FORT CALHOUN UNIT #1
ALTERNATE SHUTDOWN CAPABILITY
CONCEPTUAL DESIGN DESCRIPTION

MR FC-78-56

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1.0 DESIGN REQUIREMENTS

This design package is in response to our commitment to NRC for providing alternate shutdown capability, independent of cabling in the Cable Spreading Room or the Control Room for Fort Calhoun Unit #1 (Reference SER Section 3.1.21).

The assumptions made in preparation of this conceptual design are as follows:

- The Control Room is lost because of fire in the Control Room or the Cable Spreading Room.
- Off-site power is lost.
- Other than the fire in the Control Room or the Cable Spreading Room, there is no accident condition.
- The plant is required to be placed and maintained in a hot shutdown condition with a minimum crew of one operator at the alternate shutdown panel and a helper in the plant. When the fire is under control, sufficient additional personnel are available, and off-site power has been restored, the plant will be taken to cold shutdown using new emergency procedures.

2.0 TECHNICAL DESCRIPTION

The following modifications are proposed:

a) An alternate shutdown panel (ASP) will be added and installed next to the auxiliary feedwater panel AI-179 in the electrical penetration room at Elevation 1013'-0".

The following instruments and controls shall be provided on this panel:

- Primary Loop Hot Leg Temperature Indicator
- Primary Loop Cold Leg Temperature Indicator
- Volume Control Tank Level Indicator

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- Pressurizer Level Indicator
- Transfer Switch "Remote-Local close" with one set of indicating lights for: TCV-202, PCV-103-1, PCV-103-2
- Transfer switch "Remote-Local open" with one set of indicating lights for HCV 239
- Open/Close indication for: HCV-150, HCV-151, HCV-240, and PCV-102-2
- Transfer Switch "Remote-Local Start-Local Stop" With One Set Of indicating lights for C.A-1B

b) The controls for steam driven auxiliary feedwater pump, valves and the following instruments are already provided on Panel AI-179:

Steam Generator RC 2A Level Indicator
Steam Generator RC 2A Pressure Indicator
Steam Generator RC 2B Level Indicator
Steam Generator RC 2B Pressure Indicator
Pressurizer Pressure Indicator PI-115A1 and
Pressurizer Pressure Indicator PI-115A2

c) The following plant functions and systems will be made available for operation from the alternate shutdown panel, AI-179 and other remote stations located in the Diesel Room, the Switchgear Room and the Electrical Penetration Room. The equipment necessary for operating of these systems has been highlighted on the drawings listed in Section 6.

a) Primary System Inventory Control (See E-23866-210-110 & 120 Sh. 1)
Chemical and Volume Control System
Pressurizer Pressure and Level Indication
Pressurizer Power Operated Relief Valves (PORV)
Backup Pressurizer Heaters

b) Decay Heat Removal (See Drawing #11405-M-252 & 253)
Auxiliary Feedwater System
Steam Generator Pressure and Level Indication
Main Steam Safety Relief Valves
Reactor Coolant Temperature (See E-23866-210-110)

c) Reactivity Control

(Refer to Section 3.3.)

iv) Auxiliaries
Diesel Generator #2
Diesel Driven Fire Pump

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Provisions shall be made for isolating electrical equipment necessary for operation of systems listed above from Control Room. Key locked local controls shall be installed for operation of necessary equipment from remote locations. All electrical modifications shall be designed according to IEEE-279-1971.

3.0 ANALYSIS

This section provides an analysis of various plant systems required to bring and maintain the plant to hot shutdown condition and outlines the equipment and modifications necessary for performing the intended functions.

3.1 Primary System Inventory Control

Systems and instruments required for primary system inventory control are discussed below.

3.1.1 Chemical and Volume Control System (CVCS)

The CVCS is required in the event of this emergency to provide make-up water for the primary system for maintenance of the pressurizer level above the lower limit. Following a reactor trip, the primary coolant temperature will be reduced to the no-load temperature condition as dictated by the steam generator temperature condition, and will then gradually increase until the auxiliary feedwater system is placed in service to maintain the primary system temperature and pressure.

