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February 17, 1987

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Reference: Beaver Valley Power Station, Unit No. 1
Docket No. 50-334, License No. DPR-66
Request for Additional Information on SPDS

Gentlemen:

By letter dated April 9, 1986, the NRC requested additional information regarding the isolation devices utilized with our Safety Parameter Display System (SPDS). We have reviewed your request and have provided as Attachment A our response.

If you have any questions regarding this submittal, please contact me or members of my staff.

Very truly yours,

J. D. Sieber
Vice President
Nuclear Operations

Attachment

cc: W. M. Troskoski, Resident Inspector
U. S. Nuclear Regulatory Commission
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ATTACHMENT A

NRC QUESTION

a. For the type of device used to accomplish electrical isolation, describe the specific testing performed to demonstrate that the device is acceptable for its application(s). This description should include elementary diagrams when necessary to indicate the test configuration and how the maximum credible faults were applied to the devices.

DLC RESPONSE

a. The new 7300 Series isolation devices added as part of the SPDS modification were tested by the supplier (Westinghouse Electric Corporation) as detailed in WCAP-8892-A, "Westinghouse 7300 Series Process Control System Noise Tests," June 1977.

Existing Westinghouse 7100 Series Process Control System Model 131-110 Isolation Amplifiers and Nuclear Instrumentation System isolation amplifiers also provide electrical isolation. Testing of these isolators is described in WCAP-7824 - "Isolation Tests Process Instrumentation Isolation Amplifier Westinghouse Hagan Computer Systems Division Model 131-110" (12/16/71), WCAP-7819 - "Test Report, Nuclear Instrumentation System Isolation Amplifier" (1/72), and "Westinghouse Protection Systems Noise Tests" report dated December 1974. The "Westinghouse Protection Systems Noise Tests" report and Supplements 1 and 2 are on file with the NRC on the Diablo Canyon Docket Nos. 50-275 and 50-323. DLC letter dated 2/10/76 also sent this report and Westinghouse letter DLW-4100 which established the applicability of this report to Beaver Valley Power Station Unit #1. WCAP-7819 and WCAP-7824 have also been found acceptable by the NRC to demonstrate the functional adequacy of the isolation amplifiers.

NRC Question

b. Data to verify that the maximuim credible faults applied during the test were the maximum voltage/current to which the device could be exposed, and define how the maximum voltage/current was determined.

DLC Response

b. The new 7300 Series isolation devices were tested by the supplier (Westinghouse Electric Corporation) to maximum fault voltages of 250 VDC and 580 VAC as detailed in WCAP-8892-A, "Westinghouse 7300 Series Process Control System Noise Tests".

Testing of the existing Westinghouse 7100 Series Process Instrumentation System isolators and NIS isolation amplifiers is described in WCAP-7819-Nuclear Instrumentation Isolation Amplifier, WCAP-7824-Isolation Tests Process Instrumentation Isolation Amplifier Westinghouse Hagan Computer Systems Division Model 131-110, and Westinghouse Protection Systems Noise Tests including Supplements 1 and 2. The maximum credible faults applied during these tests are summarized as follows:

7100 Isolators

WCAP-7824	Noise Tests
± 120 VDC	250 VDC
460 VAC	460 VAC
	1 ampere

NIS Isolation Amplifiers

WCAP-7819	Noise Tests
± 150 VDC	118 VAC
120 VAC	250 VDC
	1 ampere

BVPS #1 credible faults in the cable routings and at the equipment interfaces, discussed below, were considered for this response.

Cable Routing

The criteria and bases for the installation of electrical cables are given in Beaver Valley P. S. Unit 1 Specification BVS-3001, "Criteria for Installation and Identification of Electrical Cables." This document controls the design and installation of all plant cable and raceway systems. Field quality control inspections ensure compliance with this document (reference UFSAR 8.5-2). All cables in trays are installed according to their level of service as follows:

Tray Designation

H	4,160V feeders
L	480V feeders and 125V power DC feeders
K	480 VAC and 125VDC feeders, No. 8 AWG and smaller
C	125 VDC or 115VAC controls, metering, relaying, and alarm
X	Instrumentation, communication, and data

This criteria was used in the routing of the SPDS and isolator I/O cables. All cables which terminate at the SPDS isolator cabinets are rated as "X", or "C" cables with the exception of the power feeds to the cabinets which are designated "C" or "K".

