# 5.0 REACTOR COOLANT SYSTEM AND CONNECTED SYSTEMS

## 5.4 COMPONENT AND SUBSYSTEM DESIGN

### 5.4.7 Residual Heat Removal System

The functions performed by a conventional nuclear plant residual heat removal (RHR) system are integrated within the integrated safeguards system (ISS) of the WAPWR. Those components within the ISS that perform an RHR function are the four low head pumps, four RHR heat exchangers, and the associated valves, piping, and instrumentation.

Following initial cooldown of the plant by steam dump to the main condenser, the four low head pumps would be aligned to recirculate reactor coolant through the core by taking suction from the RCS hot legs and returning the coolant to the reactor vessel through the four RHR heat exchangers. The four RHR pumps and four heat exchangers would be capable of reducing the RCS coolant temperature from 350°F to 150°F in less than 16 hours following reactor shutdown. It should be emphasized that the ISS provides four RHR subsystems which would permit three of four subsystems to be taken out of service during long-term shutdown operation.

The low head pumps have multiple uses. During plant cooldown and refueling operations, they act as conventional RHR pumps. In their accident mitigation role, they act as containment spray pumps (see Section 6.2.2) or could be aligned to provide a long term ECCS function (see Section 6.3.2.2.2). Additionally, the pumps are used to transfer refueling water from the refueling canal and the Emergency Water Storage Tank (EWST) at the beginning of refueling operations. Refueling water is returned to the EWST from the refueling cavity at the end of refueling operations by a gravity drain.

The RHR heat exchangers perform the heat removal function during plant cooldown and refueling operations as well as during accident recovery operations (see Section 6.3.2.2.7).

### 5.4.7.1 Design Basis

Design parameters for the RHR components are provided in Table 6.3-2. Table 6.3-1 provides a list of parameters which interface with other systems of the WAPWR Nuclear Power Block.

The RHR subsystem (RHRS) of the ISS is designed to operate in conjunction with other plant systems to reduce the temperature of the RCS during the second phase of normal plant cooldown.

The RHRS is placed in operation approximately 4 hours after reactor shutdown when the temperature and pressure of the RCS are approximately 350°F and 400 psig, respectively. Assuming that four heat exchangers and four pumps are in service, and that each heat exchanger is supplied with component cooling water at design flow and temperature, the RHRS is designed to reduce the temperature of the reactor coolant from 350 to 150°F within 16 hours. The heat load handled by the RHRS during the cooldown transient includes residual decay heat from the core, RCS sensible heat, and reactor coolant pump heat. The design heat load is based on the decay heat fraction that exists at 20 hours following reactor shutdown from an extended run at full power.

The RHRS is also designed to operate in conjunction with the other systems of the cold shutdown design in order to address the functional requirements proposed by Regulatory Guide 1.139, "Guidance for Residual Heat Removal to Achieve and Maintain Cold Shutdown". The cold shutdown design enables the nuclear steam supply system to be taken from hot standby to cold shutdown conditions using only safety-related systems, with or without offsite power, and with the most limiting single failure within 36 hours.

The RHRS is designed to be isolated from the RCS whenever the RCS pressure exceeds the normal RHRS cut in pressure. The RHRS is isolated from the RCS on the suction side by two motor-operated valves in series on each suction line. Each of the normally closed motor-operated valves is interlocked to prevent its opening if RCS pressure is greater than approximately [ ] psig and to (a,c) automatically close if RCS pressure exceeds [ ] psig. (These interlocks are discussed in more detail in Section 5.4.7.2.1). The RHRS is isolated from the RCS on the discharge side by two check valves in each return line and a normally closed power removed MOV located outside containment. (a,c)

Each inlet line to the RHRS is equipped with a pressure relief valve designed to relieve the combined flow of the charging pumps at the relief valve set pressure. These relief valves also protect the system from inadvertent overpressurization during plant cooldown or startup.

