DAVIS-BESSE NUCLEAR POWER STATION UNIT NO. 1

SECTION 5.0

ASSOCIATED CIRCUITS

5.0 ASSOCIATED CIRCUITS

The separation and protection requirements of 10CFR50, Appendix R apply not only to Safe Shutdown circuits, but also to "Associated" circuits whose fire-induced failure could prevent operation or cause maloperation of Shutdown systems and equipment. The identification of these Associated Circuits of concern was performed in accordance with NRC Generic Letter 81-12 and the Staff's Clarification to the Generic Letter. The letter further defined associated circuits of concern as those cables that:

1. Have a physical separation less than that required by Section III.G.2 of Appendix R, and;

2. Have one of the following:

    a. A common power source with the Shutdown equipment (redundant or alternative) and the power source is not electrically protected from the circuit of concern by coordinated breakers, fuses, or similar devices; or

    b. A connection to circuits of equipment whose spurious operation would adversely affect the Shutdown capability; or

    c. A common enclosure (e.g., raceway, panel, junction box) with the shutdown cables, and:

        1. are not electrically protected by circuit breakers, fuses or similar devices, or

        2. will allow propagation of the fire into the common enclosure.

The sections below describe the methodology and criteria for the review, evaluation, and proposed resolutions for the common power source and the common enclosure analyses of associated circuits.

The evaluation of possible spurious operation of equipment was included in the circuit analysis performed for Safe Shutdown equipment as documented in Section 4.

5.1 Common Power Source Analysis

5.1.1 Introduction

The electrical distribution system was reviewed to ensure that acceptable coordination and selective tripping is provided for all circuits in the Essential Power System. The review was limited to circuits supplied from power sources which feed loads required for Safe Shutdown.

The power sources reviewed are as follows:

- 4160V AC — Switchgears C1, C2, D1, and D2
- 480V AC — Essential Unit Substations E1 and F1
- 480V AC — Unit Substation F7
- 480V AC — Essential Motor Control Centers
- 250/125V DC — Essential Motor Control Center DC MCC 1 and DC MCC 2
- 240/120V AC — Essential MCC YE1, YE2, YF1, YF2

o	125V DC	Essential Distribution Panels D1P, D1N, D2P and D2N
o	125V DC	Distribution Panels DAP, DAN, DBP, and DBN
o	120V AC	Essential Instrumentation Distribution Panels Y1, Y2, Y3 and Y4
o	120V AC	Uninterruptable Instrumentation Distribution Panels YAU and YBU
o	Cabinets	Cabinets & Panels used as power supplies & Panels

All of the above-mentioned power supplies are essential with the exception of Distribution Panels YAU, YBU, DAP, DAN, DBP, and DBN, Unit Substation F7 as well as Switchgear Buses C2 and D2. Distribution Panels YAU and YBU are required for Non-Nuclear Instrumentation. Switchgear Bus C2 and Distribution Panels DAP and DAN supply power for the Backup Service Water Pump. Switchgear Bus D2, Unit Substation F7 and Distribution Panels DBP and DBN supply power to the Motor-Driven Feedwater Pump.

5.1.2 Methodology

The Safe Shutdown components in Appendix A are evaluated to determine if power to the component is required for Safe Shutdown. If power is required, then associated circuits which share this common power source are evaluated. The method of evaluation depends on the power source.

Electrical coordination at the 4kV level is provided as supported by the relay setting sheets. Safe Shutdown cables include power, breaker control and protective relaying circuits. Procedures require the stripping of all associated circuits on Buses C2 and D2 prior to using the Backup Service Water Pumps and the Motor-Driven Feed Pump.

Each 480V MCC associated power cable associated with a Safe Shutdown MCC is identified on the electrical one-line drawings, routed in Appendix C-1 and C-2, and evaluated as an associated circuit (ASSCKT) in each fire area.

The MCC fed from the Unit Substations are coordinated with the breakers that feed them due to the time vs current tripping characteristics of the AK-25 power circuit breakers. Certain cascaded MCC feeders from F11A, F12A, E11A, and E12A, will have the molded case circuit breaker removed. The following MCC's required for Safe Shutdown have an upstream MCC that does not coordinate and, when cables associated with these MCC's appear in an area being analyzed, the evaluation assumes that the MCC is lost:

Train 1		Train 2
E11B	E16B	F11B
E11E	YE2	F12D
E12E		YF2

Other connected MCC's are listed as associated in Appendix C-3. The net result of this approach is that all power cables connected to MCC's are listed in Appendix C-3 and appropriately evaluated in each fire area.

The control and instrument cables shown on Safe Shutdown elementary drawings were conservatively assumed to all be Safe Shutdown with the exception of certain isolated indication, computer input, motor heater circuits, alarm and annunciation circuits which cannot prevent Safe Shutdown. Therefore, the control cables are not required to be listed as associated circuits.

The AC and DC power feeds to Safe Shutdown equipment (as shown on Drawings E-6 sheets 3 & 4 and E-7) are routed and evaluated as Safe Shutdown circuits.

The AC and DC distribution panels, and cabinets which act as needed power supplies for safe shutdown components (as shown on elementaries), are included in Appendix C-3. Powering one cabinet from another cabinet is referred to as cascading or “daisy-chaining.” Coordination is required to ensure operability of the downstream safe shutdown component.

The associated circuit is evaluated for the next level of coordination based on the largest internal fuse. This is required when a safe shutdown and non-safe shutdown loads are fed from a single fuse. For example, a typical circuit feeds three panels off a 10-amp fuse. Only one is considered safe shutdown, but all three cables are associated with the safe shutdown component and routed in FHAR Appendix B. The largest fuse on the other two non-safe shutdown relay cabinets is evaluated to ensure that a short there blows the fuse at the non-safe shutdown panel instead of the 10-amp fuse.