All cables are classified according to the different "service" levels as follows:

Service Code Letter	Voltage Class of Service
H	Above 600 V (All power capacity)
L	600V and below (medium power capacity)
K	600V and below (low power capacity)
C	600V and below (control - 125 VDC, 120/240VAC)
X	600V and below (instrument low level signals

Equipment Interfaces

The majority of BVPS Unit #1 SPDS computer and isolation device inputs are from instrument circuits. These are low level voltage (120VAC/125VDC) and current (4-20 mA loop) circuits for plant pressures, levels flows, temperatures, and status signals. These circuits are powered from 120VAC uninterruptable power supplies (UPS) or the 125VDC power system.

The maximum voltages that are present in the 7100 Process Instrumentation Racks and Nuclear Instrumentation System Racks, interconnecting cable routings, and the cabinets where the isolated outputs are terminated are 127 VAC and 150 VDC with one exception addressed below. 127 VAC is the maximum potential available on the 120 VAC system based on 110% of 115VAC as controlled by the System Station Service Transformer's line tap changer. 150 VDC is the maximum potential available from the annunciator system field contact power supplies. The maximum voltages available due to interfacing with the SPDS and PVS computers are no greater than the previous maximum voltage levels.

There is one concern that was noted in the drawing review for response to this question concerning isolation devices. The output from the pressurizer pressure control circuitry terminates in the pressurizer heater control cabinet which has 460 VAC present or a maximum credible voltage of 506 VAC based on 110% of the System Station Service transformer's line tap changer. Even if a fault were to apply this 506 VAC onto the pressurizer pressure control circuit, we do not consider it credible that this would cause a fault in the process control rack resulting in the 506 VAC being applied to the isolated output from protection circuits in other racks due to the cable insulation levels.

Many of the other inputs are taken from motor control center cubicles. The maximum voltage present in the motor control centers is 506VAC (110% of 460VAC) as controlled by the System Station Service Transformer's line tap changer.

The remaining input classes are discussed on an individual basis as follows:

NOTE: In considering maximum credible currents and voltages for the following case, it is assumed that current and potential transformers provide an additional level of isolation. Primary to secondary faults are not considered credible due to the construction of these devices.

The 4160V metal-clad switchgear, purchase specification BVS-215, required that current and voltage transformers be in segregated compartments, separated by steel barriers. In addition instrument transformers are tested with 2.5KV applied to their secondary winding (reference ANSI C57.13).

120 VAC Vital Bus Volts 1-1, 1-2, 1-3, 1-4
(SPDS Points V0101, V0102, V0103, V0104)

These quantities are measured directly from the Fault Recorder input (Ref: RE-1U). The Vital Bus Voltage is regulated at 120VAC by the Vital Bus UPS.

125 VDC Bus Volts 1-1, 1-2, 1-3, 1-4
(SPDS Points Y0774, Y0775, Y0776, Y0777)

These quantities are measured from the Fault Recorder input (Ref: RE-1V). The maximum battery voltage is 140VDC (equalize mode).

4KV Emergency Bus Volts 1AE, 1DF
(SPDS Points V3201,V3202)

These quantities are measured from the secondaries of the 4KV bus potential transformers at the fault recorder input (RE-1F). The maximum 4KV voltage is 4412 volts as controlled by the SSST tap changer. This yields a voltage of $4412 \times \frac{120}{4200} = 126$ Volts.

4KV Emergency Bus Current 1AE, 1DF
(SPDS Points Y6601, Y6603)

The maximum transducer output is 4.5 mA through 10K ohm load, which results in a maximum voltage of 45 volts dc.

Pressurizer Heater Group A, B, C, D, E Current
(SPDS Points Y6641, Y6642, Y6643, Y6644, Y6645)

The maximum transducer output is 4.5 mA through a 10K ohm load, which results in maximum voltage of 45 volts dc.

Reactor Coolant Pump Current A, B, C
(SPDS Points Y6631, Y6632, Y6633)

The maximum transducer output is 4.5 mA through a 10K ohm load, which results in a maximum voltage of 45 volts dc.

FW-P-3 (A,B); RC-P-1 (A,B,C)
(SPDS Points YD6993, YD6994, YD6995, YD6996
YD6997)

This quantity is breaker status, taken from the annunciator rack (RE-7X, 7W) which is in turn, connected to the motor breaker pallet (RE-21HE, JM). Annunciator is low voltage (120 VAC/150VDC).