Each discharge line from the RHRS to the RCS is equipped with a pressure relief valve designed to relieve the possible backleakage through the valves isolating the RHRS from the RCS.

The RHRS is designed for a single nuclear power unit and is not shared among nuclear power units.

The RHRS is designed to be fully operable from the control room. Manual actions required of the operator are discussed in Section 5.4.7.2.6.

By nature of its redundant four train design, the RHRS is designed to accept all major component single failures with the only effect being an extension in the required cooldown time. There are no motor-operated valves in the RHRS that are subject to flooding. Provisions to protect equipment from flooding are discussed in Section 3.4 of the "Structural/Equipment Design" module. Although Westinghouse considers it to be of low probability, spurious operation of a single motor-operated valve can be accepted without loss of function as a result of the redundant four train design.

Provisions incorporated in the design to ensure that the system will operate when needed are discussed further in subparagraph 5.4.7.2.

Missile protection, protection against dynamic effects associated with the postulated rupture of piping, and seismic design are discussed in Section 3.5, 3.6, and 3.7, respectively of the "Structural/Equipment Design" module.

### 5.4.7.2 System Design

#### 5.4.7.2.1 Schematic Piping and Instrumentation Diagrams

Piping and instrumentation diagrams for the RHR portion of the ISS are shown in Figures 6.3-1 and 6.3-2. These diagrams show the relative location of RHR components, where the components tie together with other ISS components and piping, and the instrumentation and controls associated with the RHR components.

Component interlocks used in the different modes of ISS operation are listed in Section 6.3.2.1. Interlocks specifically utilized for RHR operations are as follows:

a. RHR Inner and Outer Isolation Valves (9000A, B, C, D and 9001A, B, C, D)

Interlocks are provided for the normally closed RHR inner and outer suction isolation valves (9000A, B, C, D and 9001A, B, C, D). These interlocks prevent the suction valves for a specific RHR subsystem from being opened by operator action unless the RCS pressure, as measured by the appropriate RCS wide-range pressure channel, is less than [ ] psig and the following corresponding valves are in a closed position: (a,c)

(1) EWST suction isolation valves (9007A, B, C, D)
(2) Containment spray header isolation valves (9009A, B, C, D and 9011A, B, C, D)
(3) System test line isolation valves (8813A, B, C, D and 8814A, B, C, D)
(4) High head pump discharge isolation valves (8803A, B, C, D)
(5) High head pump flow control valves (HCV-858, 859, 860 and 861)

This prevent-open feature ensures that each of the four RHR subsystems are properly aligned for normal cooldown operations. The closed valves, listed above, provide a double barrier against leakage from the RHR subsystems either in conjunction with a series check valve or by providing two closed series motor-operated valves.

This interlock prevents the RHR subsystems from being over pressurized by preventing the subsystems from being aligned to the RCS at an RCS pressure above [ ] psig, and by automatically closing the RHR inner and outer suction (a,c) isolation valves in the event that the RCS pressure were to increase to a value greater than [ ] psig. This automatic closing feature ensures that both (a,c) valves will be closed during a plant startup prior to reaching operating conditions, should one have been inadvertently left open by operator omission. The valves may be closed by operator action from the main control board at any time.

The wide-range RCS pressure interlock for both the prevent open and the autoclosure features on the inner isolation valves is independent and diverse from that provided to the outer isolation valves.

b. EWST Suction Isolation Valves (9007A, B, C, D)

Interlocks are provided for the EWST suction isolation valves to prevent their opening unless one of the two corresponding RHR normal cooldown suction isolation valves is closed.

These interlocks ensure that the valve cannot be reopened by operator action after the initiation of a normal cooldown operation, which provides a positive backup to the EWST pump suction header check valves (9008A, B, C, D) against RHR subsystem leakage into the EWST. The valves may be closed by operator action from the main control board at any time.

c. Containment Spray Header Isolation Valves (9009A, B, C, D and 9011A, B, C, D)

Interlocks are provided for the series containment spray header isolation valves to prevent their opening unless one of the two corresponding RHR normal cooldown suction isolation valves is closed.

