7.3 ENGINEERED SAFETY FEATURES SYSTEMS

The safety related instrumentation and controls of the Engineered Safety Feature Systems (ESFS) include (1) the Engineered Safety Feature Actuation System (ESFAS) which consists of the electrical and mechanical devices and circuitry (from sensors to actuation device input terminals) involved in generating those signals that actuate the required ESF systems, and (2) the arrangement of components that perform protective actions after receiving a signal from either the ESFAS or the operator. (Sensing parameters are listed in Table 7.3-2).

The following actuation signals are generated by the ESFAS when the monitored variables reach the levels that are indicative of conditions which require protective action:

a) Safety Injection Actuation Signal (SIAS) NSSS)

b) Containment Isolation Actuation Signal (CIAS) (NSSS)

c) Containment Spray Actuation Signal (CSAS) (NSSS)

d) Main Steam Isolation Signal (MSIS) (NSSS)

e) Emergency Feedwater Actuation Signal (EFAS) (NSSS)

f) Recirculation Actuation Signal (RAS) (NSSS)

The ESF system device actuation circuitry receives (1) actuation signals from the ESFAS or the operator, and (2) permissive signals from sensors which monitor conditions that affect ESF system performance. The signals from the ESFAS actuate the ESF system equipment. The permissive signals provide additional interlocks, blocks and sequencing necessary to provide Proper ESF system operation.

The ESF systems components automatically actuated by signals from the ESFAS are identified in Tables 7.3-5 thru 7.3-11.

→(DRN 03-2061, R14)
Automatic ADV operation is required for SBLOCA mitigation. ADVs are addressed in Section 7.4.
←(DRN 03-2061, R14)

7.3.1 DESCRIPTION

The actuation circuits for the ESFAS (as identified in Section 7.3) are all similar except for specific inputs, operating bypasses, and actuation devices. The SIAS described in Subsection 7.3.1.1.1, is typical of all ESFAS. The specific instruments and controls associated with each system are discussed separately in the appropriate Subsection of 7.3.1.1.

The actuation systems consist of the sensors, logic, and actuation circuits that monitor selected plant parameters and provide an actuation signal to each individual actuated component in the ESF system if these plant parameters reach preselected setpoints. Each actuation system is identical except that specific inputs (and blocks where provided) vary from system to system and the actuated devices are different. Figures 7.3-1 SH. 1, 2 & 3 show the ESFAS simplified functional diagram.

Two-out-of-four coincidence of like initiating trip signals from four independent measurement channels is required to actuate any ESF system. Each actuation system logic, including testing features, is similar to the logic for the Reactor Protective System, and is contained in the same physical enclosure. The combination of the ESFAS and Reactor Protective System (RPS) is designated Plant Protection System (PPS).

These same features include the capability of the ESFAS to operate, if need be, with up to two channels out of service (one bypassed and another tripped) and still meet the single failure criteria. The only operating restriction while in this condition (effectively one-out-of-two logic) is that no provision is made to bypass another channel for periodic maintenance. The system logic must be restored to at least a two-out-of-three condition prior to removing another channel for maintenance.

7.3.1.1 System Description

7.3.1.1.1 Safety Injection System

Refer to Section 6.3, Emergency Core Cooling System, for a description of the Safety Injection System (SIS). The safety related display information which provides the operator with sufficient information to monitor and perform the required safety functions is described in Section 7.5.

The SIS is composed of redundant trains A and B. The instrumentation and controls for the components and equipment in train A are physically and electrically separate and independent of the instrumentation and controls for the components and equipment in train B. Independence is adequate to retain the redundancy required to maintain equipment functional capability following those design basis events listed in Table 7.3-1 which are mitigated by the SIS.

→ (DRN 99-0459; 01-367)

The SIS is automatically actuated by a SIAS from the ESFAS. The SIAS is initiated by either two-out-of-four low pressurizer pressure signals or two-out-of-four high containment pressure signals, as shown in Figures 7.3-2 and 7.3-3. Automatic safety injection system operation is actuated at a pressurizer pressure of 1684 psia during power operation. During startup and shutdown operations a variable setpoint is used as described in Subsection 7.2.1.1.1.6.

← (DRN 99-0459; 01-367)

The measurement channels which generate low pressurizer pressure and high containment pressure signals for the SIAS also provide signals to the CIAS and CSAS. The system is designed to correlate with a two-battery power distribution system in the plant. The loss of one battery may entail the loss of two of four power feeders to the system. However in that case, the power distribution within the system is able to sustain the logic in partially energized condition so as to prevent inadvertent initiation of SIAS. The loss of any combination of two of four power feeders that emanate from two different batteries will result in deenergized condition for a portion of logic and a consequent initiation of SIAS.

Manual initiation of the SIS is provided in the main control room.

The operating mode of the SIS is automatically changed by an RAS from the ESFAS. Generation of the RAS is described in Subsection 7.3.1.1.2. The RAS is generated by two-out-of-four low refueling water tank level signals, as shown on Figure 7.3-4.

The RAS automatically stops the low pressure safety injection pumps, and transfers the high pressure safety injection pump suction from the refueling water storage pool to the Safety Injection System sump.

A list of equipment that is actuated by the SIAS is given in Table 7.3-5.
System drawings are listed in Subsection 7.3.1.3.

Initiation setpoints are given in Table 7.3-2.

7.3.1.1.1.1 Initiating Circuits

Process measurement channels similar to those described in Subsection 7.2.1.1.2.1 are utilized to perform the following functions:

a) Continuously monitor pressurizer pressure and containment pressure

b) Provide indication of operational availability of each sensor to the operator

c) Transmit analog signals to bistables within the ESFAS initiating logic

The parameters are measured with four independent process instrument channels.

A typical protective measurement channel functional diagram is shown on Figure 7.2-1. The measurement channels consist of instrument sensing lines, sensors, transmitters, power supplies, isolation devices, indicators, computer inputs, current loop resistors, and interconnecting wiring.

Each measurement channel is separated from other like measurement channels to provide physical and electrical isolation of the signals to the ESFAS initiating logic. The output of each transmitter is a current loop. Signal isolation is provided for computer inputs. Each channel is powered by a redundant 120 volt vital ac distribution bus.

Display information, which provides the operator with the operational availability of each measurement channel, is described and tabulated for all ESFAS circuits in section 7.5.

7.3.1.1.1.2 Logic

7.3.1.1.1.2.1 SIAS Initiating Logic

The SIAS initiating logic:

a) Compares the analog signals received from the protective measurement channels with preset levels;

b) Provides a variable setpoint for plant start-up, shutdown, and low power testing;

c) Forms two-out-of-four coincidence of like signals which have reached preset levels;

d) Provides a means for manual blocking of pressurizer pressure signals if permissive conditions are met;

e) Provides channel and signal status information to the operator, and

f) Provides four SIAS initiation signals for each actuation signal to the SIAS actuating logic.

The SIAS initiating logic is similar to that shown on Figure 7.2-7, and consists of bistables, bistable output relays, trip relays, matrix relays, initiation channel output relays, manual block controls, block relays, manual testing controls, indicating lights, power supplies, and interconnecting wiring.

The SIAS initiating logic is physically located in the PPS cabinet.

Signals from the protective measurement channels are sent to voltage comparator circuits (bistables) where the input signals are compared to predetermined setpoints. Whenever a channel parameter reaches the predetermined setpoint, the channel bistable deenergizes the bistable output relay. The bistable output relay deenergizes the trip relays. Contacts of the trip relays form the SIAS initiating logic. Each set of trip relays (i.e., each channel) is powered from a redundant 120 volt vital ac distribution bus. The bistable setpoints are adjustable from the front of the PPS cabinet. Access is limited by means of a key operated cover, with an annunciator indicating cabinet access. All bistable setpoints are capable of being read out on a meter located on the PPS cabinet and are sent to the plant monitoring computer.

The SIAS initiation signals are generated in four channels, designated A, B, C and D. Two-out-of-four coincidence of initiating signals from the four protective measurement channels generates all four SIAS initiation signals. (See Figures 7.3-1 and 7.3-2)

Tripping of a bistable results in a channel trip characterized by the deenergization of three trip relays.

The contacts of the four sets of three trip relays have been arranged in six logic ANDs designated AB, AC, AD, BC, BD, and CD, which represent all possible two-out-of-four combinations for the four protective measurement channels. To form an AND circuit the trip relay contacts of two redundant

protective measurement channels are connected in parallel (i.e., one from A and one from B). This process is continued until all combinations have been formed. Since more than one plant parameter can initiate a trip signal, the parallel pairs of trip relay contacts, each pair representing a monitored plant parameter, are connected in series (Logic OR) to form six logic matrices. The six matrices are also designated AB, AC, AD, BC, BD, and CD. (see Figures 7.3-1 and 7.3-2)

Each logic matrix is connected in series with a set of four parallel logic matrix output relays (matrix relays). Each logic matrix is powered from two separate 120 volt vital ac distribution buses through dual dc power supplies as shown on Figure 7.3-1.

The output contacts of the matrix relays are combined into four trip paths.

Each ESFAS trip path is formed by connecting six contacts, one matrix relay contact from each of the six logic matrices, in series. The six series contacts are in series with the trip path output relay. The trip path output relay contacts form the SIAS initiating logic.

7.3.1.1.1.2.2 Actuating Logic

The SIAS actuating logic performs the following:

a) receives SIAS signal from the SIAS initiating logic;

b) forms selective two-out-of-four coincidence logic for actuation of SIAS;

c) provides a means for manual initiation of SIAS;

d) provides status information to the operator.

The SIAS actuating logic is physically located in two ESFAS auxiliary relay cabinets. One cabinet contains the logic for ESF train A equipment, while the other cabinet contains the logic for ESF train B equipment.

Four SIAS initiation signal contacts are arranged in a selective two-out-of-four coincidence logic. Each initiation signal also deenergizes the seal-in relays of its associated channel. The seal-in relays assure that the signal is not automatically removed once initiated. The selective two-out-of-four coincidence circuitry is shown typically on Figure 7.3-5. Receipt of two selective SIAS initiation signals, as shown on Figure 7.3-5, will deenergize the subgroup relays, which generate the actuation signals. This process is performed independently in both auxiliary relay cabinets, generating both train A and train B signals.

Each leg of the selective two-out-of-four circuitry is powered by two (2) auctioneered dc power supplies as shown on Figure 7.3-5. The four power supplies in cabinet "A" are connected to 120 V ac vital buses A and B. The four power supplies in cabinet "B" are connected to 120 V ac vital buses C and D. The two redundant power sources within each cabinet are physically separated from each other.

Figure 7.3-6 is a simplified functional diagram of a typical ESFAS logic (MSIS). In this case there are only two initiating circuits in each channel (steam generator #1 and steam generator #2 pressure) and thus each matrix ladder consists of only two AND circuits in series. The four matrix relay outputs from each logic matrix again form four trip paths. Each trip path output relay, instead of controlling trip circuit breakers as in the RPS, controls a contact of the selective two-out-of-four circuit for the group actuation. Group actuation is described in Subsection 7.3.1.1.1.3.

Testing of each ESF subgroup of actuating logic components is accomplished by use of a test module. Groups are selected such that testing may be accomplished without affecting normal plant operation (i.e., unwarranted actuation).

The testing of the logic and trip paths is described in Subsection 7.3.1.1.1.9.

7.3.1.1.1.3 Group Actuation

The components in the safety injection system are placed into various groups. Selection is made such that actuation of a group will not affect normal plant operation. Components of each group are actuated by one (1) group relay. Group relay contacts are in the power control circuit for the actuated components of each ESF system.

The logic described in Section 7.3.1.1.1.2 causes the opening of a contact in a selective two-out-of-four circuit whenever any one of the logic matrices is deenergized. The circuit is shown on Figure 7.3-5 for a typical ESF system. Upon opening of selective contacts in the two-out-of-four logic, the group relays deenergized and actuate the ESF system components. Sequencing of component actuation, where required, is accomplished in the power control circuit of each actuated component. Sequencing is described in Subsection 7.3.1.1.1.8.

7.3.1.1.1.4 Bypasses

Trip channel bypasses are provided for all ESF systems as shown in Table 7.3-3. The trip channel bypass is identical to the RPS trip channel bypass (Subsection 7.2.1.1.5) and is employed for maintenance and testing of a channel

The RPS/ESFAS pressurizer pressure bypass, as outlined in Table 7.3-3 and as shown in Figure 7.3-2, is provided to allow plant depressurization below 400 psia without initiation of undesired safeguards action. The setpoint must be adjusted manually by controls in each protective channel.

→

The RPS/ESFAS pressurizer pressure bypass is not possible if pressurizer pressure is above a setpoint (500 psia). Once the bypass has been initiated, it is automatically removed if pressure rises above the setpoint. All bypasses are annunciated.

←

7.3.1.1.1.5 Interlocks

An interlock prevents the operator from bypassing more than one trip channel at a time. Different type trips may be simultaneously bypassed, however, either in one channel or in different channels.

During system testing an electrical interlock will allow only one set of four matrix relays in one matrix to be held in the test position at a time. The same circuit will allow only one process measurement loop signal to be perturbed at a time. The matrix relay hold and loop perturbation switches are interlocked so that only one test may be conducted at any one time. Figure 7.2-7 shows this interlock. The same circuit will allow only one process measurement loop signal to be perturbed at a time. The matrix test and loop perturbation switches are interlocked so that only one or the other may be done at any one time.

7.3.1.1.1.6 Redundancy

Redundant features of the SIAS include:

a) Four independent channels, from process sensor through and including channel trip relays;

b) Six logic matrices which provide the two-out-of-four logic. Dual power supplies through an auctioneering network are provided for the matrix relays;

c) Four trip paths are present for each actuation signal;

d) Four independent bistables are utilized to provide block permissive signals for the pressurizer pressure actuation signal. See Figure 7.3-2;

e) The actuation signal is generated in two output trains so that redundant system components may be actuated from separate trains;

f) Two independent sets of two manual trip pushbuttons are provided at two locations on the main control board to initiate SIAS. Pushbuttons are also located on the ESFAS Auxiliary Relay Cabinets.

g) AC power for the actuation system is provided from four separate buses. Power for control and operation of redundant actuated components comes from separate buses. Power source for each bus is from a Static Uninterruptible Power Supply (SUPS). Loss of preferred offsite power does not interrupt power to these vital buses, as described in Subsection 8.3.1.1.1.c.

The result of the redundant features is a system which meets the single failure criterion, can be tested during plant operation, and can be shifted to two-out-of-three logic.

The benefit of a system that includes four independent and redundant channels is that the system can be operated with up to two channels out of service (one bypassed, one tripped) and still meet the single failure criterion. The only operating restriction while in this condition (one-out-of-two logic) is that no provision is made to bypass another channel for periodic testing or maintenance. The system logic must be restored to at least a two-out-of-three condition prior to removing another channel for maintenance.

7.3.1.1.1.7 Diversity

The system is designed to eliminate credible multiple channel failures originating from a common cause. The failure modes of redundant channels and the conditions of operation that are common to them are analyzed to assure that a predictable common failure mode does not exist. The design provides reasonable assurance that:

a) the monitored variables provide adequate information during the accidents;

b) the equipment can perform as required;

c) the interactions of protective actions, control actions and the environmental changes that cause, or are caused by, the design basis events do not prevent mitigation of the consequences of the event, and

d) the system will not be made inoperable by the inadvertent actions of operating and maintenance personnel.

In addition, the design is not encumbered with additional components or channels without reasonable assurance that such additions are beneficial.

The system incorporates functional diversity to accommodate the unlikely event of a common mode failure with any of the accident conditions listed in Subsection 7.2.2.1.2.

