Consumers
Power
Company

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Director of Nuclear Reactor Regulation
Attn: Mr Roger Boyd, Director
Division of Project Management
US Nuclear Regulatory Commission
Washington, DC 20555

MIDLAND PROJECT
NSSS ELECTRICAL SEPARATION CRITERIA
FILE: 0505.2 SERIAL: 5069

In Amendment 32 to the Company's application for construction permits and operating licenses, we submitted Appendix 8A to the Midland PSAR which contained the separation criteria and administrative procedures for installation of Class 1E balance-of-plant (BOP) equipment and circuits. Mr S A Varga's letter of October 18, 1977 approved this criteria and noted that additional information on the NSSS electrical separation criteria remained to be provided.

Subsequent to the above, isolation cabinets were procured to isolate the majority of the BOP circuits to meet the intent of Regulatory Guide 1.75. Attachment 1, details the specific separation criteria for the BOP engineered safety isolation system (ESIS). Although isolation cabinets are utilized to isolate the majority of Class 1E to non-Class 1E circuits, the previously submitted and approved analysis method will still be utilized for circuits not isolated by the engineered safety isolation system (ESIS). Please provide your approval of this change in BOP criteria.

In addition, the isolation cabinets provide isolation for the Class 1E circuits that originate within the NSSS ECCAS, and NI/RPS and exit the NSSS cabinetry to provide analog and digital signals to non-Class 1E equipment. Attachment 2 details the specific separation criteria for the NSSS - supplied NI/RPS, ECCAS, CRDCS (trip portion) and the reactor trip switch. Your prompt review and approval of the NSSS criteria is requested.

We are available to meet with the staff as necessary during review of these criteria. Upon NRC's concurrence, the criteria will be incorporated into the FSAR by amendment.

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The following sections establish the separation criteria for the engineered safety isolation system (ESIS) supplied by the owner:

1.0 Location and Arrangement

The ESIS cabinets are located in the main control room. The ESIS cabinets consist of two cabinet groupings for each unit, one containing analog isolation devices and one containing digital isolation devices (four groups total). Each grouping contains three cabinets to house the four Class 1E channel divisions requiring isolation. Due to varying circuit quantities, Channel A and B circuits occupy individual cabinets, while Channel C and D circuits share a common, but internally barriered, third cabinet. Each cabinet provides protection from external hazards, as well as distance and barrier separation between adjacent Class 1E ESIS cabinets.

2.0 Cabinet Internal Separation

The ESIS cabinet internal wiring and isolation devices are designed to the requirements of IEEE 384-1974 and meet the intent Regulatory Guide 1.75, including separation of 6 inches air space or a suitable barrier between the Class 1E wiring and the non-Class 1E wiring. The Class 1E wiring enters each ESIS cabinet from the direction opposite that of the related non-Class 1E wiring. The isolation devices, their socket connectors, and associated terminations have been tested and analyzed to confirm their ability to decouple the Class 1E side of the isolator from faults (open and short circuits, grounds and ac and dc potentials) on the non-Class 1E side of the isolator. The isolation devices will withstand a dielectric voltage between the Class 1E and non-Class 1E terminals and ground, of 1,500 V ac, 60 Hz, for 1 minute without isolation integrity failure. Also, the isolation devices are qualified to meet the surge withstand capability requirements of IEEE 472-1974 without isolation integrity failure.

The cable trays containing isolated non-Class 1E circuits do not contain voltage levels higher than the qualified isolation device levels.

3.0 Internal Wiring Identification

Identification of each channel of wiring within the ESIS cabinets is accomplished by color coding, as follows:

Channel A - Red
Channel B - Green
Channel C - Orange
Channel D - Blue
Non-Class 1E - Black

4.0 Common Termination

No redundant Class 1E wiring is terminated to a common device within the ESIS.

5.0 Non-Class 1E Wiring

Since the total function of the ESIS is to provide Class 1E to non-Class 1E isolation, the non-Class 1E wiring is required to be separated from all Class 1E wiring by either 6 inches air gap or a suitable barrier throughout the ESIS.

6.0 Cable Entrance

Cable entry requirements for the ESIS cabinets are as follows:

Channel A - Bottom
Channel B - Top
Channel C - Bottom
Channel D - Top

In addition, non-Class 1E cable entry will be opposite that of Class 1E cable entry into each cabinet. For the combined Channel C and D ESIS cabinet, a vertical full cabinet barrier is provided to totally separate the Channel C and D cables, both from each other and from the non-Class 1E cables, while maintaining the above cable entry requirements.

The following sections establish the criteria for the location and arrangement, internal separation, internal wiring identification, common termination, and cable entrance for the NSS-supplied Nuclear Instrumentation/Reactor Protection System (NI/RPS), Emergency Core Cooling Actuation System (ECCAS), Control Rod Drive Control System (CRDCS) trip portion and the reactor trip switch.

1.0 Location and Arrangement

The RPS and ECCAS cabinets are located in the safety-related equipment room within the Seismic Category I auxiliary building. The RPS and ECCAS utilize separate cabinets to house redundant signal processing and logic equipment. The cabinets provide physical protection of cabinet internals from external hazards. Modules of redundant protection channels are not housed in the same cabinet; thus, physical separation of internal modules is not required.