These interlocks ensure that the valves cannot be reopened by operator action after the initiation of a normal cooldown operation, which provides two closed series motor-operated valves against RHR subsystem leakage into the containment spray headers. The valves may be closed by operator action from one main control board at any time.

d. System Test Header Isolation Valves (8813A, B, C, D and 8814A, B, C, D)

Interlocks are provided for the normally closed system test header isolation valves to prevent their opening unless one of the two corresponding RHR normal cooldown suction isolation valves is closed.

These interlocks ensure that the valves cannot be reopened by operator action after the initiation of a normal cooldown operation, which provides two closed series motor-operated valves against RHR subsystem leakage into the EWST. The valves may be closed by operator action from the main control board at any time.

e. High Head Pump Discharge Header Isolation Valves (8803A, B, C, D)

Interlocks are provided for the high head pump discharge header isolation valves to prevent their opening unless one of the two corresponding RHR normal cooldown suction isolation valves is closed.

These interlocks ensure that these valves which are normally open during power operation cannot be reopened by operation action after the initiation of a normal cooldown operation. These valves provide a positive backup to the high head pump discharge header check valves (8806A, B, C, D) against RHR subsystem leakage into the corresponding high head subsystem. The valves may be closed by operator action from the main control board at any time.

f. High Head Pump Flow Control Valves (HCV-858, 859, 860, and 861)

Interlocks are provided for the high head pump flow control valves to prevent their opening unless one of the two corresponding RHR normal cooldown suction isolation valves is closed.

These interlocks ensure that these valves, which are normally open during power operation, cannot be reopened by operator action after the initiation of a normal cooldown operation. These valves provide a positive backup to the high head pump discharge header check valves (8806A, B, C, D) against RHR subsystem leakage into the corresponding high head subsystem. The valves may be closed by operator action from the main control board at any time.

5.4.7.2.2 Equipment and Component Descriptions

Descriptions of the RHR components are provided in Section 6.3.2.2.

5.4.7.2.3 Control

Relief valves within the RHR subsystem of the ISS are discussed in Section 6.3.2.2.8.

The motor operated gate valves specific to RHR normal operation are 9000A, B, C, D and 9001A, B, C, D. Discussion of the controls and interlocks associated with these valves is provided in Section 5.4.7.2.1.

5.4.7.2.4 Applicable Codes and Classifications

Codes and classifications applicable to the RHR subsystem of the ISS are delineated in Section 3.2. Conformance to General Design Criteria specified in Appendix A to 10CFR 50 is discussed in Section 3.1.

5.4.7.2.5 System Reliability Considerations

The RHR subsystem of the ISS is a four train, fully redundant safety-related system. The system has been designed to withstand any single credible active or passive failure or operator error and maintain the RHR performance objectives for the system. Separate trains of pumps, heat exchangers, and flow paths are provided for redundancy such that the loss of one or more trains does not prevent heat removal from the core. Each train is physically separated and protected where necessary so that a single event cannot initiate a common failure. Sufficient diesel generating capacity is maintained on site to provide required power to each train.

The RHR subsystem in conjunction with other ISS subsystems, the high head pumps, the emergency letdown flow path, the pressurizer vent system, and the secondary side atmospheric relief valves, and the secondary side safeguards system provide a safety related means for borating and bringing the plant to cold shutdown conditions following any accident not involving a LOCA in excess of normal charging capacity. As such, the design of these systems addresses the requirements outlined in Branch Technical Position RSB 5-1. "Design Requirements of the Residual Heat Removal System."

5.4.7.2.6 <u>Manual Actions</u>

a. Plant Shutdown

Plant shutdown is defined as the operation that brings the plant from hot shutdown temperature and pressure to cold (ambient) conditions.