7.3.1.1.1.8 Sequencing

Sequencing equipment is provided to the time sequence of loading the safety injection equipment. The sequencing function is performed by the use of time delay relays associated with the equipment. Component sequencing is listed in Table 8.3-1 for ac loads and Tables 8.3-3, 8.3-4 and 8.3-5 for dc loads.

7.3.1.1.1.9 Testing

Provisions are made to permit periodic testing of the complete SIAS. These tests cover the trip actions from sensor input through the protection system and the actuation devices. The system test does not

interfere with the protective function of the system. The testing system complies with General Design Criterion 21 in that the protection system as defined by IEEE Standard 279-1971, "Proposed IEEE Criteria for Nuclear Power Plant Protection Systems," IEEE Standard 338-1971, "IEEE Trial-Use Criteria for the Periodic Testing of Nuclear Power Generating Station Protection System," and Regulatory Guide 1.22, "Periodic Testing of Protection System Actuator Functions "(February, 1972) is designed to permit testing (up to the input to the 2 actuation devices) per Regulatory Guide 1.22. Certain subgroup relays cannot be tested without adverse consequences for plant safety and/or operability and therefore do not fully comply with the provisions of Regulatory Guide 1.22 and IEEE Standard 338. These excepted subgroup relays are tested in accordance with the Technical Specifications. Jumpers or other temporary forms of bypassing are not used during testing.

The individual tests are described below. Overlap between individual partial tests exists so that the entire SIAS can be tested without gaps. Frequency of accomplishing a complete succession of these partial tests is listed in the Technical Specifications.

7.3.1.1.1.9.1 Sensor Checks

During reactor operation, the four redundant measurement channels providing an input to the SIAS (pressurizer pressure and containment pressure) are checked by comparing the output indicators of similar channels and cross-checking with related measurements.

During extended shutdown periods or refueling, these measurement channels (where possible) are checked and calibrated against known standards.

7.3.1.1.1.9.2 Trip Bistable Tests

Testing of the trip bistable is accomplished by manually varying the input signal to the trip setpoint level on one bistable at a time and observing the trip action.

Varying the input signal is accomplished by means of a trip test circuit which consists of a digital voltmeter and a test circuit used to vary the magnitude of the signal supplied by the measurement channel to the bistable signal input. The trip test circuit is interlocked electrically so that it can be used in only one channel at a time. A switch is provided to select the measurement channel and a pushbutton is provided to apply the test signal. The digital voltmeter indicates the value of the test signal.

Trip action (deenergizing) of each of the bistable trip relays is indicated by individual lights on the front of the cabinet, indicating that the bistable trip unit and the trip relays operate as required for a trip condition.

When one of the four trip bistables is in the tripped condition, a channel trip exists and is annunciated on the control room annunciator panel. In this condition, an actuation signal would take place upon receipt of a trip signal in one of the other three like trip channels. In addition, the trip channel under test is bypassed for the test, converting the PPS to a two-out-of-three logic and still meeting the single failure criterion for the particular trip parameter. In either case, full protection is maintained.

7.3.1.1.1.9.3 Logic Matrix Tests

This test is carried out to verify proper operation of the six two-out-of-four logic matrices, any of which will initiate a bona-fide system trip for any possible two-out-of-four trip condition from the signal inputs from each measurement channel. The matrix output relay hold pushbutton switch permits only one of the two-out-of-four logic matrices to be tested at a time.

Only one set of four matrix relays in one of the six logic matrices can be held in the energized position during tests. If, for example, the A-B logic matrix hold pushbutton is held depressed, actuation of the other matrix hold pushbuttons will have no effect upon their respective logic matrices.

Actuation of a matrix hold pushbutton will apply a test voltage to the test system hold coils of the selected four double coil matrix relays. This voltage will provide the power necessary to hold the matrix relays in their energized position when the bistable trip relay contacts in the matrix ladder being tested open, thus causing deenergization of the primary matrix relay coils.

While holding the matrix hold pushbutton in its actuated position, rotating the channel trip select switch will release only those bistable trip relays that have operating contacts in the logic matrix under test. The bistable trip relays are double coil relays. The channel trip select switch applies a test voltage of opposite polarity to the bistable trip relay test coils so that the magnetic flux generated by these coils opposes that of the primary coil of the relay. The resulting flux will be zero, and the relays will release.

Trip action can be observed by illumination of the trip relay indication lights located on the front panel and by loss of voltage to the four matrix relays which is indicated by extinguishing indicator lights connected across each matrix relay coil.

During this test, the matrix relay "hold" lights will remain on, indicating that a test voltage has been applied to the holding coils of the four matrix relays of the logic matrix under test.

The test is repeated for all six matrices. This test will verify that the logic matrix relays will deenergize if the matrix continuity is violated and that the trip relay output contacts function correctly. The opening of the matrix relays is tested in the trip path tests described in the following subsections.

7.3.1.1.1.9.4 Trip Path/Initiation Channel Tests

Each trip path is tested individually by depressing a matrix hold pushbutton (holding four matrix relays), selecting any trip position on the channel trip select switch (opening the matrix), and selecting a position on the matrix relay trip select switch (deenergizing one of the four matrix relays). This causes one, and only one, of the initiation channels to deenergize. Proper operation of both initiation channel output relay coils and contacts is verified by monitoring the current through the appropriate leg of the actuation logic selective two-out-of-four circuit.

The matrix relay trip select switch is turned to the next position, deenergizing the tested matrix relay and initiation channel relays.

This sequence is repeated for the other three trip paths from the selected matrix. The entire test sequence is repeated for the remaining five matrices. Upon completion of testing, all six matrices, all 24 matrix relay contacts and all eight initiation channel output relays have been tested.

7.3.1.1.1.9.5 Actuating Logic Tests

The selective two-out-of-four logic circuit is tested in a manner identical to the RPS trip breaker system (Subsection 7.2.1.1.9.5). One current path of the selective two-out-of-four logic matrix is interrupted by opening one of the path contacts and loss of path current is verified. Every contact in both current paths is checked in this manner.

The manual trips are checked one at a time from their remote locations; the lockout contacts are checked via the group relay test system (Subsection 7.3.1.1.1.9.6) and the PPS initiation relay contacts are checked as described in the preceding Subsections.

This test verifies the proper operation of the Actuating Logic circuits.

7.3.1.1.1.9.6 Actuating Device Test

Proper operation of the Group Relays (see Figure 7.3-5) is accomplished by deenergizing the group relays one at a time via a test relay contact and verifying proper operation of all actuated components in

that group. The test system is interlocked such that one and only one group relay may be deenergized at one time.

The test switch must be positioned to the group to be tested; selection of more than one group is impossible. The test circuit is electrically locked out upon actuation of a particular test group and another test group cannot be actuated for one minute after selecting another switch position. This time delay feature is a stop and think.

Since this test causes the ESF components to actuate by interrupting the normal safety signal current to individual group relays, the propagation of a valid trip during testing will not be impeded, and the system will proceed to full actuation.

This test verifies the operation of the group relays and the individual safety injection component actuation devices.

a) Response Time Tests

→(DRN 03-2061, R14)

Response time tests of the ESFAS are conducted at refueling intervals as given in the Technical Specifications. ESFAS response times are listed in the TRM. These tests include the sensors for each ESFAS channel and are based on the criteria defined in Subsection 7.3.2.1.3.

←(DRN 03-2061, R14)

The hardware design includes test connections on the instrument lines going to pressure and differential pressure transmitters, and test points wired out to convenient test jacks or terminal strips where test equipment may be connected to various portions of the system.

→ (DRN 99-1063, R11)

The design of ESFAS complies with RG 1.22. In general, the engineered safety feature systems can be tested from the sensor signal through the actuation devices. The sensors can be checked during reactor operation by comparison with similar channels. Some engineered safety feature systems (e.g. main feedwater isolation valves) cannot be practicably designed such that the actuated equipment could be tested during reactor operation without adversely affecting safety or operation of the plant. In all such cases, the protection system design is highly reliable and the actuated equipment is tested when the reactor is shutdown to assure they are capable of performing the safety function.

← (DRN 99-1063, R11)

7.3.1.1.1.10 Auxiliary Supporting Systems Required

The auxiliary supporting systems required are identified in Table 7.3-4 and described in Subsection 7.3.1.1.10.

7.3.1.1.2 Recirculation System

Refer to section 6.2 for a description of the Containment Spray System (CSS), and Section 6.3 Safety Injection System.

The RAS is automatically initiated by two-out-of-four low refueling water storage pool level signals, as shown in Figure 7.3-4.

The system is composed of redundant load groups, train A and train B. The instrumentation and controls of the components and equipment in train A are physically and electrically separate and independent of the instrumentation and controls of the components and equipment in train B. Independence is adequate to retain the redundancy required to maintain equipment functional capability following those design basis events shown in Table 7.3-1 which are mitigated by the SIS and the CSS.

The system automatically changes the mode of operation of the CSS and the SIS. The RAS automatically stops the low pressure safety injection pumps and changes the containment spray and high pressure safety injection pump suction from the refueling water storage pool to the Safety Injection System sump.

There is no system level manual actuation provided from the main control room.

A list of actuated devices is provided in Table 7.3-6, and final system drawings are listed in Subsection 7.3.1.3.

Initiation setpoints are given in Table 7.3-2.

7.3.1.1.2.1 Initiating Circuits

Initiating circuits are similar to the initiating circuits described in Subsection 7.3.1.1.1.1 for SIS except that refueling water storage pool is the only parameter monitored.

7.3.1.1.2.2 Logic

7.3.1.1.2.2.1 Initiating Logic

The initiating logic for RAS is similar to that described in Subsection 7.3.1.1.1.2.1 for SIS except that there are no variable setpoints, blocking multiple initiating signal provisions, or system level manual operation from the main control room.

7.3.1.1.2.2.2 Actuating Logic

The actuating logic for RAS is identical to that described in Subsection 7.3.1.1.1.2.2 for SIS.

7.3.1.1.2.2.3 Group Actuation

Group actuation for RAS is identical to that described in Subsection 7.3.1.1.1.3 for SIS.

7.3-1-1.2.4 Bypasses

Bypasses for RAS are identical to those described in Subsection 7.3.1.1.1.4 for SIS.

7.3.1.1.2.5 Interlocks

Interlock provisions for RAS are identical to those described in Subsection 7.3.1.1.1.5 for SIS.

7.3.1.1.2.6 Redundancy

Redundancy features for RAS are similar to those described in Subsection 7.3.1.1.1.6 for SIS, except that there are no manual trip pushbuttons in the control room.

7.3.1.1.2.7 Diversity

Diversity aspects for RAS are identical to those described in Subsection 7.3.1.1.1.7 for SIS.

7.3.1.1.2.8 Sequencing

There is no sequencing of equipment in association with RAS.

7.3.1.1.2.9 Testing

All provisions for testing RAS are identical to those described in Subsection 7.3.1.1.1.9 for SIS.

7.3.1.1.2.10 Auxiliary Supporting Systems Required

No auxiliary supporting systems required.

7.3.1.1.3 Containment Spray System

Refer to Section 6.2.2, Containment Heat Removal Systems, for a description of the CSS.

The CSS is automatically actuated by a CSAS from the ESFAS. The CSAS is initiated by coincidence of two-out-of-four-high-high containment pressure signals and an SIAS as shown in Figure 7.3-4.

The system is composed of redundant trains, A and B. The instrumentation and controls of the components and equipment in train A are physically and electrically separate and independent of the instrumentation and controls of the components and equipment in train B. Independence in adequate to retain the redundancy required to maintain equipment functional capability following those design basis events shown in Table 7.3-1 which are mitigated by the CSS.

The operating mode of the CSS is automatically changed following receipt of an RAS from the ESFAS. The RAS is generated by two-out-of-four low refueling water storage pool level signals, as shown in Figure 7.3-4.

Control switches are provided to manually operate the SIS sump and the refueling water storage pool isolation valves.

→

The SIS and RAS signals override the control switches and position the SIS sump and the refueling water storage pool isolation valves automatically to allow a proper operation of CSS. However, RWSP isolation valves are required to close manually from the control room after RAS.

←

The design is such that loss of electric power of two of the four like channels in the measurement channels or initiating logic or to the selective two-out-of-four actuating logic would actuate the CSS.

Manual initiation of the CSS is provided in the control room. The safety-related display instrumentation for the CSS which provides the operator with sufficient information to monitor and perform the required safety functions is described in section 7.5.

Instrumentation location layout drawings present the location of the pressurizer pressure, containment pressure, and refueling water tank level sensors which actuate the CSS and are listed in Subsection 7.3.1.3.

7.3.1.1.3.1 Initiating Circuits

Initiating circuits are identical to the initiating circuits described in Subsection 7.3.1.1.1.1 for SIS except that the parameter monitored is containment pressure only. An SIAS signal will allow initiation of the CSS.

The SIAS and high-high containment pressure signals are combined in four AND circuits within the ESFAS initiating logic. The AND circuits prevent inadvertent operation of the containment spray system upon generation of an SIAS only.

7.3.1.1.3.2 Logic

7.3.1.1.3.2.1 Initiating Logic

The initiating logic is identical to that described in Subsection 7.3.1.1.1.2.1 except that there are no variable setpoint or blocking of signal provisions, for either the high-high containment pressure signal or the high containment pressure signal, nor are there provisions for multiple initiating signals.

7.3.1.1.3.2.2 Actuating Logic

The actuating logic is identical to that described in Subsection 7.3.1.1.1.2.2 for SIS.

7.3.1.1.3.3 Group Actuation

Group Actuation is identical to that described in Subsection 7.3.1.1.1.3 for SIS.

7.3.1.1.3.4 Bypasses

Bypasses for CSS are identical to those described in Subsection 7.3.1.1.1.4 for SIS.

7.3.1.1.3.5 Interlocks

Interlock provisions for CSS are identical to those described in Subsection 7.3.1.1.1.5 for SIS.

7.3.1.1.3.6 Redundancy

Redundancy features for CSS are identical to those described in Subsection 7.3.1.1.1.6 for SIS.

7.3.1.1.3.7 Diversity

Diversity aspects for CSS are identical to those described in Subsection 7.3.1.1.1.7 for SIS.

7.3.1.1.3.8 Sequencing

Sequencing equipment and functions for CSS are identical to those described in Subsection 7.3.1.1.1.8 for SIS.

7.3.1.1.3.9 Testing

All provisions for testing the CSS are identical to those described in Subsection 7.3.1.1.1.9 for SIS.

7.3.1.1.3.10 Auxiliary Supporting Systems Required

The auxiliary supporting systems required are identified in Table 7.3-4 and described in Subsection 7.3.1.1.10.

7.3.1.1.4 Containment Isolation System

Refer to Subsection 6.2.4, Containment Isolation System, (CIS) for a description of this system.

The CIAS is initiated by two-out-of-four high containment pressure or low pressurizer pressure signals as shown in Figure 7.3-3. The measurement channels which generate the CIAS also provide signals to the SIAS. The system is designed to correlate with a two-battery power distribution system in the plant. The loss of one battery may entail the loss of two of four power feeders to the system. However in that case, the power distribution within the system is able to sustain the logic in partially energized condition so as to prevent inadvertent initiation of CIAS. The loss of any combination of two of four power feeders that emanate from two different batteries will result in deenergized condition for a portion of logic and a consequent initiation of CIAS.

The system is composed of redundant trains, A and B. The instrumentation and controls of the components and equipment in train A are physically and electrically separate and independent of the instrumentation and controls of the components and equipment in train B. Independence is adequate to retain the redundancy required to maintain equipment functional capability necessary to isolate the containment following those design basis events shown in Table 7.3-1 which require containment isolation.

The CIS is automatically actuated by the CIAS from the ESFAS. Manual initiation of the CIS is provided in the main control room.

A list of actuated equipment is provided in Table 7.3-8.