CH-P-1 (A,B,C); SI-P-1 (A&B); VS-F-1 (A,B,C,D); RH-P-1 (A&B)
RS-P-1 (A&B); RS-P-2 (A&B) (SPDS Points YD0100, YD0101, YD0113,
YD0114; YD6949; YD6950; YD6998; YD6999,
YD7000, YD7001, YD0600, YD0601, YD6977
YD6978; YD6979, YD6980)

These quantities are taken from the annunciator rack (RE-7X, 7W) which is low voltage (120VAC/150VDC).

Conclusion

The NRC has previously reviewed and accepted the existing NIS isolation amplifiers and 7100 Series isolator and input/output wiring separation as used at BVPS Unit 1. This acceptability is documented in Supplement 3 of the NRC Safety Evaluation Report for Beaver Valley Power Station Unit 1. Since the maximum potentials introduced by interfacing with the SPDS and PVS computer are not greater than previous existing voltage levels these existing isolation devices are still considered acceptable.

Review of WCAP-7819, WCAP-7824, and the Westinghouse Protection Systems Noise Tests indicate that the existing NIS isolation amplifiers and 7100 Series isolators were tested for the maximum credible faults to which they could be exposed with the following exception.

1. The NIS isolation amplifier was tested for 120 VAC fault and 118 VAC input/output wiring noise test but could be exposed to 127VAC. It should be noted that this 127 VAC is the maximum that could be seen at the voltage source in the unlikely event that the tap changer were being operated manually to their maximum of 110% in anticipation of significant load changes. The actual utilization voltage to which the isolated output could be exposed would be approximately 1 to 2 volts less than the source voltage. Review of the Westinghouse Protection Systems Noise Tests and WCAP-7819 indicates that there were no significant effects on the protection circuitry for the fault voltage applied in these tests. In our engineering judgement the difference of approximately 5 volts between the test voltages and the voltage to which the isolated output could be exposed would not invalidate the results of these tests.

2. The 7100 Series isolator was tested for $\pm$ 120 VDC fault but 150 VDC is present in the process racks from the annunciator system field contact power supplies. The circuit description of the 7100 Series in WCAP-7824 states that the direct current isolation is essentially infinite until voltage breakdown occurs between the primary and secondary of the output transformer which provides isolation between input and output circuits. The breakdown voltage is greater than 600 VDC. Review of the test results for the $\pm$ 120 VDC tests across the isolator output in WCAP-7824 show a maximum disturbance of a 2mv spike on the input of the isolator and damage to components in the output circuitry. The 2mv spike was far below the specified accuracy (.5% or 20mv) of the isolation amplifier. In our engineering judgement application of 150 VDC across the isolator output would result in the same damage to output circuitry components (open circuited output) and disturbance to the isolator input circuitry less than the specified accuracy of 20 mv. It is extremely unlikely that the 150 VDC would be applied to the isolator output circuit. The wiring separation concern for 150VDC in the racks is well within the 250 VDC voltage level that was applied in the Westinghouse Protection Systems Noise Test.

The maximum credible voltage fault in all cases for voltage monitoring signal through 7300 Series isolators is below WCAP-8892 test maximum of 580VAC/250VDC.

For current monitoring signals, the magnitude and duration of maximum transducer input current is within the transducer overload capability (250A for 1 second and 15A continuous) in all cases. Therefore, the maximum transducer output voltage will be within the transducer limits, which is far below 250 VDC.

NRC Question:

c. Data to verify that the maximum credible fault was applied to the output of the device in the transverse mode (between signal and return) and other faults were considered (i.e., open and short circuits).

DLC Response:

c. This data is available in the "Westinghouse 7300 Series Process Control System Noise Tests," WCAP-8892-A document.

Test data for the NIS Isolators and 7100 Series Isolators is available in WCAP-7819 and WCAP-7824.

NRC Question:

d. Define the pass/fail acceptance criteria for each type of device.

DLC Response:

d. The pass/fail acceptance criteria for the new 7300 isolation devices is provided in WCAP-8892-A, "Westinghouse 7300 Series Process Control System Noise Test."

The pass/fail acceptance criteria for the existing NIS and 7100 Series isolators is provided in WCAP-7819, WCAP-7824 and the "Westinghouse Protection Systems Noise Tests" report and supplements.

NRC Question:

e. Provide a commitment that the isolation devices comply with the environment qualifications (10 CFR 50.49) and with the seismic qualifications which were the basis for plant licensing.