The initial phase of plant shutdown consists of reactor coolant cooldown and depressurization. RCS boration is normally accomplished by the CVCS system via the RCS makeup, charging, and letdown functions. When the RCS has been borated to the cold shutdown BA concentration, heat is transferred via the steam generators from the RCS to the steam system where the rate of steam dump is controlled to establish a RCS cooldown rate of about 50°F/hr. Depressurization is accomplished by spraying reactor coolant into the pressurizer, which cools and condenses the pressurizer steam bubble.

During plant shutdown, the "S" signal must be manually blocked by operator action from the main control board after the RCS pressure has been decreased below the safety injection unblocking pressure. This action is required to prevent an automatic "S" signal actuation during the shutdown operations. When the RCS pressure has been decreased to approximately 1000 psig, the accumulator discharge isolation valves (8949A, B, C, D) are closed by the operator from the main control board and the valve breakers are administratively removed or opened to prevent an inadvertent opening of these valves.

Following this the core reflood tank isolation valves (9097A,B,C and D) are closed by the operator from the main control board and the valve breakers are administratively removed or opened to prevent inadvertent opening of these valves.

When the reactor coolant temperature and pressure have been reduced to 350°F and 400 psig, respectively, (approximately 4 hours after reactor shutdown), the second phase of plant cooldown starts with the four RHR subsystems being placed in service.

Initiation of the RHR operation includes an initial warm-up period during which each RHR subsystem is aligned to circulate coolant from the low head pump, through the RHR heat exchanger through the RHR hot leg injection line, through the RHR inner and outer isolation valves and back to the low head pump suction. Before this warm up operation can be initiated the following valves must be in a closed position.

(1) High head pump discharge header isolation valves (8803A, B, C, D)

(2) High head pump flow control valves (HCV-858, 859, 860 and 861)

(3) Containment spray header isolation valves (9009A, B, C, D and 9011A, B, C, D)

(4) EWST suction isolation valves (9007A, B, C, D)

(5) System test header isolation valves (8813A, B, C, D and 8814A, B, C, D)

After the above valves are closed the remaining alignment involves the repositioning of the following valves:

(6) Close the reactor vessel injection header isolation valves (8807A, B, C, D)

(7) Open the hot leg recirculation header isolation valves (8810A, B, C, D)

(8) Open the RHR inner and outer isolation valves (9000A, B, C, D and 9001A, B, C, D)

After the above alignment has been accomplished, the low head pumps can be started. During this warm-up period, the component cooling water system would not be aligned to deliver to the RHR heat exchangers or to the low head pump miniflow heat exchangers. Full system operation may be established upon completion of any required boron concentration adjustment via the low-pressure letdown line (valves 9018A or B) aligned to the recycle holdup tanks.

To initiate RHR heat removal, each of the RHR subsystems is independently and sequentially aligned as needed to achieve the desired RCS cooldown rate by the operator actions outlined below.

(1) Establish component cooling water flow to the low head pump miniflow heat exchanger.

(2) Open the reactor vessel injection header isolation valve (8807A, B, C, or D)

(3) Close the RHR hot leg recirculation header isolation valve (8810A, B, C, or D) after the reactor vessel injection header isolation valve has reached its full open position.

(4) Verify that component cooling water flow to the RHR heat exchanger has been established automatically on receipt of actuation signal initiated by temperature transmitter TE 912, 913, 914, or 915.

To maintain high purification flow rates, low pressure letdown is established from two of the RHR subsystems via the CVCS low pressure letdown isolation valves (9018A or B).

The operator can adjust the allowed cooldown rate by manually regulating the flow to the RCS. This can be accomplished by reopening one or more of the RHR hot leg recirculation header isolation valves 8810A, B, C, D and/or by closing one or more of the reactor vessel injection header isolation valves 8807A, B, C, D. These operations establish either a full or partial flow bypass mode where the RHR pump flow is redirected from the reactor vessel injection path to the RHR pump suction line.