The safety-related display instrumentation for the containment isolation system which provides the operator with sufficient information to monitor and perform the required safety functions is described in Section 7.5.

Instrumentation location layout drawings present the location of the sensors which actuate the containment isolation system and are described in Subsection 7.3.1.3.

7.3.1.1.4.1 Initiating Circuits

The initiating circuits for the CIS are identical to those described in Subsection 7.3.1.1.1.1 for the SIS.

7.3.1.1.4.2 Logic

7.3.1.1.4.2.1 Initiating Logic

The initiating logic for CIS is identical to that described in Subsection 7.3.1.1.1.2.1 for SIS.

7.3.1.1.4.2.2 Actuating Logic

The actuating logic for CIS is identical to that described in Subsection 7.3.1.1.1.2.2 for SIS.

7.3.1.1.4.3 Group Actuation

Group actuation for CIS is identical to that described in Subsection 7.3.1.1.1.3 for SIS.

7.3.1.1.4.4 Bypasses

CIS bypasses are identical to those described for SIS in Subsection 7.3.1.1.1.4.

7.3.1.1.4.5 Interlocks

CIS interlocks are identical to those described for SIS in Subsection 7.3.1.1.1.5.

7.3.1.1.4.6 Redundancy

CIS redundancy is identical to that described for SIS in Subsection 7.3.1.1.1.6.

7.3.1.1.4.7 Diversity

CIS diversity is identical to that described for SIS in Subsection 7.3.1.1.1.7.

7.3.1.1.4.8 Sequencing

There is no sequencing of equipment in association with CIS.

7.3.1.1.4.9 Testing

CIS testing is identical to that described for SIS in Subsection 7.3.1.1.1.9.

7.3.1.1.4.10 Auxiliary Supporting Systems Required

The auxiliary supporting systems required are identified in Table 7.3-4 and described in Subsection 7.3.1.1.10.

7.3.1.1.5 Main Steam Isolation

Refer to Section 10.3, Main Steam Supply System (MS) for a description of main steam isolation. Refer to Subsection 10.4.7, Condensate and Feedwater System, for a description of feedwater isolation.

The Main Steam Isolation Signal (MSIS) is initiated by two-out-of-four low steam generator pressure or high containment pressure signals, as shown in Figures 7.3-6 and 7.3-7. The two-out-of-four logic is provided for each steam generator. The system is designed to correlate with a two-battery power distribution system in the plant. The loss of one battery may entail the loss of two of four power feeders to the system. However in that case, the power distribution within the system is able to sustain the logic in partially energized condition so as to prevent inadvertent initiation of MSIS. The loss of any combination of two of four power feeders that emanate from two different batteries will result in deenergized condition for a portion of logic and a consequent initiation of MSIS.

The system is composed of redundant trains, A and B. The instrumentation and controls of the valves in train A, are physically and electrically separate and independent of the instrumentation and controls of the valves in train B. Independence is adequate to retain the redundancy required to maintain equipment functional capability necessary to prevent blowdown of both steam generators following those design basis events shown in Table 7.3-1 which require main steam isolation.

The MSIS provides for both main steam isolation and isolation of the main feedwater supply. Main steam isolation is achieved by actuating the main steam isolation valves (MSIV). Isolation of the normal feedwater supply is achieved by actuating the feedwater isolation valves.

Manual initiation of main steam isolation is provided in the main control room.

→(DRN 05-130, R14)

Automatic main steam and feedwater isolation is initiated at a pressure setpoint of 666 psia during normal operation. A variable setpoint is implemented to allow controlled pressure reductions such as shutdown depressurization without initiating a MSIS signal. The pressure setpoint is automatically increased as steam generator pressure is increased until the trip setpoint is reached.

←(DRN 05-130, R14)

The safety-related display instrumentation for main steam and normal feedwater isolation, which provides the operator with sufficient information to monitor and perform the required safety functions, is described in Section 7.5.

Instrumentation location layout drawings which show the location of the steam generator pressure sensors which actuate the main steam isolation system are discussed in Subsection 7.3.1.3. The actuated equipment is listed in Table 7.3-9.

Initiation setpoints are listed in Table 7.3-2.

7.3.1.1.5.1 Initiating Circuits

Initiating circuits are identical to the initiating circuits described in Subsection 7.3.1.1.1.1 for SIAS except that the parameters monitored are steam generator pressure and containment pressure.

7.3.1.1.5.2 Logic

7.3.1.1.5.2.1 Initiating Logic

The initiating logic is identical to that described in Subsection 7.3.1.1.1.2.1 for SIAS.

7.3.1.1.5.2.2 Actuating Logic

Actuating logic is identical to that described in Subsection 7.3.1.1.1.2.2 for SIS. Refer to Figure 7.3-8 for typical actuation logic circuits.

7.3.1.1.5.3 Group Actuation

Group actuation is identical to that described in Subsection 7.3-1-1.1.3 for SIS.

7.3.1.1.5.4 Bypasses

Bypasses for MSIS are identical to those described in Subsection 7.3.1.1.1.4 for SIS.

7.3.1.1.5.5 Interlocks

Interlock provisions for MSIS are identical to those described in Subsection 7.3.1.1.1.5 for SIS.

7.3.1.1.5.6 Redundancy

Redundancy features for MSIS are identical to those described in Subsection 7.3.1.1.1.6 for SIS.

7.3.1.1.5.7 Diversity

Diversity aspects for MSIS are identical to those described in Subsection 7.3.1.1.1.7 for SIS.

7.3.1.1.5.8 Sequencing

There is no sequencing of equipment in association with MSIS.

7.3.1.1.5.9 Testing

All provisions for testing the MSIS are identical to those described in Subsection 7.3.1.1.1.9 for SIS.

7.3.1.1.5.10 Auxiliary Supporting Systems Required

The auxiliary supporting systems required are identified in Table 7.3-4 and described in Subsection 7.3.1.1.10.

7.3.1.1.6 Emergency Feedwater System

7.3.1.1.6.1 General Information

Refer to Subsection 10.4.9, for a description of this Emergency Feedwater System (EFS).

→(EC-33720, R307)
Reference to Appendix 10.4.9B.
←(EC-33720, R307)

The Emergency Feedwater Actuation Signal (EFAS) is initiated to steam generator 1 either by a low steam generator level coincident with no low pressure trip present on steam generator 1 or by a low steam generator level coincident with a differential pressure between the two generators with the higher pressure in steam generator 1. (An identical EFAS is generated for steam generator 2.) This logic is shown in Figure 7.3-9. The two-out-of-four logic is provided for each steam generator. The system is designed such that loss of electric power to two of the four like channels in the measurement channels or initiating logic, or to the selective two-out-of-four actuating logic, would actuate the EFS.

The system is composed of redundant trains, A and B. The instrumentation and controls of the components and equipment in train A, are physically and electrically separate and independent of the instrumentation and controls of the components and equipment in train B. Independence is adequate to retain the redundancy required to maintain equipment functional capability necessary to automatically actuate the EFS following those design basis events shown in Table 7.3-1 which require emergency feedwater.

The EFS instrumentation and controls are designed for automatic operation during emergency situations such as steam pipe rupture, loss of normal feed, and plant blackout.

The EFAS performs the following functions:

a) Starts the emergency feedwater pumps;

b) Opens the emergency feedwater shut-off valves to the steam generators. The control valves respond to the automatic signals as described in Subsection 7.3.1.1.6.2.

→(EC-41355, R307)
Manual control switches for the emergency feedwater pumps and emergency feedwater valves are provided in the main control room. Procedures are established for operating manual handwheel overrides or lining up backup air supplies for continued safety function after the 10 hour mission time of the safety related Nitrogen Accumulator.
←(EC-41355, R307)

Automatic emergency feedwater actuation is initiated at the setpoints listed in Table 7.3-2.

The safety-related display instrumentation for the EFS, which provides the operator with sufficient information to monitor and perform the required safety functions, is described in Section 7.5.

Instrumentation location layout drawings showing the location of the steam generator pressure and level sensors which actuate the emergency feedwater system are discussed in Subsection 7.3.1.3. The actuated equipment is listed in Table 7.3-10.

The emergency feedwater control valves may be operated by operator manually or may be left in automatic mode of control.

In automatic mode, the control valves are positioned by the signals derived from the emergency feedwater flow and steam generator wide range level measurement instrumentation loops.

The control logic for one steam generator is outlined below, the control logic for the other steam generator being identical.

Figure 7.3-12 identifies the valves, flow meters, and the level setpoints in the steam generator.

7.3.1.1.6.2 Automatic Control

→(DRN 07-43, R15)
The following is a description of the automatic EFW Control system operation on regulating the flow of EFW to the steam generators so as to minimize adverse effects on the Reactor Coolant System. The automatic EFW control system as described below is credited in applicable FSAR Chapter 15 analyses and is discussed in Subsection 10.4.9.3.6.
←(DRN 07-43, R15)

1. <u>Emergency Feedwater Actuation is Reset</u>

   Plant being in normal operation, the administrative procedures will call for the emergency feedwater shut-off valves to be in closed position and the control valves to be in automatic mode.

   The automatic mode will drive the control valves into a fully closed position due to a relative high water level that is normally maintained in the steam generators.

   The emergency feedwater pumps are off.

2. <u>Emergency Feedwater Actuation Signal is Generated by ESFAS</u>

   The shut-off valves are opened, and the modulating control valves remain in the fully closed position.

   The shut-off valves are not available for the operator's manual control unless EFAS is reset.

   However, the modulating control valves are available for the operator's manual control.

The emergency feedwater pumps are started.

3. Steam Generator Level Falls to the "Critical Level"

The shut-off valves remain fully open.

Control valve "B" opens to a fixed predetermined position equivalent to 200 gpm flow of emergency feedwater to the steam generator.

Flow meter FA inputs to a flow controller demanding 175 gpm. Control valve "A" moves to satisfy that demand. If the positioning of control valve "B" fails to produce at least 175 gpm, control valve "A" will be automatically controlled to satisfy the controller demand.

The modulating control valves are available for the operator's manual control.

If the level trend reverses, at this point, and starts to rise, the control valves remain in this mode of operation until level setpoints "X" and "Y" are reached and the control valves are switched to the level control mode of operation (see 6 below).

4. Steam Generator Level Falls to "Lo Level"

The shut-off valves remain fully open.

Control valve "B" remains in a fixed predetermined position equivalent to 200 gpm flow of emergency feedwater to the steam generator.

The flow controller set point increases to 400 gpm. Flow meter FA measures the flow and the controller automatically controls valve "A" to maintain 400 gpm.

The logic operates a "Steam Generator Emergency Level Lo" alarm in the main control room.

The modulating control valves are available for the operator's manual control.

If the level trend reverses, at this point, and starts to rise, the control valves remain in this mode of operation until level setpoints "X" and "Y" are reached and the control valves are switched to the level control mode of operation (see 6 below).

5. Steam Generator Falls to the "Lo-Lo Level"

The shut-off valves remain fully open.

→(DRN 07-43, R15)

The control valves "A" and "B" are driven to the fully open position (priority open - see Subsection 7.3.1.1.6.4).

←(DRN 07-43, R15)

If the level trend reverses, at this point, and starts to rise, the control valves will remain in the fully open position until the Lo-Lo level is reached. Above Lo-Lo level the control valves will go into the mode of operation as described above in 4.

6. Steam Generator Level Rises to Level "X" (Automatic Mode)

The shut-off valves remain fully open.

Control valve "A" transfers from flow control to level control with Level "Y" as the setpoint.

Control valve "B" is transferred from the fixed position to level control with level "X" as the setpoint.

The valves will remain in the level control mode unless the steam generator level falls to the Critical Level, in this case the Control reference will return to step No. 3.

The modulating control valves are available for operator's manual control.

7. SIAS is Actuated

The operation of the shut-off valves is not affected by actuation of SIAS and remains as described in steps 1 thru 6 above.

The modulating control valves will remain closed, if the level in the steam generator is above the "Critical Level."

The modulating control valves will be switched immediately to the level control mode of operation, if the level in the steam generator is below the "Critical Level."

The modulating control valves remain available for operator's manual control as described in steps 1 thru 6 above.

7.3.1.1.6.3 Isolation of a Ruptured Steam Generator

In the case of a MSLB, inside containment (either as the initiating event or after EFW actuation) it becomes necessary to isolate the ruptured steam generator. The detection and isolation of the ruptured steam generator is performed by an interface between EFAS and MSIS.

The EFAS-MSIS interface as shown on Figure 7.3-13 is implemented in the Plant Protection System (PPS) Cabinet and at the actuated components (i.e., valves). Only the PPS interface is discussed herein with respect to single failure.

MSIS is initiated by low steam generator pressure or high containment pressure.

EFAS is initiated to steam generator 1 either by low steam generator water level coincident with no low pressure trip present for steam generator 1 or by low steam generator water level coincident with differential pressure between the two generators with the higher pressure in generator 1. This EFAS logic is provided for each steam generator.

The low steam generator pressure signal is provided to the EFAS and MSIS logic from a single bistable comparator output in each PPS channel. A single channel failure of this signal would have no effect on EFAS or MSIS operation. This is the only EFAS-MSIS interface present on the PPS.

The interrelationship between EFAS and MSIS operation is described by the following scenario assuming a ruptured steam generator:

EFAS logic permits emergency feedwater to be supplied to each steam generator upon receipt of a valid low steam generator water level condition.

Upon receipt of a low steam generator pressure condition, EFAS and MSIS logic will terminate emergency feedwater by causing the emergency feedwater valves to close by resetting EFAS and tripping MSIS. This isolation of the EFW valves will not effect the operation of the EFW pumps. MSIS logic will isolate the steam generators by causing main feedwater and main steam isolation valves to close, thus allowing steam generator pressures to vary independently. The ruptured steam generator pressure will decrease while the intact steam generator pressure will remain constant or increase, thereby causing a differential pressure condition to exist. EFAS logic will permit emergency feedwater to be supplied to the intact steam generator while maintaining isolation of the ruptured steam generator.

7.3.1.1.6.4 Priority Signals

The EFW control system utilizes two signals (priority open, priority close) that override all other automatic or manual controls to the EFW valves.

Priority close is generated when the system is determining which steam generator is ruptured (Subsection 7.3.1.1.6.3). Once this determination is made the priority close signal is deactivated to the intact steam generator only. Upon deactivation of the signal, control of the EFW will return to the status (automatic or manual) that existed prior to the generation of the priority close signal.

Priority open is generated when the water level reaches "Lo-Lo Level" (Subsection 7.3.1.1.6.2, Item 5). Once the water level rises above the "Lo-Lo Level", control of the EFW will return to the status (automatic or manual) that existed prior to the generation of the priority open signal.

In the case of the ruptured steam generator, the EFAS command that generates the priority close signal will prevent a priority open signal.

7.3.1.1.6.5 Initiating Circuits

The initiating circuits are identical to those described in Subsection 7.3.1.1.1.1 for SIS except that the parameters monitored are steam generator level and pressure.

7.3.1.1.6.6 Logic

7.6.1.1.6.6.1 Initiating Logic

The initiating logic is identical to that described in Subsection 7.3.1.1.1.2.1 for SIS except that the provision for multiple initiating signals does not apply.

7.3.1.1.6.6.2 Actuating Logic

Actuating logic is similar to that described in Subsection 7.3.1.1.1.2.2 for SIS. Refer to Figure 7.3-10.

7.3.1.1.6.7 Group Actuation

Group Actuation is identical to that described in Subsection 7.3.1.1.1.3 for SIS.

7.3.1.1.6.8 Bypasses

Bypasses are identical to those described in Subsection 7.3 1.1.1.4 for SIS.

7.3.1.1.6.9 Interlocks

Interlock provisions are identical to those described in Subsection 7.3.1.1.1.5 for SIS.