DLC Response:

e. The new 7300 isolation equipment is located in the BVPS #1 Switchgear room which is considered a mild environment. The isolation equipment supplier (Westinghouse Electric Corporation) has committed to IEEE-323-1974 and IEEE-344-1975 per WCAP-8587, Rev. 5, with testing documented in "Equipment Qualification Data Package: Process Protection System" WCAP-8587 Supplement 1 EQDP-ESE13 (non-proprietary) and "Equipment Qualification Data Package: Type V4 Voltage and Current AC Transducers" WCAP-8587 Supplement 1 EQDP-ESE58 (non-proprietary). Westinghouse has compared the required response spectra for BVPS - Unit #1, EL. 713.5', to their generic response spectra, and confirmed that it falls within the generic envelope. Westinghouse has provided Seismic Certificates of Compliance for BVPS - Unit #1 dated April 19, 1983, and May 6, 1983, for the isolation equipment documentation. This documentation certifies that the 7300 series isolation equipment seismic qualifications envelope that of BVPS - Unit #1.

The existing 7100 Series Isolators and NIS Isolation Amplifiers are located in the BVPS #1 Switchgear Area and Control Room, respectively, which are considered mild environment and not within the scope of 10CFR 50.49. However, as stated in the supplier's instruction manuals on the 7100 Series Model 131-110 isolators and NIS the ambient operating temperature range specified encompasses the expected temperature range for these areas under all normal and accident conditions. The 7100 Isolators and NIS isolation amplifiers were seismiclly qualified to IEEE-344-1971 using testing techniques that were in practice at the time BVPS #1 was licensed.

NRC Question:

f. Provide a description of the measures taken to protect the safety systems from electrical interference (i.e., Electrostatic coupling, EMI, Common Mode and Crosstalk) that may be generated by the SPDS.

DLC Response:

f. The 7300 Series isolation equipment supplier (Westinghouse Electric Corporation) has addressed electrical interferences in WCAP-8892A, "Westinghouse 7300 Series Process Control System Noise Tests," June 1977.

WCAP 7819, WCAP 7824 and the "Westinghouse Systems Noise Tests" report and Supplements provide descriptions of the measures and testing to protect against electrical interference.

NRC Question:

g. Provide information to verify that the Class 1E isolator is powered from a Class 1E source.

DLC Response:

g. The SPDS isolation devices are powered from IE power sources. The following BVPS - Unit #1 cable numbers and drawing references are provided as verification:

7300 DIGITAL ISOLATORS

Cable Number: ICESN0K500

From: 8700-RE-11D-10E-3, "Wiring Diagram 120V Emergency Dist. Pnls. AC-E1 through E6", Pnl. AC-E3, Bkr. #16

To: 8700-RE-3ES*A-25, "Wiring Diagram Digital Isolator PNL-REL-42"

Cable Number: ICESNPK500

From: 8700-RE-11D-10E-3, "Wiring Diagram 120V Emergency Dist. Pnls. AC-E1 through E6", Pnl. AC-E4, Bkr. #14

To: 8700-RE-3ET*A-26, "Wiring Diagram Digital Isolator PNL-REL-43"

7300 ANALOG ISOLATORS

Cable Number: 1VBSNWC522

From: 8700-RE-11B-12, "120VAC Vital Bus 2 & 4", PNL-VITBUS-2, Bkr. #22

To: 8700-RE-4HP*A-6, "Wiring Diagram 7300 Pri. Proc. Rack 30"

Cable Number: IVBSNYC516

From: 8700-RE-11B-12, "120VAC Vital Bus 2 & 4", PNL-VITBUS-4, Bkr. #16

To: 8700-RE-4HQ*A-5, "Wiring Diagram 7300 Pri. Proc. Rack 31"

Cable Number: IVBSNBC516

From: 8700-RE-11A-7A-2, "Wiring Diagram 120VAC Vital Bus 1 & 3", PNL-VITBUS-3, Bkr. #16

To: 8700-RE-4HS*A-3, "Wiring Diagram 7300 Pri. Proc. Rack 35"

Cable Number: IVBSNRC505

From: 8700-RE-11A-7A-2, "Wiring Diagram 120VAC Vital Bus 1 & 3," PNL-VITBUS-1, Bkr. #28

To: 8700-RE-4HW*A-4, "Wiring Diagram 7300 Pri. Proc. Rack 34"

Cable Number: ICESNOK501

From: 8700-RE-11D-10E-3, "Wiring Diagram 120V Emergency Dist. Pnls. AC-E1 through E6", PNL-AC-E3, Bkr. #19

To: 8700-RE-4JE*A-4, "Wiring Diagram 7300 Pri. Proc. Rack 36"

Cable Number: ICESNPK501

From: 8700-RE-11D-10E-3, "Wiring Diagram 120V Emergency Dist. Pnls. AC-E1 through E6", PNL-AC-E4, Bkr. #12

To: 8700-RE-4JF*A-4, "Wiring Diagram 7300 Pri. Proc. Rack #37"

NIS ISOLATORS

Cable Number: 1VBSNRC510 & 1NMPARC501

From: 8700-RE-11A, "Wiring Diagram 120VAC Vital Bus 1 & 3", PNL-VITBUS-1, Bkr. #1

To: 8700-RE-6C, "Wiring Diagram Nuclear Inst. Sys. Rack 1 & 2".