Throughout RHR cooldown operations, RCS pressure and inventory control is accomplished by the steam bubble remaining in the pressurizer and by use of the low-pressure letdown lines routed from the outlet of two RHR heat exchangers to the CVCS. By regulating the letdown flow rate in proportion to that returned to the RCS by the CVCS charging pump, the RCS inventory may be controlled as desired.

This mode of operation continues for the duration of the cooldown until the RCS temperature has been reduced to 150°F and the system depressurized. The RCS may be opened for either maintenance or refueling. Depending upon the residual heat load, one pump and one heat exchanger will eventually be sufficient for circulation and heat removal.

During these cooldown operations, strict adherence to the detailed operating instructions, combined with active monitoring of system parameters, should be observed to promote good component and system performance.

b. Refueling

One or more low head pumps can be used during refueling to pump borated water from the emergency water storage tank into the refueling cavity. During this operation, the desired number of low head pumps are first stopped and the corresponding inner and outer suction isolation valves (9000A, B, C, D and 9001A, B, C, D) are closed. The corresponding EWST suction isolation valves (9007A, B, C, D) are then opened as the reactor vessel head is slightly lifted. The low head pumps are then restarted to pump refueling water into the reactor vessel via the normal RHR/reactor vessel injection lines, with the water filling the cavity through the open reactor vessel flange. The reactor vessel head is lifted as the water level rises until sufficient water level is attained. The low head pumps are then stopped, the EWST suction isolation valve closed, the inner and outer suction isolation valves reopened, and the pumps restarted to continue decay heat removal.

During refueling, the residual heat removal loops are maintained in service with the number of pumps and heat exchangers in service as required by the decay heat load.

Following refueling, the low head pumps can be used to drain the refueling cavity to the top of the reactor vessel by pumping water rom the RCS to the emergency water storage tank as the reactor vessel head is lowered into place. (The method provides an alternate means for draining the refueling canal in lieu of the gravity drain provisions). This transfer is accomplished by first closing one of the four reactor vessel injection header isolation valves (8807A, B, C, D), and the corresponding hot leg recirculation header isolation valve (8810A, B, C, D) if opened. Next, the corresponding full flow test line isolation valves (8813A, B, C, D and 8814A, B, C, D) are opened to provide a flow path to the EWST. With this alignment, one RHR pump may be used to return refueling water as the reactor vessel head is lowered into place. When this procedure is completed, the normal residual heat removal flow path may be reestablished.

c. Plant startup

Plant startup is defined as the operations that bring the reactor plant from cold shutdown to no-load operating temperature and pressure. Generally, while at shutdown conditions, only one of the four low head pumps would continue to operate to circulate coolant and remove decay heat. When plant startup begins, low head pump operation would be terminated, however, one RHR subsystem would remain aligned to the RCS to maintain a low-pressure letdown path to the CVCS. This alignment provides RCS pressure control while the pressurizer heaters are forming the steam bubble and heating the pressurizer. As the reactor coolant pumps are started, their thermal input begins heating the reactor coolant. Once the pressurizer steam bubble formation is complete, the low-pressure letdown path to the CVCS is isolated by closing the letdown isolation valve (9018A or B). At this point in the startup operation, all four RHR subsystems would be isolated. The inner and outer suction isolation valves (9000A, B, C, D and 9001A, B, C, D) associated with each subsystem would be closed and the four low head pump discharge header isolation valves (9015A, B, C, D) would be closed. The four low head pumps are then aligned for their containment spray function by opening the four EWST suction isolation valves (9007A, B, C, D) and the outer containment spray header isolation valves (9009A, B, C, D).

Next, the four high head pumps are aligned for their emergency core cooling function. The four high head pump discharge header isolation valves (8803A, B, C, D) and the four high head pump flow control valves (HCV-858, 859, 860 and 861) must be opened. The reactor vessel injection header isolation valves (8807A, B, C, D) downstream of the RHR heat exchangers should be open as well as the EWST isolation valves (8820A, B, C, D) and the high head pump miniflow isolation valves (8824A, B, C, D). The hot leg recirculation header isolation valves (8810 A, B, C, D) must be in their normally closed position.