7.3.1.1.6.10 Redundancy

Redundancy features are identical to those described in Subsection 7.3.1.1.1.6 for SIS.

7.3.1.1.6.11 Diversity

Diversity aspects are identical to those described in Subsection 7.3.1.1.1.7 for SIS.

7.3.1.1.6.12 Sequencing

Sequencing equipment and functions are identical to those described in Subsection 7.3.1 1.1.8 for SIS.

7.3.1.1.6.13 Testing

All provisions for testing the EFS are identical to those described in Subsection 7.3.1.1.1.9 for SIS.

7.3.1.1.6.14 Auxiliary Supporting Systems Required

The auxiliary supporting systems required are identified in Table 7.3-4 and described in Subsection 7.3.1-1.10.

7.3.1.1.7 Containment Cooling System

Refer to Subsection 6.2.2, for a description of the Containment Cooling System (CCS).

The CCS is automatically actuated by a SIAS from the ESFAS. The SIAS is initiated by either two-out-of-four low pressurizer pressure signals or two-out-of-four high containment pressure signals, as shown in Figures 7.3-2 and 7.3-3.

The system is composed of redundant trains, A and B. The instrumentation and controls of the components and equipment of train A, are physically and electrically separate and independent of the instrumentation and controls of the components and equipment in train B.

7.3.1.1.8 Shield Building Ventilation System

Refer to Subsection 9.4.5 for a description of the Shield Building Ventilation System (SBVS).

The SBVS is automatically initiated upon receipt of-SIAS as shown in Figure 7.3-11. The SIAS is generated as shown in Figure 7.3-2.

The system is composed of redundant trains, A and B. The instrumentation and controls of the equipment and components in train A are physically and electrically separate and independent of the instrumentation and controls of the equipment and components in train B. Independence is adequate to retain the redundancy required to maintain equipment functional capability following those design basis events shown in Table 7.3-1 which are mitigated by the SBVS.

Both trains of the SBVS are automatically placed in operation upon receipt of the SAIS. One train may be placed in standby by the operator following verification of operation of both trains. The standby system will be automatically restarted if the operating system should fail.

Manual initiation of the SBVS is provided in the control room. The safety-related display instrumentation for the SBVS which provides the operator with sufficient information of monitor and perform the required safety functions is described in Section 7.5.

7.3.1.1.9 Combustible Gas Control System

The Combustible Gas Control System (CGCS) consists of the following:

a) Hydrogen Recombiner System (HRS)

b) Hydrogen Analyzer

c) Containment Atmosphere Release system (CARS)

→(DRN 05-1382, R14-B)

10CFR50.44 no longer defines a design basis LOCA hydrogen release and eliminates requirements for hydrogen control systems to mitigate such a release. The installation of hydrogen recombiners and/or vent and purge systems formerly required by 10CFR 50.44(b)(3) was intended to address the limited quantity and rate of hydrogen generation that was postulated from a design basis LOCA.

Engineered safety features are provided in nuclear plants to mitigate the consequences of design-basis loss of coolant accident, even though the occurrence of these accidents is very unlikely. The basis of revision to 10CFR50.44 is the design-basis LOCA hydrogen release does not contribute to the conditional probability of a large release up to approximately 24 hours after the onset of core damage. In addition, combustible gas control systems are ineffective at mitigating hydrogen releases from risk-significant beyond design-basis accidents. As a result, the CGCS no longer meets any of the four criteria in 10CFR50.36(c)(2)(ii) and no longer performs the functions of an engineered safety feature.

The CGCS is described below and is relegated to non design basis, severe accident management functions only. Refer to FSAR section 7.5 for further discussion of the post accident function of the hydrogen analyzers.
←(DRN 05-1382, R14-B)

7.3.1.1.9.1 Hydrogen Recombiner System

The dual-train HRS will be under manual administrative control. The hydrogen concentration in the containment following a LOCA will be limited to a maximum of four percent by volume. The operator will initiate the recombiner system when a high concentration of hydrogen is monitored. No automatic actuation signals are provided in the control of combustible gases. The time at which these systems must be initiated is of sufficient duration so that automatic initiation is unnecessary.

The hydrogen recombiners as described in Subsection 6.2.5 are located within the containment. When started remotely from the control room the combustible gas and air mixture, following a LOCA, will be processed through either or both recombiners to remove the hydrogen by reacting with oxygen to form water. The recombiner is provided with electric heating coils which are powered from separate emergency power supplies. Failure of any recombiner will be indicated in the main control room.

The instrumentation and control associated with the recombiners are located in the main control room. Each recombiner train will have a manual control switch to "start"/"stop" the recombiner train. When the recombiner is started, the system will continue to operate automatically. Indicating lights will indicate the status of the recombiners. Temperature elements will detect and maintain the required temperature.

7.3.1.1.9.2 Hydrogen Analyzer

Refer to Subsection 6.2.5 for description of this system.

The hydrogen analyzer has the capability of sampling and measuring the hydrogen concentration at points where hydrogen may accumulate in the containment during all modes of operation.

The system is operated from the main control room, see Subsection 6.2.5.5.3 for additional details.

The sample is analyzed in the hydrogen analyzer which determines the percentage of hydrogen in the containment and enables the rate of change of hydrogen concentration calculation to be made.

The hydrogen analyzer is independent of any other engineered safety feature operation or signal.

Instrumentation layout drawings which present the location of the hydrogen analyzer sensors are referenced in Section 1.7.

7.3.1.1.9.3 Containment Atmosphere Release System (CARS)

CARS is described in Subsection 6.2.5.2.3. The system will be under manual control in the main control room. No automatic actuation signals are provided to control the purging of the Containment. The system will contain indication of each fan and each valve and also contain annunciation of a malfunction in the system.

Each fan and its associated valves will have completely independent logic from the other fans with their respective valves.

The sensors and logics of the containment atmosphere release system are not used for variable control of the system process; thus malfunction and failures in the controls have no direct effect on the operation of the pertinent systems of the combustible gas control system. CARS will have redundant electrical components.

Figure 9.4-7 indicates CARS schematic diagram for train A and train B.

7.3.1.1.10 ESF Supporting Systems

The ESF supporting systems listed below are described in the referenced Sections.

a) Component Cooling Water System (Subsection 9.2.1)

b) Standby (Emergency) Power and Distribution System (Section 8.3)

c) HVAC Systems for ESF Systems Areas (Section 6.4 and 9.4)

d) Diesel Generator Fuel Oil Storage and Transfer System (Subsection 9.5.4)

e) Auxiliary Component Cooling Water System (Subsection 9.2.2.)

7.3.1.2 Design Basis Information

The design bases for all of the ESF system controls are essentially the same. Where differences exist, they are explained in the text or accompanying tables.

7.3.1.2.1 Design Basis Information For ESF System Equipment

The design of each of the ESF Systems, including design bases and evaluation, is discussed in Chapter 6. The following analyses address the ESFAS and instrumentation.

The ESFAS is designed to provide initiating signals for components which require automatic actuation following rupture of a primary or secondary pressure boundary.

The systems are designed on the following bases to assure adequate performance of their protective functions:

a) The system is designed in compliance with the applicable criteria of the NRC, General Design Criteria for Nuclear Power Plants, (Appendix A of 1OCFR50, 1971).

b) System testing conforms to the requirements of IEEE Standard 338-1971, Trial Use Criteria for Periodic Testing of Nuclear Power Generating Station Protection Systems, and Regulatory Guide 1.22, Periodic Testing of Protection System Actuation Functions (Feb. 1972)

c) IEEE Standard 279-1971, Criteria for Protection Systems for Nuclear Power Generating Stations, establishes specific protection system design bases. The following Subsections describe how these design bases listed in Section 3 of IEEE Standard 279 are implemented.

   1) The design basis events which require protective action are listed in Table 7.3-1.

   2) The ESF system is designed to monitor the parameters related to design basis events listed in Table 7.3-1 to provide protective actions.

   3) The number and identification of the sensors required to adequately monitor, for protective function purposes, the variables listed in Section 3(2) having spatial dependence are listed in Table 7.3-2.

   4) Prudent operation limits for each variable listed in Section 3(2) are listed in Table 7.3-2.

   5) The margin, with appropriate interpretive information, between each operational limit and the level considered to mark the onset of unsafe conditions are given in Table 7.3-2. Interpretive information is given in Subsection 7.3.2.1, Criterion 10.

   6) The setpoints that, when reached, will require protective action are listed in Table 7.3-2.

   7) The range of transient and steady-state conditions of both the energy supply and the environment (for example, voltage, frequency, temperature, humidity, pressure, vibration, etc.) during normal, abnormal, and accident circumstances throughout which the system must perform:

(a) Voltage and Frequency

The class 1E 12OV-ac vital instrumentation and control power supplies are described in Section 8.3.

(b) Temperature, humidity, pressure, radiation, chemical spray and nonseismic vibration. The design environment for the equipment is stated in Section 3.11.

8) The malfunctions, accidents, or other unusual events (for example, fire, explosion, missiles, lightning, flood, earthquake, wind, etc.) which could physically damage protection system components or could cause environmental changes leading to functional degradation of system performance, and for which provisions must be incorporated to retain necessary protective action:

(a) Fire

The fire protection system is described in Subsection 9.5.1.

(b) Missiles

Missile protection is described in Section 3.5.

(c) Flood

Water level (flood) design is described in Section 3.4.

(d) Earthquake

Seismic qualification of instrumentation and electrical equipment is described in Section 3.10. Seismic design is described in Section 3.7.

(e) Wind

Wind and tornado loadings are described in Section 3.3.

(f) Pipe Whip

Protection against pipe whip is described in Section 3.6.

9) Minimum performance requirements including the following:

→(DRN 03-2061, R14)

(a) System response time (see TRM and Technical Specification 3/4.3.1 & 3/4.3.2)

←(DRN 03-2061, R14)

(b) System accuracies (see Table 7.3-2)

(c) Ranges normal, abnormal, and accident conditions) of the magnitudes and rates of change of sensed variables to be accommodated until proper conclusion of the protective action is assured. (see Table 7.3-2)

7.3.1.2.2 Design Basis for the Instrumentation and Controls Of The Auxiliary Supporting Systems

The auxiliary supporting systems conform to the design bases given in Subsection 7.1.2.1 and as further described below.

The systems are designed on the following bases to assure adequate performance of their protective functions:

a) The system is designed in compliance with the applicable criteria of the NRC General Design Criteria for Nuclear Power Plants (Appendix A. 10CFR50, 1971). For further details see Subsection 7.3.2.2.1.

b) System testing conforms to the requirements of IEEE Standard 338-1971. Trial Use Criteria for Periodic Testing of Nuclear Power Generating Station Protection Systems, and Regulatory Guide 1.22. Feb. 1972) Periodic Testing of Protection System Actuation Functions. For further details see Subsection 7.3.2.2.3.

7.3.1.3 Final Systems Drawings

Electrical wiring diagrams, block diagrams, final logic diagrams, and location layout drawings are listed and provided by reference in Section 1.7.

7.3.1.3.1 Onsite Power System

Drawings for the onsite power system are listed in section 8.3.

7.3.1.3.2 Drawing Comparison

→

A comparison between the final logic diagrams and the logic diagrams furnished with the PSAR is provided in Table 7.3-12.

←

7.3.2 ANALYSIS

7.3.2.1 Engineered Safety Feature Actuation Systems

The design of each of the ESF System, including design bases and evaluation, is discussed in Chapter 6. The following analyses address the ESFAS and instrumentation.

7.3.2.1.1 Design

As previously described, the major portion of the ESFAS is functionally identical to the RPS. The logics for the ESFAS and RPS, in fact, are located in the same enclosures and share a common logic testing scheme. Because of this, many of the responses to the requirements of the NRC General Design Criteria, IEEE Standard 279-1971 and IEEE standard 338-1971 are identical to the responses for the RPS. Where responses for the two systems are identical, reference is made to the appropriate section.

Appendix A of 10CFR50, General Design Criteria for Nuclear Power Plants, establishes minimum requirements for the principal design criteria for water-cooled nuclear power plants.

Section 3.1 provides a detailed discussion of all General Design Criteria. This section describes how the requirements that are applicable to the ESFAS are satisfied.

Criterion 1: Quality Standards and Records

The requirements of Regulatory Guides 1.30 (8/11/72), and 1.38 (3/16/73) were met. Refer to Subsection 7.2.2. The quality assurance for the design of equipment and components is described in the QA Program Manual.

Criterion 2: Design Bases For Protection Against Natural Phenomena

The design bases for protection against natural phenomena are described in Sections 3.10, 3.11 and Subsection 7.2.2.

Criterion 3: Fire Protection

The design bases for fire protection are described in Subsections 9.5.1 and 7.2.2.

Criterion 4: Environmental and Missile Design Bases

Environmental design bases are described in Section 3.11. Missile design bases are described in Section 3.5, and Subsection 7.2.2.

Criterion 5: Sharing of Structures, Systems and Components

No ESFAS components are shared with future or existing reactor facilities.

Criterion 10: Reactor Design

The ESFAS in conjunction with the plant control systems and Technical Specification requirements, provide sufficient margin to trip setpoints so that, (1) during normal operation protective action will not be initiated, and (2) during anticipated operational occurrences, fuel design limits will not be exceeded. Typical margins for each trip parameter are shown in Table 7.3-2.

Criterion 13: Instrumentation and Control

Sensor ranges are sufficient to monitor all pertinent plant variables over the expected range of plant operation in normal and transient conditions. Variables that affect plant safety limits are monitored by the PPS. The safety-related information readout for plant monitoring is described in Section 7.5. Also refer to Subsection 7.2.2.

Criterion 19: Main Control Room

The main control room layout is presented in Section 7.5. Emergency shutdown from outside the main control room is described in Section 7.4.

Criterion 20: Protection System Functions

The ESFAS monitor all plant variables that affect plant design limits. These limits are given in Table 7.3-2. ESF systems will be initiated to prevent these limits from being exceeded for all the anticipated operational occurrences that are listed in Table 7.3-1.

Criterion 21: Protection System Reliability and Testability

Functional reliability is ensured by compliance with the requirements of IEEE Standard 279-1971, as described in Subsection 7.1.2.4. Testing is in compliance with IEEE Standard 338-1971, and consistent with the recommendations of Regulatory Guide 1.22 (February, 1972), as described in Subsection 7.3.2.1.3. Refer to Subsection 7.2.2.

Criterion 22: Protection System Independence

The ESFAS independence is assured through redundancy and diversity as described in Subsections 7.3.1.1.1.6 and 7.3.1.1.1.7. Also refer to Subsection 7.2.2.

Criterion 23: Protection System Failure Modes

Failure modes of the ESFAS components are discussed in Subsection 7.3.2.1.4 for each individual system.

Where protective action is required under adverse environmental conditions during postulated accidents the ESFAS components are designed to function under such conditions.

Criterion 24: Separation of Protection and Control Systems

The protection system is separated from the control systems as described in Subsection 7.3.2.1.2. Refer to Subsection 7.2.2.

Criterion 29: Protection Against Anticipated Operational Occurrences

Refer to Subsection 7.2.2.

Criterion 54, 55, 56, 57:

The instrument sensing lines for monitoring containment pressure are discussed in Section 3.1.

7.3.2.1.2 Equipment Design Criteria

IEEE Standard 279-1971, Criteria for Protection Systems for Nuclear Power Generating Stations, establishes minimum requirements for safety-related functional performance and reliability of the ESFAS. This section describes how the requirements listed in Section 4 of IEEE Standard 279-1971 are satisfied.

