response to Outstanding Issue 195 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report

Draft SER Section 8.3.1.17, 8.3.1.18, and 8.3.1.19: Connecting non-Class 1E Loads with Class 1E Loads

SER 8.3.1.17 Design for Connecting Non-Class 1E Standby Service Water Pumps on the Class 1E System

Section 8.3.1.1.8 of the FSAR indicates the following in regard to the non-Class 1E standby service water pumps when there is a safety injection signal:

a. Non-Class 1E loads are stripped and blocked from starting with the possible exception of the standby service water pump motors. If these motors are running, they will not be tripped.

b. During the automatic loading sequence of safety loads, the standby service water pumps will be blocked from starting until the automatic loading sequence is complete.

Clarification of the design for the loading of the non-Class 1E standby service water pumps onto the Class 1E power supples and its purpose will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

By Table 8.3-2 of the FSAR, the design for the non-safety alternate intake structure exhaust fan load appears to be the same or similar as that of the standby service water pump load. Clarification for the loading of this non-Class 1E load onto the Class 1E system and its purpose will also be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response to 8.3.1.17:

Refer to Section 9.2.1.2 for a detailed description of the design and operation of the Standby Service Water System. Also refer to Chapter 2, Sections 2.2.3.1, 2.2.3.1.4, 2.2.3.1.5, and 2.2.3.2 for a discussion of the Design Basis Events for which the Standby Service Water System was designed.

The electrical design of the Standby Service Water System meets the requirements of Regulatory Guide 1.75. As stated in Section 8.3.1.1.8, during the automatic loading sequence of safety loads, the standby service water pumps will be blocked from starting until the automatic loading sequence of the emergency diesel generators is complete. Loading of the standby service water pumps onto the Class 1E system upon completion of the automatic loading sequence is by manual action only.

The statement in Section 7.3.1.1.8 that "... non-Class 1E loads connected to the emergency buses will be stripped and blocked from starting, with the possible exception of the standby service water pump motors. If these ..." refers to a safety injection shignal without loss of power only. An amendment will be made to the FSAR to include this clarification.

The above also applies to the alternate intake structure exhaust fans, that are part of the standby service water system and are tripped during an SI electrically disconnecting them from their respective Class 1E MCC buses. Power cables for the standby service water pumps are color coded similar to Class 1E circuits from the safety-related buses to the pump motors as stated in Section 8.3.1.1.3, Item 1.

SER 8.3.1.18 Loading of the RHR Pump onto the Diesel Generator

Table 8.3-3 of the FSAR indicates that the RHR pumps are not needed for DBA mode of operation and are not needed for four hours after a loss of offsite power or after loss of offsite power with a safety injection signal. Specific reference to RHR system description in the FSAR and justification for this power availability to RHR pumps will be pursued with the applicant and coordinated with the Reactor Systems Branch. The results of the staff review will be reported in a supplement to this report.

Response to 8.3.1.18:

Availability of the RHR pumps is not required to take the plant from hot standby to cold shutdown conditions, therefore, the RHR pump motors are non-Class 1E equipment. For a complete description of the RHR system, refer to Section 5.4.7 entitled "Residual Heat Removal System." The "Cold Shutdown" portion of Section 5.4.7.2.3 describes the procedure to take the plant from hot standby to cold shutdown conditions without the availability of the RHR pumps.

The electrical design for the RHR pumps meets the requirements of Regulatory Guide 1.75. Upon loss of offsite power, the RHR pumps are blocked from starting until the automatic loading sequence of the emergency diesel generator sets has been completed. Loading of the RHR pumps onto the Class 1E system upon completion of the automatic loading sequence is by manual action only.

SER 8.3.1.19 Automatic Reconnection of Non-Safety Loads After Loss of Offsite Power

Table 8.3-3 of the FSAR indicates that the non-Class 1E pressurizer heater backup load is automatically reconnected to the Class 1E system after a loss of offsite power. The staff has been accepting design wherein non-Class 1E loads were reconnected manually after loss of offsite power as well as after an accident signal. Justification for non-compliance with the accepted practice will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response to 8.3.1.19:

The electrical design for the non-Class 1E pressurizer heater backups is in accordance with the requirements of Regulatory Guide 1.75. Upon loss of offsite power, these loads are blocked from starting until the automatic loading sequence of the emergency diesel generators has been completed. Loading of the pressurizer heater backups on to the Class 1E system upon completion of the automatic loading sequence is by manual action only.

