FENOC

FirstEnergy Nuclear Operating Company

Davis-Besse Nuclear Power Station
5501 N. State Route 2
Oak Harbor, Ohio 43449

December 22, 2009
L-09-294

10 CFR 50.90

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT:
Davis-Besse Nuclear Power Station
Docket No. 50-346, License No. NPF-3
Response to a Request for Additional Information Related to a License Amendment Request to Exclude the Source Range Neutron Flux Instrument Channel Preamplifier from the CHANNEL CALIBRATION Requirements of Technical Specification (TS) 3.3.9, "Source Range Neutron Flux," and TS 3.9.2, "Nuclear Instrumentation" (TAC No. ME1405)

By letter dated June 2, 2009, the FirstEnergy Nuclear Operating Company (FENOC), submitted to the Nuclear Regulatory Commission (NRC) a license amendment request for the Davis-Besse Nuclear Power Station. The proposed amendment would exclude the source range neutron flux instrument channel preamplifier from Technical Specification CHANNEL CALIBRATION requirements.

By letter dated October 28, 2009, the NRC staff requested additional information on the proposed amendment to complete its review. The attachment provides the responses to the NRC staff's questions, as modified during a teleconference between FENOC and the NRC staff on December 14, 2009. Enclosure A supplements the response to Technical Question 1. Enclosure B supplements the response to Technical Question 2.

There are no regulatory commitments contained in this submittal. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager - Fleet Licensing, at (330) 761-6071.

A001
NRR

I declare under penalty of perjury that the foregoing is true and correct. Executed on December 22, 2009.

Sincerely,

Clark A. Price
Director, Site Performance Improvement

Attachment:
Response To October 28, 2009 Request For Additional Information

Enclosures:
A. Photographs of a Preamplifier
B. Select Pages From The Preamplifier Vendor Manual

cc: NRC Region III Administrator
NRC Project Manager
NRC Resident Inspector
Executive Director, Ohio Emergency Management Agency, State of Ohio (NRC Liaison)
Utility Radiological Safety Board

By letter dated June 2, 2009, the FirstEnergy Nuclear Operating Company (FENOC), submitted to the Nuclear Regulatory Commission (NRC) a license amendment request for the Davis-Besse Nuclear Power Station (DBNPS). The proposed amendment would exclude the source range neutron flux instrument channel preamplifier from Technical Specification CHANNEL CALIBRATION requirements. By letter dated October 28, 2009, the NRC requested additional information on the proposed amendment to complete its review. The NRC staff questions are presented in bold type, followed by the FENOC responses.

Technical Questions

1. The licensee stated, "The need for the proposed amendment is based, in part, on the instrument channel design and location of the preamplifier, which do not provide a practical means of introducing a test signal upstream of the preamplifier for use in the performance of a CHANNEL CALIBRATION."

Provide physical details of the preamplifier and explain why a test signal can not be introduced upstream of the preamplifier, especially during refueling outages, and why modifications can not be performed to facilitate the channel calibration test with the preamplifier included in the source range neutron flux instrumentation system.

FENOC RESPONSE

The preamplifier is located within the containment and is packaged in a splash-proof double box assembly to minimize concerns associated with the continued operation in a high humidity environment. This permits the preamplifier to be located close to the detector since the detector signal is a relatively low pulse signal. The inner box contains the electronics and is insulated from the outer box. The internal circuitry is mounted on two printed circuit boards located inside the inner box.

The electrical connections for the preamplifier are made through three triaxial type connectors and one twinaxial type connector. The channel detector cable passes through the outer box and is connected to a receptacle located on the inner box using a triaxial connector. The output cable, the high voltage power supply cable, and the low voltage power supply cable are connected to receptacles located on the outer box. The output and high voltage connections use triaxial connectors, and the low voltage connection uses a twinaxial connector. Each of the four connectors is inserted into its respective receptacle and a coupling on the connector is turned to secure the connector in place. Enclosure A contains photographs of the preamplifier.

The preamplifier does not contain any test jacks, nor does the current system design provide a means to inject a signal upstream of the preamplifier using the installed source range nuclear instrument test circuitry. To test the source range nuclear instrument by injecting a test signal (this is not a signal created by the use of a neutron check source) into the preamplifier, whether the plant is on-line or during a refueling outage, would require the detector input cable to be disconnected.