Cable Number: 1VBSNWC539 & 1NMPBWC501

From: 8700-RE-11B, "120VAC Vital Bus 2 & 4" , PNL-VITBUS-2, Bkr. #1

To: 8700-RE-6C, "Wiring Diagram Nuclear Inst. Sys. Racks 1 & 2".

Cable Number: 1VBSNBC500 & 1NMPCBC501

From: 8700-RE-11A, "Wiring Diagram 120VAC Vital Bus 1 & 3" PNL-VITBUS-3, Bkr. #1

To: 8700-RE-6D, "Wiring Diagram Nuclear Inst. Sys. Rack 3 & 4".

Cable Number: 1VBSNYC500 & 1NMPDYC501

From: 8700-RE-11B, "120VAC Vital Bus 2 & 4", PNL-VITBUS-4, BKR. #3

To: 8700-RE-6D, "Wiring Diagram Nuclear Inst. Sys. Racks 3 & 4."

7100 ISOLATORS

Cable Number: 1VBSNRK508, 1VBSNRK509, 1VBSNRK510

From: 8700-RE-11A, "Wiring Diagram 120VAC Vital Bus 1 & 3" PNL-VITBUS-1, Bkr. #3

To: 8700-RE-4GA, "Wiring Diagram Primary Proc. Rack 1 & 2"

To: 8700-RE-4GB, "Wiring Diagram Primary Proc. Rack 3"

Cable Number: 1VBSNRK501

From: 8700-RE-11A, "Wiring Diagram 120VAC Vital Bus 1 & 3" PNL-VITBUS-1, Bkr. #4

To: 8700-RE-4GT, "Wiring Diagram Secondary Process Rack A"

Cable Number: 1VBSNWK515, 1VBSNWK516, 1VBSNWK517, 1VBSNWK518

From: 8700-RE-11B, "120VAC Vital Bus 2 & 4" PNL-VITBUS-2, Bkr. #3

To: 8700-RE-4GF, "Wiring Diagram Primary Proc. Rack 9 & 10"

To: 8700-RE-4GG, "Wiring Diagram Primary Proc. Rack 11 & 12"

To: 8700-RE-4GH, "Wiring Diagram Primary Proc. Rack 12 & 14"

Cable Number: 1VBSNWK502

From: 8700-RE-11B, "120VAC Vital Bus 2 & 4" PNL-VITBUS-2, Bkr. #4

To: 8700-RE-4GU, "Wiring Diagram Secondary Process Rack B"

Cable Number: 1VBSNBK509, 1VBSNBK510, 1VBSNBK511, 1VBSNBK512, 1VBSNBK513

From: 8700-RE-11A, "Wiring Diagram 120VAC Vital Bus 1 & 3", PNL-VITBUS-3, Bkr. #3

To: 8700-RE-4GH, "Wiring Diagram Primary Proc. Rack 13 & 14"

To: 8700-RE-4GJ, "Wiring Diagram Primary Proc. Rack 15 & 16"

To: 8700-RE-4GK, "Wiring Diagram Primary Proc. Rack 17 & 18"

Cable Number: 1VBSNBK501

From: 8700-RE-11A, "Wiring Diagram 120VAC Vital Bus 1 & 3", PNL-VITBUS-3, Bkr. #4

To: 8700-RE-4GV, "Wiring Diagram Secondary Process Rack C".

Cable Number: 1VBSNYK510, 1VBSNYK511

From: 8700-RE-11B, "120VAC Vital Bus 2 & 4", PNL-VITBUS-4, Bkr. #5

To: 8700-RE-4GQ, "Wiring Diagram Primary Proc. Rack 25 & 26"

Cable Number: 1VBSNYK501

From: 8700-RE-11B, "120VAC Vital Bus 2 & 4", PNL-VITBUS-4, Bkr. #6

To: 8700-RE-4GW, "Wiring Diagram Secondary Process Rack D"