



Westinghouse  
Electric Corporation

Energy Systems

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Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555

ATTENTION: T. R. QUAY

SUBJECT: VALVE QUALIFICATION AND PREOPERATIONAL TESTING

Dear Mr. Quay:

Enclosed are markups of SSAR subsections 5.4.8 and 3.9.6.2.2 that address the open items associated with DSER subsection 3.9.6 that have not previously been closed or resolved. The changes noted in the mark up will be included in Revision 12 of the AP600 SSAR. The vertical lines in the right margin reflect changes from a markup of 5.4.8 previously provided to the NRC staff in letter NSD-NRC-97-5028, dated March 19, 1997. The changes included in this transmittal are in response to questions and requests provided by the staff during telephone conferences. These changes will permit the staff to resolve these items and prepare the final safety evaluation report for subsection 3.9.6.

The items addresses include the following items:

OITS #	DSER Item #
798	3.9.6.2-1
800	3.9.6.2-3
801	3.9.6.2-4
805	3.9.6.2-8

The Westinghouse OITS status for these items will be changed to "Closed". We request the NRC acknowledge receipt of this information by changing the NRC OITS status. We support changing to "Action N".

If you have any questions please contact Donald A. Lindgren at (412) 374-4856.

*Brian A. McIntyre*

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#### 3.9.6.2.2 Valve Testing

Four basic groups of inservice tests have been identified for the AP600. These testing groups are described below.

##### **Remote Valve Position Indication Inservice Tests**

Valves that are included in the inservice testing program that have position indication will be observed locally during valve exercising to verify proper operation of the position indication. The frequency for this position indication test is once every two years. Where local observation is not practicable, other methods will be used for verification of valve position indicator operation. The alternate method and justification are provided in Table 3.9-16.

##### **Valve Leakage Inservice Tests**

Valves with safety-related seat leakage limits will be tested to verify their seat leakage. These valves include:

- Containment Isolation - valves that provide isolation of piping/lines that penetrate the containment.

Containment isolation valves are tested in accordance with 10 CFR 50, Appendix J. Depending on the function and configuration, some valves are tested during the integrated leak rate testing (Type A) or individually as a part of the Type C testing or both. The leak rate test frequency for containment isolation valves is defined in subsection 6.2.5. The provisions in 10 CFR 50.55a (b) 2. that require leakage limits and corrective actions for individual containment isolation valves by reference to ASME/ANSI OM, Part 10 apply to the AP600 containment isolation valves. The Combined License applicant will address changes to these provisions.

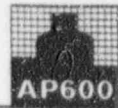




The ASME Code specifies a test frequency of at least once every 2 years. The ASME Code does not require additional leak testing for valves that demonstrate operability during the course of plant operation. In such cases, the acceptability of the valve performance is recorded during plant operation to satisfy inservice testing requirements. Therefore, a specific inservice test need not be performed on valves that meet this criteria.

The AP600 has no specified maximum leakage requirement for ~~requires no testing of~~ pressure isolation valves that provide isolation between high and low pressure systems and requires no testing of these valves.

The AP600 has no ~~requires no testing of~~ temperature isolation valves whose leakage may cause unacceptable thermal loading to piping or supports.



The motor-operated valves connected to the reactor coolant system hot leg are interlocked to prevent them from opening when reactor coolant system pressure exceeds 450 psig. These valves are also interlocked to prevent their being opened unless the isolation valve from the in-containment refueling water storage tank to the residual heat removal pump suction header is closed. Section 7.6 describes this interlock.

#### 5.4.8 Valves

Valves in the reactor coolant system and safety-related valves in connecting systems provide the primary means for the flow of water into and out of the reactor coolant system. In the following paragraphs the design basis, description, evaluation and testing of ASME Code Class 1, 2 and 3 valves is discussed. This discussion includes safety-related valves not in the reactor coolant system because the valve requirements are independent of the system.

##### 5.4.8.1 Design Bases

Valves within the reactor coolant system and safety-related valves in connected systems are designed, manufactured, and tested to meet the requirements of the ASME Code, Section III. As noted in Section 5.2, valves out to and including the second valve that is normally closed or capable of automatic or remote closure are part of the reactor coolant system. The reactor coolant pressure boundary valves are manufactured to the ASME Code Class 1 requirements. Valves of 1 inch and smaller in lines connected to the reactor coolant system are manufactured to Class 2 requirements when the flow is limited by a flow-limiting orifice.