4.1 "General Functional Requirement"

The ESFAS is designed to automatically actuate the appropriate ESF systems, when required, and to mitigate the effects of certain accidents. Instrument performance characteristics, response time, and accuracy are selected for compatibility with and adequacy for the particular function. Trip set points are established by analysis of the system parameters. Factors such as instrument inaccuracies, bistable trip times, valve travel time, and pump starting times are considered in establishing the margin between the trip setpoints and the safety limits. The time response of the sensors and protective systems are evaluated for abnormal conditions. Since all uncertainty factors are considered as cumulative for the derivation of these times, the actual response time may be more rapid. However, even at the maximum times, the system provides conservative protection.

There are no ESFAS sensors for which the trip setpoints are within five percent of the high or low and of the calibrated range.

4.2 "Single Failure Criterion"

The ESFAS is designed so that any single failure within the system shall not prevent proper protective action at the system level. No single failure will defeat more than one of the four protective channels associated with any one trip function.

The effect of single faults in the RPS is discussed in Section 7.2.2. The same analysis is applicable for the ESFAS with the modifications appropriate to redundant actuation trains instead of control element drive mechanisms (CEDM) power supply circuits.

Single faults of actuation relays or actuation relay buses have no effect as a selective two-out-of-four logic is required for actuation. Single faults of the actuation (or control) circuitry will cause, at worst, only a failure of a component or components within one of the two redundant actuation trains; actuation of the remaining trains' components are sufficient for the protective action.

4.3 "Quality Control of Components and Modules"

The quality assurance program is described in the QA Program Manual. This program includes appropriate requirements for design review procurement, inspection and testing to ensure that the system components shall be of a quality consistent with minimum maintenance requirements and low failure rates.

4.4 "Equipment Qualification"

The ESFAS meets the equipment requirements described in Sections 3.10 and 3.11.

4.5 "Channel Integrity"

Type testing of components, separation of sensors and channels, and qualification of cabling are utilized to ensure that the channels will maintain the functional capability required under applicable extremes of conditions relating to environment, energy supply, malfunctions and accidents.

Loss of or damage to any one path will not prevent the protective action. Sensors are piped so that blockage or failure of any one connection does not prevent protective system action. The process transducers located in the containment building are specified and rated for the intended service.

Components which must operate during or after the LOCA are rated for the LOCA environment. Results of type test are used to verify these ratings. In the control room protective system trip paths are located in four compartments. Mechanical and thermal barriers between these compartments reduce the possibility of common event failure. Outputs from the components in this area to the control boards are isolated so that shorting, grounding, or the application of the highest available local voltage does not cause channel malfunction. Where signals originating in the PPS feed the computer, signal isolation is provided; where the ESFAS is feeding annunciators, isolation is ensured through the use of relay contacts.

4.6 "Channel Independence"

The locations of the sensors and the points at which the sensing lines are connected to the process loop have been selected to provide physical separation of the channels, thereby precluding a situation in which a single event could remove or negate a protective function. The routing of cables from protective system transmitters is arranged so that the cables are separated from each other and from power cabling to minimize the likelihood of common event failures. This includes separation at the containment penetration areas. In the control room, protective system trip channels are located in individual compartments. Mechanical and thermal barriers between these compartments minimize the possibility of common event failure. Outputs from the components in this area to the control boards are isolated so that shorting, grounding, or the application of the highest available local voltages (120 VAC, 125 VAC) do not cause channel malfunction.

4.7 "Control and Protection System Interaction"

No portion of the ESFAS is used for both control and protection functions.

4.8 "Deviation of Systems Inputs"

ESFAS inputs are derived from signals that are direct measures of the desired variables. Variables which are measured directly include pressurizer, steam generator, and containment pressure. Refueling water storage pool level and steam generator level are derived from differential pressure measurements.

4.9 "Capability for Sensor Checks"

ESFAS sensors are checked by cross-checking between channels. These channels bear a known relationship to each other, and this method ensures the operability of each sensor during reactor operation.

4.10 "Capability for Test and Calibration"

Testing is described in Subsection 7.3.1.1.1.9 and is in compliance with IEEE standard 338-1971 as discussed in Subsection 7.3.2.1.3 as amended by Subsection 7.3.1.1.1.9.

4.11 "Channel Bypass or Removal from Operation"

Any one of the four protective system channels may be tested, calibrated, or repaired without detrimental effects on the system. Individual trip channels may be bypassed to effect a two-out-of-three logic on remaining channels for systems. The single failure criterion is met during this condition.

4.12 "Operating Bypasses"

Operating bypasses are provided as shown in Table 7.3-3. The operating bypasses are automatically removed when the permissive conditions are not met. The circuitry and devices which function to remove these inhibits are designed in accordance with IEEE Standard 279-1971.

4.13 "Indication of Bypasses"

Indication of test or bypass conditions or removal of any channel from service is given by lights and annunciation. Bypasses are automatically removed at fixed setpoints.

4.14 "Access to Means for Bypassing"

A key is required to gain access to the means for bypassing a protective system channel. An interlock prevents the plant operator from bypassing more than one of the four channels of any one type trip at any one time. All bypasses are visually and audibly annunciated.

4.15 "Multiple Setpoints"

Manual reduction of setpoints for MSIS and SIAS is allowed for the controlled reduction of pressurizer pressure and steam generator pressure as discussed in Subsections 7.3.1.1.1.4 and 7.3.1.1.1.5. The setpoint reductions are initiated by a control board mounted pushbutton, which upon actuation, adjusts the setpoints to a value a preselected distance below the operating pressure which exists at the time the pushbutton is actuated. A separate pushbutton is provided for each protection channel. This method of setpoint reduction provides positive assurance that the setpoint is never decreased below the existing pressure by more than a predetermined amount.

The setpoint will be automatically increased by the PPS as the measured pressure is increased.

4.16 "Completion of Protective Action Once it is Initiated

The system is designed to ensure that protective action will go to completion once initiated. With the exception of EFAS, operator action is required to clear the actuation signal and return to operation. EFAS resets automatically when the low steam generator water level signal clears.

4.17 "Manual Initiation"

For each ESF system manual actuation is effected by depressing two sets of two trip pushbuttons (one set per load group) at the ESF Auxiliary Relay Cabinets. Two remote sets of trip pushbuttons (switches for EFAS) at different locations on the RTG board are provided to actuate each ESF system with the exception of the RAS. For the remote pushbuttons, one set of two is sufficient to actuate both load groups.

4.18 "Access to Setpoint Adjustments, Calibration and Test Points"

A key is required for access to setpoint adjustments, calibration and test points. Access is also visually and audibly annunciated.

4.19 "Identification of Protective Action"

Indication lights are provided for all protective actions, including identification of channel trips.

4.20 "Information Readout"

Means are provided to allow the operator to monitor all trip system inputs and outputs. The specification displays that are provided for continuous monitoring are described in Section 7.5. System status displays are provided.

4.21 "System Repair"

Identification of a defective channel will be accomplished by observation
of system status lights or by testing as described in Subsection 7.3.1.1.1.9. Replacement or repair of components is accomplished with the affected channel bypassed. The affected trip function then operates in a two-out-of-three trip logic.

4.22 "Identification"

All equipment, including panels, modules, and cables associated with the actuation system, are marked in order to facilitate identification.

7.3.2.1.3 Testing Criteria

IEEE Standard 338-1971, Trial Use Criteria for the Periodic Testing of Nuclear Generating Station Protection Systems, and Safety Guide 22, Periodic Testing of Protection System Actuation Functions (February, 1972), provide guidance for development of procedures, equipment, and documentation of periodic testing. The basis for the scope and means of testing are described in this section. Test intervals and their bases are included in the Technical Specifications. Since operation of the ESF system is not expected, the systems are periodically tested to verify operability. Complete channels can be individually tested without initiating protective action, without violating the single failure criterion, and without inhibiting the operation of the systems. The organization for testing and for documentation is described in Chapter 13.

The system can be checked from the sensor signal through the actuation devices. The sensors can be checked during reactor operation by comparison with similar channels.

Those actuated devices, which are not tested during reactor operation (e.g., main feedwater isolation valves), will be tested during scheduled reactor shutdown to assure that they are capable of performing the safety functions.

Minimum frequencies for checks, calibration and testing of the ESFAS instrumentation are given in the Technical Specifications. Overlap in the checking and testing is provided to assure that the entire channel is functional. The use of individual trip and ground detection lights, in conjunction with those provided at the supply bus, assure that possible grounds or shorts to another source of voltage will be detected.

→(DRN 03-2061, R14)

The response time from an input signal to protection system trip bistables through the opening of the actuation relays is verified by measurement during plant startup testing. ESFAS response times are listed in the TRM. Sensor responses are measured during factory acceptance tests.

←(DRN 03-2061, R14)

7.3.2.1.4 Failure Modes and Effects Analysis

Failure modes and effects analyses for the ESFAS are provided in Table 7.2-5. The ESFAS are identified in Section 7.3.

7.3.2.1.5 Consideration of Selected Plant Contingencies

a) Loss of Instrument Air Systems

None of the essential control or monitoring instrumentation is pneumatic. Electrical instrumentation is powered from the emergency power system. Therefore, the loss of instrument air will not degrade instrumentation and control systems required for shutdown of the plant.

b) Loss of Cooling Water to Vital Equipment

None of the instrumentation and controls required for safe shutdown rely on cooling water for operation. Air conditioning systems required to maintain the environment within the instrument design parameters are redundant and described in sections 6.4 and 9.4.

7.3.2.2 Instrumentation and Controls for Auxiliary Supporting System

7.3.2.2.1 General Design Criteria

The general design criteria for the instrumentation and controls of the components in auxiliary supporting systems that are actuated by ESFAS are identical to those for the instrumentation and controls of the ESF systems. See Subsection 7.3.2.1.1.

The process instrumentation and controls, of the auxiliary supporting systems are described in Section 7.5 under Plant Process Display Instrumentation and listed in Table 7.5-1.

7.3.2.2.2 Equipment Design Criteria

The equipment design of the instrumentation and controls of the components in the auxiliary supporting systems that provide a safety function is described in the Subsection applicable.

The process instrumentation and controls of the auxiliary supporting systems that do not provide a protective function, provide the operator with sufficient information to maintain the system within its design limits.

TABLE 7.3-1 Revision 10 (10/99)

DESIGN BASIS EVENTS REQUIRING ESF SYSTEM ACTION

Systems

Design Basis Events	Containment Cooling System	Containment Isolation System	Containment Spray System	Recirculation Actuation System	Main Steam Isolation System	Safety Injection System	Emergency Feedwater System	Shield Building Vent System
Loss of Reactor Coolant - Large Break (1)	*	*	*	*		*		*
Loss of Reactor Coolant - Small Break (1)	*	*	*	*		*	*	*
Steam Generator Tube Rupture					*(2)	*	*	
Steamline or Feedwater Line Break (Inside Containment)	*	*	*		*	*(3)	*	*
Steamline or Feedwater Line Break (Outside Containment)					*	*(3)	*	

(1) Includes CEA Ejection
(2) Manual Actuation
(3) Steamline Break Only
➜
• Denotes Action Required
←

TABLE 7.3-2 Revision 307 (07/13)

ESFAS SENSORS AND SETPOINTS

→(DRN 06-884, R15)

Actuation Signal	Sensor (1) Tag Number and Range	Nominal Values Full Power and Normal Oper. Limits	Analytical Limit
→(DRN 99-0459; 03-2061, R14) CIAS, SIAS Pressurizer Pressure Low ←(DRN 99-0459; 03-2061, R14)	RCIP-102 A,B,C,D 0-3000 psia	2250 psia 2125-2275 psia	≥1560 psia
→(DRN 02-1730, R12-A) CIAS, MSIS, SIAS Containment Pressure High	CBIP-SMA,SMB, SMC, SMD 0.30 psia	14.7 psia 14.275-15.7 psia	≤19.7 psia
CSAS Containment Pressure High-High ←(DRN 02-1730, R12-A)	CBIP-SMA,SMB SMC, SMD 0-30 psia	14.7 psi 14.275-15.7 psia	≤19.7 psia
→(DRN 00-1044, R11-A; 03-2061, R14; 05-130, R14; EC-8460, R307) MSIS and EFAS Steam Generator Pressure Low	SGIP-1013A,B,C,D PT-1023A,B,C,D 0-1200 psi	832 psia 970 - 800 psia	(2) ≥ 576 psia
←(DRN 00-1044, R11-A; 03-2061, R14; 05-130, R14; EC-8460, R307) RAS Refueling Water Storage Pool Level Low	SGIIL-305A,B,C,D 0-100%	94% 91-100%	≥ 7%
→(EC-8460, R307) EFAS Steam Generator Level Low ←(EC-8460, R307)	SGIL-1113A,B,C,D LT-1123A,B,C,D 0-100%	64.4% 59.4-69.4%	≥ 5% (5)
EFAS Differential Between Steam Gen's Press	N/A(3)	0 psid	≤ 230 psid

←(DRN 06-884, R15)

(1) Four Sensors for each variable parameter.

(2) Setpoint can be manually decreased as pressure is reduced during a plant cooldown. The setpoint is automatically increased as steam generator pressure increases.

(3) The differential steam generator pressure signal is produced by a bistable utilizing signals from bother generators' pressure sensors.

→(DRN 06-884, R15)

(4) The analytical limits correspond to those used in the safety analysis. The actual equipment setpoints are determined to ensure that the specified protective action is initiated at or before the monitored parameter reaches the nominal values. The equipment setpoints are listed in the Technical Specifications.

| (DRN 06-884, R15)

(5) % of this distance between steam generator upper and lower level instrument nozzles.

TABLE 7.3-3 Revision 10 (10/99)

ESFAS BYPASSES

Title	Function	Initiated By	Removed By	Notes
Trip Channel Bypass	Disables any given trip channel	Manually by controlled access switch	Same switch	Interlocks allow one channel for any type trip to be bypassed at one time.
→ RPS/ESFAS Pressurizer Pressure Bypass ←	Disables low pressurizer trip and SIAS	Key Operator switch (1 per channel) if pressurizer Pressure is $\leq$ 400 psia	Automatic if pressurizer pressure is $\geq$ 500 psia	Allows plant depressurization below 400 psia without initiating SIAS or low pressurizer trip

TABLE 7.3-4

AUXILIARY SUPPORTING SYSTEMS REQUIREMENTS

				Heating, Ventilating and Air Conditioning								
Engineered Safety Features Systems	Auxiliary Component Cooling Water System	Cooling Water System	Diesel Generatotor Systems	Charging Pump Rooms	Boric Acid Make-up Pump Rooms	Diesel Generator Rooms	Chiller Rooms	ESF Swgr. Rooms	Battery Rooms	ESF Pump Rooms	CCW Pump Rooms	Standby Power Distribution Systems
Safety Injection	X	X	X	X	X	X	X	X	X	X	X	X
Containment Spray	X	X	X			X	X	X	X	X	X	X
Containment Isolation	X	X	X			X	X	X	X		X	X
Main Steam Isolation	X	X	X			X	X	X	X		X	X
Emergency Feedwater	X	X	X			X	X	X	X		X	X
Containment Cooling	X	X	X			X	X	X	X		X	X
Shield Building Ventilation System			X			X		X	X			X
Combustible Gas Control System			X			X		X	X			X

TABLE 7.3-5 (Sheet 1 of 19) Revision 9 (12/97)

