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SUBJECT: Informs of selection of Westinghouse steam generator low level ATWS mitigation sys design for installation at facility during 1989 refueling outage. NRC approval by 880603 requested. Addl info encl. W/seven oversize drawings.

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March 31, 1988

10 CFR 50.62

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
TAC #59105
AMSAC

References:
1. Letter from D. C. Hintz to USNRC dated July 1, 1987
2. Letter from M. B. Fairtile to D. C. Hintz dated September 22, 1986
3. Letter from D. C. Hintz to D. G. Eisenhut dated August 1, 1984
4. Letter from D. C. Hintz to D. G. Eisenhut dated September 4, 1984
5. Letter from M. B. Fairtile to D. C. Hintz dated April 8, 1987

As stated in reference 1, Wisconsin Public Service Corporation (WPSC) had been considering two of the Westinghouse ATWS Mitigation System designs for installation at the Kewaunee Nuclear Power Plant (KNPP). These two designs were: the initiation from main feedwater pump and valve status, and initiation from low feedwater flow. Since the time of that submittal Westinghouse has altered these generic designs (WCAP-10858P-A). The changes included the addition of variable time delays. Furthermore, WPSC has decided not to remove the reactor trip initiated by steam flow feedwater flow mismatch coincident with low steam generator water level. This modification, as discussed in reference 1, would have made existing flow transmitters available for the low feedwater flow AMSAC design. Due to these occurrences, WPSC re-evaluated all three of the Westinghouse ATWS Mitigation System designs that were described in WCAP-10858P-A, Revision 1. The main criteria used in selecting a design for the Kewaunee Nuclear Power Plant (KNPP) were human factors, system maintenance, and cost of implementation.

Based on the aforementioned considerations, the Steam Generator Low Level ATWS Mitigation System design has been selected for KNPP. Of the three Westinghouse designs, it requires the least amount of additional control room indication, and

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DRAWINGS TO REG FILES

is therefore less likely to confuse or mislead the operators. This is mainly due to the fact that no variable time delays are required for this design. Furthermore, because no variable time delays are required, design, material, and installation costs are lower. Also, the testing and maintenance requirements are less complex for the Steam Generator Low Level AMSAC design than for the other two Westinghouse designs, resulting in a lower probability of inadvertent turbine trips.

Reference 2 requested plant specific AMSAC design details. These details are provided in Attachment 1. Two sets of the appropriate drawings have also been included to aid in your review process.

Appendix A of reference 2 requested that additional information be provided for proposed AMSAC isolation devices. This information is included in Attachments 2, 3, and 4. These attachments consist of only the applicable portions of references 3, 4, and 5, respectively. References 3 and 4 included requested information on isolation devices for the KNPP Safety Parameter Display System (SPDS). Reference 5 was the NRC SER for those submittals. The isolation devices proposed for the KNPP AMSAC system are presently utilized in the SPDS, and therefore attachments 2, 3, and 4 apply to both SPDS and AMSAC. The only item not addressed in these attachments is with regard to the power supply for the isolators to be used in the AMSAC system at KNPP. We have verified that these isolators are powered from a Class 1E source.

This submittal was originally scheduled for December, 1987, as stated in reference 1. An extension to March, 1988 was agreed upon in a telephone conversation with KNPP's Project Manager on December 10, 1987. This submittal is in accordance with the revised schedule. We are planning for AMSAC installation during KNPP's 1989 refueling outage, which is scheduled to begin on or about March 11, 1989, and therefore request NRC approval by June 3, 1988 to facilitate this schedule. Should you have any questions with regard to the KNPP AMSAC design, please contact my staff.

Sincerely,

E.R. Mathews
D. C. Hintz for
Vice President - Nuclear Power

PEM/kmr

Attach.

cc - Mr. Robert Nelson, US NRC
US NRC, Region III

50-305

SELECTION OF TWO WESTINGHOUSE ATWS MITIGATION SYSTEM DESIGNS

Attachment 1

to

Letter from D. C. Hintz (WPSC)

to

Document Control Desk (NRC)

Dated

March 31, 1988

KNPP AMSAC Design Details

WPSC has selected the AMSAC design which actuates on low steam generator water level, as described in Westinghouse WCAP-10858P-A, Revision 1, with minor deviations. The details, interfaces, and deviations that are specific to KNPP are described below. Two sets of drawings are attached to supplement this information.