In April 2009, the preamplifiers were tested in-situ using a revised channel calibration procedure, for the first time, which included a section for testing the preamplifiers. The preamplifier test section is similar, but not identical to, the vendor manual bench test. The test requires preamplifier cables to be disconnected.

A plant modification to install test equipment or a test connection upstream of the preamplifier is not being pursued since the installation could potentially introduce a noise source into a relatively low pulse signal. Additionally, adequate post maintenance testing to ensure circuit continuity after completion of the testing could not be performed if reactor power is above the source range power supply cutoff, which de-energizes the source range detector power supply to prevent damage to the detector when power is in either the intermediate or power ranges. A variation in the preamplifier output pulse characteristics affecting the source range nuclear instrument operation would be identified during the performance of a channel check and/or system trending. Therefore, a license amendment is being pursued because monitoring the functionality of the preamplifier through the performance of channel checks was considered a more viable solution than installing test equipment, disconnecting/reconnecting cabling, or installing a test connection, and would less likely impact the source range channel's ability to perform its intended function.

2. The licensee also stated, "The component is tested prior to its installation."

Provide details of tests performed prior to installation and the basis for the determination that subsequent testing is not required to assure the operation of the preamplifier. If justification is based on vendor recommendation, then provide the documentation to support it.

FENOC RESPONSE

Prior to installation of a preamplifier, a bench test is performed. The bench test inputs pulses of specific height, width, and period. The preamplifier output pulse height, and rise and fall times are measured on the lowest gain link setting. The pulse height is then measured at the remaining four gain link settings to verify proper operation. The

values for these parameters are contained within the vendor manual. The applicable preamplifier vendor manual pages are provided in Enclosure B.

Once the bench-tested preamplifier is installed in the plant, a neutron check source can be used to aid setting the gain. The check source would be inserted next to the source range detector (at the reactor vessel) and the preamplifier gain link is adjusted to the appropriate setting to obtain the required pulse height as measured at the input to the count rate amplifier. The gain link is then set and screwed (locked) into place.

The gain link adjustment is not considered a routine adjustment. The nuclear instrumentation/reactor protection system design specification describes a routine calibration adjustment as "[a]ny adjustment required for routine calibration will be located on the equipment front panel. Where precision adjustment is required, a vernier dial and/or course and fine adjustments shall be provided..." The preamplifier is located in containment within a sealed enclosure and does not possess front panel adjustments or test jacks.

The vendor manual for the preamplifier only specifies a bench test. The bench test is performed prior to installation. It is not typically performed as a normal maintenance practice. This differs from the vendor recommendations for the count rate amplifier and the rate of change amplifier within the source range nuclear instrument. The vendor manual for the count rate amplifier contains a section on adjustment and calibration, and a section on a bench calibration. The vendor manual for the rate of change amplifier contains a section on adjustment and calibration. The reference to only a bench test, and the exclusion of a bench calibration or adjustment and calibration section, implies that no periodic calibration of the preamplifier is intended as part of normal maintenance practice. The preamplifier vendor manual does not specify a calibration or any other type of maintenance.

Another activity performed on the source range nuclear instruments that includes the preamplifier is the channel check. The channel checks provide a periodic check to ensure channel operability. The channel checks are required by the technical specifications.

3. The licensee stated, "Instrument cables and connector problems are known to induce noise or spiking in the instrument channels. Since this testing involves disconnection and reconnection of cables, the potential for these problems is created."

Provide information on which this statement is based, especially if suitable test devices are used for the testing.

FENOC RESPONSE

The statement is based on utility and industry experience. A review of historical information shows that cable and connector issues have been an ongoing concern at the DBNPS, as well as with the rest of the industry. These issues are related to the cables and connectors regardless of whether there was any suitable test device involved.

A recent event occurred in April 2009, after the first use of a revised source range channel calibration procedure, which included a section on testing of the preamplifier, in which source range nuclear instrument 2 failed low. The instrument failed low due to a faulty connection. The cause was due to the disconnection and reconnection of a power cable that occurred during the performance of the preamplifier testing. Though not representative of a spiking/noise issue, it does indicate that manipulation of the connectors can result in instrument channel problems.

4. In order for the NRC staff to determine the basis that the preamplifier will not drift for the life of the preamplifier, provide information on when the preamplifiers were first installed, when replaced, when calibrated, and the drifts observed during each calibration.