COMPONENTS ACTUATED ON SIAS

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Start	Shield Bldg Vent System Fan	E-17 (3ASA) SBVMFAN0001A	X	
Open(10)	Shield Bldg Vent Fan E-17 (3ASA) Train A Inlet Valve	2HV-B160A SBVMVAAA101A	(1)	
Open (10)	Shield Bldg Vent Fan E-17 (3ASA) Train A Outlet Valve	2HV-B158A SBVMVAAA110A	(1)	
Open/ Close (10)	Shield Bldg Vent Fan E-17 (3ASA) Main Discharge to Stack Valve	2HV-B162A SBVMVAAA114A	(1)	
Close/ Open (10)	Shield Bldg Vent Fan E-17 (3ASA) Recirc Valve to Annulus	2HV-B164A SBVMVAAA113A	(1)	
Start	Shield Bldg Vent System Fan	E-17 (3BSB) SBVMFAN0001B		X
Open (10)	Shield Bldg Vent Fan E-17 (3BSB) Train B Inlet Valve	2HV-B161B SBVMVAAA101B		(1)
Open (10)	Shield Bldg Vent Fan E-17 (3BSB) Train B Outlet Valve	2HV-B159B SBVMVAAA110B		(1)
Open/ Close (10)	Shield Bldg Vent Fan E-17 (3BSB) Main Discharge to Stack Valve	2HV-B163B SBVMVAAA114B		(1)
Stop	CEDM Cooling Unit	E16(3A) CDCMFAN0002A	X	
Stop ←	CEDM Cooling Unit	E16(3C) CDCMFAN0002C	X	

TABLE 7.3-5 (Sheet 2 of 19) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Stop	CEDM Cooling Unit	E16(3B) CDCMFAN0002B		X
Stop	CEDM Cooling Unit	E16(3D) CDCMFAN0002D		X
Close/ Open (10)	Shield Bldg Vent Fan E-17 (3BSB) Recirc Valve to Annulus	2HV-B165B SBVMVAAA113B		(1)
Stops (3)	Control Rm Toilet Exhaust Fan	E-34 (3ASA) HVCMFAN0011A	X	
Stops (3)	Control RM Toilet Exhaust Fan	E-34 (3BSB) HVCMFAN0011B		X
Close	Control Rm Toilet Exhaust Fan E-34 (3ASA) & E-34 (3BSB) Isolation Discharge Valve	3HV-B177A HVCMVAAA307	X	
Close	Control Rm Toilet Exhaust Fan E-34 (3ASA) & E-34 (3BSB) Isolation Discharge Valve	3HV-B178B HVCMVAAA306		X
Open	Control Rm Toilet Exhaust Fan E-34 (3ASA) By-pass Damper	D-18 (SA) HVCMVAAA304A	X	
Open	Control Rm Toilet Exhaust Fan E-34 (3BSB) By-pass Damper	D-18 (SB) HVCMVAAA304B		X
Stop	Control Rm Kitchen & Conference Rm Exhaust Fan (Not connected to emergency DG bus)	E-42 (3) HVCMFAN0012	(1)	(1)
Close ←	Control Rm Kitchen & Conference Rm Exhaust Fan E-42 (3) Isolation Discharge Valve	3HV-B171A HVCMVAAA314	X	

TABLE 7.3-5 (Sheet 3 of 19) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Close	Control Rm Kitchen & Conference Rm Exhaust Fan E-42 (3) Isolation Discharge Damper	3HV-B172B HVCMVAAA313		X
Open	Control Rm Kitchen & Conference Rm Exhaust Fan E-42 (3) By-pass Damper	D-19 (SA) HVCMVAAA312A	X	
Open	Control Rm Kitchen & Conference Rm Exhaust Fan E-42 (3) By-pass Damper	D-19 (SB) HVCMVAAA312B		X
Start (4)	Control Rm Emergency Filtration System Fan	S-8 (3ASA) HVCMFAN0010A	X	
Open	Control Rm Emergency Filtration System Fan S-8 (3ASA) Inlet Damper	D-17 (SA) HVCMVAAA205A	(1)	
Open	Control Rm Emergency Filtration System Fan S-8 (3ASA) Return Air Damper	D-41 (SA) HVCMVAAA213A	(1)	
Start	Safeguard Pump Rm A Cooler	AH-2 (3ASA) HVRMAHU0034A	(1)	
Start	Safeguard Pump Rm A Cooler	AH-2 (3CSA) HVRMAHU0036A	(1)	
Start	Safeguard Pump Rm B Cooler	AH-2 (3BSB) HVRMAHU0034B		(1)
Start	Safeguard Pump Rm B Cooler	AH-2 (3DSB) HVRMAHU0036B		(1)
Start	Safeguard Pump Rm A Cooler	AH-21 (3SAB) HVRMAHU0034AB		(1)
Start ←	Equipment Rm Cooler	AH-26(3ASA) HVCMAHU0013A	(1)	

TABLE 7.3-5 (Sheet 4 of 19) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Start	Equipment Rm Cooler	AH-26(EBSB) HVCMAHU0013B		(1)
Start (4)	Control Rm Emergency Filtration System Fan	S-8 (3BSB) HVCMFAN0010B		X
Open	Control Rm Emergency Filtration System Fan S-8 (3BSB) Inlet Damper	D-17 (SB) HVCMVAAA205B		(1)
Open	Control Rm Emergency Filtration System Fan S-8 (3BSB) Return Air Damper	D-41 (SB) HVCMVAAA213B		(1)
Start	Control Rm Air Handling Unit (Continuously running if selected)	AH-12 (3ASA) HVCMAHU0001A	X	
Start	Control Rm Air Handling Unit (Continuously running if selected)	AH-12 (3BSB) HVCMAHU0001B		X
Close	Control Rm Supply Fan AH-12 (3ASA) Intake Damper	D-40 (SA) HVCMVAAA103A	X	
Close	Control Rm Supply Fan AH-12 (3BSB) Intake Damper	D-40 (SB) HVCMVAAA103B		X
Open	AH-25(3ASA) Recirc. Damper	D-48 (SA) SVSMVAAA105A	X	
Open ←	AH-25(3BSB) Recirc. Damper	D-48 (SB) SVSMVAAA105B		X

TABLE 7.3-5 (Sheet 5 of 19) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Open	AH-25(3ASA) Recirc. Damper	D-49 (SA) SVSMVAAA106A	X	
Open	AH-25(3BSB) Recirc. Damper	D-49 (SB) SVSMVAAA106B		X
Auto Control	AH-25(3ASA) EHC CHLD WTR CONTR VA	3AC-TM188A CHWMVAAA591	(1)	
Auto Control	AH-25(3BSB) EHC CHLD WTR CONTR VA	3AC-TM189B CHWMVAAA900		(1)
Open	Control Rm Supply Fan AH-12(3ASA) Return Air Damper	D-39(SA) HVCMVAAA105A	(1)	
Open	Control Rm Supply Fan AH-12(3BSB) Return Air Damper	D-39(SB) HVCMVAAA105B		(1)
Close	Control Rm Supply Fan AH-12 (3ASA) & AH-12 (3BSB) Outside Intake Air Valve	3HV-B169A HVCMVAAA102	X	
Close	Control Rm Supply Fan AH-12 (3ASA) & AH-12 (3BSB) Outside Intake Air Valve	3HV-B170B HVCMVAAA101		X
Start (4)	CVAS Fan	E-23 (3ASA) HVRMFAN0021A	X	
Start (4)	CVAS Fan	E-23 (3BSB) HVRMFAN0021B		X
Open	CVAS Fan E-23 (3ASA) Transfer Valve	3HV-B210A HVRMVAAA302	X	
Open (10)	CVAS Filter Train A Inlet Valve	3HV-B208A HVRMVAAA304A	(1)	
Open (10) ←	CVAS Filter Train A Outlet Valve	3HV-B206A HVRMVAAA313A	(1)	

TABLE 7.3-5 (Sheet 6 of 19) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Close	Reactor Aux Bldg Normal Ventilation System Isolation Valve	3HV-B218A HVRMVAAA108	X	
Close	Reactor Aux Bldg Normal Ventilation System Isolation Valve	3HV-B217B HVRMVAAA109		X
Open	Reactor Aux Bldg Ventilation System Fan E-23 (3BSB) Transfer Valve	3HV-B225B HVRMVAAA301		X
Open (10)	CVAS Filter Train B Inlet Valve	3HV-B209B HVRMVAAA304B		X
Open (10)	CVAS Filter Train B Outlet Valve	3HV-B207B HVRMVAAA313B		(1)
Close	Reactor Aux Bldg Normal Ventilation System Isolation Valve	3HV-B226A HVRMVAAA106	X	
Status Display	QSPDS-2		X	
Enable Alarm	RAB Neg Press Lost Alarm	ANN Window CP18-915A	X	
	RAB Neg Press Lost Alarm	ANN Window CP18-915B		X
Close	Reactor Aux Bldg Normal Ventilation System Isolation Valve	3HV-B227B HVRMVAAA107		X
Close	Reactor Aux Bldg Normal Ventilation System Supply to Pipe Penetration Area Valve	3HV-B224A HVRMVAAA104	X	
Close	Reactor Aux Bldg Normal Ventilation System Supply to Pipe Penetration Area Valve	3HV-B223B HVRMVAAA105		X
Close ←	Reactor Aux Bldg Normal Ventilation System Exhaust from Pipe Chase Area Valve	3HV-B216A HVRMVAAA111	X	

TABLE 7.3-5 (Sheet 7 of 19) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Close	Reactor Aux Bldg Normal Ventilation System Exhaust from Pipe Chase Area Valve	3HV-B215B HVRMVAAA110		X
Stop	Computer Room Supplemental Air Handling Unit	AH-31(3) HVCMAHU0007	(7)	(7)
Stop	Annulus Neg. Pressure Exhaust Fan	E-19(3A) ANPMFAN0001A	(7)	(7)
Stop	Annulus Neg. Pressure Exhaust Fan	E-19(3B) ANPMFAN0001B	(7)	(7)
Stop	Cable Vault Area Exhaust Fan	E-49(3) SVSMFAN0009	(7)	(7)
Close	Annulus Negative Pressure System Isolation Valve	3HV-B175A ANPMVAAA101	X	
Close	Annulus Negative Pressure System Isolation Valve	3HV-B176B ANPMVAAA102		X
Stop	Reactor Aux Bldg Normal Ventilation System Supply Fan	S-6 (3A) HVRMFAN0002A	(7)	
Stop	Reactor Aux Bldg Normal Ventilation System Supply Fan	S-6 (3B) HV4MFAN0002B		(7)
Stop	Reactor Aux Bldg Normal Ventilation System Exhaust Fan	E-22 (3A) HVRMFAN0009A	X	
Stop	Reactor Aux Bldg Normal Ventilation System Exhaust Fan	E-22 (3B) HVRMFAN0009B		X
Close	Reactor Aux Bldg Normal Ventilation System Exhaust Fan E-22 (3A) Inlet Damper	D-4 (A) HVRMVAAA121A	(1)	
Close	Reactor Aux Bldg Normal Ventilation System Exhaust Fan E-22 (3A) Outlet Damper	D-5 (A) HVRMVAAA122A	(1)	
Close ←	Reactor Aux Bldg Normal Ventilation System Exhaust Fan E-22 (3B) Inlet Damper	D-4 (B) HVRMVAAA121B		(1)

TABLE 7.3-5 (Sheet 8 of 19) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Close	Reactor Aux Bldg Normal Ventilation System Exhaust Fan E-22 (3B) Outlet Damper	D-5 (B) HVRMVAAA122B		(1)
Start	Switchgear Area Air Handling Unit	AH-25 (ASA) SVSMAHU0001A	X	
Start	Switchgear Area Air Handling Unit	AH-30 (3ASA) SVSMAHU0002A	X	
Open	AH-30 (3ASA) Inlet Damper	D-50 (SA) SVSMVAAA201A	(1)	
Start	Switchgear Area Air Handling Unit	AH-25 (3BSB) SVSMAHU0001B		X
Start	Switchgear Area Air Handling Unit	AH-30 (3BSB) SVSMAHU0002B		X
Close to min. open position	Switchgear Area Air Handling Unit AH-25(3ASA) Outside Damper	D-65 (SA) SVSMVAAA101	X	
Close to min. open position	Switchgear Area Air Handling Unit AH-25 (3BSB) Outside Damper	D-65 (SB) SVSMVAAA102		X
Open	Switchgear Area Air Handling Unit AH-25 (3ASA) Return Air Damper	D-8 (SA) SVSMVAAA103A	(1)	
Open	Switchgear Area Air Handling Unit AH-25 (3BSB) Return Air Damper	D-8 (SB) SVSMVAAA103B		(1)
Start	Battery Room A Exhaust Fan	E-29 (3A-SA) SVSMFAN0006A	X	
Start	Battery Room A Exhaust Fan	E-29 (3B-SB) SVSMFAN0006B		X
Start	Battery Room B Exhaust Fan	E-30 (3A-SA) SVSMFAN0005A	X	
Start ←	Battery Room B Exhaust Fan	E-30 (3B-SB) SVSMFAN0005B		X

TABLE 7.3-5 (Sheet 9 of 19) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→				
Start	Battery Room AB Exhaust Fan	E-31 (3A-SA) SVSMFAN0004A	X	
Start	Battery Room AB Exhaust Fan	E-31 (3B-SB) SVSMFAN0004B		X
Open	AH-30 (3BSB) Inlet Damper	D-50 (SB) SVSMVAAA201B		(1)
Start (2)	RAB H&V Equipment Room Supply Fan	AH-13 (3ASA) HVRMAHU0022A	X	
Start (2)	RAB H&V Equipment Room Supply Fan	AH-13 (3BSB) HVRMAHU0022B		X
Start (2)	RAB H&V Equipment Room Exhaust Fan	E-41 (3ASA) HVRMFAN0024A	(1)	
Start (2)	RAB H&V Equipment Room Exhaust Fan	E-41 (3BSB) HVRMFAN0024B		(1)
Start	Computer Battery Room Exhaust Fan	E-46 (3A-SA) SVSMFAN0003A	X	
Start	Computer Battery Room Exhaust Fan	E-46 (3B-SB) SVSMFAN0003B		X
Start (6)	Water Chiller	WC-1 (3ASA) RFRMCHL0001A	X	
Start (6)	Water Chiller	WC-1 (3BSB) RFRMCHL0001B		X
Start (6)(9)	Water Chiller	WC-1 (3CSAB) RFRMCHL0001C	X	X
Close	Annulus Negative Pressure System Inlet Damper	D-25(3) ANPMVAAA103	(1)	(1)
Close	Annulus Negative Pressure System Exhaust Damper	D-26(3) ANPMVAAA106	(1)	(1)
←				

TABLE 7.3-5 (Sheet 10 of 19) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Start	Chilled Water Pump	P-1 (3A-SA) CHWMPMP0001A	(1)	
Start	Chilled Water Pump	P-1 (3B-SB) CHWMPMP0001B		(1)
Start	Chilled Water Pump	P-1 (3C-SAB) CHWMPMP001AB	(1)	(1)
Start	Diesel Gen A Room Exhaust Fan	E-28 (3A-SA) HVRMFAN0025A	(1)	
Start	Diesel Gen B Room Exhaust Fan	E-28 (3B-SB) HVRMFAN0025B		(1)
Start	Component Cooling Water Pump A Air Handling Unit	AH-10 (3ASA) HVRMAHU0028a	(1)	
Start	Component Cooling Water A/B Air Handling Unit	AH-20 (3ASAB) HVRMAHU0028AB	(1)	
Start	Pump B Air Handling Unit	HVRMAHU0028B		
Start	Component Cooling Water Pump A/B Air Handling Unit	AH-20 (3BSAB) HVRMAHU0030		(1)
Start	Charging Pump A Air Handling Unit	AH-18 (3ASA) HVRMAHU0040A	(1)	
Start	Charging Pump A/B Air Handling Unit	AH-22 (3ASAB) HVRMAHU0040AB	(1)	
Start	Charging Pump B Air Handling Unit	AH-18 (3BSB) HVRMAHU0040B		(1)
Start ←	Charging Pump A/B Air Handling Unit	AH-22 (3BSAB) HVRMAHU0042AB		(1)