I. KNPP AMSAC DESIGN OVERVIEW

A. Selected Design:

AMSAC actuation on low steam generator water level as described in Westinghouse WCAP-10858P-A, Revision 1, with minor deviations.

B. Setpoints:

1. AMSAC actuation will occur at a setpoint below the RPS steam generator lo-lo level setpoint. The AMSAC setpoint will be not more than 5% of the narrow range span (NRS) below the steam generator lo-lo level setpoint.

2. The AMSAC actuation delay will initially be set at 25 seconds. Final adjustments will be made during installation, as necessary, to compensate for instrument drift. However, the final delay setpoint will be within the 30-second turbine trip response time for an AMSAC signal, as described in Westinghouse WCAP-10858P-A, Revision 1.

C. Alarms and Annunciation:

An output signal shall provide for alarms and annunciation whenever any of the following conditions exist:

1. AMSAC is actuated.

2. AMSAC is removed from service.

3. An AMSAC system deviation, such as loss of power or partial trip, occurs.

D. Interlocks and Permissives:

The C-20 permissive, as described in WCAP-10858P-A, Revision 1, will not be required in the KNPP design. AMSAC at KNPP will be armed at all power levels. Alarms associated with an expected AMSAC actuation which occur during a planned shutdown will be treated the same as steam generator low level alarms.

E. Trips/Actuations and Associated Logic:

1. AMSAC initiation will be generated by steam generator low water level signals from existing sensor/transmitter units. The KNPP design consists of 2 channels per loop with 3 of 4 coincidence required to actuate AMSAC.

2. An AMSAC signal will result in a turbine trip and start-up of all auxiliary feedwater pumps.

3. Completion of the mitigating action, once initiated, will be consistent with existing turbine trip and auxiliary feedwater circuitry.

F. Time Response:

1. Turbine trip response time from an AMSAC signal will be less than or equal to 30 seconds.

2. Auxiliary feedwater flow response time from an AMSAC signal will be less than or equal to 90 seconds.

G. Test and Calibration:

Provisions will be incorporated to allow AMSAC to be removed from service for test and calibration purposes.

H. Requirements for Associated Equipment:

1. The logic power supply for the new components of the AMSAC system will be independent from power supplies for the existing Reactor Protection System.

2. AMSAC will be capable of performing its intended function without off-site power.

II. KEY ELEMENTS OF THE KNPP AMSAC DESIGN

A. Diversity:

In determining the extent of diversity in the KNPP AMSAC design, the following objectives were developed:

1. Minimize the amount of new indication to be added in the control room as a result of AMSAC (human factors).
2. Minimize the potential for increasing the probability of inadvertent trips due to AMSAC modifications.
3. Maintain steam generator structural integrity by minimizing the amount of new equipment to be added to the steam generators for AMSAC.
4. Minimize the addition of equipment that requires periodic calibration (additional equipment increases the probability of human error in calibration, reducing system reliability).
5. Minimize radiation exposure during installation and scheduled maintenance of the AMSAC system (ALARA).
6. Utilize simple and proven components and methods wherever practical.

Based on the above objectives, the resulting KNPP AMSAC design utilizes existing Reactor Protection System instrument sensing lines, sensors, sensor power supplies, and isolation devices. Equipment diversity is achieved from the output of the isolation devices through the use of a microprocessor-based programmable logic controller (PLC). The microprocessor selected for this design is an Allen-Bradley model 2/02. In comparison, the existing reactor protection system uses Foxboro H-line equipment for signal conditioning and relays for the required logic.

The diversity is maintained up to, but not including, the final actuation devices. An interposing relay provides isolation between the PLC output (AMSAC signal) and the final actuation devices. Existing circuit breakers will be used for auxiliary feedwater initiation and a contact output will be provided for the "Turbine Auto Trip" control logic.