When the RCS pressure exceeds the core reflood tank and accumulator pressure, the core reflood tank and accumulator discharge isolation valves (9097A, B, C, D and 8949A, B, C, D) are opened by the operator from the main control board. When the RCS pressure exceeds the safety injection unblocking pressure, the "S" signal is automatically reset.

The clearing of the "S" signal is verified. Prior to this point, all valves should be in their proper (normal full-power operation) position and all valve position monitor lights should indicate proper valve positioning.

Normal Operation

Normal operation includes the power generation and hot standby operation phases with the reactor at normal operating temperature and pressure. During normal operation, the ISS is not in service, but is aligned and ready to perform its emergency core cooling and containment spray functions. All ISS piping is completely filled with borated water. The accumulators and core reflood tanks are filled with borated water and pressurized with nitrogen to the required setpoints. The EWST is also filled with borated water to its required setpoint.

### 5.4.7.3 Performance Evaluation

Should a single failure prevent one RHRS subsystem from operating and assuming that only three RHR subsystems are in service and the RHR heat exchangers are supplied with component cooling water at design flow and temperature, the RHRS is capable of reducing the RCS temperature from 350°F to 150°F within 30 hours. Thus, with the four mechanical train design, normal cooldown can be accomplished, with one train out of service, with minimal impact on plant cooldown time.

Assuming that only 2 of 4 RHR subsystems are in service and that the RHR heat exchangers are supplied with component cooling water at design flow and temperature, the RHRS is capable of reducing the RCS temperature from 350°F to less than 200°F within 18 hours.

Assuming that only one RHR subsystem is in service and that the heat exchanger is supplied with CCW at design flow and temperature, the RHRS is capable of removing the core decay heat although RCS cooldown rate is greatly reduced.

It is noted that as a backup, the high head pumps, in conjunction with the safety-related pressurizer vent system and emergency letdown paths, provide a semi-closed path from the RCS to the EWST through the RHR heat exchangers and back to the RCS, which can bring the plant to cold shutdown.

Table 5.4.7-1 summarizes the Failure Mode and Effects Analysis for the RHRS normal cooldown function.

### 5.4.7.5 Instrumentation

Refer to Section 6.3.5.2.

TABLE 5.4.7-1 (Sheet 1 of 2)

FAILURE MODE AND EFFECTS ANALYSIS - INTEGRATED SAFEGUARD SYSTEM (ISS)
RESIDUAL HEAT REMOVAL NORMAL COOLDOWN FUNCTION - ACTIVE FAILURES