TABLE 7.3-5 (Sheet 11 of 19) Revision 12-A (01/03)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
Start	Low Pressure Safety Injection Pump	A SIMPMP00001A	X	
Start	Low Pressure Safety Injection Pump	B SIMPMP0001B		X
Start	High Pressure Safety Injection Pump	A SIMPMP0002A	X	
Start	High Pressure Safety Injection Pump	B SIMPMP0002B		X
Start (9)	High Pressure Safety Injection Pump	A/B SIMPMP0002AB	X	X
Open (10)	LPSI Flow Control Valve to Loop 1A	2SI-V1549A1 (SI-615) SIMVAAA139B	X	
Open (10)	LPSI Flow Control Valve to Loop 1B	2SI-V1539B1 (SI-625) SIMVAAA138B		X
Open (10)	LPSI Flow Control Valve to Loop 2A	2SI-V1541A2 (SI-635) SIMVAAA139A	X	
Open (10)	LPSI Flow Control Valve to Loop 2B	2SI-V1543B2 (SI-645) SIMVAAA138A	X	
Open (10)	HPSI Flow Control Valve to Loop 1A	2SI-V1550A1 (SI-617) SIMVAAA225A	X	
→(DRN 02-1017, R12) Close	LPSI Header Auto Vent Isolation Valve	SI-ISV-6011	X	
Close	LPSI Header Auto Vent Isolation Valve	SI-ISV-6012		X
←(DRN 02-1017, R12) →(DRN 02-1400, R12-A) Close	LPSI A to RC Loop 2B Upstr Auto Vent Containment Isolation	SI ISV 14023A	X	
Close	LPSI A to RC Loop 2B Upstr Auto Vent Auto Isolation	SI ISV 14024A	X	

←(DRN 02-1400, R12-A)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
Open (10)	HPSI Flow Control Valve to Loop 1B	2SI-V1546A2 (SI-627) SIMVAAA226A	X	
Open (10)	HPSI Flow Control Valve to Loop 2A	2SI-V1547B3 (SI-636) SIMVAAA227B		X
Open (10)	HPSI Flow Control Valve to Loop 2B	2SI-V1548A4 (SI-647) SIMVAAA228A	X	
Open (10)	HPSI Flow Control Valve to Loop 1B	2SI-V1540B2 (SI-626) SIMVAAA226B		X
Open (10)	HPSI Flow Control Valve to Loop 2A	2SI-V1542A3 (SI-637) SIMVAAA227A	X	
Open (10)	HPSI Flow Control Valve to Loop 2B	2SI-V1544B4 (SI-646) SIMVAAA228B		X
Open (10)	HPSI Flow Control Valve to Loop 1A	2SI-V1545B1 (SI-616) SIMVAAA225B		X
Open (10)	S I Tank 1A Isolation Valve	1SI-V1505TK1A (SI-614) SIMVAAA331A	X	
→ Close ←	S I Tank 1A Leakage Drain Valve	1SI-F1551TK1A (SI-618) SIMVAAA303A	X	
Open (10)	S I Tank 1B Isolation Valve	1SI-V1506TK1B (SI-624) SIMVAAA331B		X
→ Close ←	S I Tank 1B Leakage Drain Valve	1SI-F1552TK1B (SI-628) SIMVAAA303B		X

TABLE 7.3-5 (Sheet 13 of 19) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→				
Open (10)	S I Tank 2A Isolation Valve	1SI-V1507TK2A (SI-634) SIMVAAA332A		X
Close	S I Tank 2A Leakage Drain Valve	1SI-F1553TK2A (SI-638) SIMVAAA304A	X	
Open (10)	S I Tank 2B Isolation Valve	1SI-V1508TK2B (SI-644) SIMVAAA332B		X
Close	S I Tank 2B Leakage Drain Valve	1SI-F1554TK2B (SI-648) SIMVAAA304B		X
Close	RCS Loop 1 Hot Leg Inj. Drain Valve	1SI-V2504 (SI-301) SIMVAAA301	X	
Open	Refueling Water Storage Pool Outlet Valve	2SI-L103A SIMVAAA106A	X	
Open	Refueling Water Storage Pool Outlet Valve	2SI-L104B SIMVAAA106B		X
Open Permissive	SG No. 2 Emerg. FW Control VA	2FW-V853A EFWMVAAA224B	(1)	
Open Permissive	SG No. 1 Emerg. FW Control VA	2FW-V852A EFWMVAAA223A	(1)	
Open Permissive	SG No. 2 Emerg. FW Control VA	2FW-V854B EEFWMVAAA223B		(1)
Open Permissive	SG No. 1 Emerg. FW Control VA	2FW-V851B EFWMVAAA224A		(1)
Close ←	RCS Loop 2 Hot Leg Injection Drain VA	1SI-V2505 (SI-302) SIMVAAA302		X

TABLE 7.3-5 (Sheet 14 of 19) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Start	Diesel Generator	A EGEGEN0001A	X	
Start	Diesel Generator	B EGEGEN0001B		X
Start	Charging Pump	A CVCMPMP0001A	X	
Start	Charging Pump	B CVCMPMP0001B		X
Start (9)	Charging Pump	AB CVCMPMP0001AB	X	X
Start	Boric Acid Make-up Pump	A BAMMPMP0001A	X	
Start	Diesel Generator A Sequence Loading	A	X	
Start	Diesel Generator B Sequence Loading	B		X
Start	Boric Acid Make-up Pump	B BAMMPMP0001B	X	
Open (10)	Boric Acid Tank A Gravity Feed Valve to Charging Pumps	3CH-V106A (CH-509) BAMMVAAA113A		X
Open (10)	Boric Acid Tank B Gravity Feed Valve to Charging Pumps	3CH-V107B (CH-508) BAMMVAAA113B		X
Close	Boric Acid Pump A Recirc Line Valve	3CH-F170A (CH-510) BAMMVAAA126A	X	
Close	Boric Acid Pump B Recirc Line Valve	3CH-F171B (CH-511) BAMMVAAA126B	X	
Open (10) ←	Reactor Make-up Bypass Valve	3CH-V112AB(CH-514) BAMMVAAA133	X	

TABLE 7.3-5 (Sheet 15 of 19) Revision 10 (10/99)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
Close	Reactor Make-up Stop Valve	3CH-F117AB(CH-512) CVCMVAAA510	X	
Close	Letdown Control Valve	1CH-F2501A/B (CH-516) CVCMVAAA103		X
Close	Letdown Stop Valve	1CH-F1516A/B(CH-515) CVCMVAAA101	X	
Close (10) →	VCT Discharge Valve	2CH-V123A/B(CH-501)		X
← Trip Permissive	Diesel Generator A Output Breaker	EG-EBKR3A-14X		
Trip Permissive	Diesel Generator B Output Breaker	EG-EBKR3B-15	X	
Start	Component Cooling Water Pump	A CCMPMP0001A	X	
Start	Component Cooling Water Pump	B CCMPMP0001B		X
Start (9)	Component Cooling Water Pump	A/B CCMPMP0001AB	X	X
Open	CCW Outlet Valve from Shutdown HX B	3CC-F131B CCMVAAA963B		X
Start	Aux Component Cooling Water Pump	A ACCMPMP0001A	X	
Start	Aux Component Cooling Water Pump	B ACCMPMP0001B		X
Close	CCW Pump A Discharge Header Isolation Valve	3CC-F109A/B CCMVAAA126A	X	
Close	CCW Pump A Discharge Header Isolation Valve	3CC-RF110A/B CCMVAAA127A		X

TABLE 7.3-5 (Sheet 16 of 19) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Close	CCW Pump B Discharge Header Isolation Valve	3CC-F112A/B CCMVAAA126B	X	
Close	CCW Pump B Discharge Header Isolation Valve	3CC-F111A/B CCMVAAA127B		X
Close	CCW Pump A Suction Header Isolation Valve	3CC-F113A/B CCMVAAA114A	X	
Block Auto Operation	Instrument Air Compressor	A IAMCMP0001A	X	
Block Auto Operation	Instrument Air Compressor	B IAMCMP0001B		X
Close	CCW Pump A Suction Header Isolation Valve	3CC-F114A/B CCMVAAA115A		X
Close	CCW Pump B Suction Header Isolation Valve	3CC-F116A/B CCMVAAA114B	X	
Close	CCW Pump B Suction Header Isolation Valve	3CC-F115A/B CCMVAAA115B		X
Trip & Block Auto Close	Station Service Transformer 3A32 FDR BRKR	SSD-EBKR-3A-8	X	
Trip & Block Auto Close	Station Service Transformer 3B32 FDR BRKR	SSD-EBKR-3B-9		X
Close	CCW Train B Supply to NNS Isolation Valve	3CC-F123B CCMVAAA200B		X
Close	CCW Supply to NNS Isolation Valve	3CC-F133A/B CCMVAAA501	X	
Close	CCW Train B Return to CCW Pumps Common Suction Hdr Isolation Valve	3CC-F121B CCMVAAA563		X
Close ←	CCW Return from NNS to CCW Pumps Common Suction Hdr Isolation Valve	3CC-F132A/B CCMVAAA562		X

TABLE 7.3-5 (Sheet 17 of 19) Revision 9 (12/97)

Action →	Component	Tag Number	Actuation Channel A	Actuation Channel B
Reset to SIAS operational mode	CCW Heat Exchanger A Temperature Control Valve	3CC-TM290A ACCMVAAA126A		X
Reset to SIAS operational mode	CCW Heat Exchanger B Temperature Control Valve	3CC-TM291B ACCMVAAA126B		X
Close	Fuel Pool Temp Control Valve	3CC-FM138A/B CCMVAAA620	X	
Close	Letdown Temperature Control Valve	3CC-TM169A/B CCMVAAA636	(1)	(1)
Start	Charging Pump AB Seal Lube Pump	AB CVCMPMP0012AB	(1)	(1)
Start	Charging Pump A Seal Lube Pump	A CVCMPMP0012AB	(1)	
Start	Charging Pump B Seal Lube Pump	B CVC MPMP00012B		(1)
Close (10)	SIS Sump Isolation Valve	2SI-L101A SIMVAAA602A	X	
Close (10)	SIS Sump Isolation Valve	2SI-L102B SIMVAAA602B		X
Start (8)	Containment Fan Cooler	AH-1 (3ASA) CCSMFAN0003A	X	
Start (8)	Containment Fan Cooler	AH-1 (3CSA) CCSMFAN0003C	X	
Start (8)	Containment Fan Cooler	AH-1 (3BSB) CCSMFAN0003B		X
Start (8)	Containment Fan Cooler	AH-1 (3DSB) CCSMFAN0003D		X
Open (8)	Containment Fan Cooler AH-1 (3CSA) CCW Inlet Containment Isolation Valve	2CC-F154A1 CCMVAAA807A	X	
Open (8) ←	Containment Fan Cooler AH-1 (3CSA) CCW Outlet Containment Isolation Valve	2CC-F158A1 CCMVAAA823A	X	

TABLE 7.3-5 (Sheet 18 of 19) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→				
Open (8)	Containment Fan Cooler AH-1 (3DSB) CCW Inlet Containment Isolation Valve	2CC-F155A2 CCMVAAA808A	X	
Open	Containment Fan Coolers System "A" CCW Flow Control Valve	3CC-TM 148A CCMVAAA835A	X	
Open	Containment Fan Cooler Safety Discharge Damper	D-69 (SA) CCSMVAAA102A	X	
Open (8)	Containment Fan Cooler AH-1 (3ASA) CCW Outlet Containment Isolation Valve	2CC-F159A2 CCMVAAA822A	X	
Open (8)	Containment Fan Cooler AH-1 (3DSB) CCW Inlet Containment Isolation Valve	2CC-F156B1 CCMVAAA808B		X
Open (8)	Containment Fan Cooler AH-1 (3DSB) CCW Outlet Containment Isolation Valve	2CC-F160B1 CCMVAAA822B		X
Open (8)	Containment Fan Cooler AH-1 (3BSB) CCW Inlet Containment Isolation Valve	2CC-F157B2 CCMVAAA807B		X
Open (8)	Containment Fan Cooler System "B" CCW Flow Control Valve	3CC-TM 149B CCMVAAA835B		X
Open	Containment Fan Cooler Safety Discharge Damper	D-70 (SB) CCSMVAAA102B		X
Open (8)	Containment Fan Cooler AH-1 (3BSB) CCW Outlet Containment Isolation Valve	2CC-F161B2 CCMVAAA823B		X
Open	Diesel Generator A Room Exhaust Fan E-28 (3A-SA) Intake Damper	LD-2(SA) HVRMVAAA501A	(1)	
Auto Control	Diesel Generator B Room Exhaust Fan E-28 (3B-SB) Pitch Rotor	D-6(SB) HVRMVAAA502B		(1)
Open	Diesel Generator B Room Exhaust Fan E-28 (3B-SB) Intake Damper	D-7(SB) HVRMVAAA501B		(1)
Auto Control ←	Diesel Generator A Room Exhaust Fan E-28 (3A-SA) Pitch Rotor	D-6(SA) HVRMVAAA502A	(1)	

NOTES:

(1) Auxiliary equipment actuated through interlock with primary equipment. No separate actuation is provided.

(2) One selected fan is running during normal operation. On SIAS second fan is started (both fans running).

(3) One selected fan is running during normal operation. On SIAS both fans are tripped and locked-out.

(4) Neither fan is operated during normal operation. On SIAS both fans are started.

(5) Operator shall manually open one of the two emergency outside Air Intake System (no individual contacts from SIAS required).

(6) Selected number of water chillers are running during normal operation. On SIAS two water chillers shall receive start signal.

(7) Non-safety units are actuated through isolated contacts during emergency operation (no individual contacts from SIAS).

(8) Three selected fans are running at fast speed and their associated isolating CCW valves are open during normal operation. On SIAS all four fans shall run at low speed with all associated isolating CCW valves open.

→

(9) Will start only if AB pump is selected for B pump and AB Bus aligned to B Bus or if AB pump is selected for A Pump and AB Bus aligned to A Bus.

←

→

(10) Thermal overload contacts are bypassed on SIAS.

←

TABLE 7.3-6 Revision 9 (12/97)

COMPONENTS ACTUATED ON RAS

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Stop	LPSI Pump	A SI-MPMP0001A	X	
Stop	LPSI Pump	B SI-MPMP0001B		X
Open-Alarm	SIS Sump Outlet Valve to Recirc	2SI-L101A (SI-653) SI-MVAAA602A	X	
Open-Alarm	SIS Sump Outlet Valve to Recirc Header B	2SI-L102B (SI-654) SI-MVAAA602B		X
Close Permissive	Refueling Water Storage Pool Outlet Valve	2SI-L103A SI-MVAAA106A	X	
Close Permissive	Refueling Water Storage Pool Outlet Valve	2SI-L104B SI-MVAAA106B		X
Overload Bypass Only	Safety Injection Pumps "A" Min. Flow Isol. VA	2SI-V809A SIMVAAA121A	X	
Overload Bypass Only	Safety Injection Pumps "A" Min. Flow Isol. VA	2SI-V810A SIMVAAA120A	X	
Overload Bypass Only	Safety Injection Pumps "B" Min. Flow Isol. VA	2SI-V801B SIMVAAA121B		X
Overload Bypass Only ←	Safety Injection Pumps "B" Min. Flow Isol. VA	2SI-V802B SIMVAAA120B		X

TABLE 7.3.7 Revision 9 (12/97)

→

COMPONENTS ACTUATED ON CSAS

←

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
Start	Containment Spray Pump	A CS-MPMP0001A	X	
Start	Containment Spray Pump	B CS-MPMP0001B		X
Open	Containment Spray Isol Valve	2CS-F305A CS-MVAAA125A	X	
Open	Containment Spray Isol Valve	2CS-F306B CS-MVAAA125B		X
Fail to start	Cont. Spray Pump A Alarm		X	
Fail to start	Cont. Spray Pump B Alarm			X
Close	RCP Cooling Water Supply Cont Isol Valve	2CC-F146A/B CC-MVAAA641		X
Close	RCP Cooling Water Return Isol Valve	2CC-F-243A/B CC-MVAAA710	X	
Close	RCP Cooling Water Return Isol Valve	2CC-F147A/B CC-MVAAA713		X
Close	CCW Train A Return to CCW Pumps Common Suction Hdr Isolation Valve	3CC-F120A CC-MVAAA727	X	
Close	CCW Train A Supply to NNS Isolation Valve	3CC-F122A CC-MVAAA200A	X	
Open	CCW Outlet Valve from Shutdown HX A	3CC-F130A CC-MVAAA963A	X	
Start	Safeguard Pump Room A Cooler	AH-2 (3A-SA) HVRMAHU0034A	(1)	
Start	Safeguard Pump Room A Cooler	AH-2 (3C-SA) HVRMAHU0036A	(1)	
Start	Safeguard Pump Room B Cooler	AH-2 (3B-SB) HVRMAHU0034B		(1)
Start	Safeguard Pump Room B Cooler	AH-2 (3D-SB) HVRMAHU0036B		(1)

→

NOTES: (1) Actuates through interlock with primary equipment.