FENOC RESPONSE

The current source range nuclear instrument 1 preamplifier was installed in 1983. The current source range nuclear instrument 2 preamplifier was installed in 1996. Commencing with the initial fuel loading in April 1977, records indicate that the nuclear instrument 1 preamplifier was replaced twice prior to the 1983 installation. Although the nuclear instrument 1 preamplifier installed in 1983 is still in service, it was removed for a brief time in 1988 to support troubleshooting activities and had a repair made to it before it was reinstalled. Commencing with the initial fuel loading, records indicate that the nuclear instrument 2 preamplifier was replaced twice prior to the 1996 installation. In one of the earlier replacements, the preamplifier was removed for a brief time for troubleshooting activities but was later reinstalled.

The preamplifiers are not calibrated. A bench test is performed. If the preamplifier does not pass the bench test, the preamplifier will not be used.

In April 2009, the preamplifiers were tested in-situ using a revised channel calibration procedure, for the first time, which included a section for testing the preamplifiers. The preamplifier test section is similar, but not identical to, the vendor manual bench test, but uses the vendor manual values as described in the bench test. The as-found data for source range nuclear instrument 1 was taken on the x2, x10 and x20 (range of use)

gain link positions. The as-found data when compared to the vendor manual values was satisfactory. The as-found data for source range nuclear instrument 2 was taken on the x2 and x10 (range of use) gain link positions. The as-found data when compared to the vendor manual values was satisfactory.

Since the calibration procedure test is similar to the vendor bench test, a comparison of the data was performed. Refer to the following table for the comparison.

Nuclear Instrument	Gain Link Setting	Vendor Manual Value	Initial Value	2009 As-Found Value	Drift	Yearly Average Change
1	X20[1]	-1.8 volts to -2.2 volts	N/A[2] (1985)	-1.92 volts	0.28 volts / 24 years	0.01 volts/year
2	X10	-1.9 volts to -2.1 volts	-2.0 volts (1996)	-1.9 volts	0.1 volts / 13 years	0.01 volts/year

Notes: 1. Gain link was re-set in 1985 from X10 to X20, this was used as the starting point.
2. Initial values have not been located, worse case value was used.

The results of the as-found data being within tolerance and the small variance in the preamplifier output over time supports the conclusion that the preamplifiers are relatively stable devices.

5. The licensee stated, "A malfunction of the preamplifier would be evident during normal operation by observing the channel response and indication while the instrument channel is in service. Performance of intrusive testing of the preamplifier would provide minimal benefit at the risk of introducing noise or a high resistance connection at the preamplifier connectors." Explain how channel response and indication during channel checks will provide the information that can be obtained during channel calibration tests with the preamplifier included in the source range neutron flux instrumentation system.

FENOC RESPONSE

The channel check does not provide the same information as the channel calibration. The channel check provides a frequent qualitative assessment of channel operation. The channel calibration performs adjustments of the channel output such that it responds within the necessary range and accuracy to known values of the parameter the channel monitors.

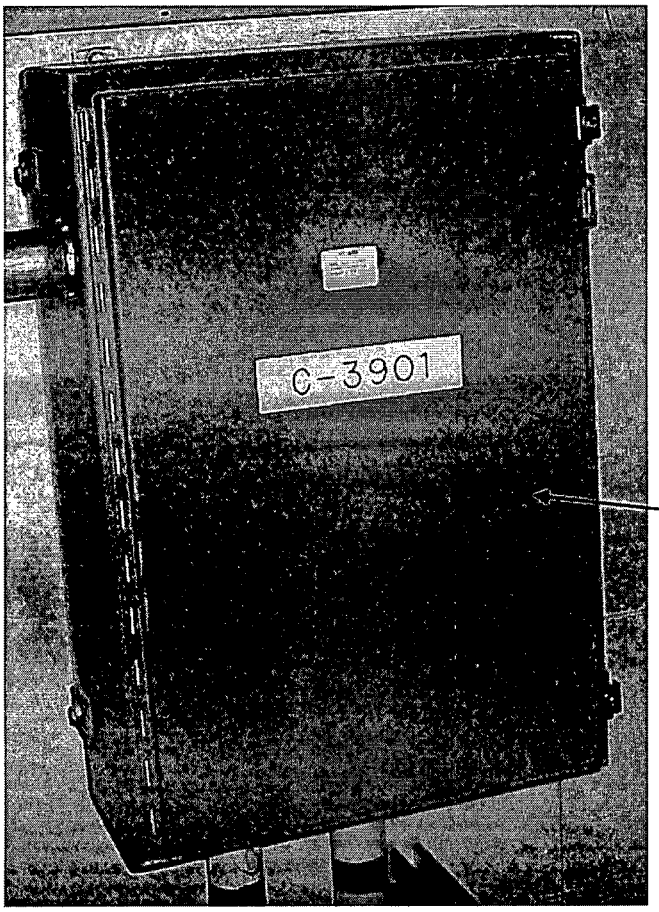
As stated in the response to Technical Question 4, the preamplifiers have been installed for a long time period and have a relatively stable output. Though there has been a small variance in their output, the output is still within the tolerances established in the vendor manual. Additionally, other than the gain link, which is set