Containment isolation valves are manufactured to ASME Code, Class 2 requirements. Other AP600 equipment Class C safety-related valves are manufactured to ASME Code, Class 3 requirements. Safety-related valves in auxiliary systems are manufactured to ASME Code Class 2 and 3 requirements depending on their function and classification, as outlined in subsection 3.2.2.

Table 5.4-15 provides ~~gives~~ design data for the reactor coolant pressure boundary valves. Valves and operators are sized to provide valve operation under the full range of design basis flow and pressure drop conditions, including recovery from potential mispositioning of the valves. Operating modes, normal operating and worst-case differential pressures, fluid temperature ranges, and environmental effects are considered in sizing valves and valve operators. Table 5.4-16 gives the normal and maximum differential pressure expected during opening and closing of motor-operated valves in the reactor coolant pressure boundary. Check valves considered part of the reactor coolant system are located inside the containment.

##### 5.4.8.1.1 Check Valves ~~5.4.8.1.1.2~~ Design and Qualification

Design basis and required operating conditions for safety-related check valves are established based on design conditions including the required system operating cycles to be experienced by the valve (~~numbers of each type of cycle and duration of each type of cycle as identified in subsection 3.9.1.1~~), environmental conditions under which the valve is required to function, and severe transient loadings expected during the life of the valve. The maximum loading

resulting from the design conditions and transients are evaluated in accordance with the ASME Code, Section III Class 1 design requirements.

Active safety-related check valves include the capability to verify the movement of each check valve's obturator during inservice testing by observing a direct instrumentation indication of the valve position or by using non-intrusive test methods. This instrumentation provides nonintrusive check valve indication and may be either permanently or temporarily installed.

Check valve model and size selection are based on the systems flow conditions, installed location of the valve with respect to flow disturbance, and orientation of the valve in the piping system. ~~For selected valves, d~~Design features include provisions for nonintrusive determination of disk position and potential valve degradation over time. Valve internal parts are designed with self-aligning features for the purpose of assured alignment after each valve opening. Qualification testing provides for the adequacy of the safety-related check valves under design conditions. This testing includes test data from the manufacturer, field test data and empirical test data supported by test or test (such as prototype) of similar valves where similarity is justified by technical data. Sampling size for the qualification test is justified by technical data.

For safety related active check valves with extended structures functional qualification will be performed to demonstrate by test, by analysis or by a combination thereof, the ability to operate at the safety-related design conditions. This functional qualification will demonstrate the valve operability during and after loads representative of the maximum seismic and vibratory event. Check valve internal parts are analyzed for maximum design basis loading conditions in accordance with the requirements in ASME Code, Section III.

#### 5.4.8.1.2 Motor-Operated Valves ~~5.4.8.1.2.1~~ Design and Qualification

Design basis and required operating conditions are established for active safety-related motor-operated valves. ~~are established for the development and implementation of the design, qualification and pre-operational testing.~~ Based on the design conditions the valves will have a structural analysis performed to demonstrate its components are within the structural limits at the design conditions. The motor operated valves are designed for a range of conditions up to the design conditions which includes fluid flow, differential pressure (including line break, if necessary), system pressure and temperature, ambient temperature, operating voltage range and stroke time. ~~Design transients including the numbers of each type of cycle and duration of each type of cycle are identified in subsection 3.9.1.1.~~ The sizing of the motor operators on the valves take into account diagnostic equipment accuracies, changes in output capability for increasing differential pressures and flow, control switch repeatability, friction variations and other parameters that could result in an increase in operating loads or a decrease in operator output. Valves that are subjected to large temperature changes during operation and can have water or high pressure fluid trapped in the bonnet cavity are evaluated for pressure locking. Provisions are provided, as required to reduce the susceptibility to bonnet overpressurization, pressure locking, and thermal binding.



