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5.2.2 Overpressure Protection

Overpressure protection of the reactor coolant systems is provided by three pressurizer safety valves and two power-operated relief valves, all discharging through a common header to the pressurizer relief tank. The basis for acceptance of the overpressure protection system is that it conforms to the ASME Boiler and Pressure Vessel Code, Section III, and General Design Criterion 15.

Each of the power-operated relief valves has the capacity to relieve 210,000 pounds mass per hour of saturated steam at 2350 pounds per square inch gauge. These relief valves are designed to limit pressurizer pressure to a value below the high pressure reactor trip set point for a 10 percent step load decrease and to prevent unnecessary safety valve action. Each power-operated relief valve can be individually isolated by remotely operated stop valves in the event of excessive leakage.

The applicant has referenced WCAP-7769 to describe the sizing of the Watts Bar pressurizer safety valves and has provided additional plant specific analyses to demonstrate the adequacy of the sizing basis.

Each pressurizer safety valve is spring-loaded and has a relieving capacity of 420,000 pounds mass per hour of saturated steam at 2485 pounds per square inch gauge. The combined capacity of two of these three valves is adequate to prevent the pressurizer pressure from exceeding the ASME Boiler and Pressure Vessel Code, Section III limit of 110 percent design pressure following the worst reactor coolant system pressure transient, identified to be a 100 percent load rejection resulting from a turbine trip with concurrent loss of main feedwater. This event was analyzed with no credit taken for operation of reactor coolant system relief valves, steam line relief valves, steam dump system, pressurizer level control system, and pressurizer spray.

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In the analysis the applicant has taken credit for a high pressurizer pressure trip (the first safety grade primary system trip), but has stated that, without that credit, an overtemperature ΔT trip (second safety grade trip) would terminate the transient without significantly more severe results. The evaluation is supported by a generic sensitivity study of required safety valve flow rate versus trip parameter presented in WCAP-7769. We have requested additional information on the details of this calculation.

The above analyses were performed using the LOFTRAN Code, a digital simulation which includes point neutron kinetics, Reactor Coolant System including the reactor vessel, hot leg, primary side of the steam generator and cold leg, secondary side of the steam generator, pressurizer, and pressurizer surge line. This code is currently under review by the staff. Our review has progressed to the point that there is reasonable assurance that the conclusions based on these analyses will not be appreciably altered by completion of the analytical review. If the final approval of LOFTRAN indicates that any revisions to the analyses are required, the effect of these changes on Watts Bar will be evaluated and we will require implementation, if indicated.

The safety valves are designed in accordance with American Society of Mechanical Engineers Code, Section III and periodic testing and inspection are performed in accordance with Section XI. In Chapter 14 of the FSAR, the applicant has described his preoperational test program, which includes testing of the pressure relieving devices discussed in this SER section, and has indicated that these tests would be conducted in full compliance with the intent of Regulatory Guide 1.68. Additionally, item II. D.1 of NUREG-0737 requires performance testing of relief and safety valves. We require that the applicant address conformance with the item. With resolution of the above issues by the applicant, we

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conclude that the overpressure protection provided for Watts Bar at hot operating conditions will comply with the guidelines of Standard Review Plan 5.2.2 and the requirements of General Design Criterion 15.

With regard to operation when the reactor coolant system is at low temperature (e.g., while water solid during startup and shutdown), the staff is concerned about potential reactor vessel damage as a result of an overpressure transient. We have requested that the applicant provide a protection system to mitigate the consequences of this event and will review the details of the applicant's proposed protection system when submitted.

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5.4.7 Residual Heal Removal System

The residual heat removal system (RHR) is used in conjunction with the main steam and main or auxiliary feedwater systems during normal plant shutdown to reduce reactor coolant system temperatures from hot conditions to cold shutdown and to provide core cooling during initial refueling operations. The principal basis for our review of the RHR system is its conformance to the requirements in General Design Criterion 34. The residual heat removal system operates in several other modes. These are:

1. Startup - connected to chemical and volume control systems, acting as an alternate letdown path to control reactor pressure.

2. Refueling - used for refilling the refueling canal.

3. Emergency core cooling system - the residual heat removal system is aligned during power operation and hot shutdown for low pressure coolant injection into the reactor coolant system as an integral part of the emergency core cooling system.