The operator will then control the pressurizer level by operation of charging pump CH-1B. Feed to this charging pump shall be from the volume control tank.

3.1.2 Charging Pump CH-1B

The charging system was chosen over the high pressure safety injection (HPSI) system for maintaining the primary inventory because the maximum head of the HPSI pumps is 1,735 psig versus a primary system pressure of 2,100 psig at hot shutdown. Charging pump CH-1B was chosen because it is powered by train 4 (bus 1A4, diesel generator number 2).

Diesel D2 will be run locally; the power supply will be unaffected by a loss of the Control Room or Spreading Room.

Controls for the operation of Charging Pump CH-1B will be added to the alternate shutdown panel.

To operate the pump using the local control switch, the external wires, (CH-1B-PC, CH-1B-T, CH-1B-NT, CH-1B-GW and CH-1B-PT at breaker 1B4C-6) will be locally isolated at the switchgear. This will prevent spurious signals from the Control Room from starting the pump, tripping the pump or blowing the fuses.

The remaining two charging pumps, CH-1A and CH-1C, will be protected from inadvertent operation by tripping and "lockingout" the breakers in the Switchgear Room.

The following valves must be in the "open" position for the pump to take suction from the volume control tank and discharge into the 2A primary loop. It is not necessary to operate or modulate these valves, as the flow variations will be accomplished by operating the pump.

LCV-218-2: This motor operated valve is on the pump suction line, its normal operating position is open, and it fails "AS-IS". As a backup, the valve can be manually opened. To avoid spurious closing, breaker located at MCC 3A2 can be locked open.

HCV-239: This is a control valve on the discharge side of the charging pump inside the containment which fails in the safe open position.

(If additional boration is required or the volume control tank does not contain sufficient water, the charging pump suction can be aligned to the Safety Injection & Refueling Water Tank (SI RWT) by manually closing valve LCV-218-2 and opening valve LCV-218-3).

HCV 240: To avoid the possibility of inadvertent auxiliary spray, HCV 240 should be closed. This is a pneumatic valve and fails closed. "Open-close" indication for this valve will be provided on ASP.

3.1.3 Letdown Control Valve (TCV-202)

TCV-202 is an electro-pneumatic control valve required for the primary loop letdown system. It receives its electrical signal from the main control boards CB-1, 2, 3. Electrical supply is from D.C. bus number 1 via distribution panel AI-41A. During this emergency, this valve should be in a closed position.

The loss of electrical signal or air results in this valve failing closed. The control/indication cable between the electrical penetration and main control board will be rerouted through the Local-Remote-Close transfer switch in the alternate shutdown panel. Lights will also be provided on the new shutdown panel to provide open/close indication.

3.2 Decay Heat Removal

Systems, equipment and instruments required for decay heat removal are outlined below.

3.2.1 Auxiliary Feedwater System (AFS)

This system will be used to remove the decay heat from the core via the primary system and the steam generators. Following a reactor trip there is sufficient water in the steam generators to provide heat removal from the primary system for a period of 12 minutes. There is, therefore, sufficient time before any operator action on the AFS is required. A steam driven auxiliary feedwater pump (FW-10) is proposed to be used for pumping feedwater.

The AFS turbine is supplied with steam from the main steam system via valves YCV-1045A and B, and YCV-1045, see 11405-M-252. The controls for these valves are already on panel AI-179.

Valves HCV-1107A and B and HCV-1108A and B should be open to supply feedwater to the steam generators, see 11405-M-253. Valves 1107A and 1108A are located within the containment, while 1107B and 1108B are located in the Auxiliary Building. The valves are fail-open and can be placed in the desired position by removing power from them.

The valves are redundantly fed by 125VDC from Control Room panel CB-10 (D.C. Bus 1) and auxiliary feedwater panel AI-179 (D.C. Bus 2). Upon loss of the Control Room power and control for these valves, control can be transferred from CB-10 to panel AI-179 using the transfer switch presently installed in AI-179. In addition, the transfer switch isolates the control circuits from the Control Room; this prevents spurious signals, therefore, no modification is required for the circuitry of valves HCV-1107A and B, and HCV-1108A and B.