during initial installation, the preamplifier has no other adjustment capability. Therefore, performing the channel calibration test with the preamplifier does not provide any added benefit when compared to performing the same test without the preamplifier.

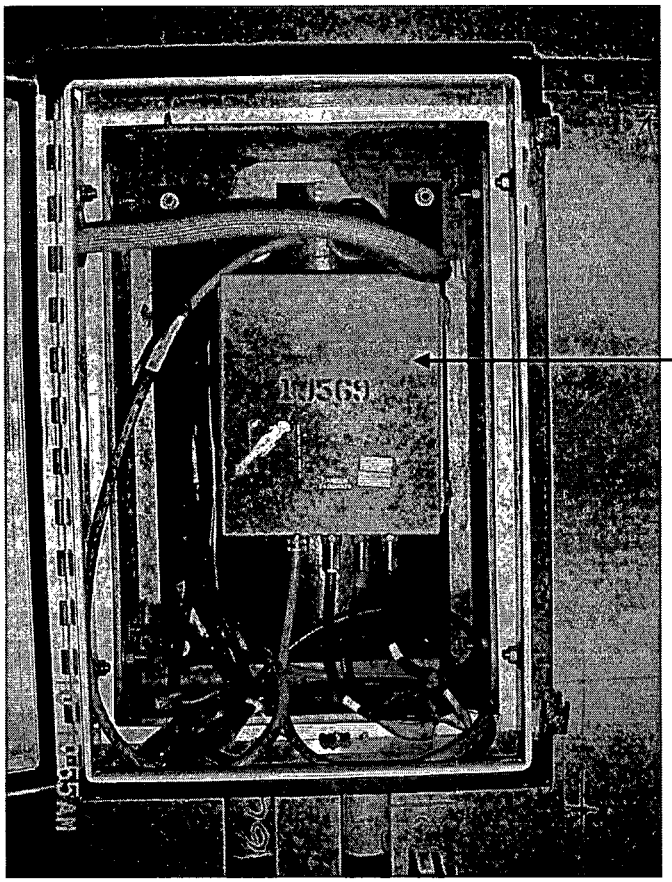
Both the channel calibration and the channel check can be used to determine if the instrument channel is properly operating. A preamplifier malfunction could result in either a higher or lower pulse height, or a change in the number of pulses input to the count rate amplifier. The discriminator in the count rate amplifier would then eliminate more or less of the input pulses. The result would be the affected instrument displaying a different count rate than the opposite source range nuclear instrument and the two post accident monitoring (PAM) source range channels. An intermittent preamplifier failure could also be detected by a comparison with the other three instruments as well. If a preamplifier malfunction results in a change in the count rate, then the difference in counts or count rate would be identified during the shiftly channel checks. Successful completion of the channel check provides an indication that the source range preamplifier is responding to the detector signals within the required range and is accurately amplifying the signal inputted to the count rate amplifier. A channel calibration to test the remainder of the source range nuclear instrument components (for example, the count rate amplifier and the rate of change amplifier) will still be performed. Adjustments of the source range nuclear instrument output will be performed such that the source range nuclear instrument will respond within the necessary range and accuracy to known values of the parameter the instrument monitors.