~~Motor-operated valve assemblies are designed to accept the maximum compression, tension, and torsional loads which the operator is capable of producing in combination with other design loads such as pressure, thermal or externally applied loads. Motor-operated valves have provisions to reduce the susceptibility to bonnet overpressurization and thermal binding and are evaluated for these conditions. Qualification testing is performed to demonstrate the capability of the motor operator to operate over the full range of expected voltage variation. Qualification testing demonstrates closing, opening, and seating of the valve against the maximum design basis accident pressure differential and flow over the operating range.~~

The valves have a functional qualification performed to demonstrate by test, by analysis or by a combination thereof, the ability to operate at the design conditions. This functional qualification will demonstrate the valve operability during and after loads representative of the maximum seismic or vibratory event, demonstrate the valve sealing capability, demonstrate operability under cold and hot operating conditions, demonstrate operability under maximum pipe end loads and demonstrate flow interruption and functional capability. The testing includes test data provided by the manufacturer, field test data, empirical data supported by testing or prototype tests of similar valves that support the qualification where similarity must be justified by technical data. The qualification may be used for validating the required thrust and torque to operate the valve.

Motor-operated valves are ~~will be~~ designed to be able to change their position from an improper position (mis-positioned) either prior to or during accidents. The recovery from mis-positioning is considered a nonsafety-related function. The nonsafety-related capability to recover from valve mis-positioning is provided for plant operational availability considerations. Systems with safety-related functions that contain motor-operated valves are designed to tolerate mis-positioning as a single failure or redundant features are provided to preclude mis-positioning. These features include multiple position indicators and alarms, technical specification surveillance, power lock-out, and confirmatory open or close signals.

Since recovery from mis-positioning is a nonsafety-related function, equipment qualification testing and inservice testing is not required for the recovery from mis-position function.

Provisions are made, where possible, for in-situ testing of motor-operated valves at a range of conditions up to the maximum design basis operating conditions in the safety-related design direction (open or close). Where an alternative to in-situ testing is required, the justification of the alternative method to design condition differential testing is documented as part of the valve test program.

#### 5.4.8.1.3 Other Power-Operated Valves Including Explosively Actuated Valves 5.4.8.1.3.1 Design and Qualification

Design basis and required operating conditions are established for power-operated (POV) and explosively actuated valve assemblies with an active safety-related function. Power-operated valve assemblies include pneumatic-hydraulic-, air piston-, and solenoid-operated assemblies. Explosively-actuated valves have the valve disk welded to the valve seat and are actuated by an explosive charge fired by an electrical signal. ~~The design basis and operating conditions~~

~~are established for the development and implementation of the design, qualification, and preoperational testing. Design transients including the numbers of each type of cycle and duration of each type of cycle are identified in subsection 3.9.1.1.~~

The power operated safety related valves will have a structural analysis performed to demonstrate its components are within the structural limits at the design conditions. Power operated valve assemblies and explosively actuated valves are designed to accept the maximum compression, tension, and torsional loads which the assembly is capable of producing in combination with other loads such as pressure, thermal, or externally applied loads. The maximum loading resulting from the design conditions and transients is evaluated in accordance with the ASME Code, Section III Class 1 design requirements. Packing adjustment limits are identified to reduce the potential for stem binding.

The power operated valves are designed to operate at design operating conditions which include fluid flow, differential pressure (including pipe break, if necessary), system pressure, fluid temperature, ambient temperature, fluid supply conditions (or electrical power supply), spring force and stroke time requirements. The power operated valves, depending on their design and actuation mode, have the operators sized to account for diagnostic equipment accuracies, changes in output capability for increasing differential pressures and flow, friction variations and other parameters that could result in an increase in operating loads or a decrease in operator output.

The power-operated, safety-related valves have a functional qualification performed to demonstrate by test, by analysis or by a combination thereof, the ability to operate at the design conditions. Qualification testing of each size, type, and model is performed under a range of differential pressures and maximum achievable flow conditions up to the design conditions. This functional qualification will demonstrate the valves operability during and after loads representative of the maximum seismic or vibratory event, demonstrate the valve sealing capability, demonstrate operability under cold and hot operating conditions, demonstrate operability under maximum pipe end loads and demonstrate flow interruption and functional capability. The testing includes test data from the manufacturer, empirical data supported by test, or test or ~~(such as prototype)~~ tests of similar valves that support qualification of the valve. Similarity must be justified by technical data. ~~Qualification testing results under in-situ conditions can be used to demonstrate the capability of the power-operated valve assemblies to operate under design conditions. Requirements for qualification testing of power-operated active valves and sampling size of valves to be tested are based on ASME B16.41 (Reference 8).~~ Solenoid-operated valves are verified to satisfy the applicable requirements for Class 1E components. Solenoid-operated valves are verified to perform their safety-related design requirements over a range of electrical power supply conditions including minimum and maximum voltage.