Reference Drawings: E1475, E1038, E1486, and E1053

B. Logic Power Supplies:

The KNPP design provides for AMSAC logic power to be supplied from a balance-of-plant non-interruptible 120 VAC inverter (BRB-115), which is independent of the existing reactor protection system.

Reference: Figure 8.2-3 of the KNPP USAR (DC Auxiliary and Emergency AC, Single Line Diagram)

C. Safety-Related Interface:

The KNPP AMSAC system will be adequately isolated from the existing protection system, so as to ensure that the existing protection system continues to meet all applicable safety criteria. Analog inputs to the

PLC will be generated through existing Foxboro isolators. These isolators provide isolation between the existing reactor protection and control systems and their qualifications are consistent with the requirements of Appendix A of reference 2. Contact outputs to the final actuation devices will be provided through an interposing relay.

D. Quality Assurance:

The KNPP AMSAC modification is in compliance with the guidance of Generic Letter 85-06, "Quality Assurance Guidance for ATWS Equipment that is not Safety-Related". Existing Administrative, Engineering, and Quality Control Directives govern all modifications, including both safety-related and non-safety-related, at KNPP. These directives, and the programs they govern, including plant modifications, meet the requirements of 10 CFR 50 Appendix B, and as applied to AMSAC will meet the requirements of Generic Letter 85-06. This ensures that good engineering, design, procurement, and installation practices are utilized, resulting in high component and system reliability.

E. Maintenance Bypasses:

The KNPP design provides a means of bypassing AMSAC for maintenance, repair, test, and calibration activities. This bypass, when activated, allows these activities to be performed at power, without the concern of an inadvertent actuation. The use of maintenance bypasses will not involve lifting leads, pulling fuses, tripping breakers or physically blocking relays.

Bypass is accomplished through the use of a block switch. When this block switch is open, the AMSAC actuation signal is disabled. A control room annunciator will indicate the block switch status.

AMSAC testing provisions include the ability to input a simulated transmitter signal to the PLC. This transmitter signal can be varied to check setpoints. Setpoints will be verified through the use of indicating lights located at the AMSAC cabinet. Each channel of the AMSAC system will have separate light indication.

AMSAC SYSTEM FAULT, AMSAC IN TEST, and AMSAC TURBINE TRIP/AFW PUMPS START will be indicated in the control room via three annunciator windows. The AMSAC actuation block switch will provide a contact output to the plant process computer for position status. The PLC provides one contact output per instrument channel to the plant process computer, and a single associated plant process annunciator in the control room, for AMSAC CHANNEL ALERT. This indication is consistent with existing control room design philosophy.

F. Operating Bypasses:

There are no operating bypasses in the KNPP AMSAC design. The KNPP AMSAC system will be armed at all power levels. WCAP-10858P-A, Revision 1 states that the purpose of the C-20 (turbine load) permissive is to prevent spurious AMSAC actuations during startup. However, the KNPP low steam generator level AMSAC actuation setpoint will be below the existing low-low steam generator level reactor trip setpoint. Therefore, any transient that would give a spurious AMSAC actuation during startup would have first caused a reactor trip. As can be seen from this discussion, a C-20 permissive would serve no purpose at KNPP.

By not including the C-20 permissive, use of the turbine impulse pressure transmitter in the AMSAC circuitry is not required. This lowers the probability of adverse interaction between the AMSAC system and the existing reactor protection system. It also simplifies the AMSAC circuitry and operator interface, compared to the designs proposed in WCAP-10858P-A, Revision 1.

G. Means for Bypassing:

The KNPP design provides a means of bypassing the AMSAC system through the use of permanently installed block switch and test switches. These switches will be mounted behind an access cover, the status of which will be monitored in the control room with an annunciator. The switch positions are tied into the access cover annunciator circuit.

Reference: The sections E and L of this attachment entitled MAINTENANCE BYPASSES and TESTABILITY AT POWER, respectively.