Enclosure A
L-09-294

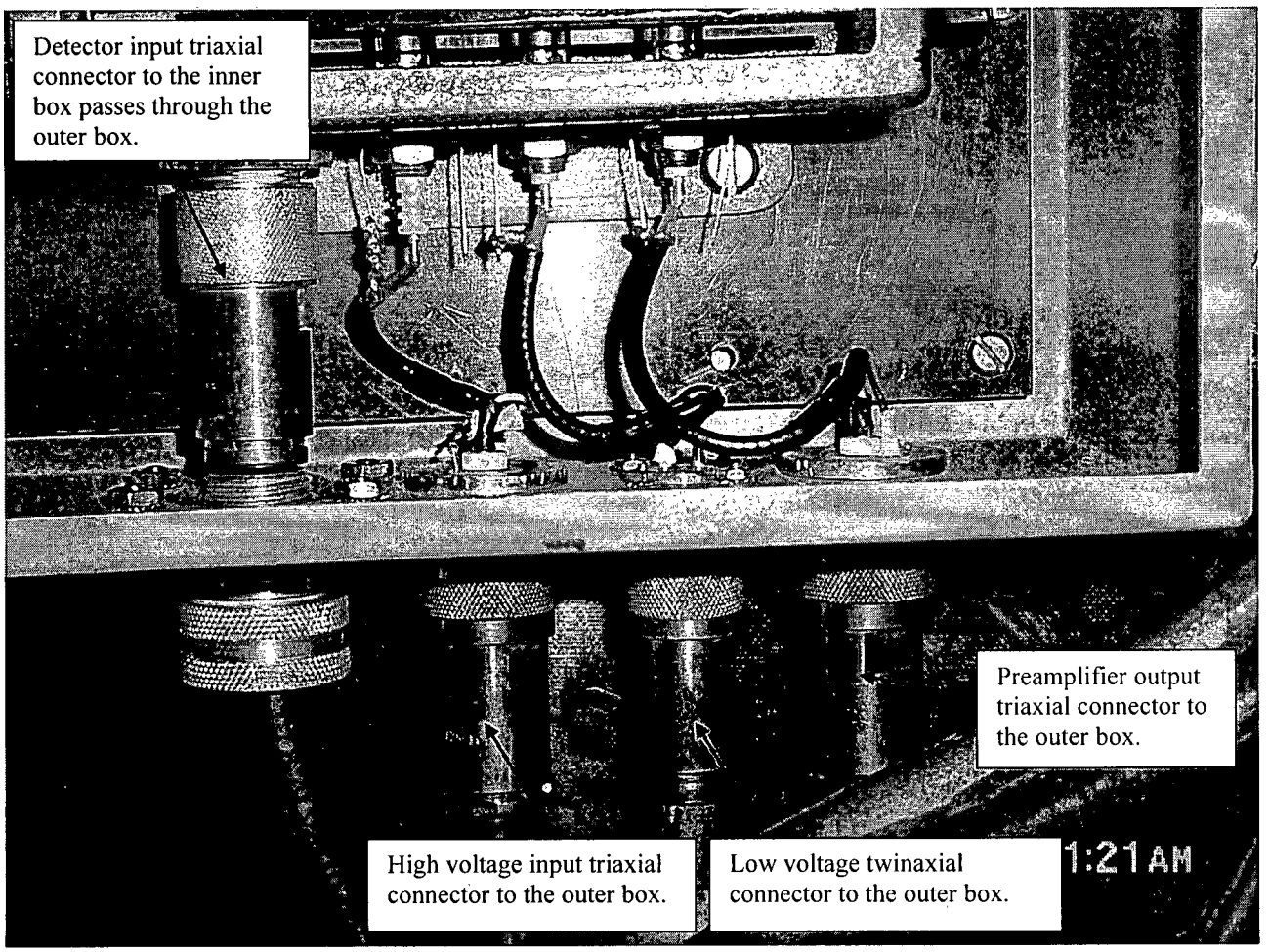
Photographs of a Preamplifier
(2 pages follow)