#### 5.4.8.2 Design Description

The materials of construction are selected to minimize the effects of corrosion and erosion and are compatible ~~comparable~~ with the environment. The valves in contact with reactor coolant fluid shall be constructed of stainless steel materials or alloys acceptable for the fluid



chemistry. Valves with stem packing use packing compatible with the system fluid and valve stem material.

Safety-related valves do not have full penetration welds within the valve body walls except that explosive actuated valves may be fabricated using full penetration welds of the valve bodies.

Where practical and proven designs are available, valves greater than 2 inches in diameter use live loading of the packing by conical spring washers or equivalent means to maintain compressive force on the packing. Leakage to the atmosphere is essentially zero for these valves.

Valves and actuators are furnished as a matched system capable of operating over the entire range of design basis conditions. The function of the valve and operator including switch settings for motor-operated valves are qualified by testing, analysis or a combination thereof, based on in-situ or prototypical testing of the valve at maximum differential pressure.

Valves that have stem packing are constructed with packing material comparable with the system fluid and stem material. Where the design permits, valves greater than 2 inch diameter have live load packing to maintain a compressive packing force. Valves using supplied with stem packing include are supplied with a backseat capability which may be utilized to minimize stem leakage. The backseat capability does not rely on system pressure to achieve a satisfactory backseat seal. Valve designs such as The main steam isolation valves, safety relief valves, packless valves and small solenoid valves by nature of the design of these valves do not have backseat capability. Motor operated valves are not backseated during normal operation. The valve design is such that manual backseating does not compromise structural integrity of the valve. However, backseating may require additional maintenance to reduce potential packing leakage. The backseating of the valve does not compromise the structural integrity of the valve and the backseats shall be capable of retaining the valve stem against full system pressure and maximum thrust produced by the actuator.

Gate valves at the interface with the reactor coolant system and connected safety-related systems are either of the wedge or parallel disc design and have are essentially straight through flow. The wedge design is are flex-wedge; gate valves with a solid wedge designs are not used. Gate valves have backseats. Gate valves have bonnets and discs that will prevent overpressurization due to heatup of fluid trapped in the bonnet. Gate valves that are susceptible to overpressurization as the result of the heatup of trapped fluid shall be provided with venting capability to alleviate the issue. The valve shall be of outside screw and yoke design. Gate valves are not used in flow regulation or throttling service.

Globe valves are either T or Y type of either a standard or balanced plug design. Valves that are used for throttling service are designed with a disc or disc/cage assembly that will provide the required flow characteristic. Motor operated and manual valves are of the outside screw and yoke construction design.



Check valves are typically swing type, but tilt disk, —Nozzle check, and lift check may also be used. Check valves containing radioactive fluid are fabricated of stainless steel. These valves do not have body penetration other than the inlet, outlet and bonnet. The check hinge is serviced through the bonnet. Operating parts are contained within the body. The disc of swing check valves has limited rotation to provide a change of seating surface and alignment after each valve opening.

#### 5.4.8.3 Design Evaluation

ASME Code, Class 1 valves meet the design requirements of ASME Code, Section III, Article NB-3000. ASME Code, Class 2 valves meet the design requirements of ASME Code, Section III, Article NC-3000. ASME Code Class 3 valves meet the design requirements of ASME Code, Section III, Article ND-3000. The AP600 equipment Classes A, B, and C valves, which are manufactured to ASME Code Classes 1, 2 and 3 respectively, meet established functional requirements. The functional requirements include operability, differential pressure during opening or closure, and seat leakage. The functional requirements are consistent with the guidelines in Regulatory Guide 1.148 and ANSI N278.1-1975 (Reference 7).

The design transients for the valves including the number and the duration of each type of cycle are identified in subsection 3.9.1.1.