Table 8.3-3 does not indicate that the pressurizer heater backups are automatically reconnected to the Class 1E system after a loss of offsite power. The purpose of the table is to indicate any loads which may be connected to the Class 1E system after a loss of offsite power, either automatically (Class 1E) or manually (non-Class 1E). Automatic loading of the Class 1E system after a loss of offsite power is accomplished in sit steps, which are sequentially numbered 1 through 6. Therefore, any load in Table 8.3-3 with a number (1 through 6) in the "Start Step" column is automatically loaded during the step number indicated. Any load for which "TD" is listed in the "Start Stop" column, must be manually loaded after completion of the automatic loading sequence at the approximate time indicated under the "Time Delay" column.

Also refer to the response provided for Question 430.39, Amendment 3, in which it addressed separation of the pressurizer heater power.

When the emergency diesel generator attains rated voltage and frequency, the diesel generator supply breaker will be closed and the reconnection of loads will commence, sequentially, in specified load blocks (Table 8.3-3).

In the event a safety injection signal occurs, the diesel generator unit corresponding to the developed safety injection system train signal will automatically start and non-Class 1E loads connected to the emergency buses will be stripped and blocked from starting, with the possible exception of the standby service water pump motors. If these pumps are running, they will not be tripped (Table 8.3-2). Automatic loading or load shedding actions will occur, depending upon the status of the normal ac station service power system as follows:

1. If the normal power source (unit station service transformers) is lost (Figure 8.3-1), the entire Class 1E and non-Class 1E running station load, except the steam generator feedwater pumps, will be fast-transferred to the preferred (offsite) power source. When the transfer is completed (approximately 8 cycles), the total required emergency load (4,160 V and 480 V) will be simultaneously started.

2. If the offsite source is not available or is lost during the safety injection signal event (the fast-transfer fails to occur and/or the offsite source is not available or the bus is degraded below 90 percent of 4,160 V for a sustained period of time, Section 8.3.1.1.11.7), all bus loads are stripped and the normal bus tie opened, as described previously in automatic-control action items 1, 2, and 3, and the diesel generator (when at rated voltage and frequency) output breaker is closed onto the bus. The automatic control actions will be conditional upon a bus fault not existing on the bus. Two levels of undervoltage protection are provided. The first level detects the complete loss of power. The second level detects a degraded voltage condition which, if not improved within 1 minute, initiates the control actions described previously. With bus voltage reestablished, the required safety class loads will be sequenced onto the bus (Table 8.3-3). During the automatic loading sequence of safety loads, the standby service water pumps will be blocked from starting until the automatic loading sequence is complete.

[illegible] If [illegible] available and these [illegible]

The loading sequences for the loss of offsite power (LOOP) event without a safety injection signal and a LOOP event with a safety injection signal are the same.

The undervoltage relays that detect undervoltage on the emergency 4,160 V buses are located in the safety class switchgear and are described in Section 8.3.1.1.11.

ATTACHMENT 10

Response to Outstanding Issue 196 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report

Draft SER Section 8.3.3.1.2: Design, Qualification and/or Protection of Class 1E Equipment from Natural Phenomena

Sections 8.3.1.2 and 8.3.2.2 of the FSAR states, in regard to compliance with General Design Criterion (GDC) 2 of Appendix A to 10CFR50, that Class 1E ac and dc systems are housed in structures that are designed to, and are capable of, withstanding the effects of natural phenomena such as earthquakes, tornados, hurricanes, and floods without loss of capability to perform its function.

Based on this statement of compliance, the staff is unable to conclude that all instrumentation, control, and electrical structures, systems, and components important to safety have been either designed and qualified to operate in an environment caused by natural phenomena or have been adequately protected from its effects.