| Component | Failure Mode | RHR Function | Effect on System Operation | Failure Detection Method | Remarks |
|---|---|---|---|---|---|
| 1) Motor operated gate valves 9007A, 9009A, 8803A, 8813A and 8814A (corresponding B,C and D valve no. analogous and motor operated globe valve HCV-858 (HCV-859, 860, and 861 analogous). | Fails to close on demand | RHR flowpath alignment-completes redundant isolation of containment spray header, HHSI pump discharge line and RWST suction line. | Should one or more of the listed valves fail to close on demand, the RCS/RHR suction isolation valves for that subsystem are interlocked such that they will not open. The valves are located outside containment and action taken to manually close them will restore subsystem operability. If the valves are not closed, fault reduces redundancy of RHR coolant trains as described in 2) below. | Valve position indication (open to close position change) at CB and valve closed position monitor light and alarm at CB. | With the exception of 8813A and 8814A, the valves are normally open to align the ISS for accident mitigation functions during power power. |
| 2) Motor operated gate valve 9000A and 9001A (corresponding B,C and D valves analogous). | Fails to open on demand. | RCS hot leg loop No. 1 low head pump suction line isolation. | Failure blocks reactor coolant flow from hot leg of RC loop no. 1 through train "A" of RHRS. Fault reduces redundancy of RHR coolant trains provided. No effect on safety for system operation. Plant cooldown requirements will be met by RC flow from hot leg of RC loop nos. 2,3,4 flowing through trains B,C,D of RHRS, however, time required to reduce RCS temperature will be extended. | Valve position indication (closed to open position change) at CB; valve open position monitor light and alarm at CB; RHR train "A" discharge indication (FI-920) and low flow alarm at CB; and low head pump no. 1 discharge pressure indications (PI-904) at CB. | Valve is electrically interlocked with isolation valve listed in 1) above and with a "prevent open" pressure interlock RC loop no. 1 hot leg. The valve cannot be opened remotely from the CB if isolation valves in 1) above are open or if RC loop pressure exceeds 550 psig. |
| 3) Low head pump no.1 APRH/CS (pump nos. 2, 3, 4 analogous) | Fails to deliver working fluid. | Delivery of coolant to cold legs in RCS loop no. 1. | Failure results in a loss of RC flow from hot leg of RC loop no. 1 through train "A" of RHRS. Fault reduces redundancy of RHR coolant trains provided. No effect on safety for system operation. Plant cooldown requirements will be met by RC flow from hot leg of RC loop nox. 2,3,4 flowing through trains B,C,D of RHRS; however, time required to reduce RCS temperature will be extended | Open pump switchgear circuit breaker indication at CB; circuit break close position monitor light and alarm at CB pump discharge coolant flow indication (FI-920) and low flow alarm at CB; and pump discharge pressure indication (PI-904) at CB. | The low head pump has ESF functions (see Section 6.3.4). Pump failure may also be detected during ESF component periodic testing. |

TABLE 5.4.7-1 (Sheet 2 of 2)

FAILURE MODE AND EFFECTS ANALYSIS - INTEGRATED SAFEGUARD SYSTEM (ISS)
RESIDUAL HEAT REMOVAL NORMAL COOLDOWN FUNCTION - ACTIVE FAILURES

| Component | Failure Mode | RHR Function | Effect on System Operation | Failure Detection Method | Remarks |
|---|---|---|---|---|---|
| 4) Motor-operated gate valve 9018A (9018B analogous). | Fails to open on demand. | CVCS letdown line isolation. | Failure blocks flow from train "A" of RHRS to CVCS letdown heat exchanger Fault prevents (during the initial phase of plant cooldown) the adjustment of boron concentration level of coolant in pipe lines of RHR train "A" so that it equals the concentration level in the RCS using the RHR cleanup line to CVCS. No effect on safety for system operation. Sufficient CVCS purification and RCS pressure control provided by redundant CVCS valve RHR letdown via 9018B. | Valve position indication (closed to open position change) at CB; valve open position monitor light and alarm at CB; and CVCS letdown flow indication (FI-132) and low flow alarm at CB. | Valve is normally at "closed" position to align the ISS for ECCS operation during plant power operation and load follow. |
| 5. Motor-operated gate valve 8807A (8807 B, C, D analogous) | a. Fails to close on demand. | RHR train "A" discharge line isolation. | Failure reduces the redundancy of valves used to isolate flow from RHR train "A" to the reactor vessel during initial period of operation for system heating and chemical equilibrium. No effect on safety for system operation. | Valve position indication (open to closed position change) at CB and valve closed position monitor light and alarm at CB. | Valve is normally at an "open" position to align the ISS for ECCS operation during plant power operation and load follow. |
| | b. Fails to open on demand. | | Failure blocks flow from RHR train "A" to the reactor vessel resulting in reducing the redundancy of RHR coolant trains provided. No effect on safety for system operation. Plant cooldown requirements will be met by reactor coolant flow from RHR trains B, C, and D however, time required to reduce RCS temperature will be extended. | Valve position indication (closed to open position change) at CB; valve closed position monitor light and alarm at CB; and RHR train "A" discharge to RCS cold leg flow indication (FI-920) and low flow alarm at CB. | |