2.0 Cabinet Internal Separation

The system logic organization requires the exchange of signals between redundant channels located in different divisions of redundancy. Isolation device circuits are utilized to provide signal coupling while providing for electrical fault decoupling. The isolation device circuits have been tested and analyzed to confirm their ability to protect (decouple) against short circuits, open circuits, grounds, and the application of ac and dc potentials. The isolation device circuits possess the same flame retardancy, maximum operating temperature and dielectric strength ratings as the remaining protection system internal circuitry. The tests and analyses of the isolation device circuits permit less than 6-inch physical separation between isolated circuits and remaining circuits within the cabinet, and do not require the use of barriers internal to the cabinet. The digital signal isolation device circuits have been tested and analyzed for potentials up to and including 480 V ac rms. The analog signal isolation device circuits have been tested and analyzed for potentials up to and including 400 V dc or 400 V ac peak.

Cable trays containing RPS/ECCAS isolated signals do not contain voltage levels higher than the qualified isolation device levels.

3.0 Internal Wiring Identification

Each cabinet is identified as belonging to a particular protection channel. Therefore, it is unnecessary to identify cabinet internal wiring.

4.0 Common Termination

Coincidence logic networks and other logic functions require redundant signals to perform the required functions. Isolation device circuits are utilized to provide signal coupling while providing for electrical fault decoupling. The isolation device circuits have been tested and analyzed to confirm their ability to protect (decouple) against short circuits, open circuits, grounds, and the application of ac and dc potentials. The isolation device circuits possess the same flame retardancy, maximum operating temperature, and dielectric strength ratings as the remaining protection system internal circuitry. The tests and analyses of the isolation device circuits permit less than 6-inch physical separation between isolated circuits and the remaining circuits within the cabinet and do not require the use of barriers internal to the cabinet.

Cable trays containing RPS/ECCAS isolated signals do not contain voltage levels higher than the qualified isolation device levels.

5.0 Non-Class IE Wiring

Although certain analog and digital signals derived within the protection system cabinets are transmitted to non-Class 1E systems and equipment, there is no penetration of non-1E wiring into the protection system cabinets proper. Isolation of these signals takes place outboard the protection system cabinets in cabinets which are dedicated to providing for electrical isolation. These signals are classified 1E up to the input side of the isolation devices. Refer to Section II following for a description of the isolation cabinets and devices.

6.0 Cable Entrance

All connections to a protection channel are made inside the boundaries of that channel's cabinets. The cabinets limit the damage potential to faults or failures internal to the cabinet boundary. Test and analysis of the type of faults and failures internal to the cabinet are enveloped by the isolation, flame retardancy, maximum operating temperature, and dielectric characteristics of the circuits and materials utilized within the cabinet.

7.0 Control Rod Drive Control System (Trip Portion)

To comply with the physical separation requirements of IEEE 384-1971, the CRDCS trip switchgear consists of four ac circuit breakers which are mounted in separate, totally enclosed cabinets. The trip switchgear and cabinets are qualified Seismic Category I and are located in the auxiliary building.

The Class 1E trip circuit in a breaker consists of an undervoltage coil which is powered by an RPS channel. Upon interruption of power to the undervoltage coil (automatically by the RPS or manually by either reactor trip switch), the undervoltage coil will de-energize and its associated mechanical trip mechanism will trip the circuit breaker to the open position. The circuit breaker is classified non-1E while the undervoltage coil and trip mechanism are classified 1E.

The non-1E component (circuit breaker) and 1E components (trip mechanism and undervoltage coil) are mounted in one of four compartments in the associated cabinet. The Class 1E trip signal cable is routed, through a conduit, from the top or side of the cabinet to a disconnect stab located in the rear of the second compartment. The Class 1E cable that is routed from the stab to the undervoltage coil follows a path which is close to a non-Class 1E control interlock cable. Since a short section (less than 20 inches) of the 1E cable is less than 6 inches from a non-Class 1E cable, a fault voltage test was conducted on all non-Class 1E circuits and control components of the breaker. The test results verified that a maximum available potential of 600 V ac does not cause a loss of protective function of the Class 1E circuit and the Class 1E trip mechanism.

A type tested and qualified isolation relay in the CRDCS trip breaker cabinet is used to interface between a Class 1E trip confirm indication lamp in the RPS and a non-Class 1E signal source in the circuit breaker. This isolation relay is employed to comply with the associated circuit requirement of Section 4-5(2) of IEEE 384-1971. The trip confirmation isolation relay is mounted in a conduit box. Thus, all CRDCS trip circuits meet the requirements of Section 4 of IEEE 384-1971, by a combination of safety class structure, spacing barriers, and testing of isolation device circuits.

8.0 Reactor Trip Switches

Each reactor trip switch is composed of four double-pole single-throw heavy duty switches that are mounted in a conduit box. The switches are provided with a common operator. Physical separation between channels within a switch is provided by metal barriers internal to the conduit box. Physical separation external to the conduit box is provided by conduit. By the use of metal barriers and conduit, reactor trip switches meet the general design requirement of Section 4.0 of IEEE 384-1971.

Two switches, as described above, are wired in series to provide redundancy for the manual trip function.

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