By Amendment 3 to the FSAR, the applicant did not provide the requested information for an expanded analysis of compliance with GDC 2. This item will continue to be pursued with the applicant and the results of the staff review will be included in a supplement to this report.

Response:

All Class 1E ac and dc instrumentation, control, and electrical structures and systems have been either designated to operate in an environment caused by natural phenomena or adequately protected from its effects.

Sesimic qualification of seismic Category I and Category I Class 1E structures and systems are addressed in Sections 3.10 and 3.10N. Environmental qualification for these Class 1E structures and systems is addressed in Section 3.11.

Draft SER Section 8.3.3.1.3: Protection of Class 1E Equipment from Dynamic Effects

In Section 8.3.1.2 and 8.3.2.2 of the FSAR, it has been stated, in regard to compliance with General Design Criterion (GDC) 4 of Appendix A to 10CFR50, that Class 1E ac and dc power systems are designed to accommodate the effects of the environmental conditions associated with normal operation and postulated accidents and that the structures, the ac and dc systems are housed in, are protected against internally-and-externally-generated missiles, pipe whip, and jet impingement forces systems, and components important to safety have been appropriately protected against dynamic effects in accordance with the requirements of GDC 4.

By Amendment 3 to the FSAR, the applicant did not provide the requested information for an expanded analysis of compliance with GDC 4. This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

All Class 1E ac and dc systems are protected by structures that are designed to withstand any externally generated missiles and all postulated dynamic effects, as addressed in Sections 3.2, 3.3, 3.4, 3.5, 3.7, 3.7B, and 3.7N.

In addition, all Class 1E ac and dc systems are designed to accomodate the environmental conditions associated with normal operation and postulated accidents and are protected against internally generated missiles, pipe whip, and jet impingement forces associated with pipe breaks such that safety functions are not precluded, as addressed in Section 3.5 for missile protection and Sections 3.6, 3.6B, and 3.6N for protection against dynamic effects associated with the postulated rupture of piping.

Draft SER Section 8.3.3.1.4: Protection of Class 1E Equipment From Fire Protection System Effluents

Section 8.3.1.4 of the FSAR indicates that fire suppression systems are installed in a number of plant areas at Beaver Valley that contain Class 1E systems and components. For the design basis event "fire protection system operation," it is the staff position that Class 1E systems and components located in areas with fire suppression systems should be capable and qualified to perform their function when subject to the effects of the subject design basis event (Section 4.2 and 4.7 of IEEE Standard 308-1974).

By Amendment 3 to the FSAR, the applicant (in response to a request for information) provided a positive statement of compliance to the above stated position. Pending documentation in Section 8 of the FSAR, this item is considered resolved.

Response:

Class 1E equipment is either protected from the by-products and effluents of automatic fire protection system actuation or located in areas where the Class 1E equipment is not affected by these effluents or, on the basis of test data, have demonstrated their operability (Cardox Corporation Test Report, July 1955 and Consolidated Edison tests for Three Mile Island Nuclear Power Station, March 1977).

Refer to the Fire Protection Evaluation Report Section 1.1.5 for a statement of conformance.

10

Physical Identification of Equipment (Section 8.3.1.3)

Test Documentation to Qualify Electrical Equipment (Section 8.3.1.2.4).

8.3.3 Fire Protection for Cable Systems

Specifications of electrical cables include flame retardant requirements, low gas generation during combustion, and the ability to operate in a wet environment. All BVPS-2 cables for 5 kV power, 600 V power, 600 V control, 300 V instrument, 300 V thermocouple, 300 V communication, and high temperature cable, meet or exceed the standards delineated in IEEE Standard 383-1974 for the gas burner vertical cable tray flame test as modified by Regulatory Guide 1.131. The cables are also suited to provide undiminished performance while subjected to a water spray as would occur during fire fighting or activation of fire suppression systems.

Only noncombustible materials (aluminum and steel) are used in the construction of cable trays.

In the fabrication of indoor conduit, only aluminum and steel are utilized.