H. Manual Initiation:

1. Turbine Trip

There are three main methods which an operator could use to manually trip the turbine. The first of these, and the most obvious, is by depressing the turbine trip pushbutton located in the control room. This pushbutton will actuate the solenoid trip circuitry of the turbine electrohydraulic control system. The end results of this would be actuation of steam dump, reactor trip (when above 10% power), generator trip, and closing of the turbine stop valves.

The second method, should the pushbutton fail, would be a manual run back of the turbine. This would be accomplished by depressing the turbine manual pushbutton and then manually running back the turbine governor valve. These controls are also located in the control room. Running back the turbine governor valves stops steam flow to the turbine. The end results of this method are the same as those for the pushbutton turbine trip.

The third method of manually tripping the turbine would consist of manually initiating Main Steam Isolation. This would be accomplished by depressing the Main Steam Header Manual Isolation Initiation pushbuttons (1 per train), located in the control room. This action would stop steam flow to the turbine and would also achieve the same end results as those described for the pushbutton turbine trip.

2. Auxiliary Feedwater Actuation

Manual auxiliary feedwater actuation can be accomplished in the control room. All three of the auxiliary feedwater pumps can be started by turning their associated control switch to the start position. In the case of the two motor driven pumps, this action will close the associated pump motor's 4160 volt breaker which will energize the motor and start the pump. In the case of the turbine driven pump, this action will open the motor valve which controls main steam flow to the turbine driven auxiliary feedwater pump and the pump will start. Normally all valves in the auxiliary feedwater system, from the discharge of the pumps to the steam generators, are open (except vents and drains). However, there are adequate remote auxiliary feedwater valve controls in the control room such that various system configurations could be established to allow for isolation and flow, as circumstances dictate.

I. Electrical Independence from Existing Reactor Protection System:

The KNPP design is a stand-alone system electrically independent from the existing reactor protection system. As previously stated, existing isolators (Foxboro model 66B current repeaters) provide electrical independence from sensing outputs. These isolators are qualified devices that will isolate the safety-related circuits under conditions where credible voltage/current faults are postulated to be imposed on the non-safety-related circuits. The AC supply voltage is from a non-interruptible source independent of the existing reactor protection system. Independence at the final actuation device is achieved through the use of relay contacts.

Reference: Sections B and C of this attachment entitled LOGIC POWER SUPPLIES AND SAFETY-RELATED INTERFACE, respectively.

Attachment 2 provides qualifications which demonstrate that the isolators proposed for AMSAC will function under the maximum worst case fault conditions.

J. Physical Separation from Existing Reactor Protection System:

The separation criteria applied to the existing reactor protection system will not be violated by the AMSAC design proposed for KNPP. The KNPP AMSAC design provides for physical separation from the existing reactor protection system. The new AMSAC equipment will be installed in the Train B Inadequate Core Cooling Monitoring System (ICCMS) cabinet which is located in the relay room at KNPP. Also, cable routing will be independent of existing reactor protection system cable routing.

K. Environmental Qualification:

In accordance with AMSAC requirements, the new AMSAC equipment proposed for KNPP is qualified for anticipated operational environmental conditions only, not for accidents. An anticipated operational occurrence for a pressurized water reactor is a condition of normal operation which is expected to occur one or more times during the life of the nuclear power unit and includes tripping of the turbine generator set, isolation of the main condenser, and loss of all offsite power. The relay room, which is where this equipment will be located at KNPP, is classified as having a mild environment, and is supplied with class 1E ventilation and air conditioning. The environmental parameters for the relay room, which will not be affected by the aforementioned anticipated operational occurrences, are listed below:

Area	Temperature (°F)	Relative Humidity (%)	Pressure (psia)
Relay Room	70-85	10-40	13.7 - 15.7

L. Testability at Power:

The KNPP AMSAC design will incorporate a full function test panel consistent in design with the existing reactor protection system, with the exception of the block switch. The block switch prevents inadvertent AMSAC actuation during testing by disabling the trip and actuation signals. In comparison, testing of the existing reactor protection system usually involves placing the affected channel in the tripped position. The KNPP AMSAC design provides for on-line testing of the system under all modes of operation. A test switch is provided which will allow insertion of a simulated transmitter signal, which can be varied, to check setpoints using the indicating lights on the test panel.