~~The testing programs described in Section 3.10 demonstrate the capability of the valves to operate, as required, during anticipated and postulated plant conditions.~~

~~Testing or analysis of the valves and valve/operator combination demonstrates~~ Valves with extended structures have testing or analysis performed to demonstrate that the natural frequency is greater than 33 hz. In addition, a structural analysis is performed to verify the design loading will not effect the intended operation of the valve.

Qualification testing of each power operated valve which includes motor-operated, air operated, hydraulic operated, solenoid operated and explosive actuated valves, ~~design and ratings~~ demonstrates the capability of the motor-operator to operate over the full range of expected plant operating conditions. ~~voltage variation~~. Qualification testing also demonstrates the closing, opening, and seating capability of the valve against the maximum pressure differential and flow within a specified time over the entire operating range. Requirements for qualification testing of power-operated active valves are based on ANSI B16.41 (Reference 8). The testing programs in section 3.10 demonstrate the capability of the valves to operate, as required, during anticipated and postulated plant conditions.

Reactor coolant chemistry parameters are ~~specified in the design specifications to provide the~~ compatible with ~~ity of valve construction materials with the reactor coolant.~~

#### 5.4.8.4 Tests and Inspections

The nondestructive examinations for the reactor coolant pressure boundary valves meet the more stringent requirements of the ASME Code, Section III, or ANSI B16.34 (Reference 9). The nondestructive examination required is evaluated for each type and class of valve. The examinations consist of the following:

- **Radiographic Examination** - Classes 1 and 2 valve bodies, bonnets, and discs which of cast material are radiographically examined in accordance with the ASME Code, Section III. The procedure and acceptance standards are according to the requirements for Class 1 in the ASME Code, Section III.
- **Ultrasonic Examination** - Classes 1 and 2 valve bodies, bonnets, and discs and Classes 1, 2, and 3 valve stems of 1 inch nominal diameter or larger fabricated of wrought or forged material are ultrasonically examined. The procedures and acceptance standards are according to the requirements for Class 1 in the ASME Code, Section III.
- **Liquid Penetrant Examination** - Bodies, bonnets, discs, and stems, including machined surfaces on these parts, are liquid-penetrant examined in accordance with the ASME Code, Section III. The procedures and acceptance standards are according to the requirements for Class 1 in the ASME Code, Section III.

Hydrostatic pressure boundary test and seat leakage are performed on the reactor coolant pressure boundary valves. The valves are subjected to the following tests as appropriate following manufacture: hydrostatic pressure boundary test, disc hydrostatic test, backseat leakage test, packing leakage test, and stem leakage test, and main seat leakage test. Valves used for containment isolation are subjected to an air-a pneumatic seat leakage test. Each diaphragm actuator assembly is subjected to a pneumatic leakage test.

Preoperational testing is performed on the valves to verify operability during design basis operating conditions. The preoperational testing is described in the following sections. The requirements of NRC Generic Letter 89-10 are used as guidelines to develop the preservice test program for valve operability. Except when test alternatives are justified, design conditions are used for the operability testing. ~~The tests and inspections discussed in Section 3.10 are performed to verify active valve operability during seismic events.~~

Subsection 5.2.4 discusses inservice inspection for ASME Code Class 1 valves. Section 6.6 discusses inservice inspection for ASME Code Class 2 and 3 components. ~~There are no full-penetration welds within the valve body walls.~~ Valves are accessible for disassembly and internal visual inspection to the extent practical. Subsection 3.9.6 discusses the inservice testing program for active valves.

#### 5.4.8.5 Preoperational Testing

Results of preoperational testing will be used by the Combined License applicant to demonstrate that the results of testing under insitu or installed conditions can be used to confirm the capacity of the valve to operate under design conditions.