Cable, conduit, and raceway penetrations of all fire barriers are sealed to provide a level of protection equal to or greater than that of the barrier. Refer to Section 8.3.3.3 for a description of fire stops and seals for cables.

Cable trays, conduit, electrical trenches, culverts, and ducts are used only for cables. Miscellaneous storage or piping for flammable or combustible liquids or gases is not permitted in these areas. Fire suppression of safety-related cable tray areas is accomplished by total flooding with CO_2, while fire water hose stations serve as the back-up system. Cable tray areas that are not protected with CO_2 are provided with fire water hose stations.

For a detailed description of fire protection, including detection devices and systems, refer to Section 9.5.1.

8.3.3.1 Fire Protection and Suppression

Fire detection and protection systems, either automatically or manually initiated, are provided in these areas required to preserve the integrity of circuits for redundant safety-related services.

¶ Class 1E equipment are either protected from the by-products and effluents of automatic fire protection system(s) actuation, are located in such areas that the Class 1E equipment is not affected by these effluents or, on the basis of test data have demonstrated their operability (Cardox Corporation Test Report, July 1955 and Consolidated Edison tests for Three Mile Island Nuclear Power Station, March, 1977).

¶ Refer to FSAR Section 9.5.1 and the Fire Protection Evaluation Report for additional detailed description

8.3.3.2 Fire Barriers and Cable Tray Separation

Fire barriers for electrical raceways and cable are described in Section 9.5.1. Cable tray separation is described in Section 8.3.1.4.

ATTACHMENT 11

Response to Outstanding Issue 197 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.3.3.3.1: Use of Regulating Transformers as Isolation Devices

Table 8.3.2 and Section 8.3.1.1.17 of the FSAR indicates that there are six Class 1E isolating voltage regulation transformers allocated to the four vital bus systems. They serve to isolate either certain designated non-Class 1E loads from the Class 1E portion of the system or to isolate Class 1E train loads from the Class 1E channel portion of the system.

The FSAR further states that each of the isolating transformers is fully qualified and is designed such that a continuous bolted short circuit on the secondary winding will not be reflected on the primary winding. By Amendment 3 to the FSAR, the applicant, in response to a request for information, indicated the following:

a. Oscillograph traces of transformer input current showed 101.6 to 109.4 percent of the transformer's full load rating current being input with the output terminals shorted.

b. The transformers were specified to limit input current to the transformer to 150 percent of its full load rating under short circuit.

c. The vital bus UPS system can supply the full burden of the transformer with a shorted secondary.

d. Output circuits are run in dedicated conduit from the transformer to the connected load.

e. The non-Class 1E loads are composed of control and instrument circuits.

Based on the above information, the staff is unable to conclude the acceptability of these transformers as isolation devices. Areas that require additional information or clarification include:

a. Duration of time to which the isolation transformer was tested with justification of its adequacy.

b. Qualification test report that demonstrates the capability of the transformers to withstand anytime during its design life the continuous bolted short circuit on its secondary winding.

c. Analysis that demonstrates the capability of the vital UPS system to supply its normal loads plus the 150 percent load specified for the shorted transformer.

d. Extent of compliance of the non-Class 1E output circuits from the transformer to and including the load to all the requirements placed on Class 1E circuits.

This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

a-b. The Class 1E isolating voltage regulating transformers were tested for a period of 100 total hours, i.e., 50 hours unloaded and 50 hours at full rated output. The duration of the short circuit test was a conservative 15 minutes, which is a far greater interval than upstream protective devices, i.e, transfer input and inverter output protective devices, would require to clear this fault.

c. The vital UPS system was tested to carry 125 percent of its rated output, which is a sufficient level of load to simultaneously carry its normal UPS load plus the 150 percent load specified for the shorted transformer.