Deleted.

Credit is taken for a power source only when adequate coordination can be shown. The most conservative characteristic curve for a fuse is assumed based on the various types stocked in the warehouse. When the incoming and load protective device coordinate, a YES is entered in Appendix C-3.

5.2 Common Enclosures Analysis

5.2.1 Introduction

The objective of this study was:

1. To determine if an interrupting device (i.e., breaker, fuse, or similar device) has been provided for non-Safe Shutdown and Safe Shutdown circuits routed within a common enclosure, and to determine if the design practice of installing interrupting devices has been carried out for circuits where appropriate.

2. To determine if appropriate measures have been taken to prevent propagation of the fire for common enclosure cases of Associated Circuits.

The scope of this study was to ensure compliance with the guidelines of the Clarification to NRC Generic Letter 81-12, Enclosure 2, to provide electrical protection for common enclosure cases of Associated Circuits.

5.2.2 Assumptions

The identification of Safe Shutdown Circuits was used as the basic input to this study.

The Associated Circuits (identified from a common enclosure review) would only present a concern if they were to impact the train of system/circuits accredited for Safe Shutdown in a particular fire area.

5.2.3 Methodology

The methodology utilized to perform the common enclosure study is outlined below:

1. The Safe Shutdown "Circuit/Subcomponent Location Summary by System" (Appendix B-1) was used to identify common enclosures (i.e., cable trays, conduits, junction boxes, terminal boxes, relay cabinets, local panels, and electrical penetrations) which contain both Safe Shutdown Circuits and Non-Safe Shutdown Circuits.

2. Non-Safe Shutdown Circuits contained within the above common enclosures were identified from the Electrical Raceway Schedule and the Equipment Circuit Schedule.

3. A sample population of circuits was chosen to include all representative types of electrical circuits, that is, power, control, and instrumentation. A verification was made that an interrupting device (i.e., breaker, fuse or similar device) is shown on the electrical drawings for the circuits within common enclosures in this sample population.

4. Documentation was obtained which indicated that appropriate measures have been provided at DB-1 to prevent propagation of fire which may damage Safe Shutdown Circuits for common enclosure cases of Associated Circuits. The specific requirements are outlined in Criterion B.2.c. of the Clarification of NRC Generic Letter 81-12, Enclosure 2.

5.2.4 Results

The interrupting device for each circuit within a common enclosure is adequately sized to perform its design function as part of the original plant design. The sizing and protection criteria for the interrupting devices in the electrical circuits is provided in the Updated Safety Analysis Report, Section 8.3.

Based on a document review of the sample population of the Non-Safe Shutdown Circuits discussed above (Item 4), it is concluded that where appropriate, an interrupting or isolation device exists in all the common enclosure circuits at DB-1. Hence, there were no common enclosure cases of Associated Circuits of concern identified.

Safe shutdown circuit common enclosures are adequately protected to ensure that a fire will not propagate along an associated circuit into a common enclosure. Fire area boundaries are separated by fire barriers and penetration seals which will prevent a fire from propagating into a common enclosure. Smoke and hot gas seals are provided where required to adequately prevent internal conduit fire propagation. Where 20 ft. separation is used to provide separation, no cables connect the separated common enclosures.

5.3 Summary Of Multiple High Impedance Fault Analysis

An analysis to evaluate the impact of multiple high impedance faults on the required 4160V AC, 480V AC, 250V DC, 125V DC, and 120/240V AC distribution systems was performed. The results of this analysis demonstrate that multiple high impedance faults will not impact the Safe Shutdown of the plant. (See References 2.6.I and J).

NRC Generic Letter 86-10 includes the consideration of simultaneous high impedance faults (item 5.3.8) on associated circuits. A High impedance fault current is assumed to result in a total current that is higher than normal but below the trip point of the circuit breaker or fuse. A fire is assumed to cause multiple high impedance faults on associated circuits. The purpose of the analysis is to show that the incoming breaker or fuse does not trip and cause a loss of the accredited common power source.

High impedance faults on the essential 4kV system do not impact Safe Shutdown for the following reasons. All cables that are connected to a Safe Shutdown common power source are routed as Safe Shutdown (there are no associated circuits). Calculations have shown that high impedance faults will not trip the diesel breaker and these cables are accredited for Safe Shutdown if, and only if, they are free of fire damage.

High impedance faults on other essential systems 480V and below have been evaluated and determined not to be a concern. The following method was used for the evaluations:

1. A high impedance fault current of 4-amps is assumed for each associated circuit potentially affected by fire damage. This is conservative, see ANSI/IEEE Standard 242-1986, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book) Section 8.4.1.4, "Ground Fault Currents and Rates of Decay". Fault current greater than 4-amps will rapidly lead to a bolted fault.

2. The number of circuits affected by a fire is assumed to equal the number of continuous loads passing through a fire area, unless a specific analysis is done. For cases where the areas associated with a load are not tabulated, it is conservatively assumed that the cable passes through all fire areas.

3. Normal loads on the MCC are assumed to be operating. Although MOV's are intermittent loads, they are assumed to be operating simultaneously for 60-seconds (most valves operate at diverse times and for less than 20-seconds).

4. All MOV's, including SFAS, are assumed to start and the inrush current is added to continuous current and high impedance fault current to ensure that the incoming breaker will not trip. Inrush currents are conservatively assumed to be 5 times normal and last 5-seconds.

On the above basis, multiple high impedance faults will not prevent Safe Shutdown.