AMSAC equipment which is not safety-related will be tested quarterly. Testing of AMSAC outputs through the final actuation devices will be performed during annual refueling outages. AMSAC testing will be incorporated into plant surveillance and maintenance programs.

Reference: Section E of this attachment entitled MAINTENANCE BYPASSES.

Drawing E 3600

M. Completion of Mitigative Action:

The KNPP AMSAC system is designed such that, once actuated, the completion of mitigating action is consistent with the plant turbine trip and auxiliary feedwater logic. A turbine trip signal, initiated by AMSAC, will be sealed in by a fixed time delay in the PLC logic. This fixed time delay will also result in an automatic reset of an AMSAC initiated turbine trip signal. Existing seal in circuits, which are part of the manual and Reactor Protection System automatic actuation circuitry, will be used for auxiliary feedwater actuation signals initiated by AMSAC. This will ensure that the AMSAC protective actions, once initiated, will go to completion. Subsequent return to operation, after any trip signal at KNPP, requires deliberate operator action, by procedure. Auxiliary feedwater pumps, after an automatic initiation, can be returned to manual operation by turning the associated control room control switch to the STOP position, provided no automatic initiation signal exists (i.e., automatic initiating conditions no longer exist).

Auxiliary feedwater pumps can be manually stopped anytime by placing their associated control room control switch in the PULLOUT position.

Reference drawings: E1602, E2057

N. Technical Specifications:

It is our position that Technical Specifications for ATWS equipment are not required and are not necessary. AMSAC is not a safety-related system. It will be used to mitigate an ATWS event, which is an event beyond the design basis. An ATWS event couples the occurrence of an anticipated operational occurrence with the complete (multiple) failure of the reactor protection system, and neglects to consider the multiple operator actions which would also effectively mitigate the event.

There are means available, other than Technical Specifications, for ensuring the reliability of the AMSAC system. These include the proper performance of design reviews and safety evaluations during the design process, appropriate quality assurance and quality control coverage, accurate operating procedures, and a thorough maintenance program. All of these items are auditable. Therefore, it is our conclusion that the methods implemented to ensure that AMSAC will perform its intended function should be left to the discretion of the utility.

Attachment 2

to

Letter from D. C. Hintz (WPSC)

to

Document Control Desk (NRC)

Dated

March 31, 1988

Applicable portions of Reference 3

(Letter from D. C. Hintz to D. G. Eisenhut
dated August 1, 1984)

NRC Question 3: Isolation Devices

The licensee is to provide the following information to the NRC for confirmatory review:

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

WPS Response:

The NIS electrical isolation devices used at Kewaunee are Foxboro isolation amplifiers. The Foxboro models used at Kewaunee were tested by Westinghouse as reported in Westinghouse reports WCAP-7506-L (Proprietary), WCAP-7819, Revision 1 (Nonproprietary), WCAP-7508-L (Proprietary) and WCAP-7685 (Nonproprietary). The nonproprietary reports are enclosed as Appendices 3A and 3B.

The Westinghouse reports describe the specific testing performed on the isolation amplifiers and include elementary diagrams of the test configuration. In addition, the Atomic Energy Commission determined the Westinghouse reports demonstrated the ability of the isolation amplifiers to perform their isolation function (References 1 and 2, page 23).

b. Data to verify that the maximum 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.

WPS Response:

The data requested is given in the enclosed Westinghouse reports. The maximum faults were defined as the voltages commonly present in the control room and in the racks containing the isolation equipment.

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).

WPS Response:

The data requested is given in the enclosed Westinghouse reports.

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

WPS Response:

While the acceptance criteria is not explicitly set forth in the test reports, the isolation amplifiers did meet the acceptance criteria of Westinghouse and the AEC (References 1 and 2, page 23).

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

WPS Response:

The isolation devices are located in the relay room below the control room. The relay room is a mild environment under post-accident conditions. The isolation amplifiers are qualified to operate in a mild environment. The application of original seismic testing to the isolation amplifiers is currently being researched. When the documentation has been verified, a supplement to this report will be submitted.