Note: The following test result summaries for the above tests are attached:

1. Production Testing of AC Line Regulators, Power Conversion Products, Inc. (PCP), dated 4/20/82
2. Test Data - Isolating Voltage Regulator - 5KVA, PCP, dated 6/23/83
3. Test Data - Isolating Voltage Regulator - 10KVA, PCP, dated 6/23/83

d. Transformer output circuits are run in completely dedicated conduits not only from the transformer's secondary to it distribution panel but also from its assigned distribution panels to each individual load. This design is consistent with the transformers providing Class 1E to Class 1E isolation and those transformers providing Class 1E to non-Class 1E isolation. Section 8.3.1.1.17 will be revised to address the dedicated conduit system.

rectifier and battery sources are unavailable or the inverter malfunctions, the systems load is transferred within 1/4 cycle to the 480-120 V alternate source line voltage regulator by means of the static switch. The alternate source is regulated at 120 V ± 1.2 V.

The BVPS-2 operator also has the option, by means of the manual bypass switch, of manually overriding the automatic transfer feature to allow for remote manual transfer. The automatic transfer permissives, however, can not be manually defeated.

Vital buses *2-3 (blue) and *2-4 (yellow) have Class 1E batteries *2-3 and *2-4, respectively, dedicated solely to these UPSs. For this reason, the rectifier/chargers, in addition to being the primary source of dc power to the inverter assemblies, also serve as battery chargers for these batteries.

Vital buses *2-1 (red) and *2-2 (white) receive their dc inputs from non-dedicated Class 1E batteries *2-1 and *2-2, respectively, via dc switchboards. Several non-vital bus Class 1E dc loads not in this system are also powered from these two sources; consequently, batteries *2-1 and *2-2 are provided with separate battery chargers. Blocking diodes have been added to the input circuits of inverters *2-1 and *2-2, thus preventing back-feeding from rectifiers 2-1 and 2-2, and the rectifier assemblies from providing reverse dc voltage to the respective battery bus. (Two non-Class 1E dc systems are provided for the majority of the non-safety dc loads, as discussed in Section 8.3.2.1).

A spare mobile battery charger is also available to provide charging current to the Class 1E batteries in the event that a Class 1E battery charger fails.

There are six Class 1E isolating voltage regulating transformers allocated to the four vital bus systems. They serve to isolate either certain designated non-Class 1E loads from the Class 1E portion of the system or to isolate Class 1E train loads (orange or purple) from the Class 1E channel portion of the systems (red, blue, yellow, white). These isolating regulators are identified as follows:

Vital Bus System	Isolating Transformer	Isolating Function
*2-1	Reg*VITBS2-1B	Red-Black
*2-2	Reg*VITBS2-2B	White-Black
*2-3	Reg*VITBS2-3B Reg*VITBS2-3C	Blue-Black Blue-Orange
*2-4	Reg*VITBS2-4B Reg*VITBS2-4C	Yellow-Black Yellow-Purple
	TRT*IRT-ASP	Orange-Black

¶ The following Class 1E Isolating voltage regulating transformer is used in the Alternate Shutdown Panel Room to provide for safe shutdown in the event of a single exposure fire (Refer to the FPER for a description):

Each Class 1E isolating voltage regulating transformer is fully qualified to IEEE Standard 323-1974, and is designed such that a continuous bolted short circuit on the secondary winding will not be reflected on the primary winding.

Transformer output circuits are run in completely dedicated conduits not only from the transformer secondary to its distribution panel but also from its assigned distribution panel to each individual load.

8.3.1.1.18 Physical Arrangement of Class 1E Electrical Equipment

Class 1E electrical equipment is located so as to minimize potential damage commensurate with the in situ identified hazard in a particular area, as well as maintaining adequate separation from equipment of the redundant train or channel or from non-Class 1E equipment. Separation is achieved by physical distance when possible, location in separate rooms, or providing barriers if either of the preceding two methods is not attainable.

The location of all Class 1E equipment takes into account the ease of personnel access and the provision of adequate physical space for performing testing and maintenance as well as equipment removal.

Where practical, Class 1E electrical equipment is located away from mechanical equipment and piping in order to minimize damaging effects from pipe whip, pipe rupture, jet impingement, and internally-generated missiles propelled from rotating machinery. In addition, floor levels have adequate drainage provisions to preclude accumulation of fluids in the case of a pipe rupture.