Initially, heat is rejected by the steam generators to the condenser or atmosphere. When the reactor coolant temperature and pressure have been reduced to approximately 350 degrees Fahrenheit and 400 pounds per square inch, the residual heat removal system is put into operation to reduce the reactor coolant temperature to the refueling temperature. The system takes its suction from one hot leg through two isolation valves in series.

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The discharge from each of the two parallel residual heat removal pumps passes through a separate heat exchanger which is cooled by the component cooling water system. The flow is then discharged to the four reactor cold legs.

Evaluation

The applicant has indicated that under normal shutdown conditions the residual heat removal system is capable of removing residual heat from the reactor in accordance with the requirements of General Design Criterion 34; with only one residual heat removal train in operation, the time required to cool the reactor coolant system to the cold shutdown condition (200 degrees Fahrenheit) is 34 hours; with both pumps in operation, the cooldown time is 16 hours. The staff has reviewed the component cooling water system to assure that sufficient cooling capability is available to the heat exchangers. The acceptability of this cooling capability and its satisfaction of General Design Criteria 44, 45, and 46 discussed in Section 9.0.

The applicant has not yet responded to the staff position on (Branch Technical Position RSB 5-1) on the ability of the plant to go to cold shutdown using only safety-grade equipment in the event of a safe shutdown earthquake. We will discuss the resolution of this position in a future supplement to this report.

We have reviewed the description of the residual heat removal system and the piping and instrumentation drawings to determine whether the system can be operated with or without offsite power and assuming a single failure.

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The two residual heat removal pumps are connected to separate buses which can be powered by separate diesel generators in the event of loss of offsite power. The parallel trains containing the residual heat removal pumps and heat exchangers provide redundancy of the major components.

The two isolation valves in series in the suction line each have a bypass line containing a normally closed, motor-operated valve. This alternate path can be used in the event that one of the normal isolation valves can not be opened. We require that the valves in the bypass lines be normally locked closed at all times with the power removed from the operators. Strict administrative keylock control must be demonstrated. If the alternate bypass lines are utlized, we require that the malfunctioning main isolation valve be corrected and the valve in the bypass line locked closed (with power removed) prior to repressurizing the plant. We also noted that an inadvertent closure of one of the main isolation valves during residual heat removal operation would result in loss of suction and potential failure of the residual heat removal pumps. We require that the applicant provide a residual heat removal flow alarm which will provide time for the operator to initiate alternate cooling modes.

We have reviewed the applicant's instruments and controls necessary to operate the residual heat removal system and find that, except for the low flow alarm, they are acceptable for operating the residual heat removal system. Discussion of the adequacy of instrumentation and control system design is addressed in Section 7.0.

Overpressure protection of the residual heat removal system is provided by relief valves on the suction line and each of the discharge lines. The suction line relief valve has a capacity of 900 gallons per minute at 450 pounds per square inch gauge which is sufficient to relieve flow equivalent to two charging pumps. The relief valves in the discharge lines have a capacity of 20 gallons per minute at a pressure of 600 pounds per square inch gauge to protect the system from leakage past the check valves. These relief valves are adequate to protect the residual heat removal system from overpressurization.

The residual heat removal system is designed to provide an adequate isolation between the reactor coolant system and residual heat removal system when the reactor coolant system is above the design pressure of the residual heat removal (600 pounds per square inch absolute) as follows:

1. There are two separate and redundant motor-operated isolation valves between the residual heat removal pump suction line and the reactor coolant system (see previous discussion of bypass valves). These valves are interlocked with one of the independent reactor coolant system pressure signals. Valve opening is prevented until the reactor coolant system pressure falls to a value of 425 pounds per square inch gauge. Already-opened valves are closed when the reactor cooling system pressure rises to 750 pounds per square inch gauge. This arrangement satisfies the staff position on the suction valves.

2. There are two check valves and an open motor-operated valve on each residual heat removal discharge line to protect the system from the reactor coolant system pressure during operation. Watts Bar design features permit leak testing of each check valve separately during plant operation to fulfill the staff requirements for high/low

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pressure isolation with two check valves. The leak testing program for these valves is discussed in SER Section 3.9.6.*

The design provisions and staff requirements noted above (see Section 3.9.6) satisfy our requirements for system isolation as specified in Branch Technical Position RSB 5-1. Provisions for detecting leakage into the residual heat removal system are discussed in Section 5.2.7.*

The planned preoperational and startup test program provides for demonstrating the operation of the residual heat removal system. Conformance with Regulatory Guide 1.68, "Initial Test Programs for Water-Cooled Reactor Power Plants" is discussed in Chapter 14. Any additional testing requirements which result from our review of the applicant's compliance with RSB 5-1 will be discussed in a future SER supplement.