#### 5.4.8.5.1 Check Valves

##### 5.4.8.1.1.2 ~~Pre-Operational Testing~~

Active check valves are tested in the open and/or close direction ~~as required by the safety functions~~. Testing a check valve confirms the valve operability to move to the position to fulfill the safety-related mission during applicable plant modes. The test shows that the check valve opens in response to flow and closes when the flow is stopped. Operability testing of the valves is described in subsection 3.9.3.2.2. Full-flow testing during applicable plant modes of check valves or sufficient flow to fully open the check valve to demonstrate valve operability under design conditions is permitted in most cases by the system design. Where this ~~full-flow~~ testing cannot be accomplished, an alternate method of demonstrating operability is developed, and justified. A demonstration of reverse-flow isolation of the check valves that is that the check valve closes when the flow is stopped is performed using direct means or diagnostics. The testing includes the effects of rapid pump starts and stops as required by expected system operating conditions.

The valves to be tested, the safety-related functions of the valves, and the type of testing to be done to verify the capability of the valves to perform the safety-related functions are outlined in valve inservice test requirements found in subsection 3.9.6 and Table 3.9-1647. The valves to be tested, safety-related functions, and test requirements for preoperational testing are the same as outlined in inservice test requirements.

During pre-operational testing the following is verified to demonstrate the acceptability of the functional performance.

- The valves are verified to fully open or fully closed under design flow conditions.
- The disc movement from full open to full close is free.
- The valve leakage when fully closed is within established limits, as applicable.
- The disc is stable in the full open position at the system operating flow, conditions.
- The valve disc position can be verified without disassembly of the valve.
- The valve design features, surface finish and materials can accommodate nonintrusive diagnostic testing methods.
- The testing requirements in the inservice test plan can be accommodate in the piping system design.

#### 5.4.8.5.2 Motor-Operated Valve

##### 5.4.8.1.2.2 ~~Preoperational Testing~~

Active safety-related motor-operated valves are tested ~~in the open or close directions under static and maximum achievable conditions using diagnostic equipment that measures torque~~



and thrust (as applicable to the type of motor-operated valve), and motor parameters, to verify that the valves open and close under static and safety-related design conditions. Where the safety-related design conditions cannot be achieved, the testing is performed at the maximum achievable dynamic conditions. During the testing critical parameters needed to determine the required closing and opening loads are measured. These parameters include thrust, torque, travel, differential pressure, system pressure, fluid flow, voltage, temperature, operating time and thrust/torque at seating, unwedging and at control switch trip. The data collected during the testing on the parameters is used to determine the required operator loads for the design operating conditions in conjunction with the diagnostic equipment inaccuracies, load changes for increasing differential pressures and flow, control switch repeatability, friction variations and other parameters that could result in an increase in operating loads or decrease in operator output capability. The resulting operating loads including uncertainties are then compared to the structural capabilities of the valve. Active safety-related motor-operated valves are tested prior to operation for operability as described in subsection 3.9.3.2.2.

~~The valves to be tested, the safety-related functions of the valves, and the type of testing to be done to verify the capability of the valves to perform the safety-related functions are the outlined in valve inservice test requirements found in subsection 3.9.6 and Table 3.9-17. The valves to be tested, safety-related functions, and test requirements for preoperational testing are the same as outlined in inservice test requirements.~~

Pre-operational testing and evaluation is used to demonstrate the acceptability of the valves functional performance including the following.

- The valves are verified to open and close as applicable at a range of safety-related conditions up to the design conditions to perform their safety function.
- The control switch settings must be adequate to provide margin for diagnostic accuracy, control switch repeatability, load sensitive behavior and degradation.
- The motor operator capability at degraded voltage must exceed the required operating loads and the loads at the control switch settings including diagnostic equipment inaccuracies, load changes for increasing differential pressures and flow, control switch repeatability, friction variations and other parameters that could result in an increase in operating loads or decrease in operator output capability.
- The maximum operating loads including diagnostic equipment inaccuracies, load changes for increasing differential pressures and flow, control switch repeatability, friction variations and other parameters that could result in an increase in operating loads or decrease in operator output capability are verified not to exceed the allowable capability limits of the valve components.
- The stroke time measurements during opening and closing must be within the design requirements if stroke time is important to the safety function.
- The remote position indication is verified against the local position indication.