Separation of major Class 1E equipment is as follows:

1. Unit station service and system station service transformers are located outdoors and are physically separated from each other, as shown on Figure 8.3-13. Each transformer is protected by a water deluge fire protection system. These protective measures ensure extinguishment of oil fires and confinement of the fire to one transformer. A crushed stone-filled sump is installed for each transformer and is capable of containing the volume of oil in the transformer. The main transformer is separated from each unit station service transformer by a firewall.

   Although these transformers are not classified as Class 1E equipment, careful attention is given to the design of these facilities to ensure reliable and continuous operation since these transformers provide normal and preferred sources of power to the Class 1E buses.

2. Separate rooms in the Seismic Category I service building at el 730 ft-6 in provide adequate separation for the redundant Class 1E 4,160 V switchgear buses and 480 V load centers. These rooms are located above the probable mean flood level. Piping containing fluids is excluded from these rooms.

GL BEATTY OI 197

STONE & WEBSTER ENGINEERING CORPORATION

SUPPLIER'S DOCUMENT DATA FORM

BEAVER VALLEY POWER STATION - UNIT 2
DUQUESNE LIGHT COMPANY
J.O. 12241

REVIEW & RETURN TO SUPPLIER REQUIRED (E1)

FOR INFORMATION ONLY – NO REVIEW REQUIRED (E1)

3 SUPERSEDES S & W FILE NO. (E1) (25-34) (35-38): NA ~~1 1 3 4 0 3 3 7~~

REMARKS (LIMIT TO 22 CHARACTERS & BLANKS) (53-74) (CODES OR SPECIAL REQUIREMENTS)

NAME

RESP. ENG.: S. KAMPANELLAS DEPT./DIV.: 39 (E1)

REVIEWER: G. FLIGG DEPT./DIV.: 39 (E1)

2 S & W EQUIP. I.D. CODE (E1) (25-36): R E G X V I T B S

AREA DESIGNATION CODES (E1) (75-80)

DATE TO REVIEWER (E1): 12-16-82

REQUIRED RETURN DATE (E1): 12-22-82

MFR'S DOC. NO. (E1) (LIMIT TO 24 CHARACTERS & BLANKS) (INCLUDE DOC. REV. OR DATE): PS-79-3 REV 4

MFR'S NAME (E1) (LIMIT TO 20 CHARACTERS & BLANKS) (61-80): POWER CONVERSION PRODUCTS INC

REVIEW STATUS (R)

[✓ APPROVED]

APPROVED AS REVISED

UNACCEPTABLE

AS DEFINED IN SPECIFICATION

DATE RECD (C)	MONTH	DAY	YR(25-30)	DOC TYPE (E1)	(31)	MAX DAYS IN REVIEW (E1)	(32-33)
1	1 2	1 6	8 2				1 0

REVIEWER'S SIGNATURE (R): G. Fligg

DATE: 12-20-82

1 FUNCTIONAL TITLE (E1) (LIMIT TO 44 CHARACTERS & BLANKS) (37-80): PRODUCTION TESTING OF AC LINE REGULATORS

RESPONSIBLE ENGINEER'S DATE STAMP (E2): NOTED DEC 21 1982 Kampanellas

(C) PROJECT CLERK (R) REVIEWER
(E1) RESPONSIBLE ENGINEER PRIOR TO REVIEW
(E2) RESPONSIBLE ENGINEER AFTER REVIEW

DUP S & W FILE NO. (E1) (C) (11-20) (21-24): 2 7 0 1 3 4 0 3 3 7 0 0 6 A

JOB ORDER NO.: 12241 00 (4-10)

TYPE CODE (E1): A3.220 ~~3.197~~

SEQUENCE NO. (C): 0006

REVIEWER COMMENTS:

1. Para. 1.8
I don't understand what the words "nominal input voltage plus or minus 1%" means.

2. Para. 4.5 Harmonic Distortion Test
The specification 2BVS-337 requires that no single harmonic shall exceed 3% of the fundamental.

DEC 20 1982

ATTACH TO DOCUMENT