The residual heat removal system is housed within a structure that is designed to withstand tornadoes, floods, and seismic phenomena in accordance with General Design Criterion 2 as discussed in Section 3.0.* The system seismic requirements (Regulatory Guide 1.29, "Seismic Design Classification") and quality standards (10 CFR Part 50.55a and Regulatory Guide 1.26, "Quality Group Classification and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants") are discussed in Chapter 3.

The residual heat removal system capability to withstand pipe whip inside containment as required by General Design Criterion 4 and Regulatory Guide 1.46 is discussed in Section 3.0.* . Protection against piping failures outside of containment in accordance with General Design Criterion 4 is discussed in Section 3.0.* .

*LPM to verify final SER section numbers

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As noted above, the RHRS serves both during normal shutdown cooling, and emergency low pressure cooling as part of the emergency core cooling system (ECCS). However, both functions are mutually exclusive, since RHRS is aligned for ECC except for normal cooldown below reactor coolant conditions of 350^{0}F and 425 psig. When the RHRS is aligned for normal shutdown cooling the suction paths from the RWST are closed and the suction paths from the hot legs are opened. When the RHRS is aligned for ECC operation the suction paths from the Refueling Water Storage Tank (RWST) are kept open, and the two suction paths (from separate hot legs) are isolated each by two MOVs in series. A separate residual heat removal system is provided for each unit, thus satisfying General Design Criterion 5.

All residual heat removal lines, including instrument lines, have containment isolation features; their satisfaction of the requirements of General Design Criteria 56, 57, and Regulatory Guide 1.11 is discussed in Section 6.2.

Except for the areas discussed above, we find that the residual heat removal system has suitable redundancy in components and features, and suitable interconnections, and isolation capabilities provided to assure that with either onsite or offsite power the residual heat removal system can perform its normal safety function, assuming a single failure as required by General Design Criterion 34.

ENCLOSURE 2

RSB OPEN ITEMS SECTION 5.2.2

1. Low Temperature Overpressure Protection

In FSAR Amendment 31, responding to RSB question 212.11, the applicant committed to document the protection system design when it is finalized. In Amendment 41, the applicant has provided a preview description of the planned low temperature overpressure protection design. RSB awaits the final detailed description of the design.

2. Safety Valve Testing

RSB awaits the applicant's response to, "Performance Testing of . . . Pressurized-Water Reactor Relief and Safety Valves," from NUREG-0737, "Clarification of TMI Action Plan Requirements." We anticipate that this response would be included in a general response to all applicable NUREG-0737 items for Watts Bar.

3. Safety Valve Sizing Analyses

We have requested that the applicant provide information to justify his statement that taking credit for the second safety grade reactor trip (rather than the high pressure trip, as in submitted analyses) would not have significantly changed the results calculated in analyses to justify safety valve sizing.

ENCLOSURE 2
(cont.)

RSB OPEN ITEMS SECTION 5.4.7
(FSAR SECTION 5.5.7)

1. Cold Shutdown (RSB 5-1)

In FSAR Amendment 35, responding to RSB question 212.93 (RSB 5-1), the applicant estimated that he would submit a response to RSB 5-1 in December, 1978. RSB awaits that response. Resolution of RSB 5-1 is required before startup.

2. RHR Flow Alarm

In FSAR Amendment 42, responding to RSB question 212.99 (requiring an RHR flow alarm), the applicant discussed monitors to indicate a loss of RHR flow and actions that would be taken to restore flow, but did not commit to provide the required alarm. We require the alarm or other system modification to satisfy BTP RSB 5-1, Item D, "Pump Protection Requirements."

3. Recent experience at Sequoyah showed that inadequate administrative controls resulted in valves in or interfacing the RHR system being inadvertently mispositioned. Address the spurious mispositioning of "RHR" valves showing either that adequate administrative controls exist or that consequences of mispositioning are acceptable for all modes of plant and/or RHR operation. Specifically address inadvertent opening of RHR suction isolation bypass valves or RHR auxiliary containment spray valves.