#### 5.4.8.5.3 Power Operated Valves

##### 5.4.8.1.3.2 ~~Pre-Operational Testing~~

Active safety related power-operated valve assemblies are tested ~~in the open and close directions under static and maximum achievable conditions using diagnostic equipment to~~ verify that the valve opens and closes under static and design conditions. Where the design conditions cannot be achieved, the testing is performed at the maximum achievable dynamic conditions. During the testing, critical parameters needed to determine the required closing and opening loads are measured. These parameters include seat load, torque or thrust, travel, spring rate, differential pressure, system pressure, fluid flow, temperature, power supply, operating time and minimum supply pressure. The data collected during the testing on the parameters is used to determine the required operating loads for the design operating conditions in conjunction with the diagnostic equipment inaccuracies and other parameters that could result in an increase in operating loads or decrease in operator output capability. The resulting operating loads including uncertainties are then compared to the structural capabilities of the valve.

~~The valves to be tested, the safety related functions of the valves, and the type of testing to be done to verify the capability of the valves to perform the safety-related functions is outlined in valve inservice test requirements found in subsection 3.9.6 and Table 3.9-1617. The valves included, safety-related functions, and the test requirements for preoperational testing are the same as outlined in inservice test requirements.~~

During pre-operational testing the following are verified to demonstrate the acceptability of the functional performance.

- The valves are verified to open and close as applicable at a range of conditions up to the design conditions to perform its safety function.
- For air-operated valves and hydraulically-operated valves the operator capability at minimum supply pressure, power supply or loss of motive force exceed the required operating loads including diagnostic equipment inaccuracies and other parameters that could result in an increase in operating loads or decrease in operator output capability.
- For solenoid-operated valves the valve must be capable of opening or closing the valve at the minimum power supply.
- For air-operated valves and hydraulically-operated valves the maximum operating loads including diagnostic equipment inaccuracies and other parameters that could result in an increase in operating loads are verified not to exceed the allowable capability limits of the valve components.
- The stroke time measurements during opening and closing must be within the design requirements for safety-related functions.
- The remote position indication are verified against the local position indication.





Explosively actuated valve assemblies ~~are not~~ tested in-situ are defined in subsection 14.2.9.1.3. Preoperation testing is based on appropriate qualification and production testing. Provisions are made to test the removable explosive charge.

#### 5.4.9 Reactor Coolant System Pressure Relief Devices

Safety valves connected to the pressurizer provide overpressure protection for the reactor coolant system during power operation. The relief valve on the suction line of the normal residual heat removal system (RNS) provides low temperature overpressure protection consistent with the guidelines of NRC Branch Technical Position RSB 5-2. The following discusses the requirements for the valves. Sizing of the safety valves is discussed in subsection 5.2.2.

Power-operated relief valves are not provided in the AP600 reactor coolant system. Non-reclosing pressure relief devices are not used for pressure relief on the AP600 reactor coolant system. Section 10.3 discusses safety valves for the main steam system. The automatic depressurization valves which are also connected to the pressurizer and are the interface with the passive core cooling system, are not pressure relief devices. (See subsection 5.4.6.)

##### 5.4.9.1 Design Bases

The combined capacity of the pressurizer safety valves can accommodate the maximum pressurizer surge resulting from complete loss of load. The safety valve on the suction line of the normal residual heat removal system can accommodate the flow from both makeup pumps with no letdown and a water-solid reactor coolant system during low-temperature modes. Table 5.4-17 gives design parameters for the pressurizer safety valves and the residual heat removal system relief valve.

Use of the pressurizer safety valves and the normal residual heat removal relief valve at elevated temperatures in post-accident environments is not anticipated.

##### 5.4.9.2 Design Description

The pressurizer safety valves and the normal residual heat removal system relief valve are spring loaded, self-actuated by direct fluid pressure, and have backpressure compensation features. These valves are designed to reclose and prevent further flow of fluid after normal conditions have been restored. The pressurizer safety valves are of the totally enclosed pop type. The normal residual heat removal relief valve is designed for water relief.

The pressurizer safety valves are incorporated in the pressurizer safety and relief valve (PSARV) module, which provides the connection to the pressurizer nozzles. The routing of pipe between the pressurizer and the safety valves does not include a loop seal. Any condensation of steam in the connecting pipe up to the valve rains back to the pressurizer. Condensate does not collect as a slug of water to be discharged during the initial opening of the valve. The discharge of the safety valve is routed through a rupture disk to containment atmosphere. The rupture disk is provided to contain leakage past the valve, is designed for