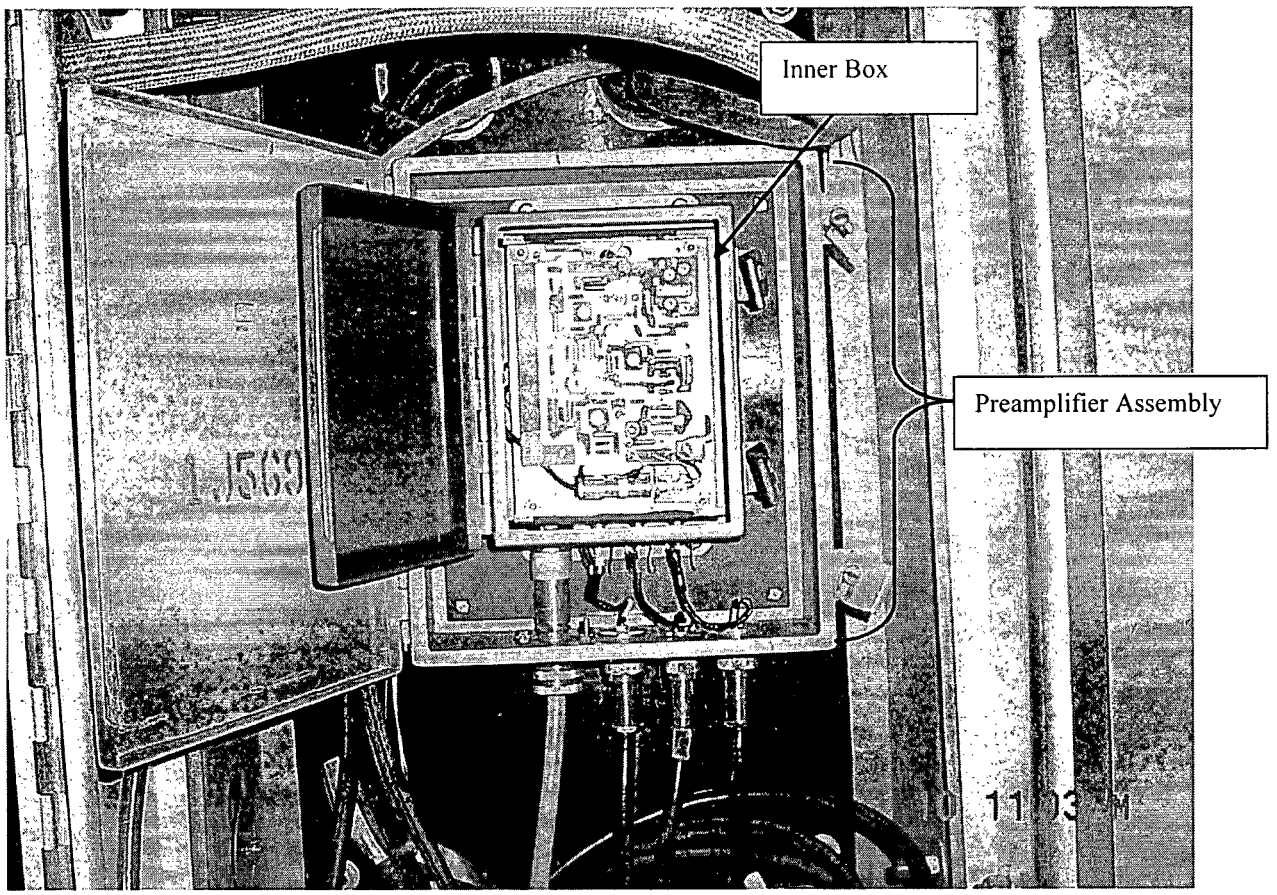


Cabinet containing preamplifier on the containment wall.



Preamplifier


Detector input triaxial connector to the inner box passes through the outer box.
Preamplifier output triaxial connector to the outer box.
High voltage input triaxial connector to the outer box.
Low voltage twinaxial connector to the outer box.
1:21 AM


Inner Box
Preamplifier Assembly

Enclosure B
L-09-294

Select Pages From The Preamplifier Vendor Manual
(2 pages follow)

3088
M-536-101-7

BENCH TESTING PROCEDURE

The bench testing procedure is followed if it is desired to check the output gain and pulse shape of the Preamplifier. Auxiliary equipment needed for this procedure is:

a. A +15 V dc power supply of similar quality to one used in system (E92-331).

b. A pulse generator having a continuously variable main output repetition rate to greater than 1 megahertz and an external trigger output connection. Main output pulse height should be variable from −0.05 to −4.0 volts when operated into a 50 ohm load (base line at ground). Rise and fall time of generator should be in order of 10 nanoseconds.

c. An oscilloscope with vertical deflection characteristics of dc thru 80 megahertz, displays at 50 millivolts/division and horizontal time base characteristics from 50 nanoseconds/division to 2 seconds/division.

NOTE: Use a dual trace oscilloscope to eliminate need for transferring oscilloscope input between input shaping network and Preamplifier output.

d. An input shaping network, see Figure 5. Construction and layout of the network is not critical. However, keep component leads and shielded cable as short as possible.