Necessary controls for the operation of the steam driven feedwater pump are also provided on panel AI-179.

3.2.2 Steam Generator Pressure and Level Indication

Pressure and level indication for the steam generator are already provided on panel AI-179.

3.2.3 Main Steam Safety Relief Valves

No modification or operator action is required for these valves to perform the necessary function of relieving steam to the atmosphere. These valves will relieve at a secondary steam generator pressure of 1,000 psia, following mainsteam isolation. They will reseat at a pressure of 950 psia.

3.3 Reactivity Control

The rod control system is of fail-safe design. Faulting in this system circuit trips the reactor. Following a reactor trip, soluble poison may be added to the primary system to further assure subcritical ily. The chemical and volume control system is normally used for such boron addition; CH-1B will be used for pumping borated water.

3.4 Auxiliaries

Plant auxiliaries required for this emergency are outlined below.

3.4.1 Diesel Generator Number 2

One diesel generator is required to supply auxiliary station power in the event normal power is interrupted during a fire in the Control Room or Cable Spreading Room.

Normal control and test of the diesel generators is at Control Room panels AI-30A and AI-30B. If these panels and/or associated cabling are destroyed, provisions have been made, on the local diesel generator control panels to transfer the circuits to the local panels via a transfer switch (183). Power cables from the diesel generators are routed such that they will not be affected by fire in the Control or Cable Spreading Rooms. The only required modification is a minor change to the 183 switch so it will also "isolate" the circuits from panel CB-20 located in the Control Room.

3.4.2 Load Shed

To avoid overloading of Diesel Generator #2, load shedding on both 480V and 4160V busses shall be required. Under normal plant condition, load shedding on 480V busses is done from Panel AI-30B and AI-109B. During this emergency, it is assumed that panel AI-30B may be lost. Panel AI-109B is located in the Switchgear Room and all load shedding relays are located in this panel. These relays can also be actuated from local control station for diesel generator panel AI-133B. Some minor modification will be required to isolate panel AI-109B from the Control Room and provide it with an alternate control power source.

Load shed on 4160V busses is done by undervoltage relays located in Panel CB-20 (Control Room). Loss of this panel is assumed with fire in Control Room and as such provision shall be made in emergency procedures to open and lock non essential 4160V breakers. Procedure will also provide for tripping of all loads connected to bus 1A4, before diesel generator #2 is brought on line.

3.4.3 Diesel Fire Pump

The diesel fire pump can be operated manually from the Screen House and the Control Room. The controls from the Control Room will be isolated at the Screen House.

4.0 SEQUENCE OF EVENTS

This section outlines the sequence of events and operator actions required following the loss of the Control Room and the Cable Spreading Room. This is not a detailed procedure, which is outside the scope of this design package and will be part of detailed design. The intent here is to demonstrate the feasibility of maintaining a safe hot shutdown condition with the two-man crew.

As soon as Control Room evacuation is ordered, the reactor operator will trip the reactor from the Control Room and then proceed to panel AI-179. The following is an outline of the actions of the two-man crew.

TIME	PANEL OPERATOR	HELPER
0-10 Mins.	Proceeds to AI-179. Starts up auxiliary feedwater system.	Load sheds Bus 1A4 & proceeds to diesel number 2, isolates diesel from Control Room and starts it.
10 Mins. - 1 Hour	Monitors plant instrumentation. Determines whether charging pump operation is necessary.	Proceeds to Charging Pump CH-1B. Performs pump isolation and valve alignment.
1-4 Hours		
4 Hours		Aligns fire protection System to fill emergency feedwater tank.

5.0 CRITICAL QUALITY EQUIPMENT (CQE)

5.1 All cables and alternate shutdown panel are classified as Critical Quality Equipment. Components added to existing safety related circuits shall also be CQE.

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6.0 DRAWINGS

Systems necessary for plant shutdown are shown on the following drawings. Equipment necessary for operation of these systems has been highlighted.

1. E-23866-210-110
2. E-23866-210-120
3. 11405-M-252
4. 11405-M-253