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 tha SPDS.

WPS Response:

The operation of the SAS requires plant signals to be input from existing instrumentation and control circuitry. To protect safety systems, safety-related inputs are isolated from electrical or electronic interference through the use of isolation amplifiers. The electrical isolation provided by the isolation amplifiers ensures that neither the normal operation nor the periodic failure of any SPDS component will prevent existing instrumentation and control equipment from performing its safety-related function.

References

1. Letter from D. B. Vassallo (AEC) to R. Salvatori (W) dated June 6, 1973.
2. Letter from D. B. Vassallo (AEC) to R. Salvatori (W) deted Sept. 3, 1974.

Attachment 3

to

Letter from D. C. Hintz (WPSC)

to

Document Control Desk (NRC)

Dated

March 31, 1988

Applicable portions of Reference 4

(Letter from D. C. Hintz to D. G. Eisenhut
dated September 4, 1984)

NRC Question 3: Isolation Devices

The licensee is to provide the following information to the NRC for confirmatory review:

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

WPSC Response:

The Foxboro isolation amplifiers used for electrical isolation at the Kewaunee Nuclear Power Plant were tested by Westinghouse as reported in Westinghouse report WCAP-7817, Seismic Testing of Electrical and Control Equipment. The Westinghouse report concluded that the isolation amplifiers functioned properly both during and after the simulated seismic condition. This test report documents the compliance of the isolation amplifiers with the seismic qualifications which were the basis for plant licensing.

Attachment 4

to

Letter from D. C. Hintz (WPSC)

to

Document Control Desk (NRC)

Dated

March 31, 1988

Applicable portions of Reference 5

(Letter from M. B. Fairtile to D. C. Hintz
dated April 8, 1987)

4. THE SPDS SHALL HAVE RAPID AND RELIABLE DISPLAY OF THE SAFETY STATUS OF THE PLANT

The Kewaunee SPDS has for the most part satisfied the requirement of Supplement 1 to NUREG-0737 regarding rapid and reliable display of SPDS information in the sense that the computer and the displays function most of the time. However, as reliability figures were only approximate more care should be taken by WPS in monitoring and documenting this, such as having a centralized record indicating down times of the SPDS system and individual displays. The decision to exclude system down time of less than one hour in calculating the SPDS unavailability is questionable, these appear to be frequent, and this should be addressed by the licensee.

5. THE SPDS SHALL BE SUITABLY ISOLATED FROM ELECTRICAL OR ELECTRONIC INTERFERENCE.

NUREG-0737, Supplement 1, requires that the SPDS be suitably isolated from equipment and sensors that are used in safety systems to prevent electrical and electronic interference. WPS is providing isolation amplifiers for this interface. These amplifiers are manufactured by Foxboro and tested by Westinghouse. The amplifiers are two independent cascaded operational amplifiers with no overall feedback. Each amplifier operates independently of the other and uses its own feedback to determine the gain of its stage. The first stage functions as a high impedence buffer from the safety signal. Any fault applied to the output of the second stage will not propagate back to the first stage due to its low output impedence. Tests were performed to demonstrate that faults on the output of the amplifier will not affect the input signal.

Test results are documented in the following reports: (1) WCAP-7819, Revision 1-A, "Test Report, Nuclear Instrumentation System Isolation Amplifier," April 1975, (2) WCAP-7685-A, "Test Report on Isolation Amplifiers," May 1975, and (3) WCAP-7817, "Seismic Testing of Electrical and Control Equipment." The first two reports were reviewed and accepted by the staff in the following documents: (1) AEC letter, D. B. Vassallo to R. Salvatori, WEC, September 3, 1974, (2) AEC letter, D. B. Vassallo to R. Salvatori, WEC, June 6, 1973, and the third report was accepted by: AEC memo R. R. Maccery to R. C. DeYoung, August 22, 1974.

The seismic qualification testing is in accordance with the seismic criteria that was the basis for plant licensing. Environmental testing was not included because the amplifiers are located in the mild environment of the relay room that is located beneath the control room.