Bench testing the Preamplifier

1. Connect testing circuit of Figure 6 (Preamplifier gain link in X2 position and oscilloscope input connected to input shaping network, cable A). Set pulse generator output pulse controls to obtain 40 microsecond width, 160 microsecond period and −2.0 volt height. Allow a 15 minute warm-up period.

2. Replace oscilloscope input cable A with cable B (Preamplifier output). Measure: a. rise time, b. fall time and c. height. Compare measurements with specifications (use negative output pulse only, see Figure 7) as follows:

a. rise time < 0.11 microseconds

b. fall time < 0.39 microseconds

c. height between −1.4 and −2.1 volts

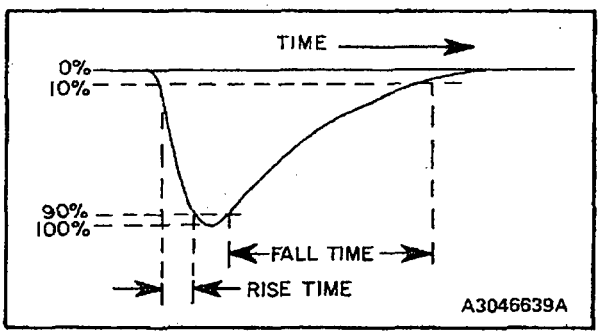


FIGURE 7 – Typical Output Signal Pulse

3. Set Preamplifier output pulse height to −2.0 volts with output height control on pulse generator. Replace oscilloscope input cable B with A. Record input pulse height (V_{IN1}). This reading is used in remaining steps of testing procedure.

4. Change Preamplifier gain link to X4 position. Decrease pulse generator pulse height to V_{IN1} (from step 3) /2. Replace cable A with cable B. Preamplifier output pulse height should be between −1.9 volts and −2.1 volts.

5. Replace cable B with cable A. Change gain link to X10 position. Decrease pulse generator pulse height to V_{IN1} /5. Replace cable A with cable B. Preamplifier output pulse height should be between −1.9 and −2.1 volts.

6. Replace cable B with cable A. Change gain link to X20 position. Decrease pulse generator pulse height to V_{IN1} /10. Replace cable A with cable B. Preamplifier output pulse height should be between −1.8 and −2.2 volts.

7. Replace cable B with cable A. Change gain link to X40 position. Decrease pulse generator pulse height to V_{IN1} /20. Replace cable A with cable B. Preamplifier output pulse height should be between −1.75 and −2.25 volts. Disconnect testing circuit. This completes bench testing procedure.

MAINTENANCE

No special module maintenance is required other than the bench testing procedure included with this instruction. If a Preamplifier module malfunctions replace it with a known good module of the same part number.

The module gain link adjustment should be set (with the Detector Power Supply turned OFF) prior to reactor start-up. The average pulse output signal, as read at the Count Rate Amplifier front plate, should be between 0.5 and 1.0 volts.

Module assembly repair in the field by anyone other than the supplier is not recommended. Qualified repair of the module may be assured by returning it to the factory or the nearest Bailey Controls Company Service Center.

CAUTION: Module components listed as items *44, 45, 46, 49, 50, 51, and 52 on Drawing* D8033171 undergo special screening by the supplier; accordingly, it is especially important that repairs affecting them, module component replacements in particular, are performed by the module supplier.

SPECIFICATIONS

Charge Sensitivity (Conversion Gain)	Adjustable in steps from 0.23 to 4.6 V/pC (volts/picocoulomb, unloaded) for input rise times of 100 ns
Input	0.1 to 10^6 pulses per second (randomly distributed) with an average charge range of 0.5 to 10 pC
Input Impedance	75 ohms
Maximum Detector Power Supply Input Voltage	2400 V dc continuous
Output	−100 mV to −4 V pulse height (short circuit protected)
Output Impedance	75 ohms
Output Noise	20 to 200 mV (Peak) for all gain link settings
Output Pulse Rise Time	50 to 100 ns (input dependent)
Output Pulse Fall Time	75 ns
Voltage Gain Adjustment	X2, X4, X10, X20, X40
Gain Stability	0.1%/F typical 23.9 to 82.2°C (75 to 180°F) 1.5/V typical (14.5 to 15.5 V)
Resolving Time	350 ns typical (detector rise time, 100 ns)
Input Cable Length	100 ft. maximum, RG11 TRIAXIAL
Output Cable Length	500 ft. maximum, RG11 TRIAXIAL
Power Requirements	90 mA @ 15 V dc