←

TABLE 7.3-8 (Sheet 1 of 5) Revision 12 (10/02)

COMPONENTS ACTUATED ON CIAS

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
Trip Override Permis.	Containment Atmos Release Sys Supply Fan	S-3 (3A-SA) CAR MFAN 0001A	X	
Trip Override Permis.	Containment Atmos Release Sys Exhaust Fan	E18 (3A-SA) CAR MFAN 0002A	X	
Close (2)	Containment Atmos Release Sys Disch Valve	2HV-B167A CAR MVAAA 204A	(1)	
Close (2)	Containment Atmos Release Sys Suct Valve	2HV-F253A CAR MVAAA 201A	X	
Trip Override Permis.	Containment Atmos Release Sys Supply Fan	S-3 (3B-SB) CAR MFAN 0001B		X
Trip Override Permis.	Containment Atmos Release Sys Exh Fan	E18 (3B-SB) CAR MFAN 0002B		X
Close (2)	Containment Atmos Release Sys Disch Valve	2HV-B168B CAR MVAAA 204B		(1)
Close (2)	Containment Atmos Release System Suct Valve	2HV-F254B CAR MVAAA 201B		X
→(DRN 02-1017)				
←(DRN 02-1017)				
Close	Containment Pressure Exhaust Valve	2HV-F228A CAR MVAAA 200B	X	
Close	Containment Pressure Exhaust Valve	2HV-F229B CAR MVAAA 202B		X
Close	Letdown Control Valve	1CH-F2501A/B (CH-516) CVC MVAAA 103		X

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Close ←	Letdown Control Valve	2CH-F1518A/B (CH-523) CVC MVAAA 109	X	
→ Close ←	RCP Bleed Off Cont Isol Valve	2CH-RF1512A/B (CH-505) CVC MVAAA 401	X	
→ Close ←	RCP Bleed Off Cont Isol Valve	2CH-F1513A/B (CH-506) RC MVAAA 606		X
→ Close ←	Reactor Drain Tk Cont Isol Valve	2BM-F108A/B (BM-301) BM MVAAA 109		X
→ Close ←	Reactor Drain Tk Cont Isol Valve	2BM-F109A/B (BM-302) BM MVAAA 110	X	
→ Close ←	Nitrogen Cont Isol Valve	2NG-F604 NG MVAAA 157		X
→ Close ←	Waste Gas Cont Isol Valve	2WM-F157A/B (WM-320) GWM MVAAA 104		X
→ Close ←	Waste Gas Cont Isol Valve	2WM-F158A/B (WM-321) GWM MVAAA 105	X	
→ Close ←	Cont Sump Pumps Isol Valve	2WM-F104A/B SP MVAAA 105		X
→ Close ←	Cont Sump Pumps Isol Valve	2WM-F105A/B SP MVAAA 106	X	
→ Close ←	Coolant Sampling Containment Isol Valve	2SL-F1501A/B PSL MVAAA 105		X
→ Close ←	Coolant Sampling Containment Isol Valve	2SL-F1504A/B PSL MVAAA 107	X	
→ Close ←	Pressurizer Surge Line Cont Isol Valve	2SL-F1502A/B PSL MVAAA 203		X
→ Close ←	Pressurizer Surge Line Cont Isol Valve	2SL-F1505A/B PSL MVAAA 204	X	
→ Close ←	Pressurizer Stm Space Sampling Cont Isol Valve	2SL-F1503A/B PSL MVAAA 303		X

TABLE 7.3-8 (Sheet 3 of 5) Revision 10 (10/99)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
Close	Pressurizer Stm Space Sampling Cont Isol Valve	2SL-F1506A/B PSL MVAAA 304	X	
Close	Steam Gen 1 Sampling Isol Valve	2SL-F601 SSL MVAAA 8004A		X
Close	Steam Gen 1 Sampling Isol Valve	2SL-F602 SSL MVAAA 8006A	X	
→ Close ←	Steam Gen 2 Sampling Isol Valve	2SL-F603 SSL MVAAA 8004B		X
Close	Steam Gen 2 Sampling Isol Valve	2SL-F604 SSL MVAAA 8006B	X	
Close	Instr Air Containment Isol Valve	2IA-F601AB IA MVAAA 909	X	
Close	Fire Wtr Containment Isol Valve	2FP-F129 FP MVAAA 601B		X
Close	Fire Wtr Containment Isol Valve	2FP-F127 FP MVAAA 601A	X	
Close	Steam Gen No. 1 Blowdown Cont Isol Valve	2BD-F603 BD MVAAA 102A		X
Close	Steam Gen No. 1 Blowdown Cont Isol Valve	2BD-F604 BD MVAAA 103A	X	
Close	Steam Gen No. 2 Blowdown Cont Isol Valve	2BD-F605 BD MVAAA 102B		X
Close	Steam Gen No. 2 Blowdown Cont Isol Valve	2BD-F606 BD MVAAA 103B	X	
Close	Stm Line 1 Upstream Normal Drain Valve	2MS-V670 MS MVAAA 120A	X	
Close	Stm Line 1 Upstream Emerg Drain Valve	2MS-V671 MS MVAAA 119A	X	
Close	Stm Line 2 Upstream Normal Drain Valve	2MS-V663 MS MVAAA 120B		X
Close	Stm Line 2 Upstream Emerg Drain Valve	2MS-V664 MS MVAAA 119B		X

TABLE 7.3-8 (Sheet 4 of 5) Revision 12-A (01/03)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
Close	Hydrogen Analyzer	2HA-E609A HRA ISV 0110A	X	
Close	Supply & Return Line Valves	2HA-E608A HRA ISV 0109A	X	
Close		2HA-E610A HRA ISV 0126A	X	
Close		2HA-E629B HRA ISV 0110B		X
Close		2HA-E628B HRA ISV 0109B		X
Close		2HA-E630B HRA ISV 0126B		X
Close	Containment Purge Air Make-Up Isol Valve	2HV-B151A CAP MVAAA 103	X	
Close	Containment Purge Air Make-Up Isol Valve	2HV-B150B CAP MVAAA 102		X
Close	Containment Purge Air Make-Up Isol Valve	2HV-B152A CAP MVAAA 104	X	
Close	Containment Purge Exhaust Isol Valve	2HV-B155A CAP MVAAA 205	X	
Close	Containment Purge Exhaust Isol Valve	2HV-B154B CAP MVAAA 204		X
Close	Containment Purge Exhaust Isol Valve	2HV-B153B CAP MVAAA 203		X
Close	SI Tank Drain to RWSP Control Isol Valve	2SI-F1561A/B (SI-682) SIMVAAA343	X	
→(DRN 02-1400, R12-A) Close	LPSI A to RC Loop 2B Upstr Auto Vent Containment Isolation	SI ISV 14023A	X	
Close	LPSI A to RC Loop 2B Upstr Auto Vent Auto Isolation	SI ISV 14024A	X	
←(DRN 02-1400, R12-A) Close	Containment Atmosphere	2CA-E604B ARM ISV 0109		X
Close	RAD Monitoring Cont	2CA-E605A ARM ISV 0110	X	

TABLE 7.3-8 (Sheet 5 of 5) Revision 12-A (01/03)

Action	Component	Tag Number	Actuation Channel A	B
Close	Isol Valves	2CA-E606A ARM ISV 0103	X	
→(DRN 00-531, R11-A; 01-990, R11-B)				
Close	Containment Pressure Instrumentation Isolation Valve	2HV-E633B CVR ISV 0400		X
Close	Containment Pressure Instrumentation Isolation Valve	2HV-E634A CVR ISV 0401	X	
←(DRN 00-531, R11-A; 01-990, R11-B)				
Close	Letdown Temperature Control Valve	3CC-TM 169A/B CC MVAAA 636	(1)	(1)
Status Display	QSPDS-2		X	

NOTES:

(1) Actuates through interlock with primary equipment.

(2) Thermal Overload bypassed on CIAS.

TABLE 7.3-9 (Sheet 1 of 2) Revision 9 (12/97)

COMPONENTS ACTUATED ON MSIS

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Close ←	Steam Generator No. 1 Main Steam Isolation Valve	2MS-V602A MS MVAAA 124A	X	X
→ Close ←	Steam Generator No. 2 Main Steam Isolation Valve	2MS-V604B MS MVAAA 124B	X	X
→ Close ←	Steam Generator No. 1 Main Feedwater Isolation Valve	2FW-V823A FW MVAAA 184A	X	X
→ Close ←	Steam Generator No. 2 Main Feedwater Isolation Valve	2FW-V824B FW MVAAA 184B	X	X
→ Close ←	Steam Generator No. 1 Main Feedwater Control Valve	5FW-FM833 FW MVAAA 173A	X	X
→ Close ←	Steam Generator No. 1 Main Feedwater Control Bypass Valve	5FW-FM835 FW MVAAA 166A	X	X
→ Close ←	Steam Generator No. 2 Main Feedwater Control Valves	5FW-FM834 FW MVAAA 173B	X	X
→ Close ←	Steam Generator No. 2 Main Feedwater Control Bypass Valve	5FW-FM836 FW MVAAA 166B	X	X
→ Close ←	Main Steam Line 1 Sample Isolation Valve	2MS-F714 SSL MVAAA 301A	X	
→ Close ←	Main Steam Line 2 Sample Isolation Valve	2MS-F715 SSL MVAAA 301B		X
→ Close ←	Emergency Feedwater Valve to SG #1	2FW-V847B EFW MVAAA 229A		X
→ Close ←	Emergency Feedwater Valve to SG #1	2FW-V848A EFW MVAAA 228A	X	

TABLE 7.3-9 (Sheet 2 of 2) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Close ←	Emergency Feedwater Valve to SG #1	2FW-V851B EFW MVAAA 224A		X
→ Close ←	Emergency Feedwater Valve to SG #1	2FW-852A EFW MVAAA 223A	X	
→ Close ←	Emergency Feedwater Valve to SG #2	2FW-V849A EFW MVAAA 229B	X	
→ Close ←	Emergency Feedwater Valve to SG #2	2FW-V850B EFW MVAAA 228B		X
→ Close ←	Emergency Feedwater Valve to SG #2	2FW-V853A EFW MVAA 224B	X	
→ Close	Emergency Feedwater Valve to SG #2	2FW-V854B EFW MVAAA 223B		X
Status Display ←	QSPDS-2		X	

TABLE 7.3-10 (Sheet 1 of 2) Revision 9 (12/97)

COMPONENTS ACTUATED ON EFAS

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Starts ←	Emergency Feedwater Pump A	EFW MPMP 0001A	X	
→ Starts ←	Emergency Feedwater Pump B	EFW MPMP 0001B		X
→ Open ←	Emergency Feedwater Pump Turbine STM Shut Off Valve	2MS-V611A MS MVAAA 401A	X	
→ Override Permissive ←	Emergency Feedwater Pump Turbine STM Shut Off Valve	2MS-V611A MS MVAAA 401A	X	
→ Open ←	Emergency Feedwater Pump Turbine STM Shut Off Valve	2MS-V612B MS MVAAA 401B		X
→ Override Permissive ←	Emergency Feedwater Pump Turbine STM Shut Off Valve	2MS-V612B MS MVAAA 401B		X
→ Open ←	Emergency Feedwater Valve to SG #1	2FW-V847B EFW MVAAA 229A		X
→ Open ←	Emergency Feedwater Valve to SG #1	2FW-V848A EFW MVAAA 228A	X	
→ Open ←	Emergency Feedwater Valve to SG #1	2FW-V851B EFW MVAAA 224A		X
→ Open ←	Emergency Feedwater Valve to SG #1	2FW-V852A EFW MVAAA 223A	X	
→ Open ←	Emergency Feedwater Valve to SG #2	2FW-V849A EFW MVAAA 229B	X	
→ Open ←	Emergency Feedwater Valve to SG #2	2FW-V850B EFW MVAAA 228B		X
→ Open ←	Emergency Feedwater Valve to SG #2	2FW-V853A EFW MVAAA 224B	X	
→ Open ←	Emergency Feedwater Valve to SG #2	2FW-V854B EFW MVAAA 223B		X
→ Close ←	Steam Generator No. 1 Blowdown Containment Isolation Valve	2BD-F603 BD MVAAA 102A		X

TABLE 7.3-10 (Sheet 2 of 2) Revision 9 (12/97)

Action	Component	Tag Number	Actuation Channel A	Actuation Channel B
→ Close ←	Steam Generator No. 1 Blowdown Containment Isolation Valve	2BD-F604 BD MVAAA 103A	X	
→ Close ←	Steam Generator No. 2 Blowdown Containment Isolation Valve	2BD-F605 BD MVAAA 102B		X
→ Close	Steam Generator No. 2 Blowdown Containment Isolation Valve	2BD-F606 BD MVAAA 103B	X	
Starts	Emergency FW Pump A Cooler	AH-17 (3A-SA) HVR MAHU 0038A	(1)	
Starts	Emergency FW Pump B Cooler	AH-17 (3B-SB) HVR MAHU 0038B		(1)

NOTE:

(1) Actuates through interlock with primary equipment.
←

TABLE 7.3-11 Revision 10 (10/99)

MONITORED VARIABLES REQUIRED FOR ESF SYSTEM PROTECTIVE ACTION

System

Variable	Containment Isolation System	Containment Spray System	Recirculation System	Main Steam Isolation System	Safety Injection System	Emergency Feedwater System
Pressurizer Pressure	*	*			*	
Containment Pressure	*	*		*	*	
Steam Generator Pressure				*		*
Refueling Water Storage Pool Level		*	*		*	
→ Steam Generator Level ←						*

→
* Denotes monitored variable is required.
←

TABLE 7.3-12

DRAWING COMPARISON

System	Reference	PSAR Function/Description	Reference	FSAR Function/Description	Effect of Safety
Safety Injection	Figure 7.3-1	Block enable signal is derived from 2-out-of-4 low pressurizer pressure signals.	Figure 7.3-2	Bypass enable signal is provided for each channel from a separate pressurize pressure measurement channel.	Bypass and block functions are equivalent operating controls. There is no effect on safety.
Safety Injection, containment spray, containment isolation, containment cooling	Figure 7.3-1	Only initiation logic is shown.	Figures 7.3-2, 7.3-3, 7.3-4	Selective 2-out-of-4 actuation logic has been added, with 2 actuation trains having manual actuation at equipment level.	Provides more complete information. The depicted system describes additional improved safety features; e.g.; manual actuation at equipment level, and remote manual actuation at system level.

→(DRN 03-2061, R14)

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